Classification of Materials

1. In terms of which of the following properties, metals are better than ceramics?
a) Hardness
b) Ductility
c) Toughness
d) Yield Strength
View Answer
Answer: b
Explanation: Generally ceramics have equal or better hardness, toughness and yield strength but are highly susceptible to plastic deformation. Even a small stress beyond their yield point leads to fracture.

2. Steels mainly contain iron and carbon. Under which of the following categories do they belong?
a) Metallic Solid
b) Polymer
c) Composites
d) Ceramics
View Answer
Answer: a
Explanation: Since steels have very small amounts of carbon (usually less than 6%), they are considered iron alloy; hence metallic solid.

3. GFRP is an important composite. It stands for
a) Gelatin Fibre Reinforced Polymer
b) Graphite Fibre Reinforced Polymer
c) Germanium Fibre Reinforced Polymer
d) Glass Fibre Reinforced Polymer
View Answer
Answer: d
Explanation: Glass Fibre Reinforced Polymer (GFRP) or commonly called fiberglass is a lightweight, high-strength, and corrosion-resistant industrial material.

4. Ceramics make excellent refractory materials. A material is said to be refractory if it:
a) resists the flow of electric current
b) has high refractive index
c) retains its strength at high temperatures
d) all of the mentioned
View Answer
Answer: c
Explanation: Ceramics, which mainly consist of oxides, carbides and nitrides, can withstand very high temperatures; furnaces are generally lined with such ceramics.

5. Which of the following cannot be used as bio-materials?
a) Metals
b) Ceramics
c) Polymers
d) None of the mentioned
View Answer
Answer: d
Explanation: Bio-materials are implanted into living bodies for replacement of damaged parts and hence, must be compatible with the body tissues and be non-toxic. As long as these criteria are met, all of the above materials – metals, ceramics, polymers and their combinations can be used as bio-materials.

6. Which of the following is true for polymers?
a) They have very high molecular mass
b) They do not have a linear stress-strain curve
c) They have high strength to mass ratio
d) All of the mentioned
View Answer
Answer: d
Explanation: Polymeric molecules are aggregates of a large number of monomer units and possess high molecular mass. Hooke's law generally does not apply to polymers as the stress developed is not directly proportional to deformation. Due to low densities, strength to mass ratio of polymers is often comparable to metals and ceramics.

7. Various isotopes of a given element have same:
a) Number of protons
b) Number of neutrons
c) Molar mass
d) Thermodynamic stability
View Answer
Answer: a
Explanation: Isotopes of a given element have the same number of protons but not of neutrons which causes variation in molar mass. This also results in different p-n ratio, thus making one isotope more stable than other. For example, protium is stable but tritium is radioactive.

8. Calcium is an isobar of Argon. They differ in:
a) Atomic weight
b) Number of nucleons
c) Number of neutrons
d) None of the mentioned
View Answer
Answer: c
Explanation: Isobars differ in a number of protons as well as that of neutrons but total number of nucleons(protons and neutrons) is the same for all the isobars. Hence, isobars have the same atomic weight.

Atomic Structure Terminology

1. Species with the same number of neutrons but the different number of protons are called:
a) Isotones
b) Isotopes
c) Isomers
d) Isobars
View Answer
Answer: a
Explanation: Isotones are atoms of different elements having the same number of neutrons but different atomic and mass numbers. For e.g., Boron-12 and Carbon-12 are isotones each having 7 neutrons.

2. Atomic number of a species is the number of:
a) Neutrons
b) Protons
c) Valence electrons
d) Nucleons
View Answer
Answer: b
Explanation: Atomic number or the number of protons is the property that differentiates atoms of one species from another. For e.g., atomic numbers of Hydrogen and Helium are 1 and 2 respectively.

3. Oxygen gas is denser than Carbon Dioxide gas?
a) True
b) False
View Answer
Answer: b
Explanation: At any specified temperature, molar volume for every gas is the same. However, CO_2(g) has higher molar weight than O_2(g) which results in higher density.

4. Which of the following has the least number of atoms?
a) One gram of Hydrogen gas
b) One gram of Helium gas
c) One gram-mole of Oxygen gas
d) One gram-mole of Chlorine gas
View Answer
Answer: b
Explanation: One gram-mole of any gas contains Avogadro's number of atoms/molecules. Hence, one gram-mole of Hydrogen gas and Helium gas weigh two grams and three grams respectively. 1g H_2 = 1/2 g-mol H_2; 1g He = 1/3 g-mol He. Thus, one gram of Helium has the least number of atoms.

5. Which of the following is not a pure form of matter?
a) Element
b) Compound
c) Solution
d) Both Compound and Solution
View Answer
Answer: c
Explanation: Different samples of the same element or compound will have an exactly same composition and hence both – element and compound are considered pure forms of matter.

6. Which if the following is not an SI unit?
a) Kilogram
b) Mole
c) Atomic Mass Unit
d) Coulomb
View Answer
Answer: c
Explanation: Because the SI unit of mass is a kilogram.

7. One unified atomic mass unit equals:
a) 1/12 of molar mass of Carbon
b) 1/16 of atomic mass of Oxygen
c) molecular mass of Hydrogen
d) all of the mentioned
View Answer
Answer: b
Explanation: 1 amu = 1/12 of atomic(not molar) mass of carbon = 1/16 of the atomic mass of Oxygen = 1/2 of molecular mass of Hydrogen

8. Avogadro's number of water molecules occupy 22.4 liters of space at 273 K.
a) True
b) False
View Answer
Answer: b
Explanation: Molar volume at 273 K is 22.4 liter, only for gases. However, at this temperature water does not exist as a gas.

Atomic Models

1. In the wave-mechanical model of an atom, degenerate energy levels have:
a) Equal energy
b) Equal number of electrons
c) Same shape
d) Electrons with the same spin
View answer
Answer: a
Explanation: Degenerate energy levels have equal energy. In an atom, the orbitals in the same subshell are degenerate in absence of an external magnetic field.

2. Paired electrons in an atom have equal values of all of the four quantum numbers.
a) True
b) False
View answer
Answer: b
Explanation: According to Pauli's exclusion principle, no two electrons in an atom can have all four quantum numbers equal. Paired electrons have opposite spins.

3. Protons attract electrons. Then why do electrons not fall on the nucleus?
a) Neutrons repel the electrons
b) Electrons in ground state cannot radiate energy
c) At very small distances, protons repel electrons
d) Inner electrons repel those in outer orbitals
View answer
Answer: b
Explanation: In the ground state, electrons form standing waves. Standing waves are those in which energy is not transferred. Hence, electrons are bound to revolve around the nucleus with constant potential energy.

4. Number of atomic orbitals in nth shell is:
a) n^2
b) $2n^2$
c) $2n + 1$
d) $n - 1$
View answer
Answer: a
Explanation: Every shell contains n^2 orbitals and every orbital can accommodate a maximum of 2 electrons. Hence a maximum of $2n^2$ electrons can reside in nth shell.

5. Electronic configuration of Cu is [Ar] 3d10 4s1. Which rule is violated in this configuration?
a) Aufbau Principle
b) Hund's Rule of Maximum Multiplicity
c) Pauli's Exclusion Principle
d) None of the mentioned
View answer
Answer: a
Explanation: According to the Aufbau principle, orbitals of lower energy are completely filled before electrons start occupying higher energy orbitals. But in copper, higher energy 3d is filled before lower energy 4s. Such violation of the Aufbau principle appears in about 20 elements.

6. When an electron shifts to an inner shell, it:
a) Absorbs photon
b) Emits a photon
c) Emits a positron
d) Absorbs a positron
View answer
Answer: b
Explanation: Generally, lower potential energy means more stability. Excited electrons lose energy in the form of photons to shift to stable empty inner shells. Positron is anti-particle of an electron.

7. Around 1911, Rutherford suggested a planetary model of atomic structure. Which of the following was not a proposition of this model?
a) Electrons revolve in circular orbits around the nucleus
b) Nucleus consists of protons and neutrons
c) Mass of atom is concentrated in the nucleus
d) Most of the volume in an atom is void
View answer
Answer: b
Explanation: Neutrons were not discovered by then. Rutherford only suggested that the nucleus has a positive charge, but did not comment on its structure.

8. Which of the Bohr's postulates was incorrect?
a) Energy of electrons is quantized
b) Momentum of electrons is quantized
c) Electrons release energy when shifting from excited state to ground state
d) Electrons revolve around the nucleus in fixed circular orbits
View answer
Answer: d
Explanation: Heisenberg uncertainty principle implies that exact position and momentum of electrons cannot be known with certainty and hence, definite circular paths are not feasible. Certain regions around the nucleus (called orbitals) have a high probability of the existence of electrons.

9. 4f orbital has higher energy than 5p.
a) True
b) False
View answer
Answer: a
Explanation: Sum of principal and azimuthal quantum numbers for 4f is (4+3=) 7 and that for 5p is (5+1=) 6. As a general rule, higher the sum, higher is the energy.

10. Which of the following orbitals do not exist?
a) 3p
b) 4s
c) 2s
d) 3f
View answer
Answer: d
Explanation: For principal quantum number 3, only possible values of azimuthal quantum number are 0, 1, and 2. Azimuthal quantum number of an f-orbital is 3.

Atomic Bondings in Solids

1. Which of the following is a secondary bond?
a) Metallic bond
b) Hydrogen bond
c) Covalent bond
d) Ionic bond
View answer
Answer: b
Explanation: Metallic, covalent, and ionic bonds are strong in nature, hence primary; hydrogen bond has comparatively lower bond energies; hence secondary.

2. VSEPR stands for Valence Shell Electron Pair Repulsion. This theory helps us predict:
a) Bond angles
b) Bond length
c) Electron energy
d) Shell radius
View answer
Answer: a
Explanation: VSEPR theory implies that electrons in valence shell arrange themselves in a manner so as to experience minimum repulsion from other electrons. For e.g., in a CH_4 molecule, all the bonds are symmetrically arranged at approximately 109°.

3. In water, the bond angle between the H-O H-O bond is less than 109° Why?
a) The H atoms attract each other
b) Oxygen atom is much larger than Hydrogen atoms
c) Lone pair-bond pair repulsion is greater than bond pair-bond pair repulsion
d) VSEPR theory does not apply for planar molecules like water
View answer
Answer: c
Explanation: Bond angle is 109° for symmetric molecules like methane. However, it is known that repulsion between a lone pair and a bond pair is more than that between two bond pairs. Hence, bond angle is reduced from 109° so as to experience minimum repulsion from lone pairs.

4. For covalent molecules, van der Waals radius is always greater than a covalent radius.
a) True
b) False
View answer
Answer: a
Explanation: Van der Waals radius is half the internuclear distance between two non-bonded atoms on their closest approach whereas covalent radius is half the bond length of a homo-nuclear molecule. Since the distance between two bonded atoms is less than non-bonded atoms, hence the answer.

5. If E1 is the bond enthalpy of a sigma-bond and E2 is that of a pi-bond, then:
a) E1 > E2
b) E1 = E2
c) E1 < E2
d) Can't be predicted
View answer
Answer: a
Explanation: Since the overlap of orbitals in a sigma-bond is along the internuclear axis contrary to sideways overlap in pi-bonds, the bonding is more effective in a sigma-bond. Hence, E1 > E2. Though, the total energy of a double bond is more than a single bond)

6. Which of the following molecules is non-linear?
a) Hbr
b) CO_2
c) C_2H_2
d) H_2S
View answer
Answer: d
Explanation: H_2S is non-linear due to presence of lone pairs on S atom. Hbr being a binary molecule is linear. Double bonds in CO_2 and C_2H_2 also leads to linear geometry.

7. With an increase in bond length, bond energy:
a) increases
b) decreases
c) may either increase or decrease
d) does not change
View answer
Answer: b
Explanation: The coulombic force of attraction is inversely proportional to the square of a distance between the charges. As the internuclear distance in a bond increases, the force of attraction between nuclei and electrons decreases.

8. sp^3 hybridization is present in which of the following molecules?
a) $BeCl_2$
b) H_2O
c) C_2H_4
d) BCl_3
View answer
Answer: b
Explanation: Hybridization takes place between one 2s and three 2p orbitals of Oxygen so as to minimize electronic repulsion. $BeCl_2$, C_2H_4, and BCl_3 have sp, sp^2, and sp^2 hybridization respectively.

9. Which of the following is the correct order for bonding energies of molecular orbitals?
a) σ1s < σ2s < σ*2s < σ*1s
b) σ1s < σ2s < σ*1s < σ*2s
c) σ1s < σ*1s < σ2s < σ*2s
d) none of the mentioned
View answer
Answer: c
Explanation: Energy of bonding MO is less than that of anti-bonding MO formed from same atomic orbitals. Also, MO formed from atomic orbitals of higher energy possess higher energy.

10. Which of the following molecules is diamagnetic?
a) O_2
b) CO
c) N_2
d) NO
View answer
Answer: b
Explanation: Out of the above species, only CO does not have unpaired electrons. Others have partially filled molecular orbitals and hence are attracted by external magnetic fields.

Periodic Table of Elements

1. Elements in the same column of the periodic table have:
a) Similar valence shell electron configuration
b) Same value of highest principal quantum number
c) Same number of nucleons
d) All of the mentioned
View answer
Answer: a
Explanation: The elements having similar valence shell electrons have similar chemical properties like reactivity, nature of bonds in their molecules etc. Hence in the modern periodic table, they were grouped in vertical columns called 'groups'.

2. As we move down a group, electronegativity of elements generally:
a) Increases
b) Decreases
c) Increases and then decreases
d) Decreases and then increases
View answer
Answer: a
Explanation: As we move down a group, atomic size increases which means that the valence electrons are much farther from the nucleus and hence experience less force of attraction. Hence the electronegativity decreases down the group.

3. How many periods are there in a modern periodic table?
a) 5
b) 6
c) 7
d) 8
View answer
Answer: c
Explanation: Modern periodic table places elements having the same maximum principal quantum number in one period. There are seven periods, though the seventh period consists of many unstable artificial elements.

4. Temporary IUPAC systematic symbol for the synthetic element 117 is:
a) Uuh
b) Uns
c) Uus
d) Une
View answer
Answer: c
Explanation: IUPAC has assigned temporary systematic name Ununseptium [=Un(1) +un(1) + sept(7) + ium] to the element with atomic number 117. It belongs to group 17 of the periodic table and is predicted to be a halogen. As of 2015, its discovery has not been officially confirmed.

5. There are seventeen non-metals in the periodic table. Unlike metals in the same period, they have higher:
a) Atomic number
b) Atomic size
c) Electropositivity
d) All of the mentioned
View answer
Answer: a
Explanation: Non-metals are located at the right end of their respective periods. As we move from left to right in a period or from top to bottom in a group, atomic number increases. Due to increasing charge on the nucleus, atomic size also decreases on moving right in a period. This is also the reason of increasing electronegativity or decreasing electropositivity.

6. d-block elements generally show multiple oxidation states. An exception to this is:
a) Zinc
b) Mercury
c) Copper
d) None of the mentioned
View answer
Answer: d
Explanation: Due to a small increase in successive ionization enthalpies, most d-block elements exist in multiple oxidation states. However, Zn(I) compounds are very rare and the ion exists in a dimeric form.

7. Uranium and Thorium are two important elements in the nuclear power industry. In which block of the modern periodic table are they placed?
a) s-block
b) p-block
c) d-block
d) f-block
View answer
Answer: d
Explanation: Ground state Uranium and Thorium atoms have partially or totally empty 5f-orbitals. They are members of the actinide family and their naturally occurring isotopes are radioactive.

8. Moving down a group, which of the following properties generally diminishes?
a) Electronegativity
b) Metallic character
c) Atomic radius
d) Molar mass
View answer
Answer: a
Explanation: Due to the addition of one shell on moving down a group, the neighbourhood of the atom is better shielded by the electrons from an attractive pull of the nucleus.

9. Radon is the sixth member of group 18 of the modern periodic table. Unlike other members of this group, Radon:
a) is solid near room temperature
b) is radioactive
c) possess high chemical reactivity
d) all of the mentioned
View answer
Answer: b
Explanation: Radon is a radioactive noble-gas at room temperatures. It is one of densest gases and the only naturally occurring radioactive gas. However, its daughter nuclei are solids. Not many compounds of Radon are known.

10. Ionization energy decreases down the group. It is the energy required by an isolated gaseous atom to form an anion.
a) True
b) False
View answer
Answer: b
Explanation: Ionization energy is the energy required by an isolated gaseous atom to lose the least tightly bound electron to form a cation. It decreases down the group as atomic size increases.

Properties of Crystals

1. Allotropes differ in which of the following properties:
a) Atomic Number
b) Atomic Mass
c) Crystal Structure
d) Electronegativity
View Answer
Answer: c
Explanation: Allotropes are different crystalline structures of the same element. Hence, they have the same atomic number, atomic mass and electronegativity. For e.g., graphite and diamond are allotropes of carbon.

2. Co-ordination number of a crystalline solid is:
a) Number of particles in the unit cell
b) Number of nearest neighbours of a particle
c) Number of octahedral voids in a unit cell
d) Number of tetrahedral voids in a unit cell
View Answer
Answer: b
Explanation: Coordination number of a crystal structure is the number of particles with which a given particle is in direct contact.

3. Packing efficiency of a crystal structure is the ratio of:
a) Volume occupied by particles to the total volume of the unit cell
b) Volume occupied by particles to that by voids
c) Total volume of the unit cell to the volume occupied by particles
d) Volume occupied by voids to that by particles
View Answer
Answer: a
Explanation: Packing efficiency represents the fraction of the unit cell volume that is utilized to hold the particles.

4. HCP and BCC are called close-packed structures. Close packed structures have:
a) Highest packing efficiency
b) Highest void fraction
c) Highest density
d) All of the mentioned
View Answer
Answer: a
Explanation: Due to the largest number of particles in a unit cell, close-packed structures have the highest packing efficiency and hence, lest void fraction. Density is NOT a property of the crystal structure but the substance and depends also on molar mass.

5. An octahedral void is surrounded by:
a) 8 atoms
b) 18 atoms
c) 6 atoms
d) 16 atoms
View Answer
Answer: c
Explanation: An octahedral void resembles a regular octahedron with atoms situated at all the six vertices.

6. Which of the following is a property of amorphous solids?
a) Sharp melting point
b) Isotropy
c) Long range order
d) Definite heat of fusion
View Answer
Answer: b
Explanation: Due to irregularity in structure, the average of physical properties like density, thermal and electrical conductivity etc. is same along any direction for a particular amorphous solid.

7. Which of the following is a crystalline solid?
a) Copper wire
b) Glass bottle
c) Polythene bag
d) Rubber ball
View Answer
Answer: a
Explanation: Copper wires are made of crystalline copper. In fact, most metallic objects are crystalline. However, research for the large-scale production of amorphous metals is in progress.

8. The smallest portion of a crystal which when repeated in different directions generates the entire crystal is called:
a) Lattice points
b) Crystal lattice
c) Unit cell
d) None of the mentioned
View Answer
Answer: c
Explanation: Unit cell is the smallest unit of a crystal which repeats itself to generate the crystal. Lattice point represents the centres of atoms in a unit cell. Crystal lattice refers to the entire structure of a crystalline solid.

9. Which of the following is not a property of metal glass?
a) Transparent
b) Poor thermal conductivity
c) High magnetic susceptibility
d) None of the mentioned
View Answer
Answer: a
Explanation: Metal glass is a form of metal which like glass, is amorphous but not transparent. Most of the metal glasses are alloys, having high yield strength and high elastic strain limits. High magnetic susceptibility, low coercivity and comparatively higher electrical resistance than their crystalline counterparts make them an ideal material for power transformers.

10. Grain boundaries are one of the causes of corrosion of metals?
a) True
b) False
View Answer
Answer: a
Explanation: Grain boundaries are the regions that separate two grains in polycrystalline metallic solids. The absence of properly defined structure results in residual stresses. Hence, grain boundaries are the weak spots in the structure and are often the site of a fracture.

Bravais Lattices

1. Most Bravais lattices are of the type:
a) Primitive unit cell
b) Body centered unit cell
c) End centered unit cell
d) Face centered unit cell
View Answer
Answer: a
Explanation: Out of 14 naturally occurring Bravais lattices, 7 are primitive. Remaining seven consists of 3 body centered, 2 face centered and 2 end centered unit cells.

2. In which of the following Bravais lattices, not all axial angles are right angles?
a) Tetragonal
b) Rhombohedral
c) Orthorhombic
d) Cubic
View Answer
Answer: b
Explanation: A rhombohedral is a prism whose base is shaped as a non-square rhombus. Hence two of its six faces are rhombuses while others are rectangles. This results in a geometry for which two of the axial angles are right angles but the third is not.

3. Which of the following Bravais lattices exist as face centered unit cell?
a) Orthorhombic
b) Monoclinic
c) Tetragonal
d) None of the mentioned
View Answer
Answer: a
Explanation: Orthorhombic lattice exists as all four types of unit cells. Besides primitive cell, monoclinic lattice exists only as end centered cell while tetragonal exists only as body centered lattices.

4. Coordination number for an ideal BCC metallic crystal is:
a) 8
b) 6
c) 12
d) Varies for different metals
View Answer
Answer: a
Explanation: Consider the atom at the body center. It is touched by all the atoms present at the vertices of the cubic unit cell. We know that a cube has 8 vertices.

5. Number of particles in a primitive cubic unit cell is:
a) 1
b) 2
c) 3
d) 4
View Answer
Answer: a
Explanation: In a primitive cubic cell, 8 atoms are present at the eight vertices of the cube. However, each atom is shared by eight unit cells. Hence, only one-eighth of each of the eight atoms is present in one primitive cubic cell.

6. In which of the following Bravais lattices none of the sides are equal?
a) Triclinic
b) Monoclinic
c) Orthorhombic
d) All of the mentioned
View Answer
Answer: d
Explanation: Each of the above mentioned lattices have all axial distances unequal. Moreover, triclinic, monoclinic, and orthorhombic lattices have none, two and all axial angles as right angles respectively.

7. Graphite is a common allotrope of Carbon. Its crystal structure is:
a) Cubic
b) Monoclinic
c) Orthorhombic
d) Hexagonal
View Answer
Answer: d
Explanation: Graphite crystals consist of several planar layers of Carbon atoms arranged in interconnected hexagonal rings. Each atom makes three &sigma bonds and one &pi bond. VSEPR theory predicts a trigonal planar molecular structure with respect to each Carbon atom.

8. Which of the following lattices has the highest void fraction?
a) Hexagonal close packed
b) Body centered cubic
c) Face centered cubic
d) Primitive cubic
View Answer
Answer: d
Explanation: Void fraction = 1 − packing efficiency
Since primitive cubic unit cell has least packing efficiency out of those mentioned above, hence it has the highest void fraction of (1 − 0.52 =) 0.48 or 48 %.

9. Which of the following unit cells do not exist for tetragonal lattices?
a) Primitive centered unit cell
b) Body centered unit cell
c) Face centered unit cell
d) All of the mentioned exist
View Answer
Answer: c
Explanation: Tetragonal lattices exist only in primitive and body centered unit cells. Face centered unit cells occur only for cubic and orthorhombic lattices.

10. Most unsymmetrical Bravais lattice in terms of axial distances and angles is:
a) Monoclinic
b) Triclinic
c) Rhombohedral
d) Hexagonal
View Answer
Answer: b
Explanation: For triclinic lattice, none of the adjacent sides are equal in length; neither are any axial angles equal. Hydrated copper (II) sulphate and boric acid have triclinic crystals.

FCC and HCP Metallic Crystals

1. Coordination number of HCP and FCC lattices respectively are:
a) 12, 12
b) 4, 4
c) 12, 8
d) 8, 8
View answer
Answer: a
Explanation: Coordination number is the number of atoms that are in direct contact of any particular atom or it is the number of nearest neighbours.

2. Number of particles in one unit cell of HCP lattice is:
a) 1
b) 2
c) 4
d) 6
View answer
Answer: d
Explanation: Consider the top and bottom layers. One-sixth of each of the 12(=6×2) atoms located at the vertices of the two hexagons belong to the cell. Also half of the atoms at the centre of each of the two hexagons are also part of the cell. Three more atoms are present between two hexagonal planes.

3. Standard axial ratio for metallic HCP lattice is 2√(2/3). It is the ratio of
a) Atomic radius to hexagon edge length
b) Hexagon height length to atomic radius
c) Atomic radius to hexagon height
d) None of the mentioned
View answer
Answer: d
Explanation: Ratio of the height of the hexagonal unit cell to its edge length is called the axial ratio, usually expressed as (c/a).

4. The void fraction is the ratio of unfilled volume to total volume of a structure. For ideal metallic FCC crystal, it is:
a) 0.22
b) 0.26
c) 0.32
d) 0.38
View answer
Answer: b
Explanation: Void fraction = 1 − packing efficiency
Packing efficiency for FCC lattice is 0.74 and hence, void fraction is 1 − 0.74.

5. If N is the number of tetrahedral voids in a close-packed structure, then the number of octahedral voids is:
a) N/4
b) 4N
c) 2N
d) N/2
View answer
Answer: d
Explanation: Tetrahedral voids are formed when triangular voids of one close-packed layer do not overlap while octahedral ones when they overlap. The above relation is valid for both ABAB type(HCP) and ABCABC type(FCC) packing.

6. An octahedral void is present at each edge of the FCC lattice. How much of each of these voids belong to each unit cell?
a) One-eighth
b) One-sixth
c) One-fourth
d) Half
View answer
Answer: c
Explanation: In a cubic lattice, each edge is shared by four adjacent cubes. Hence, the octahedral voids present at these edges are equally divided among the four cells.

7. The edge length of an FCC lattice is X times the atomic radius. Value of X is:
a) 2
b) 2√2
c) 4/√3
d) 3/√2
View answer
Answer: b
Explanation: In FCC unit cell, the atoms at face diagonal touch each other; thus diagonal is four times the atomic radius(r). Diagonal of the square faces is also equal to √ times of the edge length(a). Hence, √2a = 4r.

8. Density is the ratio of the mass of crystal to its volume. For a perfect FCC metallic crystal, the mass of a unit cell is 4 times M_0. M_0 is:
a) specific mass
b) molar mass
c) atomic mass
d) none of the mentioned
View answer
Answer: c
Explanation: Mass of an ideal FCC metallic crystal unit cell is four times the atomic mass of the metal since there are four atoms per unit cell.

9. A maximum of 74% packing efficiency can be achieved for crystalline solids.
a) True
b) False
View answer
Answer: b
Explanation: 74% is the maximum packing efficiency for pure metallic crystals. However, if there are particles of two or more different sizes, greater packing efficiency is possible by filling the tetrahedral and octahedral voids.

10. Which of the following quantities is larger in HCP as compared to FCC if the constituting atoms are similar?
a) Number of particles per unit cell
b) Volume per unit cell
c) Mass per unit cell
d) All of the mentioned
View answer
Answer: d
Explanation: An HCP unit cell contains 6 atoms rather than only 4 present in FCC. Also, both structures are assumed to be comprised of similar atoms thus HCP being heavier. However, the HCP unit cell is also larger in volume than an FCC one such that both have same packing efficiency.

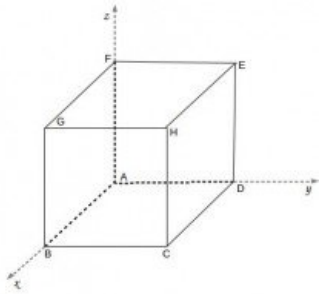
Crystallographic Directions and Planes

1. Which of the following is not true for crystallographic axes?
a) They must be parallel to the edges of the unit cell
b) They must be perpendicular to each other
c) They must originate at one of the vertices of the cell
d) They form a right-handed co-ordinate system
View answer
Answer: b
Explanation: The axes must be parallel to the edges of the unit cell, which in case of some crystal systems like monoclinic, hexagonal etc. are not mutually perpendicular.

2. The point coordinate indices q, r, and s are multiples of:
a) Unit cell edge lengths
b) Distance between nearest neighbours
c) Cosine of angles between unit cell edges
d) None of the mentioned
View answer
Answer: a
Explanation: Point coordinate indices are the fractions which when multiplied by the corresponding unit cell edge lengths, provide the location of a given point in the crystallographic coordinate system.

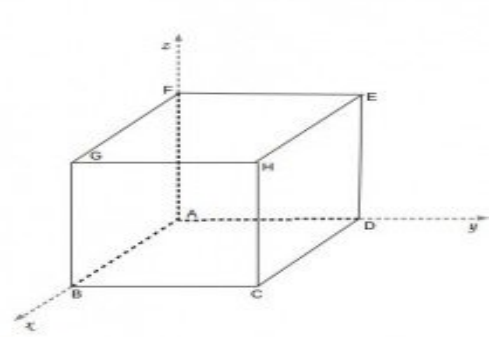
3. The point coordinates of the vertex just opposite to the origin are
a) 0 0 0
b) 0 0 1
c) 0 1 1
d) 1 1 1
View answer
Answer: d
Explanation: Since the opposite vertex is located at distances equal to the edge lengths along the coordinate axes.

4. If x, y, and z are three positive axes of the crystallographic coordinate system with origin at point A, then which line points in the direction [1 0 1] ?



a) AD
b) CH
c) FB
d) GE
View answer
Answer: c
Explanation: Moving 1 unit along positive x-axis, 0 units along positive y-axis, 1 unit along negative z-axis points in a direction parallel to line FB.

5. In the following diagram, what is the direction cosine of the line EB?



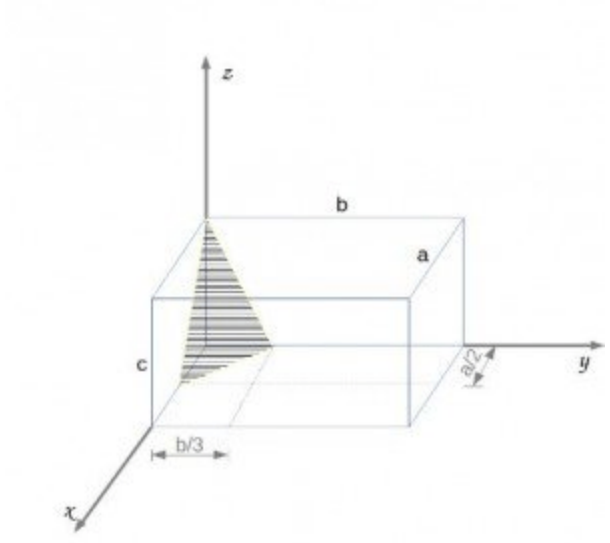
a) [1 11]
b) [111]
c) [1 1 1]

d) [1 0 0]
View answer
Answer: a
Explanation: One can reach from point E to B by traversing 1 unit along each of positive x, negative y, and negative z-axis, where one unit along any axis equals the corresponding edge length.

6. In cubic crystals, crystallographic directions are arranged in families. Which of the following directions does not belong to the family <110>?
a) [1 0 1]
b) [11 0]
c) [10 $\bar{1}$]
d) None of the mentioned
View answer
Answer: d
Explanation: Since the cubic lattice is symmetrical about all the three axes, the above directions are equivalent irrespective of order & sign and are part of same direction family.

7. Convert [2 111] from four-index system to three-index system.
a) [2 1 0]
b) [3 0 1]
c) [111]
d) [12 1]
View answer
Answer: b
Explanation: [u v t w] can be converted to [U V W] using the formula: i) U = 2u+v ii) V = 2v+u iii) W = w. Four-index systems are generally used for hexagonal lattices.

8. Miller indices of the hatched plane in the following figure are:



a) (2 3 1)
b) (3 2 1)
c) (3 2 0)

d) (1 1 1)
View answer
Answer: a
Explanation: If a plane intercepts the coordinate axes at distances A, B, and C from the origin, then Miller indices are given by multiplying (a/A b/B c/C) by a suitable factor so as to obtain integers.

9. Which of the following is a property of Miller indices?
a) They uniquely identify a plane
b) They are always positive
c) They are not fractions
d) None of the mentioned
View answer
Answer: c
Explanation: Two or more planes can have same Miller indices which can be negative, zero or positive depending on the intercept on the axes. If the ratios of intercepts to lattice constants come out be fractional, then they are scaled to lowest integers to be represented as Miller indices.

10. Miller indices for perpendicular planes are always the same.
a) True
b) False
View answer
Answer: b
Explanation: It is true only for cubic lattices. For other systems, there is no simple relationship between planes with the same Miller indices.

Bragg's Law

1. X-rays have larger wavelengths than which of the following?
a) Gamma rays
b) Beta rays
c) Microwave
d) Visible light
View answer
Answer: a
Explanation: Larger wavelengths mean less energy. Only gamma rays have higher energy (or shorter wavelengths) than x-rays. Beta rays are actually streaming of particles and have much less energy than x-rays.

2. X-ray diffraction patterns are used for studying crystal structure of solids because
a) They have very high energy, hence they can penetrate through solids
b) They are electromagnetic radiation, and hence do not interact with matter (crystals)
c) Their wavelengths are comparable to inter-atomic distances
d) Their high frequency enables rapid analysis
View answer
Answer: c
Explanation: For diffraction to occur, the obstacle size should be comparable to the wavelength of the incident radiation.

3. For destructive interference to take place, the path difference between the two waves should be:
a) $n\lambda$
b) $2n\lambda$
c) $(n + 1/2)\lambda$
d) $(2n + 1)\lambda$
View answer
Answer: a
Explanation: Constructive interference occurs when the phase difference between two interfering waves is an integral multiple of 2π. Also, the ratio of path difference to wavelength equals that of phase difference to 2π.

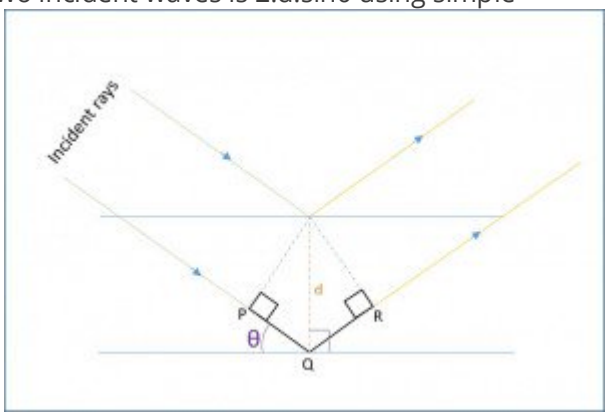
4. Bragg's law is not a sufficient condition for diffraction by crystalline solids.
a) True
b) False
View answer
Answer: a
Explanation: Atoms present at non-corner positions may result in out-of-phase scattering at Bragg angles.

5. The Miller indices h, k, and l of parallel planes in a BCC lattice should satisfy which of the following X-ray diffraction reflection rules?
a) h + k + l should be even
b) h, k, and l should all be either even or odd
c) h, k, and l should form Pythagoras triplet
d) all planes allow reflections
View answer
Answer: a
Explanation: If the sum of Miller indices becomes odd for a BCC lattice, destructive interference occurs.

6. Minimum interplanar spacing required for Bragg's diffraction is:
a) λ/4
b) λ/2
c) λ
d) 2λ
View answer
Answer: b
Explanation: Maximum value of incident angle can be 90° for which sine is 1. Hence d = λ/2 ($n\lambda = 2.d.\sin\theta$)

7. Laue's model pictures XRD as reflection from parallel crystalline planes. Reflection is different from refraction as:
a) diffraction occurs throughout the bulk
b) intensity of diffracted beams is less
c) diffraction in crystals occurs only at Bragg's angles
d) all of the mentioned
View answer
Answer: d
Explanation: Reflection is a surface phenomenon, and large portions of the incident waves can be reflected. Moreover, reflection can occur at any angle of incidence whereas diffraction patterns (alternative dark and bright bands) occur only at Bragg's angles.

8. In Bragg's equation [nλ = 2.d.sinθ], θ is the angle between:
a) specimen surface and incident rays
b) normal to specimen surface and incident rays
c) parallel lattice surfaces d distance apart and incident rays
d) normal to parallel lattice surfaces d distance apart and incident rays
View answer
Answer: c
Explanation: In the following figure, one can easily deduce that the path difference (PQ + QR) between the two incident waves is 2.d.sinθ using simple trigonometry.



9. In the powder method of XRD, the intensities of various bright lines are compared to determine the crystal structure. For simple cubic lattice the ratio of intensities at first two maxima are:
a) ½
b) ¾
c) ½
d) None of the mentioned
View answer
10. K-alpha x-rays have shorter wavelengths than K-beta x-rays?
a) True
b) False
View answer
Answer: b
Explanation: K-alpha is formed from a transfer of electrons from L shell to K while K-beta result from M-to-K transition. Hence K-alpha lines have lower energy (or longer wavelength).

Amorphous Solids

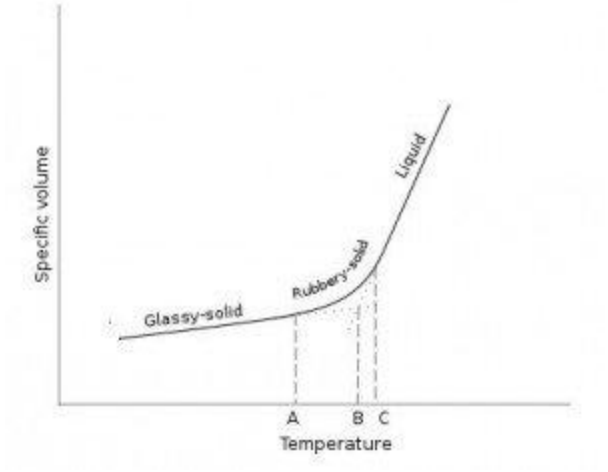
1. Which of the following properties is generally exhibited by amorphous solids?
a) Anisotropy
b) Glass-transition
c) Equal strength of all bonds
d) All of the mentioned
View Answer
Answer: b
Explanation: Due to random organization of particles, amorphous solids have the same physical properties along all directions, or are isotropic. Random organization of particles also results in unequal bond strengths. Upon cooling, amorphous solids turn into a brittle glass-like state from a flexible rubber-like state. This is called glass-transition.

2. Metal glass was first prepared at:
a) California Institute of Technology
b) Massachusetts Institute of Technology
c) Technion
d) University of Michigan
View Answer
Answer: a
Explanation: Metal glass or amorphous metal was reportedly first produced by W. Klement (Jr.), Willens and Duwez in 1960 at Caltech. It was prepared by rapid cooling (~ 1 MK/s) of molten metal alloys.

3. Polycrystalline solids are isotropic.
a) True
b) False
View Answer
Answer: a
Explanation: Anisotropy is a characteristic behavior shown by ideal crystals. However, the presence of flaws like grain boundaries causes the solid to deviate from crystalline properties.

4. Metal glasses differ from their crystalline counterparts in many ways. Chief application(s) of metal glasses include(s):
a) Bullet-proof glasses
b) Power transformers
c) Conducting wires
d) All of the mentioned
View Answer
Answer: b
Explanation: Amorphous metals are not transparent and have relatively lower electrical conductivity. However, most metal glasses possess high magnetic susceptibility and low coercivity.

5. Consider the following cooling diagram for an amorphous solid.



Glass-transition temperature is represented as:
a) A
b) B
c) C
d) None of the mentioned
View Answer
Answer: b
Explanation: An exact melting point does not exist for amorphous solids. An approximate glass-transition temperature is defined by extrapolating the cooling curve as shown.

6. Soda-lime glass is the most common type of glass. The component present in largest w/w percentage is:
a) SiO_2
b) Al_2O_3
c) Na_2O
d) CaO
View Answer
Answer: a
Explanation: Glass inherits its transparency from crystalline SiO_2, also called quartz. However, quartz has very high and narrow glass-transition. To overcome this, small amount of Na_2 is added. CaO is also added to prevent water-solubility imparted by soda.

7. Lead-oxide glass is called “crystal glass” because:
a) It contains crystalline Pb
b) It contains SiO_2 crystals
c) It contains PbO crystals
d) None of the mentioned
View Answer
Answer: d
Explanation: Well, crystal glass is amorphous, not crystalline. This glass earns its name from its excellent decorative properties and high refractive index.

8. Crystallinity increases with increasing rate of cooling of a liquid.
a) True
b) False
View Answer
Answer: b
Explanation: When a liquid is cooled rapidly, the particles get less time to move and arrange themselves in an orderly fashion and hence the crystallinity of the resulting solid decreases.

Classification of Crystallographic Defects

1. Frenkel defect belongs to which of the following classes?
a) Point defect
b) Linear dislocation
c) Interfacial defect
d) Bulk defect
View Answer
Answer: a
Explanation: Frenkel defect occurs when some of the smaller ions shift from their lattice point to interstitial positions.

2. The ratio of the number of vacancies to a total number of lattice points for a metal near melting temperature is of the order of 10^{-4}. For lower temperatures, the ratio:
a) increases
b) decreases
c) remains the same
d) may increase or decrease depending on the metal
View Answer
Answer: b
Explanation: At lower temperature, less energy is available in the system which means less number of atoms are able to leave their lattice sites to create vacancies.

3. Foreign species is present in which of the following defects?
a) Interstitial
b) Vacancy
c) Substitution
d) All of the mentioned
View Answer
Answer: c
Explanation: In substitution defect, particles of other species having similar sizes replace the host particles in a lattice whereas interstitial defect occurs when particles of the same species are present at interstitial voids.

4. Edge dislocation and skew dislocation are linear crystalline defects.
a) True
b) False
View Answer
Answer: b
Explanation: Skew dislocation is a type of interfacial defect.

5. Burger vectors are relevant to which of the following crystalline defects?
a) Point defects
b) Line defects
c) Interfacial defects
d) Bulk defects
View Answer
Answer: b
Explanation: Burger vector denotes the magnitude and direction of a line defect.

6. Pores & cracks in crystalline solids can be classified as bulk defects.
a) True
b) False
View Answer
Answer: a
Explanation: Pores and cracks are not localized to a particular point or edge, but have sizes much larger than atomic dimensions.

7. Ferromagnetic material shows strong para-magnetic behaviour due to the formation of domains. These domains belong to:
a) Point defects
b) Linear defects
c) Interfacial defects
d) Bulk defects
View Answer
Answer: c
Explanation: In ferromagnetic materials, the alignment of magnetic dipoles vary across domain walls. These walls spread across large surfaces but have negligible thickness.

8. Electrical conductivity of the specimen is a requirement for which of the following microscopic examination techniques?
a) Optical microscopy
b) Transmission electron microscopy
c) Scanning electron microscopy
d) Scanning probe microscopy
View Answer
Answer: c
Explanation: Non-conducting specimen will develop electrostatic charge due to an incident electron beam. This field tends to produce faults in the signal interpretation.

9. Which of the following point defects is non-stoichiometric in nature?
a) Schottky defect
b) Metal excess defect
c) Interstitial defect
d) Impurity defect
View Answer
Answer: b
Explanation: When alkali halides are heated in an atmosphere of the constituent metal, halide ions diffuse to the surface to react with the vapour particles. This results in excess of cations over anions.

10. The solubility of solute in a solvent in a solid solution is governed by Hume-Rothery rules. The solubility is more if:
a) radii of solute are much smaller than that of solvent
b) solute an solvent have a similar crystal structure
c) solute has low valence
d) all of the mentioned
View Answer
Answer: b
Explanation: For high solubility, the solute-solvent pair should have similar radii, crystal structure, and electronegativity. Moreover, for other factors being equal, a solute with higher valence is more soluble than one having lower valence.

Point Defects – 1

1. Which type of defect are point defects?
a) One dimensional defect
b) Zero dimensional defect
c) Two dimensional defect
d) Three dimensional defect
View Answer
Answer: b
Explanation: Point defects are zero dimensional defects as they cannot extend in any direction in space. Point defects occur where an atom is missing or misplaced in a crystal lattice. The limit of the size of point defect is not defined.

2. Which of the following point defects can be attributed to from the below options?
i) Stress Fields
ii) Strain fields
iii) Charge
iv) Current
a) i) and ii)
b) ii) and iv)
c) i) and iii)
d) ii) and iv)
View Answer
Answer: c
Explanation: Stress fields are produced due to point dislocation and charges are needed for point dislocation. When an atom dislocates from its original position to an interstitial position or it is completely removed from the lattice, hence creating stress fields.

3. Which is not a name given to vacancy in some ionic solid?
a) H-center
b) F-center
c) Color center
d) Luminescence center
View Answer
Answer: a
Explanation: Other than H-center which is used when a halogen occupies the interstitial position, all the other terms are used for a vacancy in ionic solid. For some ionic solid when there is a vacancy in crystal, an F-center or color enter or luminescence center is formed due to which the ionic solid exhibits different colors.

4. What is the color of zinc oxide?
a) Blue
b) Red
c) Yellow
d) Orange
View Answer
Answer: c
Explanation: In zinc oxide, there is a creation of F-centers, due to a vacancy in its lattice structure. As the F-centers absorbs light and shows complimentary color, zinc oxide exhibits yellow as its colour.

5. If the number of F-centers are more, the color of the compound gets more intense.
a) True
b) False
View Answer
Answer: a
Explanation: When the number of F-center increases, more light is absorbed from the visible spectra and intense color is obtained. By the same logic when the number of F-centers are less, colors are less intense.

6. F-centers are _____
a) Cathodic vacancy in a crystal occupied by one or more paired electron
b) Cathodic vacancy in a crystal occupied by one or more unpaired electron
c) Anionic vacancy in a crystal occupied by one or more paired electron
d) Anionic vacancy in a crystal occupied by one or more unpaired electron
View Answer
Answer: d
Explanation: F-centers occur when in a crystal the vacancies are filled by one or more unpaired electron. When there is an anionic vacancy the charge on the whole body becomes positive as an anion is negatively charged. The presence of the unpaired electron makes the body neutral and hence stable.

7. In which of the following defect the density of the crystal is affected?
a) Schottky defect
b) Frenkel defect
c) Stone-Wales defect
d) Antisite defect
View Answer
Answer: a
Explanation: The density of the solid crystal in case of the Schottky defect is less than the theoretical density of the material. This happens as the total number of ions in the lattice is less than the theoretical number of ions according to its volume when this defect occurs.

8. Schottky and Frenkel defects are _____
a) Interstitial and vacancy defects respectively
b) Vacancy and interstitial defect respectively
c) Both interstitial defects
d) Both vacancy defects
View Answer
Answer: b
Explanation: Schottky defect occurs when oppositely charged ions leave the crystal and creating a vacancy and hence is a vacancy defect while in Frenkel defect an atom moves from its original site to an interstitial position and hence is an interstitial defect.

9. Which of the following compound shows both Schottky and frenkel defect?
a) Silver(I) iodide
b) Silver(I) bromide
c) Magnesium sulphide
d) Titanium oxide
View Answer
Answer: b
Explanation: For a compound to show Schottky defect the size of anion and cation are similar size while Frenkel defect occurs where the size of the anion is larger than the cation. As the radius ratio of silver to bromine is intermediate, it shows both the defects.

10. For the given magnitude of shift which of the following can cause the formation of an off-center ion?
a) 0.1 Å
b) 0.05 Å
c) 0.5 Å
d) 1.1 Å
View Answer
Answer: c
Explanation: Off center ions are a type of substitutional ion whose equilibrium position is a little shifted from its original lattice site. The magnitude of shift for an off center ion is typically in the range of 0.2Å to 1.0Å.

11. The presence of interstitial carbon atom increases the hardness of which of the following:
a) Martensite
b) Austenite
c) Cementite
d) Pearlite
View Answer
Answer: a
Explanation: Martensite is formed in steel when the austenite form of iron is quenched. Due to rapid cooling, interstitial carbons are found in interstitial positions. The interstitial carbon is what makes martensite a hard form of steel.

12. How are point defects classified based on the source of the atom?
a) Statistical and structural
b) Random and ordered
c) Intrinsic and extrinsic
d) Interior and exterior
View Answer
Answer: c
Explanation: When no foreign atom is present in the crystal lattice and the same kind of atoms are forming the defect then it is called as an intrinsic atom. When there is a presence of an additional atom in the crystal lattice, it is called extrinsic defect and hence they are classified according to the source of the atom.

13. In which of the following case the first element can occupy both lattice position and interstitial position?
a) Cu in FCC-Ni
b) C in FCC-Fe
c) B in steel
d) Al in FCC-Fe
View Answer
Answer: c
Explanation: For the first element to occupy the lattice position the size of the first element should be like that of the second element while for the first element to occupy interstitial position the size of the first element should be less than the second element. Due to the intermediate size of boron crystal, it can occupy both lattice and interstitial position.

14. At temperatures greater than 570 degree centigrade, which of the following can be a stable composition of iron oxide?
a) $Fe_{0.99}O$
b) $Fe_{0.9}O$
c) $Fe_{0.96}O$
d) $Fe_{0.97}O$
View Answer
Answer: b
Explanation: Over 570 degree centigrade, the composition of iron oxide is in the form of Fe (1-X) O, where x lies between 0.05 to 0.16. Any value of x other than that will not form a stable composition of iron. We can see that only in $Fe_{0.9}O$, x is 0.1 which lies between the permissible ranges.

Point Defects – 2

1. Which thermodynamic property increases in a crystalline solid due to the presence of vacancies?
a) Enthalpy
b) Entropy
c) Internal energy
d) Work done
View answer
Answer: b
Explanation: Presence of vacancies in crystalline solid creates randomness in structure due to which entropy increases as it is directly proportional to the number of vacancies per mole of solid.

2. Which type of diffusion occurs due to the exchange of an atom with vacancies?
a) Substitution diffusion
b) Elimination diffusion
c) Passive diffusion
d) Facilated diffusion
View answer
Answer: a
Explanation: Substitution as the name suggests it deal with substituting an atom or element in the empty gaps present in crystalline solid which are commonly called as a vacancy.

3. Which of the following technique is not used to measure the concentration of vacancy to determine the activation energy for its formation?
a) Positron annihilation technique
b) Thermal expansion measurements
c) Measuring resistivity after quenching
d) Thermal imaging
View answer
Answer: b
Explanation: Thermal imaging technique is used to determine the position of the defect. It gives the information about depth at which defect will be located. It does not give details about the concentration of vacancy.

4. Calculate temperature of copper at which equilibrium number of vacancies per cubic meter is $2.2*10^{20}$ vacancies/m^3. The energy of vacancy formation is 0.7ev/atom and total number of atom is $2*10^{30}$atom/m^3.
a) 3541.4k
b) 300k
c) 354.14k
d) 2.82*10-3k
View answer
Answer: c
Explanation: The equilibrium number of vacancies Nv for a given quantity is given by
$Nv = Nexp(-Qv/KT)$
$T = -Qv/(K*ln(Nv/N))$
$T = -0.7/(8.62*10^{-5}*ln(2.2*10^{20}/(2*10^{30})))$
T = 354.14k.

5. Which of the following is not the feature of solute and solvent atoms that determine the degree to which former dissolve in latter?
a) Corrosion factor
b) Atomic size factor
c) Crystal structure
d) Valences
View answer
Answer: a
Explanation: Corrosion factor determines the rate at which a metal can be corroded it is not related to the solubility of solute and solvent.

6. How is the concentration of defect related with free energy?
a) The concentration of defect increases free energy
b) The concentration of defect decrease free energy
c) The concentration of defect is equal to free energy
d) The concentration of defect is not related to free energy
View answer
Answer: b
Explanation: Point defects are equilibrium defect varies inversely with free energy.

7. In which type of defect smaller cation can get displaced into an interstitial void?
a) Schottky defect
b) Intrinsic defect
c) Extrinsic defect
d) Frankel defect
View answer
Answer: d
Explanation: In some compounds where cation anion difference is large cation being smaller compared to anion tends to displace from its original position to the other position. This type of defect is called as Frankel defect.

8. Which of the following phenomenon creates point defect in ceramics?
a) Thermal excitation
b) Precipitation
c) Densification
d) Electrical conductivity
View answer
Answer: a
Explanation: In ceramics on providing external energy valence electrons get excited creating a point defect in ceramics. This phenomenon is known as the thermal excitation.

9. Which of the following oxides are highly defective?
a) Al_2O_3
b) MgO
c) CaO
d) FeO
View answer
Answer: d
Explanation: FeO is a transition metal oxide. Now in this case FeO is cation deficient due to presence of at least 5% of iron in Fe^{3+} state.

10. In case of point defect in polymers probability of which part of the polymer is likely to be defected more compared to other?
a) Center of polymer chain
b) Chain ends
c) Main chain units
d) Starting part of chain
View answer
Answer: b
Explanation: Chain ends being the outer most part of the polymeric chain the probability of formation of vacancies in this part is more hence they are more defected compared to other parts.

Linear Defects – 1

1. A dissolution in which an extra portion of a plane of atoms or a half plane terminates within a crystal is called as _____
a) Edge dislocation
b) Mixed dislocation
c) Interfacial dislocation
d) Screw dislocation
View answer
Answer: a
Explanation: Screw dislocation is formed by a shear stress that is applied to produce the distortion. Mixed Dislocations are dislocations found in crystalline materials are probably neither pure edge nor pure screw, but exhibit components of both types.

2. The magnitude and direction of lattice distortion are expressed in terms of which vector?
a) Dislocation vector
b) Screw vector
c) Edge vector
d) Burger vector
View answer
Answer: d
Explanation: Burger vector is used to denote magnitude and direction. In physics, the Burgers vector, named after Dutch physicist Jan Burgers, is a vector, often denoted as b, that represents the magnitude and direction of the lattice distortion resulting from a dislocation in a crystal lattice.

3. What is the relative orientation of dislocation lines for edge dislocation?
a) Parallel
b) Perpendicular
c) Circular
d) Both parallel and perpendicular
View answer
Answer: b
Explanation: For edge dislocation the nature of dislocation line is perpendicular.

4. What type of direction will the burger vector of dislocation for a metallic material show?
a) Closed-packed crystallographic direction
b) Rounded-packed crystallographic direction
c) Open-packed crystallographic direction
d) Parallel-packed crystallographic direction
View answer
Answer: a
Explanation: For a metal being solid, its atoms are closely packed and also metals are crystalline in nature so the direction shown by the vector will be closed packed crystalline direction.

5. Which technique is used to observe dislocation?
a) Positron annihilation technique
b) Thermal imaging
c) Thermal expansion measurements
d) Electron-microscope technique
View answer
Answer: d
Explanation: This type of microscope consists of a high magnification transmission electron micrograph in which dark lines represent dislocation.

6. Path of screw dislocation is in the form of _____
a) Circular
b) Cylindrical
c) Spiral or helical
d) Rectangular
View answer
Answer: c
Explanation: Ramp that is traced around dislocation line is spiral or helical that's the reason it is called screw dislocation.

7. Which type of deformation occurs due to dislocation?
a) Slip plastic deformation
b) Elastic deformation
c) It does not show deformation
d) Slip elastic deformation
View answer
Answer: a
Explanation: Dislocation involves sliding of crystal blocks over one another along the definite crystallographic plane which results in a slip.

8. Which type of stress is involved in the motion of screw dislocation?
a) Tensile stress
b) Shear stress
c) Compressive stress
d) Does not involve stress
View answer
Answer: b
Explanation: If shear stress is increased in screw dislocation it results in a slip of one layer over other which ultimately leads to deformation.

9. Which type(s) of dislocation are included in mixed dislocation?
a) Only Edge dislocation
b) Only shear dislocation
c) Only screw dislocation
d) Both edge and screw dislocation
View answer
Answer: d
Explanation: Mixed dislocation is a combination of screw and edge dislocation. It does not consist of only pure edge or pure screw dislocation.

10. What is the mechanism in which edge dislocation move out of the slip is called _____
a) Climb dislocation
b) Screw dislocation
c) Shear dislocation
d) Slip dislocation
View answer
Answer: a
Explanation: In this type of dislocation edge moves perpendicular over its slip plane.

Linear Defects – 2

1. Which type of defect are line defects?
a) One-dimensional defect
b) Zero-dimensional defect
c) Two-dimensional defect
d) Three-dimensional defect
View Answer
Answer: a
Explanation: Line defects are one dimensional defects as they extend in a singular direction in space. Line defects are present in solids whereas the whole row of atoms is arranged in anomalous order. Hence line defects are linear defects and one dimensional in nature.

2. Edge dislocation and skew dislocation are linear crystalline defects.
a) True
b) False
View Answer
Answer: a
Explanation: Line defects are mainly dislocations which can be broadly classified into two distinct defects. These two dislocations are called edge dislocation and screw dislocation.

3. Which of the following statement is false?
a) Burger vector is the right angle to edge dislocation
b) In screw defect the line defect is parallel to the displacement vector
c) Grain boundary defect is a type of line defect
d) Line defect occurs during the recrystallization process or during slip
View Answer
Answer: c
Explanation: Grain boundary defect is a two-dimensional defect. Grain boundary is the interface between two grains and hence they stop the dislocations from moving freely. Therefore, they cause a two-dimensional defect to spread around the grain boundary.

4. In which type of dislocation an extra plane is inserted inside the crystal?
a) Edge dislocation
b) Screw dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: a
Explanation: The edge defect is simply pictured as an additional half plane of atoms in a lattice. The dislocations are termed a line defect because of the number of defective points created within the lattice along a line. Hence, an extra plane of atoms is added inside the crystal in this type of defect.

5. What is the difference between the angle of Burgers vector and dislocation line in edge dislocation and screw dislocation?
a) -90 degrees
b) 0 degrees
c) 45 degrees
d) 90 degrees
View Answer
Answer: d
Explanation: The angle between Burgers vector and dislocation line in edge dislocation is 90 degrees while the angle between burger vector and dislocation line for screw dislocation is 0 degree. To find the difference we have subtract 0 from 90, giving us 90 degrees as our final answer.

6. To determine yield strength of a material which of the following needn't be affected?
a) Solute hardening
b) Precipitation hardening
c) Work hardening
d) Martensic transformation
View Answer
Answer: d
Explanation: Burgers vector plays an important role in determining yield strength by affecting solute hardening, precipitation hardening and work hardening. Martensic transformation which refers to quenching from high temperature doesn't play any role in the determination of yield strength.

7. In which type of dislocation planes are displaced relative to each other through shear?
a) Edge dislocation
b) Screw dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: b
Explanation: In screw dislocation, planes are displaced relative to each other through shear. The trace of the atomic planes around the screw dislocation makes spiral or whorled path sort of resembling a screw and hence, it is named screw dislocation.

8. In an edge dislocation, a helical path is traced around the dislocation line.
a) True
b) False
View Answer
Answer: b
Explanation: A helical path is traced along the dislocation line in screw dislocation whereas in edge dislocation a new additional half plane of an atom is inserted and a screw like path is not traced by the dislocation.

9. Which of the following is fields are not present for edge dislocation?
a) Tensile
b) Compressive
c) Shear stress
d) Strain
View Answer
10. Which of the following is fields are present for screw dislocation?
a) Tensile
b) Compressive
c) Shear stress
d) Strain
View Answer
Answer: c
Explanation: As in screw dislocation a helical path is traced along a dislocation line, there is only presence of shear stress field and no compressive, tensile or strain field is produced. Shear stress field is produced due to the spiral aspect of this type of dislocation.

11. Which of the following dislocation can glide but not climb?
a) Screw dislocation
b) Edge dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: a
Explanation: Screw dislocation can only glide in a crystal lattice along the helical path while edge dislocations can glide and climb as there is an extra plane of atom present.

12. What are the dislocation in which the line direction and Burgers vector are neither perpendicular nor parallel?
a) Screw dislocation
b) Edge dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: d
Explanation: Mixed dislocation are dislocation consisting of both screw and edge dislocation character where in screw dislocation the line direction and burger vector are parallel and for edge dislocation it is perpendicular. Therefore, the angle between line direction and Burgers vector is neither perpendicular nor parallel.

13. Which of the following can be theoretical shear stress produced in metals? (GPa stands for Giga pascal)
a) 10 GPa
b) 32 GPa
c) 2 GPa
d) 50 GPa
View Answer
Answer: a
Explanation: The theoretical shear stress is in the range of 3 Gpa to 30 GPa. 10GPa is the only option which lies within that range while 32 GPa, 2 GPa and 50 GPa are beyond the range in which the theoretical shear stress can lie for pure metal.

Interfacial Defects

1. Annealing twins which are found in metal have which type of crystal structure?
a) BCC
b) FCC
c) HCP
d) HCP and BCC
View answer
Answer: b
Explanation: Mechanical twins are observed in HCP and BCC crystal structure. A higher stored energy level favors the formation of annealing twins, but mainly at the beginning of the recrystallization regime.

2. At room temperature what is an approximate order of vibration frequency in vibration per second?
a) 1013
b) 1010
c) 104
d) 107
View answer
Answer: a
Explanation: Since amplitude vibration is few thousands of nanometre at room temperature. The frequency of the periodic motion is known as a vibration frequency.

3. In polymeric material the surface of which type of layer is considered to be an interfacial defect?
a) Chain ends
b) Short side branches
c) Main chain unit
d) Chain folded layer
View answer
Answer: d
Explanation: Chain folded layers create/ are boundaries between two crystalline regions which results in the interfacial defect.

4. Which type of boundary exists in multiphase materials across which there is a sudden change in physical/chemical properties?
a) Phase boundary
b) Chain folded layer
c) Domain wall
d) Grain boundary
View answer
Answer: a
Explanation: Chain folded layers are boundaries in case of polymeric materials. Domain wall deals with ferromagnetic and ferromagnetic materials and multiphase deals with phase boundary.

5. What is the density of polycrystalline specimen virtually identical to?
a) Singe crystal of different material
b) Single crystal of same material
c) Different crystal of different material
d) Different crystal of same material
View answer
Answer: b
Explanation: Single crystal of same material will have the same crystalline structure so their density will be identical.

6. Which type of boundary causes a constant angle of tilt between lattice planes of the same type in adjacent regions of the sample?
a) Twinning boundary
b) Tilt boundary
c) Grain boundary
d) Domain wall
View answer
Answer: b
Explanation: When a small grain boundary is formed due to tilt in the angle of orientation is called tilt boundary. A Twin Boundary happens when the crystals on either side of a plane are mirror images of each other.

7. Volume defect or bulk defects are which dimension defect?
a) 1 dimension
b) 2 dimension
c) 3 dimension
d) 4 dimension
View answer
Answer: c
Explanation: Volume defects are three dimensional defects. Interfacial defects are two dimensional. In short volume defect is an application of interfacial defect.

8. Interfacial defect does not include which of the following defect?
a) Grain boundary
b) Twin boundary
c) Phase boundary
d) Volume defect
View answer
Answer: d
Explanation: Interfacial defects are 2 dimensional defects whereas volume defect is 3 dimensional defects. Grain boundary, Twin boundary and Phase boundary are types of interfacial defect.

9. What will be the interfacial energy for domain wall?
a) Greatest compared to other interfacial defects
b) Least compared to other interfacial defects
c) Less than external surface but more than other interfacial defects
d) Less than the external surface and grain boundary but more than other interfacial defects
View answer
Answer: b
Explanation: Domain wall is the boundary that separates the region having a different direction of magnetization in case of ferromagnetic and ferrimagnetic material. Hence interfacial energy is least in case of a domain. As magnetization energy is less compared to other energies.

10. Which dimension defect are interfacial defects?
a) 2 dimension
b) 1 dimension
c) 3 dimension
d) 4 dimension
View answer
Answer: a
Explanation: Interfacial defect are boundary defect that has 2 dimension and normally separate regions of the materials that have different crystal structures and/or crystallographic orientations. These imperfections include external surfaces, grain boundaries, twin boundaries, stacking faults, and phase boundaries.

Microscopic Examination

1. Calculate the average number of grains per square inch at a magnification of 100. Consider grain number is 40?
a) $5.49*10^{9}$
b) $5.49*10^{7}$
c) $5.49*10^{11}$
d) $5.49*10^{6}$
View answer
Answer: c
Explanation: Grain size number and average number of grains per square inch are related as,
$N = 2^{n-1}$
$N = 2^{40-1}$
$N = 5.49*10^{11}$.

2. For grain size number (ASTM) which of the following is true?
a) Size of grains with grain size no 8 will be more than that of grain size no 5
b) Size of grains with grain size no 6 will be more than that of grain size no 7
c) Size of grains with grain size no 6 will be more than that of grain size no 2
d) Size of grains with grain size no 14 will be more than that of grain size no 15
View answer
Answer: b
Explanation: Grain size number ranges from 1 to 10. Larger the no of grain size smaller are the grains.

3. Which of the following is not an important application of microstructure examination?
a) To ensure that the associations between the properties and structure (and defects) are properly understood
b) To predict the properties of materials once these relationships have been established
c) To design alloys with new property combinations
d) To ascertain the mode of chemical fracture
View answer
Answer: d
Explanation: First three are the applications of microstructure examination while in case of fourth, to ascertain mode of physical fracture is the application instead of chemical fracture.

4. Which of the following microscope are not used for microscopy?
a) Optical
b) Ultrasonic
c) Electron
d) Scanning probe
View answer
Answer: b
Explanation: Ultrasonic microscope has a very high resolution of the range of 300*300 pixels which is not desired for micro compounds. It is useful for compounds having very small size range.

5. Which technique is used to determine the grain size of polycrystalline materials?
a) Photo micrographic technique
b) Positron annihilation technique
c) Measuring resistivity after quenching
d) Thermal imaging
View answer
Answer: a
Explanation: Positron annihilation technique, Measuring resistivity after quenching and Thermal imaging this technique is used to measure the concentration of vacancy to determine the activation energy for its formation.

6. Which type of microscopic technique has been developed that generate topographical maps representing the surface features and characteristics of the specimen?
a) Optical
b) Ultrasonic
c) Electron
d) Scanning probe
View answer
Answer: d
Explanation: More recent scanning probe microscopic techniques have been developed that generate topographical maps representing the surface features and characteristics of the specimen. Examinations on the atomic and molecular levels are possible using these techniques.

7. Which of the following method is commonly used to determine grain size?
a) Precipitation
b) Standard comparison charts
c) Densification
d) Electrical conductivity
View answer
Answer: b
Explanation: Intercept and standard comparison charts are commonly used in grain size determination.

8. What is the range of grain size number in case of ASTM?
a) 1 to 10
b) 1 to 100
c) 1 to 1000
d) 1 to 10000
View answer
Answer: a
Explanation: Grain size number ranges from 1 to 10. Size of grain varies inversely with grain size number. Example if grain size number is 10 then the size of grain will be smallest and for 1 it will be largest.

9. What is the full form of ASTM?
a) American society for testing and materials
b) African society for testing and materials
c) American society for torque and momentum forces
d) American society for tensile motion forces
View answer
Answer: a
Explanation: The American Society for Testing and Materials (ASTM) has prepared several standard comparison charts, all having different average grain sizes.

10. Which of the following is not the structural characteristic of a polycrystalline specimen?
a) Shape
b) Average size
c) Reactivity
d) Diameter
View answer
Answer: c
Explanation: Shape, Average size and Diameter are the structural characteristics of polycrystalline specimen while reactivity is the chemical property.

Diffusion Mechanisms

1. Diffusion is the result of:
a) Random motion of particles
b) Concentration gradient
c) Kinetic energy of particles
d) All of the mentioned
View Answer
Answer: d
Explanation: Particles in all three phases possess some kinetic energy and are constantly under random motion. However, the rate of this movement is proportional to the number of particles available and hence the net direction of diffusion is from higher concentration to lower.

2. Concentration gradient refers to:
a) Change of concentration with respect to time
b) Change of concentration with respect to space
c) Change of concentration with respect to temperature
d) None of the mentioned
View Answer
Answer: b
Explanation: Net direction of diffusion depends on the concentration of particles in a particular region of space and hence concentration gradient is defined as the rate of change concentration of particles in a given sample with respect to time.

3. Interstitial diffusion is generally faster than diffusion by vacancy mode. This is because:
a) Number of interstitial sites is greater than vacancies
b) Vacancy diffusion requires more energy than interstitial diffusion
c) Interstitial species are smaller than substitution species
d) All of the mentioned
View Answer
Answer: d
Explanation: At normal conditions probability of occurrence of an adjacent interstitial site is much greater than that of a vacancy. Moreover, the bondings between the host lattice and interstitial atoms are much weaker.

4. As the temperature rises, the rate of vacancy diffusion in metals:
a) increases
b) decreases
c) remains the same
d) may increase or decrease
View Answer
Answer: a
Explanation: Since more energy is available at higher energy, it is easier to break existing bonds and form additional vacancies.

5. Generally, the metal-to-metal diffusion takes place by vacancy diffusion.
a) True
b) False
View Answer
Answer: a
Explanation: Interstitial diffusion occurs for smaller impurities like Carbon, Oxygen, Hydrogen etc. For larger species vacancy diffusion is more common.

6. Osmosis is different from diffusion as:
a) Diffusion requires semi-permeable membrane
b) Osmosis requires a liquid solvent
c) Osmosis is a form of active transport
d) In osmosis, solute moves from lower concentration to higher
View Answer
Answer: b
Explanation: Osmosis is a special type of diffusion where an SPM separates two liquid solutions. Solutes cannot pass through the SPM. As more solvent particles are present in dilute solution than the concentrated one, these particles move through SPM from the former to the latter.

7. Rate of solid-state diffusion does not depend on which of the following?
a) Temperature
b) Diffusing species
c) Host solid
d) Gravity
View Answer
Answer: d
Explanation: Diffusion is the result of a random motion of particles, i.e. their kinetic energy rather than their potential energy. Hence gravity does not effect the rate.

8. Diffusion is not used in which of the following?
a) Doping of semiconductors
b) Manufacturing of alloys
c) Heat treatment of metals
d) Catalysis
View Answer
Answer: b
Explanation: Alloy manufacturing is a bulk process, achieved by mixing metal melts. Whereas diffusion is a surface phenomenon.

9. Carburisation is a heat treatment used for case hardening steels. Carbon is trapped on steel surface by:
a) Osmosis
b) Interstitial diffusion
c) Vacancy diffusion
d) None of the mentioned
View Answer
Answer: b
Explanation: Carbon forms interstitial carbides with iron due to the large difference in atomic radii.

10. You want to demonstrate the phenomenon of diffusion to a group of school kids using two coloured gases. For this, you need to slow down the process. Which of the following tricks will help you achieve this feat?
a) Cooling the gases
b) Using gases of larger molecular radii
c) Decreasing the size of orifice
d) All of the mentioned
View Answer
Answer: a
Explanation: Rate of diffusion increases with temperature and surface area whereas decreases with particle size.

Diffusion Mechanisms II

1. In steady state diffusion, which of the following remain unchanged with time?
a) Concentration at source
b) Concentration at sink
c) Concentration profile
d) All of mentioned
View Answer
Answer: d
Explanation: In steady state diffusion, the concentration of the diffusing species is kept constant at both ends and hence, the concentration at different points remain unaffected as time passes. Purification of hydrogen gas employs steady-state diffusion through a thin palladium sheet.

2. For steady-state diffusion, diffusion flux is proportional to the concentration gradient. Concentration gradient is:
a) Rate of change of concentration with respect to space
b) Rate of change of concentration with respect to time
c) Difference in concentrations at the source and sink
d) Ratio of concentrations at source and sink
View Answer
Answer: a
Explanation: Concentration gradient is the major driving force behind diffusion. It is the slope of the concentration profile and measures the difference in concentration of the diffusing species per unit length.

3. Which of the following is not true for steady-state diffusion?
a) The concentration profile is linear
b) The concentration gradient is constant
c) There is no net transfer of mass
d) The diffusion flux is constant
View Answer
Answer: c
Explanation: Although, the concentration at each point in the diffusion medium remains constant, yet the diffusing species is being transferred from a source end to sink end.

4. Concentration of hydrogen gas across a 2mm thick palladium sheet differs by 4 kg/m^3. Considering steady-state diffusion with diffusion constant 10^{-10} m^2/s, diffusion flux is _____ $kg/m^2.s$:
a) 2×10^{10}
b) 2×10^{-10}
c) 5×10^{-11}
d) 5×10^{9}
View Answer
Answer: b
Explanation: Magnitude of diffusion flux for steady-state diffusion is given by the product of diffusion constant and concentration gradient.

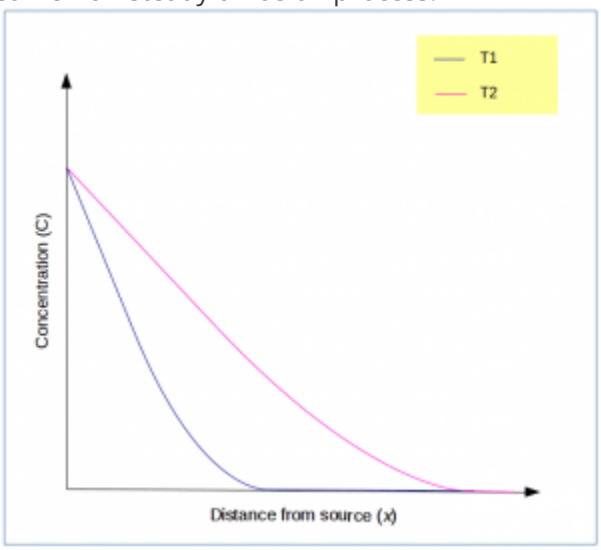
5. The expression J = M/(A.t), where J, M, A, & t are diffusion flux, mass of diffusing species, cross sectional area, and time respectively is:
a) incorrect
b) valid for steady-state diffusion only
c) valid for non steady state diffusion only
d) valid for both steady and non steady state diffusion
View Answer
Answer: d
Explanation: It follows directly from the definition of diffusion flux. It is the mass being transferred per unit area per unit time.

6. If C is the concentration of the diffusing species at distance x from the source and time t, then according to Fick's second law (assuming diffusion coefficient, D is constant):
a) $\partial C/\partial x = D.(\partial C/\partial t)$
b) $\partial C/\partial t = D.(\partial^2 C/\partial x^2)$
c) $\partial C/\partial x = D.(\partial^2 C/\partial t^2)$
d) $\partial C/\partial t = D.(\partial C/\partial x)$
View Answer
Answer: b
Explanation: According to Fick's second law, the rate of change of concentration of diffusing species with time at a given point in space is proportional to the slope of the concentration gradient curve at that point.

7. The relation between temperature and diffusion coefficient is:
a) Linear
b) Exponential
c) Sinusoidal
d) Diffusion coefficient is not related to temperature
View Answer
Answer: b
Explanation: Diffusion coefficient is indicative of rate of diffusion. Its relation with temperature is given by the expression: $D = D_0.\exp(-Q_d / R.T)$
where D_0 is diffusion coefficient at initial temperature, Q_d is the activation energy, R is gas constant, and T is the change in temperature.

8. Predeposition and drive-in diffusion are two heat treatments used in the manufacture of integrated circuits.
Assertion: Predepostion is carried at a higher temperature than drive-in diffusion.
a) True
b) False
View Answer
Answer: b
Explanation: Drive-in diffusion is used to push the already added (through predeposition step) impurity atoms farther into the Si lattice to gain the desired impurity distribution and is carried out at approximately 1200℃ (contrary to 900℃ of predeposition).

9. Following plot shows the concentration profile at two different time, T1 and T2 for the same non-steady diffusion process.



What is the correct relationship between the two?
a) T1 > T2
b) T2 > T1
c) Insufficient data
d) Same process can't have two concentration profiles
View Answer
Answer: b
Explanation: As more time passes, the diffusing species reaches farther into the solid and tends to approach a linear shape.

10. Diffusion through grain boundaries is very fast and is called short-circuit diffusion.
Assertion: Their contribution to overall diffusion is negligible.
a) True
b) False
View Answer
Answer: a
Explanation: Due to very small cross sectional areas of the grain boundaries, the actual amount of mass transferred through them is much smaller than that through the bulk.

Steady State Diffusion

1. In steady state diffusion which of the following remains constant?
a) Concentration gradient
b) Kinetic energy of particles
c) Potential energy of particles
d) Change of concentration with respect to temperature
View Answer
Answer: a
Explanation: In steady state diffusion, the concentration of the diffusing with respect to space at any point remains constant. Kinetic energy and potential energy need not be constant.

2. Which of the following gases can be purified by allowing it to diffuse through palladium cap?
a) Oxygen
b) Hydrogen
c) Chlorine
d) Nitrogen
View Answer
Answer: b
Explanation: When a gas at constant pressure pervades through a thin walled metal foil, steady state diffusion occurs. Hydrogen is purified by making it pass through a palladium cap after going through steady state diffusion.

3. Which of the following law is used for steady state diffusion?
a) Fick's law
b) Newton's law of diffusion
c) Bragg's law
d) Charles's law
View Answer
Answer: c
Explanation: Fick's law is used under steady state conditions to obtain the diffusion coefficient. Bragg's law is used in diffraction of light while Charles's law is used in thermodynamics and is also known as the law of volumes.

4. Which of the following is not a part of Fick's first law?
a) Diffusion flux
b) Diffusion coefficient
c) Change in concentration with respect to the position in space
d) Change in concentration with respect to time
View Answer
Answer: d
Explanation: Fick's first law is given by: $J = – D (dc / dx)$, where J is diffusion flux or diffusivity, D is diffusion coefficient and dc/dx stands for change in concentration with respect to the position in space. Hence change in concentration with respect to time is not a part of Flick's first law.

5. Velocity of diffusing particles does not depend on _____
a) Temperature
b) Viscosity of the fluid
c) Size of the particles
d) Pressure
View Answer
Answer: d
Explanation: Diffusion coefficient is proportional to square of velocity which depends on the temperature of the fluid, viscosity of the fluid and the size of particles. The velocity of particle does not depend on pressure.

6. Flux direction is opposite to the direction of the concentration gradient.
a) True
b) False
View Answer
Answer: a
Explanation: Flux direction is opposite to the direction of the concentration gradient. Because of which there is a negative sign in Fick's first law of diffusion on the right side of the equation.

7. The diffusivity of copper in copper increases by how many times when the temperature is increased from 500 ° C to 1000 °C?
a) 200000
b) 100000
c) 150000
d) 170000
View Answer
Answer: a
Explanation: The diffusivity of copper in copper at 500 °C is 1e-18 while diffusivity at 1000 °C it is $2e^{-13}$. By dividing the values, we find that the diffusivity increases by 200000 times fold.

8. What is the shape of the graph for steady state diffusion where the concentration of diffusion species is in the y-axis and position is in x-axis?
a) Parabola
b) Hyperbola
c) Ellipse
d) Straight line
View Answer
Answer: d
Explanation: The concentration of the diffusing species is directly proportional to position. Hence graph is a straight line with negative slope.

9. In dilute aqueous solutions which of the following can be the value of diffusion coefficient at room temperature?
a) $0.7e^{-9}$
b) $0.7e^{-10}$
c) $2.2e^{-9}$
d) $2.2e^{-10}$
View Answer
Answer: a
Explanation: The diffusion coefficient in a dilute aqueous medium for most ions lies in the range of $0.6e^{-9}$ to $2e^{-9}$ m^2/s. Only $0.7e^{-9}$ lies in the range while the others are beyond the range and hence it is the answer.

10. There is no difference between diffusion and net diffusion.
a) True
b) False
View Answer
Answer: b
Explanation: In homogeneous mixture diffusion and net diffusion are same but in case of in homogeneous materials the effect of diffusion is seen to be changing in concentration with time and hence in this case the net diffusion and diffusion values are different.

Non-steady State Diffusion

1. Which of the following law is used to non-steady state diffusion?
a) Fick's first law
b) Fick's second law
c) Bragg's law
d) Charles's law
View Answer
Answer: c
Explanation: Fick's second law is used to obtain the diffusion coefficient. Bragg's law is used in diffraction of light while Charles's law is used in thermodynamics and is also known as the law of volumes.

2. Which of the following will diffuse the fastest in iron?
a) W
b) C
c) H
d) He
View Answer
Answer: c
Explanation: Hydrogen due to its small size will diffuse the fastest in iron. Carbon also diffuses fast in iron which can be observed in carburizing of steel.

3. Which of the following law is a partial differential equation?
a) Fick's first law
b) Fick's second law
c) Bragg's law
d) Charles's law
View Answer
Answer: b
Explanation: Fick's second law is a partial differential law as it is defined as: On the right-hand side we have a partial differential of concentration with respect to time while on the left we have the product of diffusion constant and double partial differential of concentration with respect to the position in space.

4. Which of the following operator is used and on which side of Fick's second law's equation?
a) Laplacian operator, right hand side
b) Laplacian operator, left hand side
c) Curl operator, left hand side
d) Gradient, left hand side
View Answer
Answer: a
Explanation: Laplacian operator whose symbol is $\Delta = \nabla 2$, is used on the right side of the equation of Fick's law. It replaces the double partial derivative of concentration with respect to space.

5. What is the dimension of d^2c/dx^2?
a) cm^3
b) cm^5
c) cm^{-3}
d) cm^{-5}
View Answer
Answer: d
Explanation: The numerator has the dimension of cm^{-3} and the denominator has a dimension of cm^2. Therefore, the quantity has a dimension of cm^{-3}/cm^2 which gives us cm^{-5} as the dimension.

6. Concentration gradient varies with time for which of the following processes?
a) Non-steady state diffusion
b) Osmosis
c) Steady state diffusion
d) Filter
View Answer
Answer: a
Explanation: The concentration gradient varies with time for non-steady state diffusion. Meanwhile, it remains constant for steady state diffusion.

7. In non-steady diffusion, a type of atom accumulates or depletes from a region.
a) True
b) False
View Answer
Answer: a
Explanation: As the concentration gradient does not constant with respect to time. So the atoms get accumulated or depleted from certain regions from the system.

8. Gaussian error function in denoted as ef.
a) True
b) False
View Answer
Answer: b
Explanation: Gaussian error function is denoted by the erf and its corresponding values can be found from standard mathematical tables. It is used to find the solution of Fick's second law.

Influential Factors

1. On which of the following does diffusion not depend on?
a) Temperature
b) Pressure
c) Concentration difference
d) Diffusion distance
View Answer
Answer: d
Explanation: Diffusion depends on the temperature, concentration difference as atoms diffuse from higher concentration region to lower concentration region, diffusion distance. It does not depend on pressure.

2. When something burns on the stove in the kitchen, the whole kitchen starts smelling smoky due to diffusion.
a) True
b) False
View Answer
Answer: a
Explanation: When something burns on the stove, the atoms of the burnt food starts spreading in the kitchen by random atomic motion by the process of diffusion. The burnt food atoms start moving from places where their concentration is high to regions of low concentration.

3. If we increase the temperature, how is the diffusion rate affected?
a) Diffusion rate increases
b) Diffusion rate decreases
c) Diffusion rate decreases drastically
d) Diffusion rate is not affected
View Answer
Answer: a
Explanation: As the temperature increases, the kinetic energy of particles increases and hence they start moving randomly faster. Due to the increase in energy the particles bounce again each other faster and start spreading evenly throughout the volume.

4. How is the diffusion rate affected by concentration difference?
a) Diffusion rate is not affected
b) Higher the concentration difference, higher the diffusion rate
c) Lower the concentration difference, higher the diffusion rate
d) Higher the concentration difference, lower the diffusion rate
View Answer
Answer: b
Explanation: The particles tend to move from higher concentration region to lower concentration difference. Therefore, higher the concentration difference, higher is the rate of diffusion.

5. How is diffusion rate related to diffusion distance?
a) Directly related
b) Inversely related
c) Not related
d) Directly related to square of diffusion distance
View Answer
Answer: b
Explanation: The diffusion rate is inversely proportional to the distance from which the particles are diffusing. Larger the diffusion distance, the rate of diffusion is slower and vice versa.

6. How is the rate of diffusion affected by the weight of diffusing atom?
a) Lighter atoms diffuse faster
b) Heavier atoms diffuse faster
c) Lighter atom diffuses slower
d) Rate of diffusion doesn't depend on weight of diffusing atom
View Answer
Answer: a
Explanation: At a given temperature, average energy of atoms is equal and hence the rate of diffusion will depend on the size and weight of the diffusing atom. A lighter atom will diffuse faster than a heavier atom.

7. Diffusion is slower for _____
a) Open crystal structure
b) Low density materials
c) Materials with lower melting temperature
d) Materials with covalent bonding
View Answer
Answer: d
Explanation: Diffusion rate is high for open crystal structure, material with low density as there is a sample amount of free space to diffuse into and material with low melting temperature as the particles reach liquid state faster and hence diffusion rate increases. On the other hand, the rate of diffusion for materials with covalent bond is slower because they are stronger bonds.

8. Diffusion is slower in polycrystalline structure than single crystalline structure.
a) True
b) False
View Answer
Answer: b
Explanation: The diffusion rate is faster in a polycrystalline structure than a single crystalline structure. This is because diffusion through grain boundaries is faster than volume diffusion.

Stress and Strain

1. Up to which point on the stress-strain curve is Hooke's law valid?
a) Elastic limit
b) Yield point
c) Proportionality limit
d) Fracture point
View Answer
Answer: c
Explanation: The proportionality limit is the point up till which the strain of an elastic body is proportional to the stress applied on it. While elastic point is the point up till which the elastic properties last. After fracture point the body breaks.

2. What is the unit for stress?
a) N/m^2
b) Nm^2
c) N/m
d) Nm
View Answer
Answer: a
Explanation: Stress is basically forced upon the unit area. The dimension for force is N and the dimension of area is m^2. Therefore, the unit for stress is the dimension of force divided by that of area which is N/mm^2.

3. Strain is a dimensionless quantity.
a) True
b) False
View Answer
Answer: a
Explanation: Strain is defined as the deformation produced on a body due to stress divided by a length of the body. Deformation due to longitudinal strength will have the same unit as that of length of the body therefore, strain is a dimensionless quantity.

4. Which of the following relation is stated by Hooke's law?
a) Stress is directly proportional to stress
b) Stress is inversely proportional to stress
c) Stress is directly proportional to square of stress
d) Stress is inversely proportional to square of stress
View Answer
Answer: a
Explanation: According to Hooke's law, stress is directly proportional to strain and the ratio of stress to strain is denoted by Y or E and is called Young's Modulus oof elasticity.

5. Given the shear modulus(G) for aluminum as $2.4e^{+10}$ N/m^2 and the shear strain is given as $6e^{-5}$. What is the value for shear stress?
a) 13.4e+5 N/m^2
b) 14.4e+5 N/m^2
c) 12.4e+5 N/m^2
d) 13.4e-5 N/m^2
View Answer
Answer: b
Explanation: Shear modulus is the ratio of shear stress and shear strain. Therefore, if we simply multiply the shear modulus and shear strain we will obtain the shear stress. Hence the final answer is $2.4e^{+10}$ x $6e^{-5}$ which gives us $14.4e^{+5}$ N/m^2 as the final answer.

6. Which of the following can be the value of Poisson's ratio for an engineering structure?
a) 2
b) 0.4
c) 29
d) 100
View Answer
Answer: b
Explanation: The Poisson's ratio for most of the engineering structure normally lies between 0.3 and 0.6. Therefore 2, 29, 100 cannot be valid values for Poisson's ratio.

7. If the Poisson's ratio is given as 0.3 and the Young's modulus is given to $7e^{10}$. What will be the value for shear modulus?
a) 2.69e10 N/m^2
b) 3.00e10 N/m^2
c) 2.59e10 N/m^2
d) 2.72e10 N/m^2
View Answer
Answer: a
Explanation: The relation between Young's modulus, shear modulus and Poisson's ratio are given by v = E/2G – 1. Taking the 1 on the left side and rearranging we get G = E/2(1+v). Inserting the values given in the question the answer comes out to be 2.69e10 N/m^2. Here E=Young's modulus, G=shear modulus and v= Poisson's ratio.

8. Stress strain curve for cemented tungsten carbide is:
a) Hyperbola
b) Parabola
c) A curve
d) Straight line
View Answer
Answer: d
Explanation: The stress strain curve for cemented tungsten carbide is a straight line as being a brittle material it doesn't have an elastic zone and therefore, it fractures after a certain load is applied.

9. Greater the angle of inclination of the stress strain curve less is the elasticity.
a) True
b) False
View Answer
Answer: b
Explanation: IF the angle of inclination of a stress strain curve is high, the elastic zone of the material is more as the curve starts curving after the elastic limit. Hence the elasticity of the material is high.

10. Which of the following is found out by calculating the area under the stress strain graph?
a) Toughness
b) Hardness
c) Endurance
d) Strength
View Answer
Answer: a
Explanation: Toughness is measured by calculating the area under the stress strain graph and is more for most ductile material than brittle material which has more toughness than ductile material.

Tension and Compression Tests

1. Which of the following property cannot be determined by a tensile test?
a) Yield strain
b) Yield stress
c) Elastic limit
d) Limit of proportionality
View Answer
Answer: a
Explanation: Tensile tests is used to determine different kinds of mechanical properties like yield stress, elastic limit, maximum tensile strength, limit of proportionality.

2. Which type of load is applied in tensile testing?
a) Axial load
b) Shear load
c) Transverse load
d) Longitudinal load
View Answer
Answer: a
Explanation: An axial load is applied to the material to be tested when performing tensile testing and the load is applied axially to the body to be tested.

3. Given the cross sectional are as 4 m^2, what will be the gauge length?
a) 12.3 m
b) 13 m
c) 11.3 m
d) 12 m
View Answer
Answer: c
Explanation: The formula for gauge length (Lo) is Lo= 5.65* root over of Area of cross section. We know that under root 4 is 2, therefore 5.65*2 is equal to 11.3 m.

4. Which of the following does not affect the value of ultimate tensile strength?
a) Quality of surface finish
b) Speed of testing
c) Dimensional accuracy of the specimen
d) Length of the specimen
View Answer
Answer: d
Explanation: The length of the specimen does not affect the value of ultimate tensile strength. While the quality of surface finish, speed of testing, dimensional accuracy of the specimen affect the value of ultimate tensile strength.

5. Which of the following is used to elongation in the material?
a) Clinometer
b) Extensiometer
c) Micrometer
d) Feeler gauge
View Answer
Answer: b
Explanation: An extensiometer is a gauge which is attached to the specimen and it gives us the value of elongation in the body at a time. Feeler gauge and micrometer or clinometer cannot be used during the testing.

6. The yield limit of compression and the tensile test can be different for the same material.
a) True
b) False
View Answer
Answer: a
Explanation: Titanium (T_i) is a material which shows different amount of yielding when subjected to tensile testing compared to when it is subjected to compressive testing.

7. An UTM can be used to conduct both tensile and compressive testing.
a) True
b) False
View Answer
Answer: a
Explanation: A universal testing machine can be used to conduct tests like tension, compression, shear, friction, tear, stiffness. Many other such mechanical properties can be tested.

8. Which of the following factors do not affect the testing?
a) Temperature
b) Increase in number of axes for application of load
c) Fatigue
d) Pressure
View Answer
Answer: d
Explanation: Increase in temperature and increase in the number of axes for load application can affect the testing results in a tensile or compressive test.

Torsional Tests

1. Which of the following cannot be determined using a torsion test?
a) Modulus of elasticity in shear
b) Torsion yield strength
c) Modulus of rupture
d) Young's modulus
View Answer
Answer: d
Explanation: Modulus of elasticity in shear, torsion yield strength and modulus of rupture can all be determined by performing torsion test on material.

2. What is the use of weight head in a torsion testing equipment?
a) Holding the job only
b) Holding the job and applying twisting moment
c) Holding the job and measuring the twisting moment
d) It is not a part of torsion testing equipment
View Answer
Answer: c
Explanation: The main job of weight head is to hold the job and measure the twisting moment.while twisting head holds the other end of job and applies twisting moment.

3. Which of the following is used to measure how much the specimen is twisted?
a) Micrometer
b) Clinometer
c) Troptometer
d) Tropometer
View Answer
Answer: c
Explanation: Troptometer is an instrument which is used for measuring the angular distortion of the material. Mocrometer and vernier callipers are used to measure length. Tropometer measures amount of torsion for a bone.

4. Torsional stress multiplied with original cross sectional are is:
a) Maximum twisting load
b) Minimum twisting load
c) Minimum shear load
d) Yield shear load
View Answer
Answer: a
Explanation: Torsional stress is given by the ratio of maximum twisting load and original are of cross section of the material. Therefore, torsional stress multiplied with original cross sectional gives us maximum twisting load.

5. Plastic deformation can only occur in case of torsional force.
a) True

b) False
View Answer
Answer: b
Explanation: The above given statement is false as plastic deformation can occur in case of tensile, compressive and torsional load after a point. After this point, the body cannot recover its original shape.

6. What is the unit of polar moment of inertia?
a) m^2
b) m^5
c) m^3
d) m^4
View Answer
Answer: d
Explanation: Polar moment of inertia denoted by J, is given by integration of radius square with respect to small area of cross-section. Hence the unit is $(m)(m)(m)^2$ which is equal to m^4.

7. Shear stress on a solid bar and hollow bar is same for given dimension.
a) True
b) False
View Answer
Answer: b
Explanation: Shear stress for a hollow bar and a solid bar are different dimensions as the hollow bar has two dimensions, outer and inner radius because of which calculation is different than the solid bar which has only one diameter.

8. In which of the following the angle of twist increases fast for a small amount of torque?
a) Cold working condition
b) Hot working condition
c) Warm working condition
d) The increase is the same for cold working, hot working and warm working
View Answer
Answer: b
Explanation: When the torsion test is conducted in hot working, it is observed that for a slight change in torque on the given specimen the angle of twist increase fast as the material becomes soft at hot working temperature.

Stress Transformation

1. How many shear stress components can act on a 3-D object?
a) 2
b) 4
c) 5
d) 6
View Answer
Answer: d
Explanation: On a 3-dimensional body, total 9 stress components can act, out of which 3 are normal stress components while 6 of the other are tangential or shear stress component.

2. Which type of stress is plane stress?
a) One dimensional
b) Two dimensional
c) Zero dimensional
d) Three dimensional
View Answer
Answer: b
Explanation: Plane stress is a two-dimensional stress in which stress components on any one direction is zero. For eg. All the stress components pertaining to z component is zero.

3. Principal plane is the plane in which _____
a) Shear stress is maximum
b) Normal stress is zero
c) Shear stress is zero
d) It doesn't depend upon stresses
View Answer
Answer: c
Explanation: Principle planes are those planes where the value of shear stress is equal to zero and maximum or minimum value of normal stress is present at these points.

4. In a Mohr's circle drawn on the x-y plane, which axis is the axis where normal stress is plotted?
a) X-axis
b) Y- axis
c) Z-axis
d) Normal stress isn't related to Mohr's circle
View Answer
Answer: a
Explanation: In a Mohr's circle, the x-axis or the horizontal axis in the x-y plane is the axis on which normal stress is plotted on. This axis is also called the abscissa.

5. In a Mohr's circle drawn on the x-y plane, which axis is the axis where shear stress is plotted?
a) X-axis
b) Y- axis
c) Z-axis
d) Shear stress isn't related to Mohr's circle
View Answer
Answer: b
Explanation: In a Mohr's circle, the y-axis or the vertical axis in the x-y plane is the axis on which normal stress is plotted on. This axis is called the ordinate.

6. Which of following is not a graphical method for representing stress?
a) Lame's stress ellipsoid
b) Cauchy's stress quadric
c) Lame's stress circle
d) Mohr's circle
View Answer
Answer: c
Explanation: Lame's stress circle cannot be used for graphical representation of stresses while Lame's stress ellipsoid, Mohr's circle and Cauchy's stress quadric are used for graphically representing stress.

7. Double angle method is a method to solve the problem in Lame's stress ellipsoid.
a) True
b) False
View Answer
Answer: b
Explanation: Double angle method cannot be used to solve Lame's stress ellipsoid problems, it is used in case of Mohr's circle. This method mainly has two rule you need to follow.

8. Principal stress is only the minimum stress.
a) True
b) False
View Answer
Answer: b
Explanation: Principal stresses are maximum and minimum stresses which act on the body and planes on which they act are called the principal plane.

Various Mechanical Properties

1. Up till which point will a body regain its original shape?
a) Yield point
b) Elastic limit
c) Fracture limit
d) Ultimate tensile strength point
View Answer
Answer: b
Explanation: Elastic limit is a point up till which the body can regain its original shape even after deformation and change in shape. After this point the body cannot regain its original shape.

2. Plasticity increases with temperature.
a) True
b) False
View Answer
Answer: a
Explanation: Plasticity increase with temperature. Metals have high plasticity at high temperature. Mainly manufacturing processes like forming, drawing, extrusion etc. are done after considering plasticity.

3. Which of the following is not an evidence of plastic action on the material?
a) Yield
b) Plastic flow
c) Fatigue
d) Creep
View Answer
Answer: c
Explanation: When a body is acted upon by plastic actions, one of the following can be seen out of yield, plastic flow and creep. Fatigue isn't an evidence left after plastic action on a body.

4. Which of the following is the property because of which a material can be drawn into wires?
a) Ductility
b) Elasticity
c) Malleability
d) Strength
View Answer
Answer: a
Explanation: Ductility is the physical property by which the material can be drawn in wires. None of the other options matched this definition.

5. What is the unit of impact strength?
a) N/m
b) MN/m
c) MN/m^2
d) N/m^2
View Answer
Answer: c
Explanation: The SI Unit for impact strength is expressed as MN/m^2. The unit in the numerator is taken in mega newton as the force acting is very high in case of impact strength.

6. Arrange the following in increasing order of hardness: talc, gypsum, topaz diamond.
a) Talc, gypsum, topaz, diamond
b) Gypsum, topaz, talc, diamond
c) Diamond, topaz, talc, gypsum
d) Topaz, gypsum, talc, diamond
View Answer
Answer: a
Explanation: Talc, gypsum, topaz and diamond is the correct order in which it is arranged in increasing order of hardness.

7. How is brittleness related to impact strength?
a) Brittleness is directly proportional to impact strength
b) Brittleness is inversely proportional to impact strength
c) Brittleness is directly proportional to a square of impact strength
d) Brittleness is inversely proportional to a square of impact strength
View Answer
Answer: b
Explanation: Brittleness is inversely proportional to the value of impact strength of the body that is more the impact strength less is the brittleness and vice versa.

8. Which of the following properties is impact strength indicative of?
a) Elasticity
b) Hardness
c) Stiffness
d) Toughness
View Answer
Answer: d
Explanation: Impact strength is indicative of toughness of material and is given by how much energy the material can absorb while going through plastic deformation.

9. Which of the following is not a correct designation of impact strength?
a) KCU
b) KCV
c) KCT
d) KCW
View Answer
Answer: d
Explanation: The first two letter signify that it is impact strength and KC are used for that. The third letter signifies the type of notch used, for example, U notch signify that the notch is U shaped.

10. KCU is used more than the other KCT and KCV.
a) True
b) False
View Answer
Answer: a
Explanation: This statement is true as KCU is more broadly used for impact strength while KCT and KCV are used in special cases.

Design and Safety Factors

1. Which of the following is the numerator of factor safety formula?
a) Working stress
b) Shear stress
c) Tensile stress
d) Ultimate stress
View Answer
Answer: d
Explanation: Factor of safety is defined as ratio of ultimate stress and working stress. It is also called as factor of ignorance. The factor of safety is dependent on the type of load.

2. Which of the following can be the factor of safety for a dead load?
a) 6
b) 2
c) 4
d) 7
View Answer
Answer: c
Explanation: For dead load, the range in which the factor of safety can lie is 4 to 5. Therefore only 4 lies in that range and 6, 2, 7 are all values which are beyond that range.

3. Which of the following can be the factor of safety for shock loading?
a) 11
b) 13
c) 4
d) 7
View Answer
Answer: b
Explanation: For shock loading, the range in which the factor of safety can lie is 12 to 15. Therefore only 13 lies in that range and 11, 4, 7 are all values which are beyond that range.

4. Factor of safety is used to find out the reliability of the design.
a) True
b) False
View Answer
Answer: a
Explanation: Factor of safety tells us about how much load the material can take before it fails. Basically, it states the load carrying capacity of a material beyond the actual load.

5. What can understand by the factor of safety equal to one?
a) It means that the structure will fail under load
b) It means that the structure will only support the actual load
c) it means that the structure will support more than the actual load
d) There is no relation between factor safety and load application
View Answer
Answer: b
Explanation: When the factor of safety is one it means that the ultimate stress is equal to the working stress and therefore the body can only support load up to actual load and no more before failing.

6. For which of the following design factor of safety the design will work properly?
a) 0.1
b) 1
c) 2
d) 0.9
View Answer
Answer: c
Explanation: If the design factor of safety is not more than 1 then the design may not work and will fail under certain conditions.

7. What is a safe factor of failure for a component which on failure can result in financial loss or serious injury?
a) 1
b) 2
c) 3
d) 4
View Answer
Answer: d
Explanation: For components which on failing can be hazardous and can lead to serious injuries, death and financial loss, the factor of safety should be taken equal to or more than 4.

8. Design factor for most aircraft structures is 2.
a) True
b) False
View Answer
Answer: b
Explanation: The design factor of safety for most aircraft structures or components is taken to be 1.5 and not 2. More factors affect this value, but it is most of the time taken as 1.5.

Concept of Dislocations

1. Edge dislocation and skew dislocation are linear crystalline defects.
a) True
b) False
View Answer
Answer: a
Explanation: Line defects are mainly dislocations which can be broadly classified into two distinct defects. These two dislocations are called edge dislocation and screw dislocation.

2. In which type of dislocation an extra plane is inserted inside the crystal?
a) Edge dislocation
b) Screw dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: a
Explanation: The edge defect is simply pictured as an additional half plane of atoms in a lattice. The dislocations are termed a line defect because of the number of defective points created within the lattice along a line. Hence, an extra plane of atoms is added inside the crystal in this type of defect.

3. What is the difference between the angle of Burgers vector and dislocation line in edge dislocation and screw dislocation?
a) -90 degrees
b) 0 degrees
c) 45 degrees
d) 90 degrees
View Answer
Answer: d
Explanation: The angle between Burgers vector and dislocation line in edge dislocation is 90 degrees while the angle between burger vector and dislocation line for screw dislocation is 0 degree. To find the difference we have subtract 0 from 90, giving us 90 degrees as our final answer.

4. In which type of dislocation planes are displaced relative to each other through shear?
a) Edge dislocation
b) Screw dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: b
Explanation: In screw dislocation, planes are displaced relative to each other through shear. The trace of the atomic planes around the screw dislocation makes spiral or whorled path sort of resembling a screw and hence, it is name screw dislocation.

5. In edge dislocation, a helical path is traced around the dislocation line.
a) True
b) False
View Answer
Answer: b
Explanation: A helical path is traced along the dislocation line in screw dislocation whereas in edge dislocation a new additional half plane of atom is inserted and a screw like path is not traced by the dislocation.

6. Which of the following is fields are not present for edge dislocation?
a) Tensile
b) Compressive
c) Shear stress
d) Strain
View Answer
Answer: d
Explanation: In an edge dislocation, tensile, compressive and shear stress field are present due to additional half plane of atom added because of which stresses are produced but no strain is produced because of the edge dislocation.

7. Which of the following is fields are present for screw dislocation?
a) Tensile
b) Compressive
c) Shear stress
d) Strain
View Answer
Answer: c
Explanation: As in screw dislocation a helical path is traced along a dislocation line, there is only presence of shear stress field and no compressive, tensile or strain field is produced. Shear stress field is produced due to the spiral aspect of this type of dislocation.

8. Which of the following dislocation can glide but not climb?
a) Screw dislocation
b) Edge dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: a
Explanation: Screw dislocation can only glide in a crystal lattice along the helical path while edge dislocations can glide and climb as there is an extra plane of atom present.

9. What is the dislocation in which the line direction and Burgers vector are neither perpendicular nor parallel?
a) Screw dislocation
b) Edge dislocation
c) Jog dislocation
d) Mixed dislocation
View Answer
Answer: d
Explanation: Mixed dislocations are dislocation consisting of both screw and edge dislocation character where in screw dislocation the line direction and burger vector are parallel and for edge dislocation it is perpendicular. Therefore, the angle between line direction and Burgers vector is neither perpendicular nor parallel.

10. What can be the unit of dislocation density?
a) mm^{-2}
b) mm^{-3}
c) mm^{2}
d) mm
View Answer
Answer: a
Explanation: Dislocation density is defined as the total dislocation length per unit volume and unit of length is mm and that of volume is mm^{3} therefore, the unit of dislocation density will be mm^{-2}.

Lattice Strain

1.Which of the following is not a lattice strain due to dislocation?
a) Tensile lattice strain
b) Compressive lattice strain
c) Shear lattice strain
d) Torsional lattice strain
View Answer
Answer: d
Explanation: Due to the movement of dislocation in a material tensile lattice strain, compressive lattice strain and shear lattice strain are felt by the neighboring atoms in the lattice.

2. When atoms are deformed approximately what fraction of deformation energy is retained internally?
a) 5%
b) 10%
c) 15%
d) 20%
View Answer
Answer: a
Explanation: When a metal is plastically deformed, the atoms inside the lattice retain approximately 5% of the deformation energy.

3. For which of the following dislocation the strain is pure shear?
a) Screw dislocation
b) Jog dislocation
c) Mixed dislocation
d) Edge dislocation
View Answer
Answer: a
Explanation: In screw dislocation only, pure shear stress is felt by the body while in edge dislocation, jog dislocation and mixed dislocation, other types of lattice strains also exist.

4. Which of the following will decrease lattice strain?
a) Line defects
b) Point defects
c) Dislocation
d) Heating the material
View Answer
Answer: d
Explanation: When a body is heated the strain on the body decreases whereas it increases when defects like line defects, point defects and dislocation are present in the lattice.

5. How high can dislocation density of a material be when it is heavily deformed?
a) 10^{10} mm^{-2}
b) 10^{9} mm^{-2}
c) 10^{11} mm^{-2}
d) 10^{12} mm^{-2}
View Answer
Answer: a
Explanation: The dislocation density when the body or material is heavily deformed due to plastic deformation can be as high as 1010 mm-2.

6. Two edge dislocation on same slip plane and the same sign will _____
a) Exert attractive force
b) Exert no force
c) Exert repulsive force
d) Exert shearing force
View Answer
Answer: c
Explanation: When two dislocations are of the same sign and are located on the same slip plane they exert a repelling force on each other.

7. Dislocation annihilation occurs when two dislocations meet.
a) True
b) False
View Answer
Answer: a
Explanation: When two dislocations of opposite sign are on located on same slip plane the two dislocations exert an attractive force and then they will start moving towards each other on meeting dislocation annihilation takes place.

8. Shear strains are observed in the vicinity of the edge dislocation.
a) True
b) False
View Answer
Answer: a
Explanation: Along with tensile and compressive strains, in edge dislocation shear strains are also observed in the neighboring regions of the dislocation.

Slip Systems

1. Slip plane along with the direction of slip is called a slip system.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Slip system is the name gib=ven to the slip plane along with the direction in which slip occurs.

2. How many slip system are there in FCC lattice?
a) 12
b) 6
c) 10
d) 18
View Answer
Answer: a
Explanation: The number of slip planes are four and the number of slip direction are three in an FCC lattice. Therefore the total number of slip system is given by their multiplication that is twelve.

3. Slip planes do not occur where:
a) Atom density is high
b) Atom density is low
c) Atoms are closely placed
d) direction of slip plane is the same as the translation vector which is the shortest
View Answer
Answer: b
Explanation: Slip planes occur in planes where the atom density is high and hence the atoms are closely packed. Further, the direction of slip plane is the same as that of the translation vector which is the shortest.

4. Which law is related to slip plane and slip direction?
a) Bragg's law
b) Fick's law
c) Schmid's law
d) Such a law doesn't exist
View Answer
Answer: c
Explanation: Schmid's law gives us a relation between critically resolved shear stress and stress applied on the material. Where critical resolved shear stress is that component of shear stress which is in the slip direction.

5. Which of the following factors are more accurate when used for polycrystal metals?
a) Schmid's factor
b) Taylor factor
c) Independent factor
d) Max factor
View Answer
Answer: b
Explanation: Schmid's factor is accurate for FCC crystal but for polycrystal metals use of the Taylor factor gives us a more accurate result.

6. Value of critical resolved shear stress for a given material at a given temperature _____
a) Increases with time
b) Decreases with time
c) Decreases harshly with time
d) Remains constant
View Answer
Answer: d
Explanation: The critical resolved shear stress is independent of time and for a given material at a given temperature its value remains constant. It varies with a change in temperature.

7. Which of the following stresses is required for the slip to occur?
a) Tensile stress
b) Compressive stress
c) Critical resolved shear stress
d) Slip doesn't occur due to stress
View Answer
Answer: c
Explanation: A critical resolved shear stress is that component of shear stress which is in the slip direction and hence needed for a slip to occur. Tensile or compressive stress aren't needed for a slip.

8. How many slip systems are there in BCC lattice?
a) 36
b) 48
c) 24
d) 18
View Answer
Answer: b
Explanation: The number of slip plane is 48 for a BCC material. There are 6 planes of type {110} with 2 direction which gives us 12, in addition, there are 24 systems of {123} and 12 systems of {112}. Hence we get a total of 48.

9. How many slip systems are there in hexagonal closed packed crystal?
a) 3
b) 6
c) 9
d) 18
View Answer
Answer: a
Explanation: In a hexagonal closed packed structure the slip is limited in comparison to bcc or fcc and allows slip in dense basal planes where the number of slip planes are calculated to be 3.

10. Slip is important for deformation to occur.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is true. Slip is the mechanism which is followed by the dislocation when under plastic force to undergo deformation which can be seen on a three-dimensional level due to these microscopic slips.

Strengthening Mechanisms

1. Which of the following isn't a strengthening mechanism?
a) Grain size reduction
b) Solid solution strengthening
c) Strain hardening
d) Grain size increment
View Answer
Answer: d
Explanation: Grain size reduction, solid solution strengthening and strain hardening are all strengthening mechanisms which increase the hardness of the material. Grain size increment isn't a strengthening mechanism.

2. Which of the following isn't a strengthening mechanism for multi-phase materials?
a) Precipitation strengthening
b) Dispersion strengthening
c) Solid solution strengthening
d) Martensite strengthening
View Answer
Answer: c
Explanation: Precipitation strengthening, dispersion strengthening, martensite strengthening are strengthening mechanism used for multi-phase materials. Solid solution strengthening is used for single-phase materials.

3. The yield strength of a material going through grain size reduction increases by a factor, k multiplied by:(where d is the diameter of grain)
a) d^{2}
b) $d^{1/2}$
c) $d^{-1/2}$
d) d^{-2}
View Answer
Answer: c
Explanation: Yield strength relation is given by Hall-Petch relation in which final yield strength is equal to initial yield strength plus k(a constant) multiplied by $d^{-1/2}$.

4. Which of the following is not improved by grain size reduction?
a) Hardness
b) Toughness
c) Elasticity
d) strength
View Answer
Answer: c
Explanation: Grain size reduction increases the hardness, toughness and the strength of the material. Elasticity is not increased by grain size reduction.

5. Which of the following is not a way of interaction between solute atoms and dislocation?
a) Elastic interaction
b) Plastic interaction
c) Modulus interaction
d) stacking fault interaction
View Answer
Answer: b
Explanation: Plastic interaction isn't a way of interaction of solute atom and dislocation while plastic interaction, modulus interaction and stacking fault interaction are ways of an interaction of solute atoms and dislocation.

6. Which of the following interactions will continue to act to about 0.6Tm?(Where Tm is melting point)
a) Elastic interaction
b) Modulus interaction
c) Electrical interaction
d) Long range interaction
View Answer
Answer: c
Explanation: Elastic interaction, modulus interaction, long range interaction are all long range interactions which act at 0.6 Tm while short range interaction like electrical interaction doesn't act at 0.6Tm.

7. Which is not a correct term for bands in yield point phenomenon?
a) Lüders bands
b) Hartmann lines
c) stretcher stains
d) Lüders lines
View Answer
Answer: d
Explanation: Lüders lines isn't a correct term for bands in yield point phenomenon. While Lüders bands, Hartmann lines, stretcher stains are a correct term which can be used for bands in yield point phenomenon.

8. At what angle are Hartmann lines inclined to the tensile axis?
a) 45 degrees
b) 15 degrees
c) 30 degrees
d) 20 degrees
View Answer
Answer: a
Explanation: The Hartmann lines are inclined to an angle of 45 degrees approximately to the tensile axis.

9. In strain hardening, the body is plastically deformed.
a) True
b) False
View Answer
Answer: a
Explanation: Strain hardening is a process which is done on a ductile method by deforming them plastically and increasing strain in the body and hence increasing the hardness.

10. In strain hardening, there is an increase in density.
a) True
b) False
View Answer
Answer: b
Explanation: In strain hardening apart from changes in mechanical properties there are physical changes like decrease in density, a small increase in the thermal coefficient of expansion.

Recovery, Recrystallization, and Grain Growth

1. In which of the following processes does recovery, recrystallization, grain growth take place?
a) Surface hardening
b) Tempering
c) Strengthening
d) Annealing
View Answer
Answer: d
Explanation: In the process of annealing, the crystal goes through three stages which are called recovery, recrystallization and grain growth in order.

2. When a material is plastically deformed at low temperature(around 25 degrees) relative to the melting temperature, which of the following change isn't observed?
a) Change in grain shape
b) Strain hardening
c) Decrease in dislocation density
d) Increase in dislocation density
View Answer
Answer: c
Explanation: When a body is plastically deformed at low temperatures compared to its melting point, we observe micro structural changes like change in grain growth, strain hardening and increase in dislocation density.

3. At which of the following temperature can recovery occur? (where Tm is melting point)
a) 0.2Tm
b) 0.4Tm
c) 0.5Tm
d) 0.6Tm
View Answer
Answer: a
Explanation: Recovery occurs at a lower temperature than recrystallization or grain growth. Recovery takes place at the temperature below 0.3Tm.

4. Strain-relief crystallization takes place when deformed metals are heated.
a) True
b) False
View Answer
Answer: a
Explanation: Recovery is subdivided into two parts, strain-relief crystallization and polygonization. Strain-relief crystallization occurs when deformed metals are heated and the latter takes place under certain conditions.

5. Which of the following statements are false in strain-relief crystallization?
a) Dislocation climb
b) Decrease in the electric resistance
c) Increase in density
d) Interaction of like signed dislocation
View Answer
Answer: d
Explanation: When strain-relief crystallization takes place dislocation climb, an increase in density and a decrease in density. During strain-relief crystallization interaction of unlike signed dislocation is observed.

6. By what percentage can the hardness decrease after strain-relief crystallization?
a) 12%
b) 5%
c) 8%
d) 17%
View Answer
Answer: a
Explanation: After strain-relief crystallization, the hardness and the strength of the material decrease by 10-15% from their original value. On the other hand, ductility increases by that percentage.

7. In which of the following metal polygonization rarely takes place?
a) Copper
b) Iron
c) Aluminium
d) Molybdenum
View Answer
Answer: a
Explanation: Polygonization is the process in which new grain boundaries are formed and isn't common for all metals and observed after slight deformation. In copper and its alloy, this process rarely develops.

8. Which of the following processes can be used to refine the grain structure?
a) Recovery
b) Recrystallization
c) Grain growth
d) Such a process does not exist.
View Answer
Answer: b
Explanation: In recrystallization new grains are formed with small nuclei and they grow until they cover the whole parent material. Therefore, the new grain structure is fine and hence the grain structure is refined.

9. Lowest temperature for recrystallization for iron is 270°C
a) True
b) False
View Answer
Answer: b
Explanation: For commercially pure iron, the lowest temperature at which recrystallization can occur is equal to 450°C. For aluminium and copper, it is equal to 100°C and 270°C respectively.

10. Which of the following is false for grain growth?
a) The grains start growing
b) Grain growth accelerates with increase in temperature
c) Decrease in free energy
d) Increase of surface energy
View Answer
Answer: d
Explanation: The surface energy decreases during grain growth because of which free energy decreases. The grain starts growing and grain growth accelerates with increase in temperature.

Fundamentals of Failure

1. Improper heat treatment can cause mechanical failure.
a) True
b) False
View Answer
Answer: a
Explanation: There are many causes of mechanical failure such as improper heat treatment, misuse, design errors, improper material and many other causes.

2. Buckling in a column occurs in the material due to which of the following forces?
a) Compressive
b) Tensile
c) Shear
d) It doesn't occur due to a force
View Answer
Answer: a
Explanation: Buckling in columns is a type of mechanical failure which occurs in materials due to the application of compressive load.

3. Which of the following is not a factor affecting fracture?
a) Stress concentration
b) Temperature
c) Pressure
d) Speed of loading
View Answer
Answer: c
Explanation: Pressure isn't a factor which affects fracture. Fracture of a material id affected by factors like stress concentration, thermal shock, temperature and speed of loading.

4. Which of the following is false?
a) Notch is a sudden change in section of a material
b) Stress concentration is produced due to notches
c) Notches change the stress applied to the body
d) Smaller the tip of the notch, less the increase in stress
View Answer
Answer: d
Explanation: A notch is a sudden change in section of a material and stress concentrations are produced due to it. The smaller the tip of a notch the larger is the increase in stress.

5. Is the speed of loading is increased then:
a) Chances of fracture increases
b) Chances of fracture decreases
c) Chances of fracture remain the same
d) Elasticity of the body increases
View Answer
Answer: a
Explanation: When the speed of loading is increased, the stress increases suddenly on the same section of the material which can lead to early failure in the form of fracture.

6. At what temperature is steel ductile?
a) -10 °C
b) -5 °C
c) -3 °C
d) 4 °C
View Answer
Answer: d
Explanation: Steel acts as a ductile material at a temperature above 0 °C while it acts as a brittle material below 0 °C. Therefore at -10 °C, -5 °C, -3 °C steel will be brittle and not ductile.

7. Which of the following decreases transition temperature in steel?
a) Carbon
b) Nitrogen
c) Phosphorous
d) Manganese
View Answer
Answer: d
Explanation: Alloying elements like manganese and nickel decrease the transition temperature of steel while alloying elements like carbon, nitrogen and phosphorous increases the transition temperature.

8. When hot water is poured into the cold glass, the glass may crack.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. When hot water is poured in a cold glass, the glass may get cracked due to thermal shock due to the sudden change in temperature of the glass.

9. What is the relation between fracture toughness and thickness?
a) Fracture toughness decreases with increase in thickness
b) Fracture toughness increases with increase in thickness
c) Fracture toughness does not depend on the thickness
d) Fracture toughness increase linearly with an increase in thickness
View Answer
Answer: a
Explanation: As the thickness increases the fracture toughness of the material decreases. It follows a curve and is not a linear graph.

10. Which of the following elements reduce fracture toughness in steel?
a) Phosphorous
b) Manganese
c) Iron
d) Aluminium
View Answer
Answer: a
Explanation: There are some alloying elements which reduce fracture toughness in alloys. For an alloy like steel, phosphorous and sulphur decrease the fracture toughness in steel.

Ductile Fracture

1. Necking occurs in which of the following fractures?
a) Ductile fractures
b) Brittle fracture
c) Fatigue
d) It doesn't occur during fracture
View Answer
Answer: d
Explanation: Necking occurs when tensile force is applied on metals and it occurs when ductile failure is occurring. In brittle fracture the material just breaks before breaking.

2. In ductile fracture, at what angle to the tensile axis does the crack propagate outwardly to the surface of the material?
a) 90°
b) 30°
c) 45°
d) 15°
View Answer
Answer: c
Explanation: The crack propagates outwardly to the surface of the material at an angle of 45° to the tensile axis and this type of fracture is called "cup and cone fracture".

3. At the point of necking which of the following is false?
a) Strain hardening occurs at this point
b) Cross sectional area increases
c) Cross sectional area decreases
d) Strength increases
View Answer
Answer: b
Explanation: At the point of the necking the strength increases due to strain hardening and the cross-sectional areas decreases at the same time. At the time where cross sectional area decreases faster than necking starts.

4. Ductile fracture happens after extensive plastic deformations.
a) True
b) False
View Answer
Answer: a
Explanation: Unlike brittle fracture, ductile fracture happens after extensive plastic deformation and goes through multiple visible stages before the final fracture is observed.

5. Which of the following cannot be a reason for ductile failure?
a) Error in design
b) Improper material
c) Improper manufacturing techniques
d) Unforeseen operating condition
View Answer
Answer: d
Explanation: Ductile fracture is a slow process with many steps and under unforeseen operating conditions if the fracture is going to occur it will be noticeable and can be avoidable.

6. After which point is necking observed?
a) Ultimate strength
b) Yield strength
c) Elastic point
d) Fracture point
View Answer
Answer: a
Explanation: Necking in a ductile material is observed after the body crosses the point of ultimate strength on the stress-strain curve.

7. What is the amount of strain in a stable neck is called?
a) Natural draw ratio
b) Forced draw ratio
c) Poisson's ratio
d) Physical activity ratio
View Answer
Answer: a
Explanation: Natural draw ratio is the name given to the amount of strain in a stable neck during necking of a material under load.

8. Material subjected to only tensile force even during necking.
a) True
b) False
View Answer
Answer: b
Explanation: Material during necking due to high dislocation density is subjected to a complex stress. At this point, the material isn't subjected only a single tensile force.

Brittle Fracture

1. Which of the following is associated with minimum plastic deformation?
a) Ductile fracture
b) Brittle fracture
c) Fatigue
d) It doesn't occur during fracture
View Answer
Answer: b
Explanation: In brittle fracture, the plastic deformation occurring in the body is minimum and there is a rapid movement of crack with a very little amount of plastic deformation.

2. In which of the following does crack propagation occur?
a) Ductile fracture
b) Brittle fracture
c) Fatigue
d) It doesn't occur during fracture
View Answer
Answer: b
Explanation: In brittle fracture, after a little plastic deformation the material fractures and then the crack propagates rapidly, making the material break.

3. Below which point does brittle fracture occur?
a) Ultimate tensile strength
b) Fracture point
c) Elastic limit
d) Yield point
View Answer
Answer: c
Explanation: Brittle fracture occurs just below the point of elasticity as brittle material aren't elastic and hence they break before reaching the elastic limit of that material.

4. Cleavage planes are a term associated with ductile fracture.
a) True
b) False
View Answer
Answer: b
Explanation: Brittle fracture occurs generally along crystal planes called cleavage planes where the number of atomic bonds are relatively low.

5. The tendency of brittle fracture increases with:
a) Decreasing temperature
b) Increasing temperature
c) Decrease in strain rate
d) It doesn't depend on temperature or strain rate
View Answer
Answer: b
Explanation: The tendency of brittle fracture to be observed increases as the temperature decreases.

6. The tendency of brittle fracture increases with:
a) Decreasing temperature
b) Increase in strain rate
c) Decrease in strain rate
d) It doesn't depend on temperature or strain rate
View Answer
Answer: b
Explanation: The tendency of brittle fracture to be observed increases as the strain rate of the body increases. As the strain rate increases the body dislocations start piling up and ultimately leading to failure.

7. Which of the statement is true?
a) Energy consumed is less in ductile fracture than brittle fracture
b) Energy consumed is more in ductile fracture than brittle fracture
c) Energy consumed is same in brittle fracture than ductile fracture
d) Energy consumed is more in brittle fracture than ductile fracture
View Answer
Answer: b
Explanation: As brittle fracture less plastic deformation and absorbs less amount of energy before breaking, the energy consumed by brittle fracture is less than the ductile fracture.

8. Which of the theory is related to brittle fracture?
a) Laundau theory
b) Dirac hole theory
c) Valence bond theory
d) Griffith's theory
View Answer
Answer: d
Explanation: Griffith's theory is a theory which was postulated by Griffith and is related to brittle fracture. It is known as Griffith's theory of brittle fracture.

9. The graph for Griffith's crack is _____
a) An ellipse
b) A circle
c) A straight line
d) A hyperbola
View Answer
Answer: a
Explanation: The graph for Griffith's crack is an ellipse. The graph tensile stress applied perpendicular to the length of crack and the length of the crack.

10. Surface energy of the specimen increases when the crack lengthens.
a) True
b) False
View Answer
Answer: a
Explanation: When the crack lengthens the surface area increases and hence the surface energy of the specimen increases.

Fracture Mechanics

1. Which of the following part of mechanics deals with study of crack propagation?
a) Solid mechanics
b) Fluid mechanics
c) Applied mechanics
d) Fracture mechanics
View Answer
Answer: d
Explanation: Fracture mechanics is that part of mechanics which deals with the study of propagation of cracks. Solid mechanics and fluid mechanics deal with solid body and fluid respectively.

2. Which of the following is not a mode of application of force for crack propagation?
a) Opening mode
b) Sliding mode
c) Tearing mode
d) Rolling mode
View Answer
Answer: d
Explanation: The application of force for the crack to propagate can be mainly of three types which are opening mode, tearing mode, sliding mode. Rolling mode cannot be used.

3. Fractography is the study of surfaces of materials which are fractured
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true and fractography is indeed the study of surfaces of materials which are fractured. They are used mainly in forensic engineering or during failure analysis.

4. What amount of actual stress would be needed to fracture bulk glass?
a) 10 MPa
b) 20 MPa
c) 100 MPa
d) 50 MPa
View Answer
Answer: c
Explanation: To fracture bulk glass, a force of about 100 Mpa or 15000 psi would be needed.

5. What amount of actual stress would be needed to fracture bulk glass?
a) 1000 MPa
b) 2000 MPa
c) 10000 MPa
d) 5000 MPa
View Answer
Answer: c
Explanation: To fracture bulk glass, theoretically the stress needed to break the atomic bonds of the glass would be 10000 Mpa or 1500000 psi.

6. According to Griffith if f is stress at fracture and a is flaw length then which of the following is true?
a) $f*a^{1/2}$
b) f*a
c) f/a
d) $f/a^{1/2}$
View Answer
Answer: a
Explanation: Griffith on conducting his experiment found out that the multiplication of stress at fracture and the square root of the flaw length remains constant.

7. Which of the following scientist proposed a modification to Griffith's theory?
a) G. R. Irwin
b) Albert Einstein
c) Isaac Newton
d) There was no modification proposed.
View Answer
Answer: a
Explanation: G. R. Irwin and people working under him at the U.S. Naval Research Laboratory found out that plasticity also plays a role in fracture of material and hence they proposed a modification.

8. What is the unit of G from Griffith's energy criterion?
a) $J\text{-}m^2$
b) J-m
c) J/m^2
d) J/m
View Answer
Answer: c
Explanation: G is the surface energy and is the given by energy per unit area which can be found out by dividing J by m^2 to get the final answer as J/m^2.

9. For polymers close to glass transition temperature which of the following can be a value of G?
a) 1 J/m^2
b) 900 J/m^2
c) 1200 J/m^2
d) 1400 J/m^2
View Answer
Answer: b
Explanation: 900 J/m^2 can be value of G for polymers close to glass transition temperature as the range of the G for this case is known to be 2 J/m^2 to 1000 J/m^2. As the other options lie out of this range, there is only one correct answer.

10. Fracture stress decreases as fiber diameter decreases.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false as the fracture strength is known to increase when the fiber diameter decreases as observed by Griffith.

Impact Fracture Tests

1. What is the unit of impact strength?
a) N/m
b) MN/m
c) MN/m^2
d) N/m^2
View Answer
Answer: c
Explanation: The SI Unit for impact strength is expressed as MN/m^2. The unit in numerator is taken in mega newton as the force acting is very high in case of impact strength.

2. Which of the following properties is impact strength indicative of?
a) Elasticity
b) Hardness
c) Stiffness
d) Toughness
View Answer
Answer: d
Explanation: Impact strength is indicative of toughness of material and is given by how much energy the material can absorb while going through plastic deformation.

3. Which of the following is false?
a) Notch is a sudden change in section of a material
b) Stress concentration is produced due to notches
c) Notches change the stress applied to the body
d) Smaller the tip of the notch, less the increase in stress
View Answer
Answer: d
Explanation: A notch is a sudden change in section of a material and stress concentrations are produced due to it. The smaller the tip of a notch the larger is the increase in stress.

4. Which of the following is not notch sensitive?
a) Carbon
b) Steel
c) Plastic
d) FCC metal
View Answer
Answer: d
Explanation: Tendency of a material to behave as a brittle material in presence of a notch is termed as notch sensitivity. Carbons, steels and plastics which are notch sensitive while FCC

metals aren't notch senitive.

5. Charpy test is not a type of impact test.
a) True
b) False
View Answer
Answer: b
Explanation: Charpy and Izod test are the two standard testing methods in case of impact fracture tests.

6. What is the angle of a standard notch?
a) 10°
b) 20°
c) 45°
d) 30°
View Answer
Answer: c
Explanation: As standard notch which is made on the material during impact fracture testing has an angle of 45°. The type of notch used in case of Charpy and Izod test is V-notch.

7. What is the dimension of material used in case of Izod test?
a) 10 mm * 10 mm * 75 mm
b) 10 mm * 10 mm * 65 mm
c) 5 mm * 5 mm * 75 mm
d) 5 mm * 5 mm * 65 mm
View Answer
Answer: a
Explanation: In Izod test the specimen is taken of the dimension 10 mm * 10 mm * 75 mm where the width and breadth of the material are 10 mm and 10 mm respectively while the length is 75 mm.

8. What is the dimension of material used in case of Charpy test?
a) 10 mm * 10 mm * 55 mm
b) 10 mm * 10 mm * 65 mm
c) 5 mm * 5 mm * 55 mm
d) 5 mm * 5 mm * 65 mm
View Answer
Answer: a
Explanation: In Charpy test the specimen is taken of the dimension 10 mm * 10 mm * 55 mm where the width and breadth of the material are 10 mm and 10 mm respectively while the length is 55 mm.

9. The direction of a blow of hammer is opposite to the notch section in case of Izod test.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false as the direction of the blow of hammer is opposite to the notch section in case of Charpy test and the direction are same in case of the Izod test.

10. Which of the following is the Charpy V impact strength for annealed pure copper?
a) 30 J
b) 31 J
c) 32 J
d) 34 J
View Answer
Answer: d
Explanation: The value of Charpy V impact strength of annealed pure copper is experimentally found out to be 34 J.

Fatigue

1. Which of the following is failure of material due to cyclic stress?
a) Brittle fracture
b) Ductile fracture
c) Creep
d) Fatigue
View Answer
Answer: d
Explanation: Fatigue is the type of failure which is observed in that material which is subjected to cyclic stress cycles. It can also be defined as the number of stress cycle a material can withstand before failing.

2. What can be height of an extrusion or an intrusion which is responsible for crack initiation in case of fatigue (in cm?
a) $2*10^{-6}$
b) $2*10^{-8}$
c) 10^{-5}
d) 10^{-8}
View Answer
Answer: a
Explanation: In case of fatigue, there is movement of dislocation because of which local deformation called extrusions are form in slip bands which are accompanied by intrusions. These extrusion and intrusion have a height ranging from 10^{-6} cm to 10^{-7} cm.

3. Which of the following is the most common type of failure in industry?
a) Brittle fracture
b) Ductile fracture
c) Creep
d) Fatigue
View Answer
Answer: d
Explanation: Almost 80% of the failure in the engineering industry occur due to fatigue failure. As components are used for a long time, the material is subjected to stress cycles and will fail due to fatigue.

4. Below which point does fatigue occur?
a) Ultimate strength
b) Fracture point
c) Elastic limit
d) Yield point
View Answer
Answer: a
Explanation: Fatigue occurs just below the point of ultimate strength as material subjected to cyclic stress start failing after the elastic limit and before the ultimate strength is reached.

5. Which of the following is not a zone of fatigue fracture?
a) Zone of crack nucleation
b) Fatigue zone
c) Elastic zone
d) Final fracture
View Answer
Answer: c
Explanation: The elastic zone isn't a zone of fatigue fracture. The main three zones in order of their occurrence in fatigue fracture are zone of crack nucleation, fatigue zone. Final fracture.

6. Corrosion can increase fatigue life.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. The fatigue life decreases if corrosion, erosion or other chemical attacks are not prevented during processing of the material or during heat treatment.

7. What is the speed of the motor in rotating beam fatigue test?
a) 200 rpm
b) 500 rpm
c) 1000 rpm
d) 1500 rpm
View Answer
Answer: c
Explanation: In rotating beam fatigue test, the test machine is high speed with the motor running at 1000 rpm. With the help of the motor, the bending moment is applied on the material.

8. The S-N curve for mild steel never becomes a horizontal line.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. The S-N curve which the curve between stress and number of cycles on the y and x axis respectively becomes a straight line for steel and titanium.

9. In Wohler's Fatigue test, how many cycles can cast iron to be subjected to before failure?
a) 10,000,000
b) 100,000,000
c) 5,000,000
d) 1,000,000
View Answer
Answer: a
Explanation: Cast iron or cast steel in Wohler's Fatigue test can approximately be subjected to 10,000,000 cycles before it fails.

10. Which of the following is not a theory of fatigue?
a) Orowan theory
b) Griffith's theory
c) Fatigue limit theory
d) Wood's theory
View Answer
Answer: b
Explanation: Griffith's theory is a theory related to fracture mechanics and it isn't a theory of fatigue. Orowan theory, fatigue limit theory and wood's theory are the three main theory of fatigue.

Creep

1. Which of the following is a slow rise of plastic deformation under the action of stresses?
a) Brittle fracture
b) Ductile fracture
c) Creep
d) Fatigue
View Answer
Answer: c
Explanation: Creep is defined as a slow rise of plastic deformation under the action of shear stresses when it is below the yield strength of the material.

2. Which of the following isn't a stage of creep?
a) Transient creep stage
b) Constant creep stage
c) Fracture stage
d) Steady stage creep stage
View Answer
Answer: b
Explanation: Transient creep stage, steady stage creep stage and fracture stage are the three stages of creep called as primary, secondary and tertiary creep respectively.

3. Which of the following stage is also known as the unstable stage?
a) Transient creep stage
b) Constant creep stage
c) Fracture stage
d) Steady stage creep stage
View Answer
Answer: a
Explanation: Transient stage or primary creep is also called the unstable stage and in this stage, there is a gradual decrease in deformation rate to a definite constant value.

4. In which of the stages, do we observe a constant deformation rate?
a) Transient creep stage
b) Constant creep stage
c) Fracture stage
d) Steady stage creep stage
View Answer
Answer: d
Explanation: Steady stage creep stage or secondary creep is the stage which is characterized by a constant deformation rate.

5. In which of the following stages do the deformation rate increases and causes failure?
a) Transient creep stage
b) Constant creep stage
c) Fracture stage
d) Steady stage creep stage
View Answer
Answer: c
Explanation: Fracture stage or the tertiary creep is that stage where the material deformation rate increases and finally results in failure of that material.

6. Creep depends on temperature.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Creep is dependent on temperature and stress. Increase in temperature for a constant stress can decrease the time of the second stage and hence accelerate failure.

7. Above what temperature is the phenomenon of creep important in steel?
a) 200 °C
b) 500 °C
c) 300 °C
d) 600 °C
View Answer
Answer: c
Explanation: For steel, the phenomenon of creep is important at a temperature above 300 °C while in polymer it is significant at room temperature.

8. Which of the following is true?
a) Slope of strain-time graph increases with temperature
b) Slope of strain-time graph decreases with temperature
c) Slope of strain-time graph decreases with stress
d) Slope of strain-time graph does not depend on temperature or stress
View Answer
Answer: d
Explanation: The slope of a strain-time graph increases with the increase in temperature. The slope of a strain-time graph increases with the increase in stress too.

9. What is the nature of the curve of a viscous creep?
a) Parabola
b) Hyperbola
c) Straight line passing through an origin
d) Circle
View Answer
Answer: c
Explanation: The nature of the curve for a viscous creep is a straight line passing through the origin while it is a horizontal line for sudden creep.

10. Diffusion creep is a type of creep. The slope of a strain-time graph increases with the increase in temperature.
a) True
b) False
View Answer
Answer: a
Explanation: Diffusion creep, logarithmic creep and recovery creep are the three major types of creep. This classification is according to the temperature at which the creep occurs. Diffusion creep occurs at a temperature above 0.7 Tm(melting point of material).

High Temperature Alloys

1. Which of the following is an alloy?
a) Duralumin
b) Bismuth
c) Magnalium
d) Alnico
View Answer
Answer: b
Explanation: Bismuth is a metal with symbol Bi and atomic number 83. Duralimn is an alloy of copper, magnalium is an alloy of magnesium and Alnico is an alloy of aluminium, copper and cobalt.

2. Which of the following is a high temperature alloy resistant to?
a) Tensile compression
b) Tensile elongation
c) Creep
d) Fatigue
View Answer
Answer: c
Explanation: Alloys resistant to creep have high melting temperature and therefore are high temperature alloys.

3. Alloys resistant to creep have a high modulus of elasticity.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. An alloy which is resistant to creep have a high modulus of elasticity and have high melting point thus giving then the name high temperature alloys.

4. Which of the relationship holds?
a) Higher the melting temperature greater is the elastic modulus
b) Lower the melting temperature greater is the elastic modulus
c) Higher the melting temperature smaller is the elastic modulus
d) There is no relationship between the melting temperature and elastic modulus
View Answer
Answer: a
Explanation: The melting temperature of an alloy and its modulus of elasticity hold a direct relationship. Therefore, higher the melting temperature greater is the elastic modulus.

5. Which of the following high resistance to creep?
a) Stainless steel
b) Refractory metals
c) Superalloys
d) Magnesium
View Answer
Answer: d
Explanation: Stainless steel, refractory metals and super alloys have resistance to creep and hence are used for high temperature usage. Magnesium does have a high resistance to creep.

6. Which of the following does not enhance the creep resistance of an alloy?
a) Solid-solution alloying
b) Addition of a dispersed phase
c) directional solidification
d) Heat treatment
View Answer
Answer: c
Explanation: Heat treatment does not enhance the creep resistance of an alloy. Solid-solution alloying and addition of dispersed phase are used for that outcome. Other advanced techniques like directional solidification can also be employed.

7. Which of the following is created by directional solidification?
a) Single crystal components
b) Polycrystalline components
c) Short grains
d) Elongated grains
View Answer
Answer: a
Explanation: In directional solidification, highly elongated grains or single-crystal components are formed.

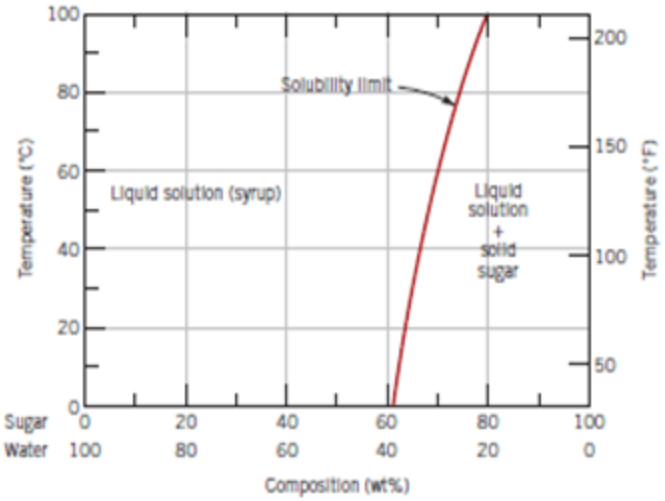
8. Controlled unidirectional solidification of an alloy is a technique to increase creep resistance.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Controlled unidirectional solidification of alloys is a technique used to increase the creep resistance of an alloy.

Basic Concepts of Phase Diagrams

1. Which of the following is/are components of a phase?
a) Brass, Copper, Zinc
b) Copper only
c) Zinc only
d) Both Copper and Zinc
View Answer
Answer: d
Explanation: Components are pure metals and/or compounds of which an alloy is composed. Brass is an alloy and Copper and zinc are components.

2. At certain temperature the maximum concentration of solute atoms that dissolve in solvent to form solid solution, this condition is called _____
a) Solubility
b) Formation of phase
c) Solubility limit
d) Formation of super saturated solution
View Answer
Answer: c
Explanation: At this limit there will maximum solubility o solution and solution formed is saturated above this there will be formation of super saturated solution.

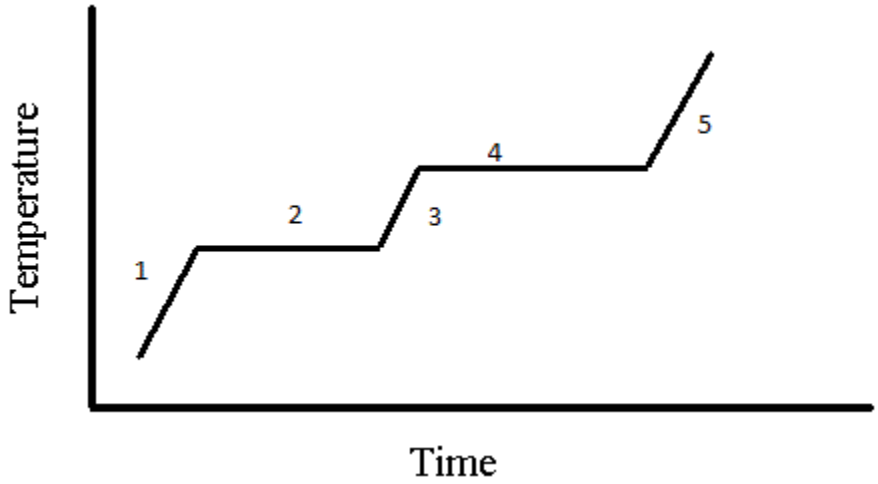
3. Analyze the following graph and the following question regarding solubility of sugar in water.



a) Decrease with increase in temperature
b) Increase with increase in temperature
c) Increase with decrease in temperature
d) Remains constant with increase or decrease in temperature
View Answer
Answer: b
Explanation: The solubility of sugar increases when the solution is heated.

4. What is a phase?
a) The substance which is physically distinct
b) The substance which is homogenous chemically
c) The substance which is both physically distinct and chemically homogenous
d) The substance which is both physically distinct and chemically heterogeneous
View Answer
Answer: c
Explanation: A phase can be defined as a physically distinct and homogeneous chemically portion of a system that has a particular chemical composition and structure.

Analyze the following diagram in which A pure solid substance is heated and answer the following questions



5. On which portion(s) only gas is present?
a) 1
b) 4
c) 5
d) 4, 5
View Answer
Answer: c
Explanation: In the figure pure substances exists at 1,3,5 out of which 1 is given solid so 5 is pure gas.

6. On which portion(s) liquid is present?
a) 2, 3
b) 2, 4
c) 3, 4
d) 2, 3, 4
View Answer
Answer: d
Explanation: From figure in process 2 the substance solid is being converted to liquid. In 3 only pure liquid exists. In 4 liquid is converting into solid.

7. On which portions only pure substance are present?
a) 1, 3, 5
b) 1, 5
c) only 1
d) 3, 5
View Answer
Answer: a
Explanation: Since pure substances like only solid, liquid, gas exists at 1, 3, 5.

8. In which portion there is freezing section?
a) 1
b) 2
c) 3
d) 4
View Answer
Answer: b
Explanation: Since this is a warming curve, this section indicates the melting temperature, but freezing point is identical to melting temperature.

9. Which portion of graph indicates boiling point?
a) 2
b) 3
c) 4
d) 5
View Answer
Answer: c
Explanation: In this point the substance is converted from liquid to gas.

10. On which section(s) of the graph would you use the formula, (Specific Heat) * (Mass) * (Change in temperature), to calculate the energy change.
a) 2
b) 1, 3
c) 1, 3, 5
d) 2, 3, 5
View Answer
Answer: c
Explanation: Since the phase of substance remains constant and there is change in temperature of substance.

Unary Phase Diagrams

1. Which of the following are examples of unary phase diagrams?
a) Cu-Ni phase diagram
b) Water phase diagram
c) Cu-Pd phase diagram
d) Mg-Db phase diagram
View Answer
Answer:b
Explanation: The simplest phase diagram is the water which is a one component system.

2. What are the external parameters that affect the phase structure?
a) Temperature, Pressure
b) Temperature, Composition
c) Pressure, Composition
d) Temperature, Pressure, Composition
View Answer
Answer: d
Explanation: The phase of the system changes accordingly with an increase or decrease in the above parameters.

3. What is the phase fraction of an alloy when it is one phase system?
a) 0.6
b) 0.8
c) 0.5
d) 1.0
View Answer
Answer: d
Explanation: Alloy is composed entirely of that phase.

4. What will be the phase composition of one phase system?
a) Same as alloy present in it
b) Different than the alloy present in it
c) Contains more than one alloys
d) Varies from molecule to molecule
View Answer
Answer: a
Explanation: It is the same as the overall composition of the alloy.

5. Which of the following remains constant in Unary phase diagrams?
a) Pressure
b) Temperature
c) Composition
d) Both pressure and temperature
View Answer
Answer: c
Explanation: Since there is only one phase there will be only one substance.

6. Along the phase boundaries, the phases on either side will be in _____
a) Equal
b) Equilibrium
c) Different
d) Constant
View Answer
Answer: b
Explanation: At phase boundary, the phase compositions will be the same.

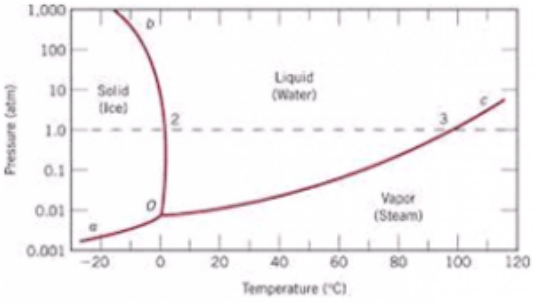
7. What is a triple point?
a) All three states are in equilibrium
b) All three states are not in equilibrium
c) All three states don't exist
d) All three states don't exist and are not in equilibrium
View Answer
Answer: a
Explanation: In triple point, all the states exist and are in equilibrium.

8. What is the temperature at triple point of water?
a) 288 K
b) 273.16 K
c) 298 K
d) 277 K
View Answer
Answer: b
Explanation: At 273.16 k all the three phases of water will be in equilibrium.

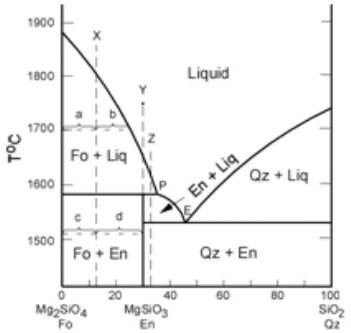
9. What is pressure at a triple point of water?
a) 5.08×10^{-3} atm
b) 6.04×10^{-3} atm
c) 7.04×10^{-3} atm
d) 6.44×10^{-3} atm
View Answer
Answer: b
Explanation: At 6.04×10^{-3} atm all the three phases of water will be in equilibrium.

10. Which of the following is unary phase diagram?

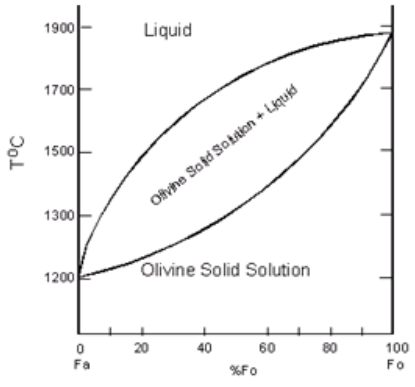
a)



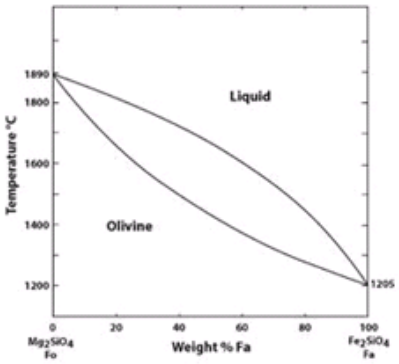
b)



c)



d)



View Answer

Answer: a

Explanation: Unary phase diagram consists of only one substance.

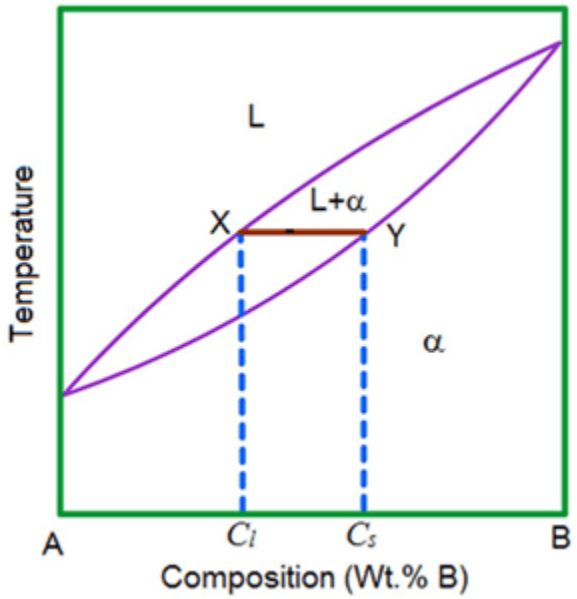
Binary Phase Diagrams

1. How many components are present in binary phase system?
a) 3
b) 4
c) 2
d) 1
View Answer
Answer: c
Explanation: In binary phase system there will be only two components.

2. The line above which the alloy is liquid is called _____
a) Solidus line
b) Tie line
c) Liquidus line
d) Lever line
View Answer
Answer: c
Explanation: The liquidus line is the line above which the alloy is liquid. At the temperature just below this line crystal of solid solution start forming.

3. It can be noted that the two substances are soluble in each other in the entire range of compositions in both liquid and solid state. This kind of system is known as _____
a) Binary phase system
b) Unary phase system
c) Multiple phase system
d) Isomorphous system
View Answer
Answer: d
Explanation: Here, the two metals are soluble in all states.

Analyze the following figure and answer the questions below (4-5)



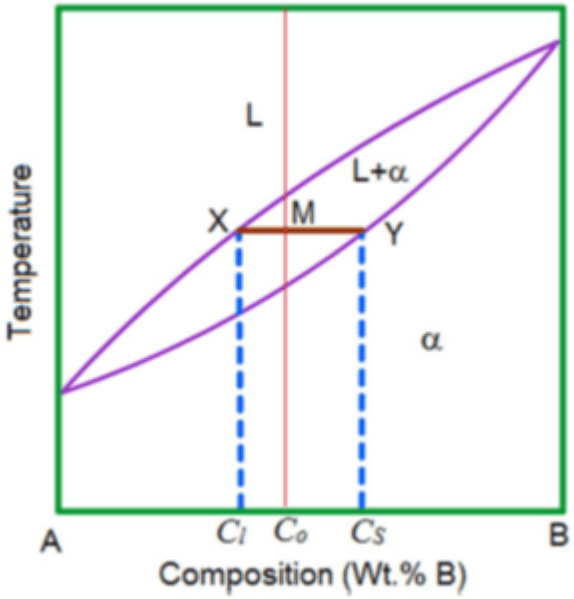
4. What is XY line?
a) Lever line
b) Tie line
c) Solidus line
d) Liquidus line
View Answer
Answer: b
Explanation: To find the composition of the individual phases in the two phase region, a line (XY) which is horizontal, called tie line, is drawn and its intercepts on the liquidus and solidus lines.

5. What is α region?
a) Homogeneous liquid solution
b) Semi solid solution
c) Vapor
d) Substitutional solid solution
View Answer
Answer: d
Explanation: The solidus line is a line below which solidification completes. Hence, the only αsolid solution exists at any temperature below the solidus line.

6. What is used for determination of Phase amounts?
a) Tie line and Temperature–Composition Point
b) Lever line
c) Temperature–Composition Point
d) Pressure
View Answer
Answer: a
Explanation: The above mentioned methods help in finding percentage fractions of phases.

7. A 53% Ni Cu-Ni alloy is cooled from the liquid state to 1300°C. Calculate the % of liquid and solid at 1300°C.
a) 28, 72
b) 38, 62
c) 35, 65
d) 65, 35
View Answer
Answer: b
Explanation: The tie line at 1300°C intersects solidus at 58% Ni and liquidus at 45% Ni.
Apply the lever rule to get the liquid fraction
% Liquid = 100* (5)/(13) = 38%
%Solid = 100* (53 – 45)/(58 – 45) = 62% (100 – %Liquid).

Analyze the following diagram and answer the following questions



8. From the figure, the relative fractions of the phases at a given temperature for an alloy composition Co is obtained by the _____
a) Lever rule
b) Tie line
c) Solidus line
d) Liquidus line
View Answer
Answer: a
Explanation: For two phase system lever rule helps i.e. the tie line must be utilized in conjunction with a procedure that is often called the lever rule.

9. What is the equation for liquid mass fraction?
a) $c_\alpha - c_0 / c_\alpha - c_L$
b) $c_0 - c_L / c_\alpha - c_L$
c) $c_\alpha / c_\alpha - c_L$
d) $c_0 / c_\alpha - c_L$
View Answer
Answer: a
Explanation: Cα is composition of solid, CL is composition of liquid, C0 is composition of alloy.

10. What is the region between liquidus and solidus lines?
a) Two-phase region where liquid and solid coexist
b) Solid region
c) Liquid region
d) Lava region
View Answer
Answer: a
Explanation: The intermediate region between liquidus and solidus lines is the two-phase region where liquid and solid coexists.

Isomorphous Alloys

1. How many components are present in unary phase system?
a) 1
b) 2
c) 3
d) 4
View Answer
Answer: a
Explanation: Unary phase systems which consist of a single component. Phase systems with two components are called binary systems and those with three are called ternary systems.

2. In a binary isomorphous system which of the following is true?
a) The two metals are completely miscible in each other in liquid as well as solid form
b) The two metals are completely immiscible in each other in liquid as well as solid form
c) The two metals are completely miscible in each other in liquid form only
d) The two metals are completely miscible in each other in solid form only
View Answer
Answer: a
Explanation: In a binary isomorphous system, the two metals are completely miscible in each other in liquid as well as solid form.

3. The number of components are 2, the number of phases are 3 and degrees of freedom are 0. Then which of the following equilibrium is it?
a) Invariant
b) Univariant
c) Bivariant
d) Trivariant
View Answer
Answer: a
Explanation: We can solve the above question by using Gibb's phase rule. When the given values are put in the equation the value is obtained to be zero which makes the reaction invariant.

4. The number of components are 2, the number of phases are 2 and degrees of freedom are 1. Then which of the following equilibrium is it?
a) Invariant
b) Univariant
c) Bivariant
d) Trivariant
View Answer
Answer: b
Explanation: We can solve the above question by using Gibb's phase rule. When the given values are put in the equation the value is obtained to be one which makes the reaction univariant.

5. The number of components are 2, the number of phases is 1 and degrees of freedom are 2. Then which of the following equilibrium is it?
a) Invariant
b) Univariant
c) Bivariant
d) Trivariant
View Answer
Answer: c
Explanation: We can solve the above question by using Gibb's phase rule. When the given values are put in the equation the value is obtained to be two which makes the reaction bivariant.

6. An alloy 30 wt% Ni- 70wt % Cu at 1315 °C (2400 °F) will lie in which state?
a) Solid state
b) Liquid state
c) Mixture of solid and liquid state
d) α state
View Answer
Answer: b
Explanation: An alloy 30 wt% Ni- 70wt % Cu at 1315 °C (2400 °F) will lie in the liquid state which we can observe from its phase diagram.

7. An alloy 30 wt% Ni- 70wt % Cu at 1095 °C (2000 °F) will lie in which state?
a) Solid state
b) Liquid state
c) Mixture of solid and liquid state
d) α state
View Answer
Answer: d
Explanation: An alloy 30 wt% Ni- 70wt % Cu at 1095 °C (2000 °F) will lie in the region where it is in α state which can be observed from its phase diagram.

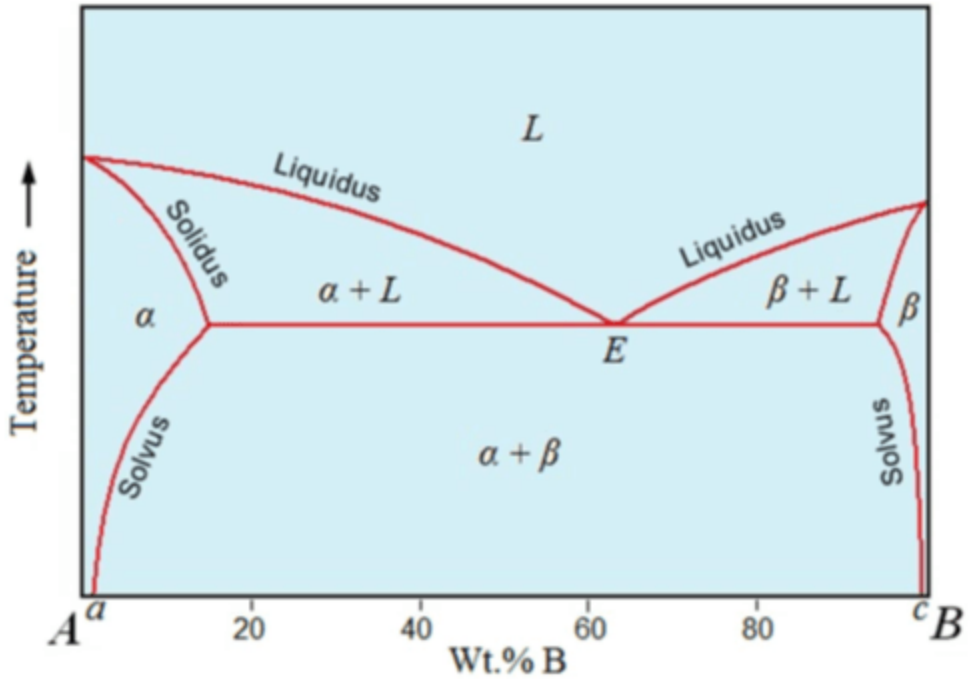
8. The copper-nickel system is an example of solid solution hardening.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true and the copper-nickel system is an example of solid solution hardening. Therefore changes are caused due to distortion in its lattice structure.

9. In a copper nickel system the tensile strength increases with an increase in the percentage of nickel in the alloy.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. As nickel has more tensile strength than copper, the tensile strength of copper increases with the increase in percentage if nickel in the alloy.

10. In which of the following the alloy is rapidly cooled?
a) Anealing
b) Coring
c) Hot working
d) Cold working
View Answer
Answer: b
Explanation: Hot working, cold working and annealing are all processes in which the alloy will be heated. In coring the alloy is rapidly cooled down.

Eutectic Systems

Analyze the following figure answer the following questions



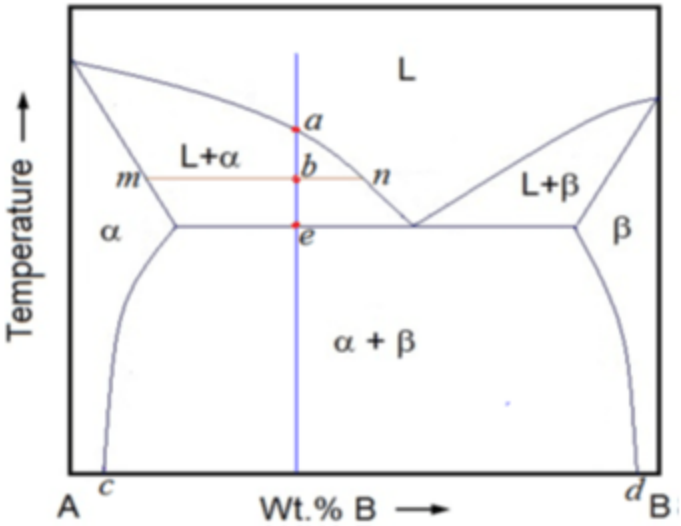
1. What is the line that defines the solubility limit of A in B and B in A from the figure?
a) Solidus line
b) Liquidus line
c) Solvus line
d) Solidus line and Liquidus line
View Answer
Answer: c
Explanation: In addition to liquidus and solidus lines there are two more lines on A and B which define the solubility limits B in A and A in B respectively. These are called solvus lines.

2. Three phases (L+α+β) coexist at point E. This point is called _____
a) Peritectic point
b) Eutectic point
c) Eutectoid point
d) Eutectic point or composition
View Answer
Answer: d
Explanation: Three phases (L+α+β) coexist at point E. This point is called eutectic point or composition.

3. In hypoeutectic alloys micro structure at room temperature consists of_____
a) Proeutectic β and α
b) Eutectic mixture (α+β)
c) Proeutectic β and eutectic mixture (α+β)
d) Proeutectic α and eutectic mixture (α+β)
View Answer
Answer: d
Explanation: In hypoeutectic alloys the αphase solidifies first and the micro structure at RT consists of this αphase (called proeutectic α) and the eutectic (α+β) mixture.

4. Why Pb-Sn eutectic alloys are used for soldering purpose?
a) The melting point at eutectic point is maximum
b) The melting point at the eutectic point is minimum
c) The melting point at the eutectic point is constant
d) The boiling point at the eutectic point is maximum
View Answer
Answer: b
Explanation: The melting point at the eutectic point is minimum. That's why Pb-Sn eutectic alloys are used as solders. Al-Cu, Al-Si, Ag-Cu are other eutectic systems.

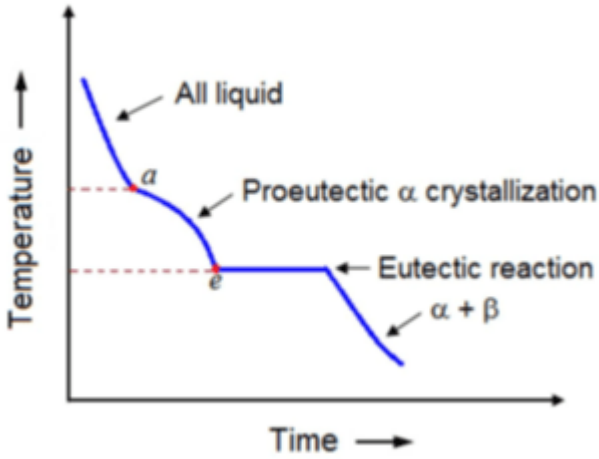
From the figure answer the following questions



5. Crystals of which material begin to form at point a from the figure?
a) Crystals of proeutectic α
b) Crystals of proeutectic β
c) Crystals of eutectic (α+β)
d) Crystals of proeutectic α and β
View Answer
Answer: a
Explanation: While cooling a hypoeutectic alloy which is in a liquid state, the temperature drops continuously till liquidus point, a, at which crystals of proeutectic αbegins to form.

6. At any point b, the αfraction is given by the lever rule as _____
a) mn/bn
b) bn/mn
c) ab/be
d) be/ab
View Answer
Answer: b
Explanation: On further cooling the fraction of αincreases. At any point, b, in the two-phase region the αfraction is given by the lever rule as bn/mn.

Analyze the following figure and answer the following



7. The inflection in the cooling curve between points a and e is due to _____
a) Latent heat
b) Low temperature
c) High temperature
d) Specific heat
View Answer
Answer: a
Explanation: Solidification of proeutectic αcontinues till the eutectic temperature is attained. The inflection in the curve between points a and e is due to latent heat.

8. At the eutectic point (e) the eutectic reaction proceeds at a constant temperature as _____
a) F = 1
b) F = 0
c) F = 2
d) F = 3
View Answer
Answer: b
Explanation: At the eutectic point the solidification of eutectic mixture (α+β) begins through the eutectic reaction which proceeds at a constant temperature as F = 0 (2– 3+ 1).

9. Any composition left of point c or right of a point will cool and solidify like a _____
a) Eutectic
b) Proeutectic
c) Eutectoid
d) Isomorphous system
View Answer
Answer: d
Explanation: Any composition left of point c or right of point d (α and β single phase region respectively) will cool and solidifies like an isomorphous system.

10. A 34.6% Pb-Sn alloy is cooled just below the eutectic temperature (183°C). What is the fraction of proeutectic α and eutectic mixture (α+β)?
a) 70% and 30%
b) 64% and 36%
c) 36% and 64%
d) 30% and 70%
View Answer
Answer: b
Explanation: The eutectic point is at 61.9% Sn and α boundary is at 19.2% Sn. Apply the lever rule % proeutectic α= 100*(61.9 – 34.6)/(61.9 – 19.2) = 64%
% (α + β) = 100* (34.6 – 19.2)/(61.9 – 19.2) = 36%.

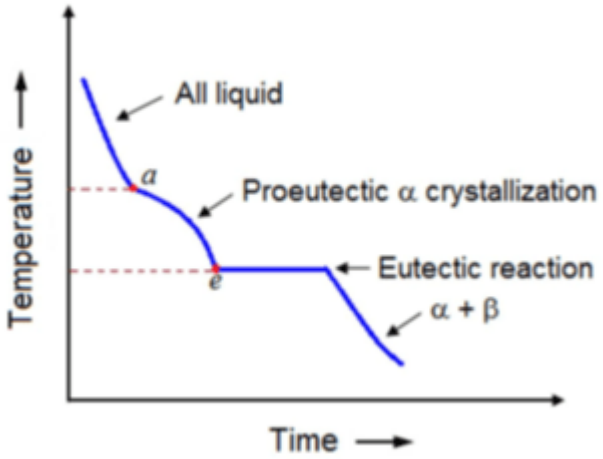
Eutectoid and Peritectic Reactions

1. On heating, one solid phase results in another solid phase and a liquid phase during _____ reaction.
a) Eutectoid
b) Peritectic
c) Eutectic
d) Peritectoid
View Answer
Answer: b
Explanation: A reaction wherein upon cooling, one solid phase transforms or changes reversibly and isothermally into two new solid phases that are intimately mixed.

2. A first solid phase results in a second solid phase another third solid phase on cooling during _____ reaction.
a) Eutectoid
b) Peritectic
c) Eutectic
d) Peritectoid
View Answer
Answer: a
Explanation: A reaction wherein upon cooling, a first solid and a liquid phase transforms or changes reversibly and isothermally to a solid phase having a different composition.

3. A first solid phase results in a second solid plus another third solid phase upon heating during _____ reaction.
a) Eutectoid
b) Peritectic
c) Eutectic
d) Peritectoid
View Answer
Answer: d
Explanation: Here only the solid phase is involved and the product is also solid.

Analyze the figure and answer the following questions



4. Which phase will crystallize first just below the liquidus line?
a) α phase
b) β phase
c) (L+α) phase
d) (L+β) phase
View Answer
Answer: a
Explanation: L + α → β. An alloy cooling through the peritectic point, P, the αphase will crystallize first just below the liquidus line.

5. At what temperature, all liquid and αwill convert to β?
a) Eutectic temperature
b) Peritectic temperature
c) Eutectoid temperature
d) Peritectoid temperature
View Answer
Answer: b
Explanation: L + α → β, the above reaction is peritectic and takes place at peritectic temperature.

6. Any composition left and right of P will generate _____
a) Excess of liquid and α
b) Excess of α and liquid
c) Excess of liquid and β
d) Excess of β and liquid
View Answer
Answer: b
Explanation: Any composition left of P will generate excess α and similarly right of P will give rise to an excess amount of liquid.

7. Which of the following are Peritectic systems?
a) Pt – Ag
b) Ni-Re
c) Ni – Re, Fe – Ge, Sn-Sb
d) Pt – Ag, Ni – Re, Fe – Ge, Sn-Sb
View Answer
Answer: d
Explanation: Peritectic systems – Pt – Ag, Ni – Re, Fe – Ge, Sn-Sb (babbit).

8. What is the eutectoid structure of Iron?
a) Cementite
b) Ferrite
c) Pearlite
d) Austentite
View Answer
Answer: c
Explanation: It is important to be known that pearlite isn't a phase, but a mixture of two phases: ferrite and cementite.

9. What is % of C by weight in hypo-eutectoid steels?
a) 0.5%
b) 0.7%
c) 0.8%
d) 1.2%
View Answer
Answer: c
Explanation: Most steels are "hypo-eutectoid", containing less than 0.8 wt% C.

10. The phase above eutectoid temperature for carbon steels is known as _____
a) Cementite
b) Ferrite
c) Pearlite
d) Austentite
View Answer
Answer: d
Explanation: In the Fe-C system, there is a eutectoid point at 0.8wt% C, and temp of 723°C. The phase just above the eutectoid temperature for carbon steels is known as austeniteor gamma.

Gibbs Phase Rule

1. What is Gibbs phase rule for general system?
a) P = C – 1 – F
b) P = C + 1 – F
c) P + F = C – 2
d) P + F = C + 2
View Answer
Answer: d
Explanation: The number of degrees of freedom, F (no. of independently variable factors), number of components, C, and number of phases in equilibrium, P.

2. What is Gibbs phase rule for metallurgical system?
a) F = C – 1 – P
b) F = C + 1 – P
c) P + F = C – 2
d) P + F = C + 2
View Answer
Answer: b
Explanation: For metallurgical system pressure has no appreciable effect on phase equilibrium and hence, F = C – P + 1.

3. In a single – component condensed system, if degree of freedom is zero, maximum number of phases that can co – exist _____
a) 2
b) 3
c) 0
d) 1
View Answer
Answer: a
Explanation: Given F = 0
Then p = c + 1, c = 1
.: P = 2.

4. The degree of freedom at a triple point in the unary diagram for water is_____
a) 2
b) 3
c) 0
d) 1
View Answer
Answer: c
Explanation: For three phase system degree of freedom is 0.

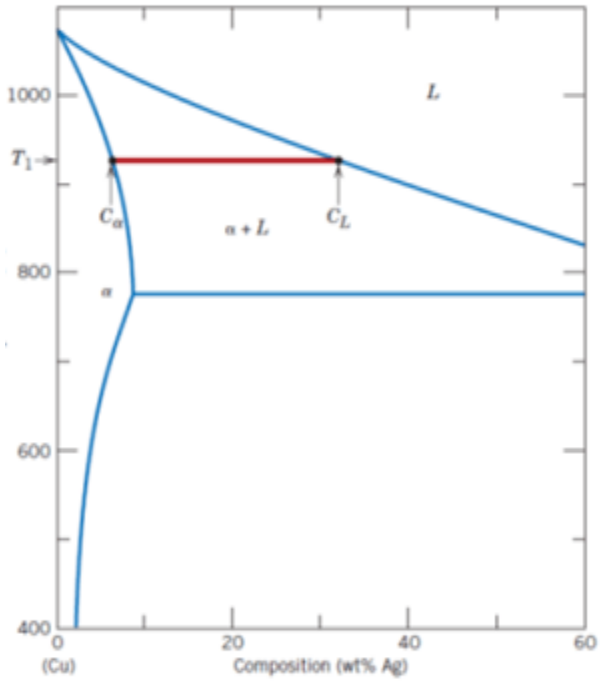
5. What is degree of freedom for single – phase fields on the phase diagram?
a) 2
b) 3
c) 0
d) 1
View Answer
Answer: a
Explanation: F = C + 1 – P
F = 3 – P (C = 2)
.:F = 2.

6. What is degree of freedom when two phases co – exist?
a) 2
b) 3
c) 0
d) 1
View Answer
Answer: d
Explanation: F = C + 1 – P
F = 3 – P (C = 2)
F = 3 – 2 = 1.

7. What is degree of freedom when three phases co – exist?
a) 2
b) 3
c) 0
d) 1
View Answer
Answer: c
Explanation: F = C + 1 – P
F = 3 – P (C = 2)
F = 3 – 3 = 0.

8. For single component system when degree of freedom is 1(one) then number of phases _____
a) 2
b) 3
c) 0
d) 1
View Answer
Answer: d
Explanation: F = C + 1 – P
F = 2 – P (C = 1)
→ p = 2 – F = 2 – 1 = 1.

Analyze the figure and answer the following questions

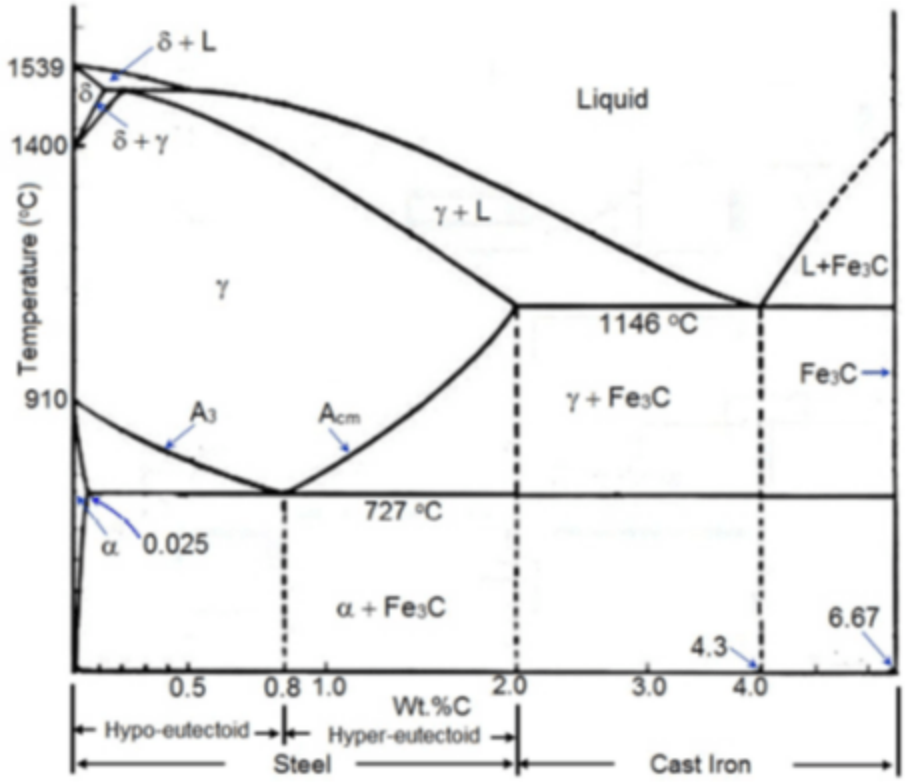


9. When α, L and β phase fields touch the isotherm line what are the respective phase compositions?
a) 8.0 wt%, 71.9 wt%, 91.2 wt% of Ag
b) 8.0 wt%, 91.2 wt%, 71.9 wt% of Ag
c) 71.9 wt%, 91.2 wt%, 8.0 wt% of Ag
d) 91.2 wt%, 8.0 wt%, 71.9 wt% of Ag
View Answer
Answer: a
Explanation: For binary systems, when three phases are present, there is no F, so composition is fixed.

10. For binary alloy consisting of three phases of non – equilibrium one, the temperature of these phases will be _____
a) Different
b) Constant
c) Same
d) Two of them will be with one temperature
View Answer
Answer: c
Explanation: One use of the Gibbs phase rule is in analyzing for non – equilibrium conditions by analyzing with above method we come to know (under these Circumstances, three phases will exist only at a single temperature).

Iron-Carbon Systems

Analyze the following figure and answer the following question



1. What are the % solubility and temperature of exist of α-ferrite?
a) 0.05% and 273°c to 910°c
b) 0.025% and 273°c to 910°c
c) 2.1% and 910°c to 1394°c
d) 0.05% and 910°c to 1124°c
View Answer
Answer: b
Explanation: Interstitial solid solution of C in BCC iron. Max solubility of C is 0.025%. Exists from 273°C to 910°C.

2. What are the % solubility and temperature of exist of Austenite (ɣ)?
a) 0.05% and 273°c to 910°c
b) 0.025% and 273°c to 910°c
c) 2.1% and 910°c to 1394°c
d) 0.09% and 1394°c to 1539°c
View Answer
Answer: c
Explanation: Interstitial solid solution of C in FCC iron. Max solubility of C is 2.1%. Exists from 910°C – 1394°C.

3. What are the % solubility and temperature of exist of δ-ferrite?
a) 0.05% and 273°c to 910°c
b) 0.025% and 273°c to 910°c
c) 2.1% and 910°c to 1394°c
d) 0.09% and 1394°c to 1539°c
View Answer
Answer: d
Explanation: δ-ferrite (BCC) exists over the temperature range of 1394°C to 1539°C. Maximum solubility of C is 0.09%.

4. What is the % C content inCementiteFe3C?
a) 6.67%
b) 0.025%
c) 2.1%
d) 0.09%
View Answer
Answer: a
Explanation: It is an intermetallic compound. C content in Fe_3C is 6.67%.

5. What is the hardest phase of Fe-C system?
a) Graphite
b) Bainite
c) Martensite
d) Cementite
View Answer
Answer: c
Explanation: The hard phase of Fe-C system martensite forms below the bainitic temperature range at high cooling rates.

6. What is eutectoid temperature?
a) 727°c
b) 768°c
c) 1146°c
d) 1495°c
View Answer
Answer: a
Explanation: The eutectoid temperature (727°C) during heating and cooling is Ac1 and Ar1 respectively.

7. At what temperature Fe turns paramagnetic while heating?
a) 727°c
b) 768°c
c) 1146°c
d) 1495°c
View Answer
Answer: b
Explanation: At 768°C is the curie temp above which Fe turns paramagnetic while heating.

8. What is the value of eutectic temperature?
a) 727°c
b) 768°c
c) 1146°c
d) 1495°c
View Answer
Answer: c
Explanation: The eutectic temperature is 1146°Cfor Fe-C system.

9. What is the value of peritectic temperature?
a) 727°c
b) 768°c
c) 1146°c
d) 1495°c
View Answer
Answer: d
Explanation: The peritectic temperature is at 1495°C for Fe-C system.

10. A carbon steel cooled from the region of austentic contains 9.1% C of ferrite. What is the percentage C content in the steel?
a) 0.05% C
b) 0.1% C
c) 0.2% C
d) 0.3% C
View Answer
Answer: b
Explanation: Let c be Carbon content. Applying the lever rule
0.091 = (6.67 – c)/ (6.67 – 0.025)
c = 0.1% C.

Phase Transformation Kinetics

1. What is/are the phenomenon involved in phase transformation?
a) Nucleation
b) Growth
c) Fission
d) Nucleation and growth
View Answer
Answer: d
Explanation: Formation of a nucleus or tiny particles of the
new phase is nucleation and increase in size of the nucleus at the expense of the parent phase is growth.

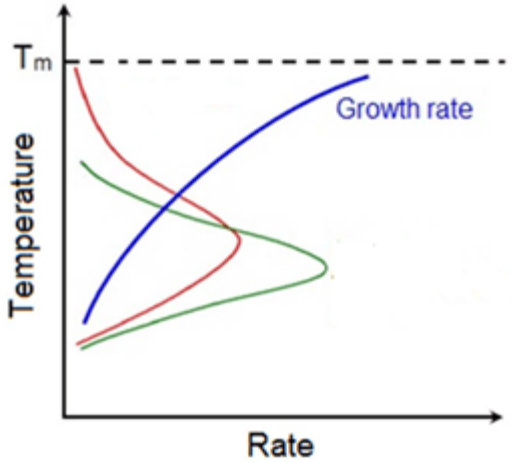
2. How many types of nucleation process are there and what are they?
a) 2 and (fusion and fission)
b) 2 and (Heterogeneous and Homogeneous)
c) 2 and (Heterogeneous and fusion)
d) 4 and (fusion, fission, Heterogeneous and Homogeneous)
View Answer
Answer: b
Explanation: Two types of nucleation – Heterogeneous and Homogeneous whereas fusion and fission are nuclear reactions.

3. What reactions come under supercooling?
a) Peritectic
b) Eutectic and Peritectic
c) Eutectic and Eutectoid
d) Peritectic and Eutectoid
View Answer
Answer: c
Explanation: Driving force to nucleate increases as we increase T.

4. What are the characteristics of large supercooling in nucleation?
a) Few nuclei, large crystals
b) Rapid nucleation, many nuclei, small crystals
c) Rapid nucleation, many nuclei, large crystals
d) Few nuclei, small crystals
View Answer
Answer: b
Explanation: Nuclei (seeds) act as a template to grow crystals and for nucleus will help in a rate of the addition of atoms to the nucleus must be faster than the rate of loss.

5. At what temperature does supercooling is needed in homogeneous nucleation?
a) 0.1-10°C
b) 100- 250°C
c) 80-300°C
d) 10-15°C
View Answer
Answer: c
Explanation: Nuclei form in the bulk of liquid metal so requires supercooling (typically 80-300°C max).

6. From the following figure if blue curve represent growth rate what does red and green curve represent respectively?



a) Nucleation rate, over all transformation rate
b) Over all transformation rate, Nucleation rate
c) Nucleation rate, finer grain size
d) Over all transformation rate, finer grain size
View Answer
Answer: a
Explanation: The overall transformation rate is the product of nucleation and growth rates.

7. What is thermodynamic parameters of homogeneous nucleation?
a) Free energy G
b) Enthalpy H
c) Entropy S
d) Free energy G, Enthalpy H, Entropy S
View Answer
Answer: d
Explanation: G is important as a phase transformation will occur immediately only when G has a negative value.

8. What does phase transformation involve?
a) Transformation rates kinetics
b) Movement/rearrangement of atoms
c) Changes in microstructure
d) Transformation rate kinetics, rearrangement of Atoms, Changes in microstructure
View Answer
Answer: d
Explanation: Formation of a new phase having a
distinct physical/chemical character and a different structure than that of the parent phase.

9. Below the critical radius the tiny particles are _____ and are called _____
a) unstable, grains
b) stable, grains
c) unstable, embryo
d) stable, embryo
View Answer
Answer: c
Explanation: The tiny particle of the solid that forms first will get stabilized only when it achieves a critical radius (r*). Below the critical radius, it is considered unstable and is said to be an embryo.

Phase Transformations in Iron-Carbon Systems

1. What is the Peritectic reaction at 1495°C?
a) L (0.53% C) + δ(0.09% C) → γ(0.17% C)
b) L (4.3% C) → γ(2.1 % C) + Fe_3C (6.67% C)
c) γ (0.8 % C) → α (0.025% C) + Fe_3C (6.67% C)
d) L (0.53% C) + δ(0.09% C) → γ (0.8 % C)
View Answer
Answer: a
Explanation: Peritectic reaction at 1495°C is
L (0.53% C) + δ(0.09% C) → γ(0.17% C).

2. What is the Eutectic reaction at 1146°C?
a) L (0.53% C) + δ(0.09% C) → γ(0.17% C)
b) L (4.3% C) → γ(2.1 % C) + Fe_3C (6.67% C)
c) γ (0.8 % C) → α (0.025% C) + Fe_3C (6.67% C)
d) L (0.53% C) + δ(0.09% C) → γ (0.8 % C)
View Answer
Answer: b
Explanation: Eutectic reaction at 1146°C is
L (4.3% C) → γ(2.1 % C) + Fe_3C (6.67% C).

3. What is Eutectoid reaction at 727°C?
a) L (0.53% C) + δ(0.09% C) → γ(0.17% C)
b) L (4.3% C) → γ(2.1 % C) + Fe_3C (6.67% C)
c) γ (0.8 % C) → α (0.025% C) + Fe_3C (6.67% C)
d) L (0.53% C) + δ(0.09% C) → γ (0.8 % C)
View Answer
Answer: c
Explanation: Eutectoid reaction at 727°C is
γ (0.8 % C) → α (0.025% C) + Fe_3C (6.67% C).

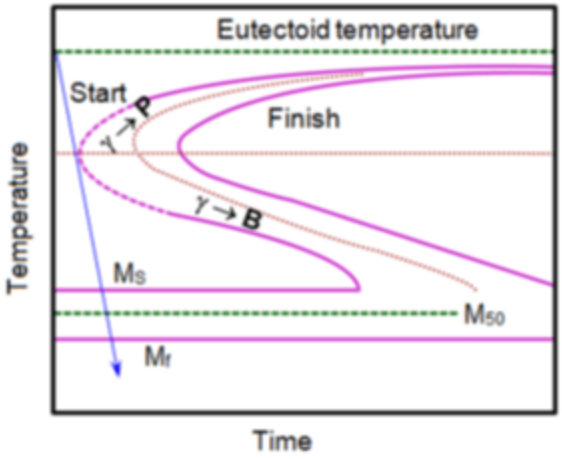
4. The eutectic mixture of austenite (γ) and cementite (Fe_3C) is called _____
a) Ledeburite
b) Pearlite
c) Hyper and hypo eutectoid steel
d) Cast iron
View Answer
Answer: a
Explanation: Eutectic reaction at 1146°C is
L (4.3% C) → γ(2.1 % C) + Fe_3C (6.67% C).
The eutectic mixture of austenite (γ) and cementite (Fe_3C) is called Ledeburite.

5. The eutectoid mixture of ferrite (α) and cementite (Fe_3C) is called _____
a) Ledeburite
b) Pearlite
c) Hyper and hypo eutectoid steel
d) Cast iron
View Answer
Answer: b
Explanation: The pearlite is formed under equilibrium
Conditions which consists of alternate lamellas or layers of ferrite and Fe_3C.

6. Compositions right and left of 0.8% C of Pearlite are called _____
a) Ledeburite
b) Ferrite
c) Hyper and Hypoeutectoid steel
d) Cast iron
View Answer
Answer: c
Explanation: Hypoeutectoid steels – α+ p; hypereutectoid – Fe_3C + p.

7.Compositions above 2.1% C is called as _____
a) Ledeburite
b) Ferrite
c) Hyper and Hypoeutectoid steel
d) Cast iron
View Answer
Answer: d
Explanation: Compositions up to 2.1% of Carbon are considered steels and beyond this it is considered as cast iron.

8. From the following figure if Diffusion rates below Ms is so low that γ → M transformation is a diffusionless process then what is change in crystal structure



a) FCC → BCT
b) FCC → BCC
c) BCC → BCT
d) BCT → BCC
View Answer
Answer: a
Explanation: Diffusion rates below Ms is so low that γ → M transformationis a diffusion less process (the C content remains same). However, the crystal structure changes from FCC (γ) to body centered tetragonal (BCT).

9.Finer size pearlite is called _____
a) Troostite
b) Ledeburite
c) Ferrite
d) Sorbite
View Answer
Answer: d
Explanation: Finer size pearlite is called sorbite and very fine size pearlite is called troostite.

10. A eutectoid steel is slowly cooled from a temperature of 750°C to a temperature just below 727°C. Calculate the percentage of ferrite and cementite.
a) 88.3% and 11.7%
b) 70% and 30 %
c) 85.4% and 14.6%
d) 20% and 20%
View Answer
Answer: a
Explanation: Eutectoid composition – 0.8% of Carbon,
Ferrite composition- 0.025% of Carbon and
cementite – 6.67% C.
Apply the lever rule to get the percentages as
% of Ferrite = 100(6.67 – 0.80)/(6.67 – 0.025)=88.3% ferrite
%of Cementite = 100(0.80 – 0.025)/(6.67 – 0.025) =11.7%.

Time Temperature Transformation(TTT) Curves

1. Time temperature transformation diagrams are drawn for _____
a) Iron
b) Manganese
c) Any alloy
d) Only steel
View Answer
Answer: d
Explanation: Time temperature transformation diagrams are drawn for only steels and only on steel of constant composition at a time is taken.

2. Which of the following is not a name for time temperature transformation diagrams?
a) S curve
b) C curve isothermal diagram
c) D curve isothermal diagram
d) Bain's curve
View Answer
Answer: c
Explanation: S curve, C curve isothermal diagram and Bain's curve are all names given to time temperature transformation diagrams. D curve isothermal diagram is not a name given to it.

3. Steel with different carbon content shows different time temperature transformation diagrams.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Steel with different carbon content shows different time temperature transformation diagrams.

4. What material is present in steel at a temperature above 750°C?
a) Austenite
b) Pearlite
c) Bainite
d) Martensite
View Answer
Answer: a
Explanation: At a temperature above 750 °C, the steel is in the form of austenite which is observed from a time temperature transformation diagram which shows the transformation time and temperature of transformation.

5. What material is present in steel at a temperature between 550 °C and 750°C?
a) Austenite
b) Pearlite
c) Bainite
d) Martensite
View Answer
Answer: b
Explanation: At a temperature between 550 °C and 750° C, the steel is in the form of pearlite which is observed from a time temperature transformation diagram which shows the transformation time and temperature of transformation.

6. What material is present in steel at a temperature between 300 °C and 550°C?
a) Austenite
b) Pearlite
c) Bainite
d) Martensite
View Answer
Answer: c
Explanation: At a temperature between 300 °C and 550°C, the steel is in the form of bainite which is observed from a time temperature transformation diagram which shows the transformation time and temperature of transformation.

7. What material is present in steel at a temperature between 100 °C and 300°C?
a) Austenite
b) Pearlite
c) Bainite
d) Martensite
View Answer
Answer: d
Explanation: At a temperature 100 °C and 300°C, the steel is in the form of martensite which is observed from a time temperature transformation diagram which shows the transformation time and temperature of transformation.

8. Which of the following is the hardest?
a) Austenite
b) Pearlite
c) Bainite
d) Martensite
View Answer
Answer: d
Explanation: Martensite is the hardest among the four followed by bainite and then pearlite. Austenite is the least hard among the following as it occurs at the highest temperature where the steel is soft.

9. To construct a TTT diagram, the specimen of steels is heated and then cooled.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. To construct a time temperature transformation diagram, the specimen of steels is heated to a fixed temperature and then rapidly cooled.

10. In an isothermal curve, which of the following is true when the temperature is increased?
a) The curve shifts rightward
b) The curve shifts leftward
c) The curve goes down
d) The curve goes up
View Answer
Answer: a
Explanation: In an isothermal curve with an increase in temperature the curve shifts towards the right and with a decrease in temperature the curve will shift towards left on the graph.

Continuous Cooling Transformation Diagrams

1. Continuous cooling transformation diagrams are mainly drawn for _____
a) Iron
b) Manganese
c) Any alloy
d) steel
View Answer
Answer: d
Explanation: Continuous cooling transformation diagrams are drawn for mainly steels and steel of constant composition at a time is taken.

2. In continuous cooling transformation diagrams, which of the following is true?
a) The material is cooled rapidly
b) The material is first heated and then cooled rapidly
c) The material is cooled at a certain rate
d) The material is kept at a constant temperature
View Answer
Answer: c
Explanation: In a continuous cooling transformation diagrams, the material is cooled at a certain rate instead of heating and then cooling it rapidly and then maintaining a constant temperature in case of TTT diagrams.

3. How many types of CCT diagram are there?
a) 1
b) 2
c) 3
d) 4
View Answer
Answer: b
Explanation: There are two types of continuous cooling transformation diagrams which can be drawn. In the two type, some factors are changed to obtain a different curve.

4. Which physical property is normally measured to determine a CCT diagram?
a) Hardness
b) Magnetic permeability
c) Pressure
d) Ductility
View Answer
Answer: b
Explanation: CCT diagrams are determined by measuring magnetic permeability and specific volume during continuous cooling.

5. Slope change in a CCT diagram signify _____
a) Change in temperature
b) Change in pressure
c) Change in phase
d) Change in state
View Answer
Answer: c
Explanation: When there is a slope change observed in a continuous cooling transformation diagram, it signifies that there is a change in phase occurring at that point.

6. Jominy end quench test is used for type 2 CCT diagram.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. Jominy end quench test apart from its use in finding out hardenability of a material, it is also used for plotting type 1 CCT diagram.

7. Which of the following scientist gave a method to calculate the transformation temperature during continuous cooling?
a) Scheil's
b) Newton
c) Jominy
d) Einstein
View Answer
Answer: a
Explanation: Scheil gave a method which can be used to calculate the transformation temperature of a material during continuous cooling of the material. The concept is called Scheil's concept of fractional nucleation.

8. Critical cooling rate required is less in CCT than in TTT diagrams.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. In a continuous cooling transformation diagrams, the critical cooling rate is less than that prescribed in TTT diagrams.

Mechanical Behavior of Iron-Carbon Alloys

1. In an iron carbon alloy, the mechanical properties are dependent on the micro structure.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. In an iron carbon alloy, the mechanical properties are dependent on the micro structure.

2. Which of the following is present in pearlite?
a) Spherodite
b) Bainite
c) Ledeburite
d) Ferrite
View Answer
Answer: d
Explanation: Pearlite consists of alternate layer of ferrite and cementite in which cementite is harder and more brittle as compared to ferrite.

3. Which of the following is true?
a) Fine pearlite is harder than coarse pearlite
b) Fine pearlite is softer than coarse pearlite
c) Fine pearlite is more ductile than coarse pearlite
d) Toughness of steel decreases with increase in carbon percentage
View Answer
Answer: a
Explanation: Fine pearlite is harder than coarse pearlite, but coarse pearlite is more ductile than fine pearlite.

4. Which is the most tough among the steels given their carbon composition?
a) 0.1%
b) 0.2%
c) 1.5%
d) 2.5%
View Answer
Answer: a
Explanation: The toughness of the steel decreases as we increase the carbon content and therefore 0.1% carbon which is lower than 1.5%, 0.2% and 2.5% is most tough among the options.

5. Which of the following is present in spherodite?
a) Pearlite
b) Bainite
c) Ledeburite
d) Ferrite
View Answer
Answer: d
Explanation: Spherodite also consists of ferrite and cementite. In spherodite it cementite is present in a sphere structure in a matrix of ferrite.

6. Which of the following is present in bainite?
a) Ferrite
b) Bainite
c) Ledeburite
d) α-Ferrite
View Answer
Answer: d
Explanation: Bainite steels consists of α-Ferrite and cementite and have a finer structure which makes then stronger than pearlite steel.

7. Which among the following is the strongest?
a) Austenite
b) Pearlite
c) Bainite
d) Martensite
View Answer
Answer: d
Explanation: Among all the structure martensite has the strongest structure. It is the hardest and most brittle among the microstructure.

8. In which of the following steels there is a chance of quenching cracks being formed?
a) 0.2% carbon
b) 0.4% carbon
c) 0.5% carbon
d) 0.6% carbon
View Answer
Answer: d
Explanation: If the carbon content in a steel is higher than 0.5 %, during quenching there can be a formation of quenching cracks.

9. At what temperature is martensite heated in tempering? (in degree Celsius)
a) 727
b) 627
c) 327
d) 927
View Answer
Answer: c
Explanation: For tempering and obtaining tempered martensite, the martensite is heated 727 degrees Celsius for a fixed period of time.

10. Tempered martensite has better ductility than martensite.
a) True
b) False
View Answer
Answer: a
Explanation: Tempered martensite has better ductility than martensite due to tempering. The hardness of the two is nearly the same.

Types of Metal Alloys

1. Which of the following is an alloy of iron?
a) Vitallium
b) Brass
c) Invar
d) Solder
View Answer
Answer: c
Explanation: Invar is an alloy of iron. In this the alloying element is nickel and this alloy has a very low coefficient of thermal expansion.

2. Which of the following is an alloy of lead?
a) Vitallium
b) Brass
c) Invar
d) Solder
View Answer
Answer: d
Explanation: Solder is an alloy of lead. The alloying element is tin mainly, it is used for electrical connection by melting and fusing to form a permanent bond between two metal pieces.

3. Which of the following is an alloy of cobalt?
a) Vitallium
b) Brass
c) Invar
d) Solder
View Answer
Answer: a
Explanation: Vitallium is an alloy of cobalt. The alloying elements are chromium and molydenum. It is used for components of turbochargers because of its high thermal resistance.

4. Which of the following is an alloy of copper?
a) Vitallium
b) Brass
c) Invar
d) Solder
View Answer
Answer: b
Explanation: Brass is an alloy of copper. The alloying element in brass is zinc. It is used for making a variety of ornaments.

5. Which of the following is not a non-ferrous metal?
a) Aluminium
b) Lead
c) Zinc
d) Iron
View Answer
Answer: d
Explanation: Ferrous metals are metals or alloys which contain iron as an element in it. Therefore cast iron is the only ferrous metal among the given options.

6. What are alloys with two components called?
a) Binary alloy
b) Ternary alloy
c) Quaternary alloy
d) There is no name given to an alloy with two components
View Answer
Answer: c
Explanation: Alloys with two components are called binary alloy, while those with three components are called ternary alloy and alloys with 4 components are called quaternary alloy.

7. Substitutional alloy and interstitial alloys are types of alloys.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Substitutional alloy and interstitial alloys are types of alloys.

8. What is sterling silver used for?
a) casting of firearms
b) used for making musical instruments
c) used for making springs
d) used for joining two metals
View Answer
Answer: b
Explanation: Sterling silver is an alloy which is used for making musical instruments such as flute and saxophone. It is also used for making cutlery.

9. Bronze is used for making medals.
a) True
b) False
View Answer
Answer: a
Explanation: Bronze is an alloy with base metal as copper and is used for making medals and some musical instruments.

10. Which of the following alloy is used for making castings of firearm chamber?
a) Brass
b) Wood's metal
c) Brass
d) Steel
View Answer
Answer: b
Explanation: Wood's metal is used for making a casting of firearm chambers by the maker of guns.

Steels

1. Which of the following is an alloy of iron and carbon?
a) Steel
b) Brass
c) Bronze
d) Solder
View Answer
Answer: a
Explanation: Steel is an alloy of iron and carbon while solder, bronze and brass are alloys of different metal other than iron.

2. Which of following crystalline form can iron not take?
a) BCC
b) FCC
c) HCP
d) It can take all crystalline forms
View Answer
Answer: c
Explanation: The correct answer is HCP or hexagonal close packing. Iron can take the crystalline structure of BCC and FCC according to the temperature.

3. Which of the following can be the carbon weight percentage in steel?
a) 2%
b) 5%
c) 3%
d) 4%
View Answer
Answer: a
Explanation: In a typical steel, the carbon may contribute the maximum of 2.14% of the weight of the alloy. Therefore only 2% lies within the range and hence is the correct answer.

4. Which of the following cannot be used as an alloying element in steel?
a) Lead
b) Chromium
c) Nickel
d) Tungsten
View Answer
Answer: a
Explanation: Lead cannot be used as an alloying element in steel. While chromium, nickel and tungsten are used as an alloying element in steel according to which the carbon percentage in the steel is found out.

5. Traces of which of the following element is considered undesirable in steel?
a) Chromium
b) Copper
c) Boron
d) Titanium
View Answer
Answer: b
Explanation: Traces of copper, oxygen and nitrogen are undesirable in a steel alloy whereas chromium, boron and titanium are common alloying elements of steel alloy.

6. Which of the following element is added to steel to form stainless steel?
a) Chromium
b) Copper
c) Boron
d) Titanium
View Answer
Answer: a
Explanation: Chromium is added to steel to inhibit corrosion and in a quantity of at least 11%. An oxide protection is formed on the surface of the steel, the alloy thus formed is called stainless steel.

7. At room temperature which is the most stable form of iron?
a) Pearlite
b) Ledeburite
c) Martensite
d) α-iron
View Answer
Answer: d
Explanation: At room temperature, the most stable form of iron is BCC structure which is also called as α-iron.

8. When steel with exactly 0.8% carbon by weight is cooled, the FCC structure of the mixture tries to revert back to its BCC structure.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. When steel with exactly 0.8% carbon by weight is cooled, the FCC structure of the mixture tries to revert back to its BCC structure.

9. Adding a nickel to the steel alloy increases its tensile strength.
a) True
b) Fasle
View Answer
Answer: a
Explanation: The above statement is true. Nickel is added to the steel alloy to increase its tensile strength and make its austenite structure more stable.

10. Which of the following can be the density of steel?
a) 8.1 g/cm^3
b) 7.8 g/cm^3
c) 7.7 g/cm^3
d) 8.2 g/cm^3
View Answer
Answer: b
Explanation: The density of steel varies between 7.75 g/cm^3 and 8.05 g/cm^3. As only 7.8 g/cm^3 lies in that range and the others are beyond the range, 7.8 g/cm^3 is the correct answer.

Cast Irons

1. Which of the following can be carbon composition of cast iron?
a) 1%
b) 1.5%
c) 0.5%
d) 2.5%
View Answer
Answer: d
Explanation: The carbon composition in cast iron is more than 2% and hence only 2.5% can be correct answer as all the answer lie outside the range.

2. Cast iron tends to be brittle.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is correct. Cast iron tends to be brittle because of the presence of a high amount of carbon in it.

3. At what temperature does pure iron turn into FCC structure?
a) 800 °C
b) 900 °C
c) 910 °C
d) 810 °C
View Answer
Answer: c
Explanation: Pure iron turns into its FCC structure at a temperature of 910 °C. This structure is called gamma iron or γ-iron.

4. Which of the following alloying element forces the carbon out of the solution?
a) Silicon
b) Sulphur
c) Nickel
d) Titanium
View Answer
Answer: a
Explanation: Silicon is used in a cast iron to bring out the carbon from the solution. If a large amount silicon is added grey cast iron is formed.

5. Which of the following alloying element increase hardness?
a) Silicon
b) Sulphur
c) Nickel
d) Titanium
View Answer
Answer: b
Explanation: The presence of sulpur increase the hardness of the alloy by reacting with iron to form iron sulohide.

6. Which of the following alloying element refines pearlite structure?
a) Silicon
b) Sulphur
c) Nickel
d) Titanium
View Answer
Answer: c
Explanation: Nickel is the most common alloying element in cast iron. It helps in refining the pearlite and graphite structure.

7. Which of the following alloying element is added as a degasser?
a) Silicon
b) Sulphur
c) Nickel
d) Titanium
View Answer
Answer: d
Explanation: Titanium is added as a degasser and it increases the fluidity of the alloy and it also acts as a deoxidiser.

8. Due to the presence of which of the following does white cast iron appear white?
a) Pearlite
b) Ledeburite
c) Martensite
d) Cementite
View Answer
Answer: d
Explanation: In white cast iron, it appears as a broken white surface due to the presence of cementite which is a metastable phase.

9. In malleable cast iron, the graphite turns into spheroidal particles.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. In malleable cast iron, the graphite turns into spheroidal particles rather than forming flakes.

10. What is the form graphite structure in ductile cast iron?
a) Spheroidal
b) Nodular
c) Flakes
d) Layers
View Answer
Answer: b
Explanation: The graphite structure of a ductile cast iron is nodular form and it is seen as tiny nodules with graphite in layers forming the nodules.

Non-ferrous Alloys

1. Which of the metal if present will make the alloy ferrous?
a) Aluminium
b) Lead
c) Zinc
d) Iron
View Answer
Answer: d
Explanation: Ferrous metals are metals or alloys which contain iron as an element in it. Therefore Iron is the only ferrous metal among the given options presence of which will make the alloy ferrous.

2. Which of the following is costliest among the non ferrous materials?
a) Magnesium
b) Aluminum
c) Titanium
d) Copper
View Answer
Answer: c
Explanation: Titanium is the costlier than magnesium, aluminum and copper. This is why titanium has limited application even though it has strength to weight ratio and corrosion resistance.

3. Which of the following is the lightest among the following?
a) Magnesium
b) Aluminum
c) Titanium
d) Copper
View Answer
Answer: b
Explanation: Aluminum is the lightest among magnesium, titanium and copper. As it is light, it is used at a variety of places.

4. Which of the following element when alloyed with magnesium does not reduce the tendency to crack under stress?
a) Aluminum
b) Silicon
c) Zinc
d) Copper
View Answer
Answer: d
Explanation: The correct answer is copper. Aluminum, silicon and zinc are alloyed with magnesium to reduce the tendency of magnesium to crack under stress.

5. Which of the following is an alloy of tin?
a) Brass
b) Bronze
c) Pewter
d) Steel
View Answer
Answer: c
Explanation: Pewter is an alloy of 85 % – 99 % of tin with alloying elements like copper and lead traces.

6. Which of the metal is alloyed with silver to make sterling silver?
a) ZInc
b) Copper
c) Magnesium
d) Aluminum
View Answer
Answer: b
Explanation: Sterling silver is an alloy of silver to reduce its cost. It is an alloy with 90% of silver and 10% copper.

7. Tin has low viscosity.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Tin has low viscosity and therefore is a good material for casting application.

8. Which of the following is highly resistant to corrosion?
a) Aluminum
b) Copper
c) Iron
d) Zinc
View Answer
Answer: d
Explanation: Zinc is an element which is highly resistant to corrosion therefore it is used as an alloying material to form corrosion resistant alloys. It is also used in galvanization.

9. Monel is an alloy of nickel.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Monel is an alloy in which major element is nickel in which copper is added. Magnesium and iron can be added with a limit of 2% and 2.5 % respectively.

Metal Fabrication Techniques

1. Which of the following is a method of applying a protective zinc coating to steel?
a) Galvanizing
b) Glazing
c) Hydroforming
d) Metal punching
View Answer
Answer: a
Explanation: Galvanizing is a process in which a zinc coating is applied over the steel or iron sources to help prevent corrosion.

2. Which of the following is a process in which two metal slide against each other?
a) Galvanizing
b) Glazing
c) Hydroforming
d) Metal punching
View Answer
Answer: b
Explanation: The correct answer is glazing. In glazing, teo metals are made to slide against each other so that a shiny oxide layer is formed over the metal surfaces which will protect it from further wear.

3. Which of the following is a method in which high pressurized fluid is used?
a) Galvanizing
b) Glazing
c) Hydroforming
d) Metal punching
View Answer
Answer: c
Explanation: Hydroforming is a type of forming in which a special die is used which uses high pressurized fluid to give shape to metals and metal alloys like steel, copper and brass.

4. Which of the following is a process in holes are punchedl?
a) Galvanizing
b) Glazing
c) Hydroforming
d) Metal punching
View Answer
Answer: d
Explanation: Metal punching is the correct answer. It is a process in which a machine is used to punch a hole or a predetermined shape is punched out of the sheet metal

5. Milling uses rotatory cutters.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Milling is a process which uses rotatory cutters to remove material from a piece of metal which moves in a direction at an angle to the axis of the tool.

6. Which of the following a process in which material is made to pass through a roll?
a) Blanking
b) Cutting
c) Roll forming
d) Welding
View Answer
Answer: c
Explanation: Roll forming is a method in which materials in the form of coins, bars or strips are made to pass through rolls that by constant bending form the metal.

7. Which of the following a process in which a part or shape is the cutout of the sheet metal?
a) Blanking
b) Cutting
c) Roll forming
d) Welding
View Answer
Answer: a
Explanation: Blanking is the correct answer. Blanking is a process in which a part of a metal sheet is cut out of the sheet and the remaining material is discarded.

8. Which of the following a process in which sawing and shearing are used?
a) Blanking
b) Cutting
c) Roll forming
d) Welding
View Answer
Answer: b
Explanation: The process in which sawing and shearing are used is cutting. It is processed in which a part is cut out using power tools or CNC or by manually using saws and chisel.

9. Which of the following a process is used to join two metals?
a) Blanking
b) Cutting
c) Roll forming
d) Welding
View Answer
Answer: d
Explanation: Welding is a process which is used to join two metals using heat and sometimes pressure by melting the metals. It is a permanent joint and the joint will have to be broken to separate it again.

10. Shrinking is a process of making the metal smaller by applying force.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. Shrinking is a process which is used to remove dents in which direct damage is not severely stretched.

Thermal Processing Techniques

1. Which of the following is an application of cold working?
a) Extrusion
b) Forging
c) Hot rolling
d) Deep drawing
View Answer
Answer: d
Explanation: In all the other option the metal is heated over the recrystallization and hence they are hot worked.

2. Which is the correct order of temperature arranged in ascending order of the following processes:
i. Partial annealing
ii. Full annealing
iii. Subcritical annealing
a) ii, i, iii
b) ii, iii, i
c) iii, ii, i
d) i, iii, ii
View Answer
Answer: a
Explanation: Full annealing is done at a temperature higher than upper critical temperature while partial annealing is done at a temperature in between upper critical temperature and lower critical temperature and subcritical annealing is done at a temperature below lower critical temperature.

3. Which of the following can be recrystallization temperature for a pure metal? (where Tm is melting point of the metal)
a) 0.3Tm
b) 0.45Tm
c) 0.35Tm
d) 0.4Tm
View Answer
Answer: b
Explanation: Recrystallization temperature for a pure metal is roughly in the range of 0.3 to 0.4 Tm. Only 0.3 Tm lies in that range and 0.35 Tm, 0.4 Tm and 0.45 Tm does not lie in that range.

4. What does the term soaking signify?
a) Heating to a required temperature
b) Holding at a constant temperature
c) Cooling the material
d) Heating for a long time
View Answer
Answer: b
Explanation: Soaking is a term used in annealing in which the material is hold at a constant temperature after heating to a required temperature.

5. Which of the following will not happen when metal is cooled fast in annealing?
a) Warping of material
b) Cracking of material
c) Formation of thermo elastic stresses
d) Strength increase
View Answer
Answer: b
Explanation: A material in annealing is cooled slowly to avoid warping of the material, cracking of the material due to the formation of thermal gradients and thermo elastic stresses inside the body.

6. In process annealing, heating is limited to avoid excessive oxidation.
a) True
b) False
View Answer
Answer: a
Explanation: In process annealing, the material is heated to revert the effects of work hardening by recovery and recrystallization and heating is done in such a way that excessive grain growth and oxidation can be avoided.

7. Which of the following does not happen when a material is annealed?
a) Internal stresses get relieved
b) Increase in ductility
c) Decrease in toughness
d) Increase in softness
View Answer
Answer: c
Explanation: A material is annealed to relieve internal stresses, increase ductility, toughness and softness and produce specific microstructure.

8. Which material is present above the upper critical temperature line in an iron carbon phase diagram?
a) Martensite
b) Pearlite
c) Ledeburite
d) Austenite
View Answer
Answer: d
Explanation: Above the upper critical line in a iron carbon phase diagram, all the material is austenite while below the lower critical no austenite material exists.

9. In stress relief annealing, the annealing temperature is relatively low.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Annealing temperatures are low in stress relief annealing so that the useful effects of cold working are not eliminated.

10. Which of the following is not a type of annealing?
a) Spherodizing
b) Tempering
c) Full annealing
d) Normalizing
View Answer
Answer: b
Explanation: Tempering is used to increase hardness by reheating and cooling the material. It is not a type of annealing. Spherodizing and normalising are types of annealing.

Heat Treatment of Steels

1. Which of the following alloying element can be used to deoxidize steels?
a) Phosphorous
b) Carbon
c) Cerium
d) Selenium
View Answer
Answer: c
Explanation: Cerium, calcium, magnesium, manganese and titanium can be used to deoxidise steel.

2. Which of the following processes will one use on hardened steel to reduce brittleness?
a) Annealing
b) Normalizing
c) Spheroidizing
d) Tempering
View Answer
Answer: d
Explanation: Tempering is a process of heating to lower critical temperature, then maintaining it at temperature followed by slow cooling to relieve stress and reduce brittleness, increase ductility.

3. Which of the following material in the final structure of steel increases the strength of steel?
a) Martensite
b) Pearlite
c) Ledeburite
d) Austenite
View Answer
Answer: a
Explanation: The amount of martensite remaining in the final structure is correlated with the strength of the steel.

4. Which of the following is defined as the ability of the structure to transform into martensite?
a) Hardenability
b) Strength
c) Toughness
d) Hardness
View Answer
Answer: a
Explanation: Hardenability is defined as the ability of the structure to transform into martensite.

5. Which of the following has the highest hardness number?
a) Martensite
b) Tempered martensite
c) Pearlite
d) Fine pearlite
View Answer
Answer: a
Explanation: Martensite is the hardest and the most brittle microstructure of steel. It has a higher hardness number than tempered martensite, fine pearlite and pearlite. Tempered martensite is harder than fine pearlite.

6. Jominy end-quench test is used to determine the hardness of a material.
a) True
b) False
View Answer
Answer: b
Explanation: Jominy end-quench test is a test used on a material by quenching using a jet of water to determine the hardenability of the material.

7. In a hardnability curve which of the following is true:
a) Hardness increases as distance from quenched end increases
b) Hardness decreases as distance from quenched end increases
c) Hardness increases as martensite decreases
d) Hardenability curve is a straight line
View Answer
Answer: b
Explanation: In a hardenability curve, which is made by keeping hardness number on y-axis and distance from a quenched end at the x-axis. The hardness number decrease as the distance from the quenched end increases.

8. Which of the following is formed less when cooling rate is decreased?
a) Pearlite
b) Fine pearlite
c) Bainite
d) Martensite
View Answer
Answer: d
Explanation: As the cooling rate decreases with increase of distance from the quenched end, more pearlite and bainite is formed and therefore hardness number decreases.

9. Hardness number decreases with an increase in carbon content in steel.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. The hardness number increase with the increase in the carbon content in steel as more martensite is formed with the increase in carbon content.

10. Which of the following statement is false?
a) Greater ratio of surface area to volume, more the hardening effect
b) Cooling is faster in water than oil
c) Spheres cool faster than irregular shaped objects
d) Precipitation hardening can also be called age hardening
View Answer
Answer: c
Explanation: The statements greater ratio of surface area to volume, more the hardening effect, cooling is faster in water than oil and precipitation hardening can also be called age hardening are true. Spheres cool slower than irregular shaped object.

Crystal Structure of Ceramics

1. Which of the following is false about ceramic structures?
a) They are made up of two or more different elements
b) More complex than metal structures
c) They are electrically neutral
d) Less complex than metal structures
View Answer
Answer: d
Explanation: Ceramic structures are electrically neutral, more complex than metallic structures and are made up of two or more different elements.

2. Which of the following bonds are present in ceramic structures?
a) Ionics bonds only
b) Covalent bonds only
c) Ionic, covalent and a mix of ionic and covalent bond
d) Mix of ionic and covalent bond only
View Answer
Answer: c
Explanation: Ceramic structures have ionic bonds, covalent bonds. They show a mix of covalent and ionic bonds in some cases.

3. What is the cation to anion ratio for a ceramic having coordination number 2?
a) <0.155
b) 0.155-0.225
c) 0.414-0.732
d) 0.732-1.0
View Answer
Answer: a
Explanation: The cation to anion ratio for a ceramic having coordination number 2 is less than 0.155. For the given coordination number, the coordination geometry is also fixed.

4. What is the cation to anion ratio for a ceramic having coordination number 3?
a) <0.155
b) 0.155-0.225
c) 0.414-0.732
d) 0.732-1.0
View Answer
Answer: b
Explanation: The cation to anion ratio for a ceramic having coordination number 3 lies in the range of 0.155 to 0.225. For the given coordination number, the coordination geometry is also fixed.

5. What is the cation to anion ratio for a ceramic having coordination number 6?
a) <0.155
b) 0.155-0.225
c) 0.414-0.732
d) 0.732-1.0
View Answer
Answer: c
Explanation: The cation to anion ratio for a ceramic having coordination number 6 lies in the range of 0.414 to 0.732. For the given coordination number, the coordination geometry is also fixed.

6. What is the cation to anion ratio for a ceramic having coordination number 8?
a) <0.155
b) 0.155-0.225
c) 0.414-0.732
d) 0.732-1.0
View Answer
Answer: d
Explanation: The cation to anion ratio for a ceramic having coordination number 8 lies in the range of 0.732 to 1.0. For the given coordination number, the coordination geometry is also fixed.

7. Which of the following compounds have a coordination number of 8?
a) Cesium chloride
b) Sodium chloride
c) Zinc blende
d) Calcium fluoride
View Answer
Answer: a
Explanation: Cesium chloride has a coordination number of 8 while coordination number of sodium chloride and zinc blende are 6 and 4 respectively. Calcium chloride has a different coordination number for its anion and cation.

8. The coordination number of fluorine in calcium fluoride is?
a) 8
b) 6
c) 2
d) 4
View Answer
Answer: d
Explanation: The calcium atoms are in the center and the fluorine atoms are at the corners of the cube and therefore only half sites are filled with calcium atoms and coordination number of fluorine id 4 and that of calcium is 8.

9. The geometry of a material with coordination number 6 is a tetrahedron.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. The geometry of a material with coordination number 6 is octahedron and tetrahedron is the geometry of a material with coordination number 4.

10. Cesium chloride has an FCC structure.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. Cesium chloride has a simple cubic structure with a coordination number of 8.

Silicate Ceramics

1. Which of the following is an aluminosilicate?
a) Steatite
b) Cordierite
c) Forsterite
d) Porcelain
View Answer
Answer: d
Explanation: Porcelain is a type of aluminosilicate. They are kaolin or clay based ceramics.

2. Which of the following is magnesium silicates?
a) Porcelain
b) Earthenware
c) Stoneware
d) Steatite
View Answer
Answer: d
Explanation: Steatite is a magnesium silicate. Magnesium silicates are talc based ceramics.

3. According to the percentage of water absorption in dense silicate ceramic which of the following is has fine microstructure?
a) 1%
b) 3%
c) 4%
d) 5%
View Answer
Answer: a
Explanation: For a dense silicate ceramic, water absorption percentage should be less than 2% for fine structure and less than 6% for coarse structure.

4. There are ceramics which are electric resistant.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. There are mullite based fine silicates which are used as electrical insulator.

5. According to the percentage of water absorption in porous silicate ceramic which of the following has fine microstructure?
a) 1%
b) 1.9%
c) 0.4%
d) 2.1%
View Answer
Answer: d
Explanation: For a porous silicate ceramic, water absorption percentage should be greater than 2% for fine structure and greater than 6% for coarse structure.

6. Which of the following is the firing temperature of earthenware?
a) 1400 °C
b) 1300 °C
c) 1500 °C
d) 1200 °C
View Answer
Answer: d
Explanation: The firing temperature commonly used for hard earthenware is 1200 °C. It can lie in a range of +50 °C and -50 °C that is 1150 °C and 1250 °C respectively.

7. Which of the following is firing temperature of hard porcelain?
a) 1400 °C
b) 1300 °C
c) 1500 °C
d) 1200 °C
View Answer
Answer: a
Explanation: The firing temperature commonly used for hard porcelain are 1400 °C. It can lie in a range of +50 °C and -50 °C that is 1350 °C and 1450 °C respectively.

8. Which of the following is the firing temperature of stoneware?
a) 1400 °C
b) 1300 °C
c) 1500 °C
d) 1200 °C
View Answer
Answer: d
Explanation: The firing temperature commonly used for stoneware is 1250 °C. It can lie in a range of +50 °C and -50 °C that is 1200 °C and 1300 °C respectively. Therefore 1200 °C is the correct answer.

9. Brick having high porosity will have the ability to resist frost.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. As the ability to resist frost in a brick is observed in bricks having low porosity and thermal insulation is observed in bricks with high porosity.

10. Which of the following is not a component of steatite ceramic?
a) Talc
b) Clay
c) Feldspar
d) $MgCO_3$
View Answer
Answer: d
Explanation: Steatite is ceramic composed of talc and clay which common for all magnesium ceramics. Along with that, it has feldspar which is also $BaCO_3$. Hence it does not contain $MgCO_3$.

Carbon

1. Carbon is a ceramic.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. Carbon is not a ceramic material. An allotropic form of carbon called diamond can be considered as a ceramic.

2. What kind of bonds are present in diamond?
a) Covalent bond only
b) Ionic bond only
c) Mix of covalent and ionic bond
d) Metallic bonds
View Answer
Answer: a
Explanation: Diamonds have only carbon-carbon bonds which are covalent in nature.

3. Which of the following materials can be used as a substitute ceramic?
a) Diamond
b) Brass
c) Bismuth
d) Lead
View Answer
Answer: a
Explanation: Diamond has properties resembling that of ceramics and hence can be used as a substitute ceramic. All the other options are metals and hence they can never be used as a ceramic.

4. What is a difference between carbon and ceramic?
a) Both are hard
b) Both are non metallic
c) Both have covalent bonds
d) Both have very high thermal conductivity
View Answer
Answer: d
Explanation: Diamond has a very high thermal conductivity and doesn't melt even at high temperature whereas ceramics do not have a high thermal conductivity.

5. Which of the following processes I not needed for making a synthetic diamond?
a) Application of high temperature
b) Application of high pressure
c) Chemical vapor deposition
d) Distillation
View Answer
Answer: d
Explanation: To make a synthetic diamonds, application of high temperature and pressure is used. Chemical vapor deposition can also be used to make synthetic diamonds.

6. Which of the following can be used for lubrication?
a) Graphite
b) Diamond
c) Brass
d) Bronze
View Answer
Answer: a
Explanation: Graphite due to its weak Vander Waals bonding between layers can be used as a lubricating agent.

7. Graphite is a good conductor of electricity.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Graphite is indeed a good conductor of electricity and it is chemically stable at even high temperatures.

8. The chemical composition of Buckminster Fullerene?
a) C60
b) C50
c) C55
d) C45
View Answer
Answer: a
Explanation: The chemical composition of Buckminster Fullerene is C60. It is an allotropic form of carbon also called as Bucky-ball.

Imperfection in Ceramics

1. In which of the following defect the density of the crystal is affected?
a) Schottky defect
b) Frenkel defect
c) Stone-Wales defect
d) Antisite defect
View Answer
Answer: a
Explanation: The density of the solid crystal in case of Schottky defect is less than the theoretical density of the material. This happens as the total number of ions in the lattice is less than the theoretical number of ions according to its volume, when this defect occurs.

2. Schottky and Frenkel defects are _____
a) interstitial and vacancy defects respectively
b) vacancy and interstitial defect respectively
c) interstitial defects
d) vacancy defects
View Answer
Answer: b
Explanation: Schottky defect occurs when oppositely charged ions leave the crystal and creating a vacancy and hence is a vacancy defect while in Frenkel defect an atom moves from it's original site to an interstitial position and hence is an interstitial defect.

3. Frenkel defects change the ratio of cation to anions.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. Frenkel and Schottky's defects do not change the ratio of cations and anions. The compound is stoichiometric.

4. In which of the following iron compounds, the compound is non-stoichiometric?
a) Fe^{2+} and Fe^{3+}
b) Fe^{2+} ion only
c) Fe^{3+} ion only
d) It doesn't depend on the iron ions
View Answer
Answer: a
Explanation: A compound is non- stoichiometric when there is presence of the same ion in two valence state in the compound. In this case that is Fe^{2+} and Fe^{3+}.

5. In which of the following the concentration of defect is constant?
a) Point defect
b) Intrinsic defect
c) Extrinsic defect
d) Linear defect
View Answer
Answer: c
Explanation: The concentration of defect is constant in case of extrinsic defect. For example Rock salt structure like Nacl and MgO.

6. In which of the following the concentration of defect increases with temperature increase?
a) Point defect
b) Intrinsic defect
c) Extrinsic defect
d) Linear defect
View Answer
Answer: b
Explanation: The concentration of intrinsic defect increase with an increase in its temperature.

7. Which of the following does point defect does not depend on?
a) Density
b) Melting point
c) Hardness
d) Optical absorb
View Answer
Answer: c
Explanation: Point defects do not depend on the hardness of the material and it depends on density, optical absorb and the melting point of the material.

8. Transition metal oxides are highly defective.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Transition metal oxides like NiO and FeO are often highly defective.

Stress-Strain Behavior in Ceramics

1. Ceramics are brittle.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. Ceramics are generally not used in place of metals as they are brittle and their stress-strain characteristics are undesirable.

2. Which of the following test are done to find out the mechanical behavior of ceramics?
a) Tensile test
b) Compressive test
c) Shearing test
d) Transverse bending test
View Answer
Answer: d
Explanation: Transverse bending test is performed on the material to find out its mechanical behavior. Tensile and compressive tests cannot be performed on them as they crack when gripped.

3. What is shape of a stress strain curve for ceramics?
a) Parabola
b) Hyperbola
c) Straight line
d) Inverted parabola
View Answer
Answer: c
Explanation: The stress strain curve for a ceramic is a straight line as after a point the ceramic suddenly reaches the fracture point and breaks.

4. Which of the point is there in a stress strain curve for a ceramic?
a) Ultimate tensile strength
b) Fracture point
c) Limit of proportionality
d) Yield point
View Answer
Answer: b
Explanation: The correct answer is fracture point. Unlike metals or non metals, ceramics just break which is reach the fracture point after a certain amount of strain.

5. Which of the following is correct?
a) Aluminum oxide reaches fracture point before glass
b) Aluminum oxide reaches fracture point after glass
c) Aluminum oxide reaches fracture point at the same time as glass
d) They do not reach a fracture point
View Answer
Answer: a
Explanation: Aluminum oxide reaches fracture point before glass. In aluminum oxide for a large amount of stress little strain is produced.

6. Which of the following is correct?
a) Slope of stress strain curve of aluminum oxide is more than glass
b) Slope of stress strain curve of aluminum oxide is less than glass
c) Slope of stress strain curve of aluminum oxide is the same as glass
d) Slope of stress strain curve of aluminum oxide and glass are not comparable
View Answer
Answer: a
Explanation: The slope of stress strain curve of aluminum oxide is more than glass that is the curve for aluminum oxide is steeper than that of glass.

7. Which of the following can be the tensile strength of aluminum oxide?
a) 600 MPa
b) 800 Mpa
c) 1000 MPa
d) 1200 MPa
View Answer
Answer: a
Explanation: The range for the tensile strength of aluminum oxide which is a ceramic is 275 MPa – 700 MPa. Therefore only 600 Mpa lies in that range and is the correct answer.

8. Which of the following can be the tensile strength of spinel?
a) 200 MPa
b) 300 Mpa
c) 100 MPa
d) 90 MPa
View Answer
Answer: a
Explanation: The range for the tensile strength of spinel which is a ceramic is 110 MPa – 245 MPa. Therefore only 200 Mpa lies in that range and is the correct answer.

9. Which of the following can be the tensile strength of fused silica (SiO_2)?
a) 110 MPa
b) 150 Mpa
c) 90 MPa
d) 80 MPa
View Answer
Answer: a
Explanation: The range for the tensile strength of fused silica (SiO_2) which is a ceramic is 110 MPa. Therefore only 110 Mpa is the correct answer.

10. Silicon carbide is ductile.
a) True
b) False
View Answer
Answer: b
Explanation: Silicon carbide is a ceramic and hence it is not ductile. It does not have the elasticity to be drawn into wire. Any attempts to change its shape will break the ceramic.

Fractures in Ceramics

1. Which of the point is there in a stress strain curve for a ceramic?
a) Ultimate tensile strength
b) Fracture point
c) Limit of proportionality
d) Yield point
View Answer
Answer: b
Explanation: The correct answer is fracture point. Unlike metals or non metals, ceramics just break which is reach the fracture point after a certain amount of strain.

2. Which of the following is correct
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View Answer
Answer: a
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3. Which of the following is a flexural strength not dependent on?
a) Force
b) Distance between supports
c) Specimen width
d) Length of specimen
View Answer
Answer: d
Explanation: Flexural strength is dependent on the force applied on the specimen, distance between the supports, width of the specimen and the height of the specimen and hence it does not depend on the length of the specimen.

4. For edge flaws to occur which of the following should be the value of constant in stress intensity factor formula?
a) 1.1
b) 1.2
c) 1.02
d) 1.12
View Answer
Answer: d
Explanation: The correct answer is 1.12. For an edge flaw to occur, the value of the constant in the stress intensity factor formula should be 1.12.

5. Which of the following can be the tensile strength of fused silica (SiO_2)?
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Explanation: The range for the tensile strength of fused silica (SiO_2) which is a ceramic is 110 MPa. Therefore only 110 Mpa is the correct answer.

6. For zircon for the same flaw size, the intensity factor is more than alumina.
a) True
b) False
View Answer
Answer: a
Explanation: The above statement is true. For a given flaw size for example 50 micrometers, the intensity factor for zircon is 4.6 units and that of alumina is 3.7 units.

7. The largest constituent elements and flaws increase the flexural strength.
a) True
b) False
View Answer
Answer: b
Explanation: The above statement is false. The smallest constituent element and flaws increase the flexural strength.

8. Which of the following shows the best fracture strength?
a) Zircon
b) Macor
c) Alumina
d) There fracture strength are not comparable
View Answer
Answer: a
Explanation: Zircon shows the best fracture strength among the three elements, alumina, zircon and macor

Multiple Choice Questions:

1. % C in medium carbon steels ranges from _____.
(a) 0.3 – 0.4 (b) 0.3 – 0.5 (c) 0.3 – 0.6 (d) None
2. Stainless steel is so called because of its _____.
(a) High strength (b) High corrosion resistance (c) High ductility (d) Brittleness
3. In white cast irons, carbon present as _____.
(a) Graphite flakes (b) Graphite nodules (c) Cementite (d) Carbon does not exist
4. Refractory metal
(a) Ag (b) W (c) Pt (d) Ni
5. Not a noble metal
(a) Cu (b) Ag (c) Au (d) Pt
6. Noble metal
(a) Al (b) Ag (c) Mo (d) W
7. Usual casting method for making dental crowns
(a) Sand casting (b) Die casting (c) Continuous casting (d) Investment casting
8. Prime structural disadvantage of P/M products
(a) Low density (b) Porosity (c) High damping capacity (d) None
9. Not an important heat treatment process parameter
(a) Heating rate (b) Temperature (c) Cooling rate (d) Atmosphere
10. Final structure of austempered steel
(a) Pearlite (b) Ferrite + graphite (c) Bainite (d) Martensite

Answers:

1. c
2. b
3. c
4. b
5. a
6. b
7. d
8. b
9. a
10. c

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(a) Cotton (b) Bronze (c) Iron (d) Rock

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13. a
14. c
15. d
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Answers:

1. c
2. a
3. b
4. a
5. a
6. b
7. a
8. d
9. d
10. d
11. b
12. d
13. c
14. c
15. a

Multiple Choice Questions:

1. Diffusion can occur in _____ materials.
(a) Solid (b) Liquid (c) Gaseous (d) All
2. Probably the fastest diffusing species in Fe is
(a) H (b) Ni (c) W (d) C
3. The value of error function for '∞' is
(a) - ∞ (b) -1 (c) 1 (d) ∞
4. The value of error function for '0' is
(a) -1 (b) 0 (c) 1 (d) None
5. The units for diffusivity, *D*, are
(a) m^2sec^1 (b) m^2sec^{-1} (c) $m^{-2}sec^{-1}$ (d) $m^{-2}sec^1$
6. The following mechanism contributes very little the diffusivity
(a) Vacancy (b) Interstitial (c) Substitutional (d) Self-interstitial
7. Not an example for short-circuit path
(a) Vacancy (b) Dislocations (c) Grain boundaries (d) External surfaces
8. Example for steady-state diffusion
(a) Hydrogen purification by palladium sheet
(b) Doping semi-conductors
(c) Corrosion resistance of duralumin
(d) Decarburization of steel
9. The most influencing factor of diffusivity
(a) Diffusing species (b) Temperature (c) Lattice structure (d) Presence of defects
10. The following phenomena are useful in zone-refining process
(a) Coring (b) Segregation (c) Both (d) None
11. Macro-segregation can be removed by
(a) Annealing (b) Hot working (c) Both (d) None
12. The following enhances the coring
(a) Minute difference between liquidus and solidus
(b) Marked difference between liquids and solids
(c) Either (d) None

Answers:

1. d
2. a
3. c
4. b
5. b
6. d
7. a
8. a
9. b
10. c
11. d
12. b

Multiple Choice Questions' Bank:

1. Corrosion of metals involves

(a) Physical reactions (b) Chemical reactions (c) Both (d) None

2. The following factors play vital role in corrosion process

(a) Temperature (b) Solute concentration (c) Both (d) None

3. Following equation is related to corrosion rate

(a) Nernst equation (b) Faraday's equation (c) Either (d) Neither

4. Passivity is due to
(a) Higher EMF (b) Lower EMF (c) Oxide film (d) All

5. Passivity is not reason for inertness of the following

(a) Au (b) Al (c) Ti (d) Ni

6. Difficult to monitor and very dangerous form of corrosion

(a) Galvanic (b) Pitting (c) Crevice (d) Stress

7. This form of corrosion occurs due to concentration difference in a component

(a) Uniform (b) Galvanic (c) Inter-granular (d) Stress

8. Main form of ceramic degradation

(a) Corrosion (b) Weathering (c) Dissolution (d) Swelling

9. The following influences deterioration of polymers

(a) Weather (b) Radiation (c) Temparature (d) All

10. Following is not the main form of polymer deterioration

(a) Corrosion (b) Swelling and Dissolution (c) Weathering (d) Scission

11. When Pt and Co are electrically connected, which one gets corroded

(a) Pt (b) Co (c) None (d) Can't decide

12. Which of the following can be used for cathodic protection:

(a) Al (b) Cd (c) Cu (d) Either

Answers:

1. b
2. c
3. b
4. c
5. a
6. b
7. c
8. c
9. d
10. a
11. b
12. a

Multiple Choice Questions:

1. Failure due to excessive deformation is controlled by _____.
(a) Material properties (b) Design & Dimensions (c) Both (d) None
2. Failure due to excessive deformation is controlled by _____.
(a) Yield strength (b) Tensile strength (c) Young's modulus (d) All
3. Time dependent yield is known as
(a) Fracture (b) Fatigue (c) Buckling (d) Creep
4. Cleavage fracture appears
(a) Bright (b) Dull (c) Difficult to identify (d) None
5. Usually materials with following crystal structure fail in ductile mode
(a) FCC (b) BCC (c) HCP (d) None
6. Brittle fracture is more dangerous than ductile fracture because _____.
(a) No warning sign
(b) Crack propagates at very high speeds
(c) No need for extra stress during crack propagation
(d) All
7. Fracture voids usually form at
(a) Inclusions (b) Second phase particles (c) Grain boundary triple points (d) All
8. Fracture stress (σ_f) is proportional to
(a) crack length (b) 1/crack length (c) (crack length)$^{1/2}$ (d) (crack length)$^{-1/2}$
9. Fracture toughness is measured in terms of
(a) Strain energy release rate (b) Stress concentration factor (c) Both (d) None
10. In fracture mode-II, fracture surfaces
(a) shear parallel to edge of crack
(b) shear perpendicular to edge of crack
(c) displace normal to each other
(d) None
11. Fracture toughness, K_{IC}, decreases with
(a) increasing temperature
(b) increasing strain rate
(c) increase in yield strength
(d) increase in grain size
12. DBTT for ceramics is in the range of _____ X T_m.
(a) 0.1-0.2 (b) 0.2-0.3 (c) 0.3-0.5 (d) 0.5-0.7
13. Following impurity decreases DBTT for steels
(a) Mn (b) P (c) Si (d) Mo
14. Fatigue strength for non-ferrous materials in defined at _____ stress cycles.
(a) 10^3 (b) 10^5 (c) 10^7 (d) 10^9
15. The following equation defines S-N curve
(a) Paris equation (b) Basquin equation (c) Andrede equation (d) Garofalo equation
16. Creep rate in ternary stage _____.
(a) Decreases (b) Constant (c) Increases (d) None
17. Ternary stage creep is associated with _____.
(a) Strain hardening (b) Recovery (c) Necking (d) None
18. Total strain range in a creep test
(a) <1% (b) around 10% (c) around 50% (d) > >50%
19. Creep mechanism that is operational at stresses $10^{-2} > \sigma/G > 10^{-4}$ _____.
(a) Dislocation creep (b) Dislocation glide (c) Diffusion creep (d) GB sliding
20. Most often machine components fail by
(a) Buckling (b) Creep (c) Fatigue (d) All

21. If the surface crack causing fracture in a brittle material is made twice as deep, the fracture strength will
(a) decrease by a factor of $\sqrt{2}$
(b) decrease by a factor of 2
(c) decrease by a factor of 2^2
(d) No change

Answers:

1. c
2. c
3. d
4. a
5. a
6. d
7. d
8. d
9. c
10. b
11. b
12. a
13. a
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11. b
12. d
13. c
14. c
15. a

Multiple Choice Questions:

1. Time dependent permanent deformation is called _____.
(a) Plastic deformation (b) Elastic deformation
(c) Creep (d) Anelastic deformation
2. Figure-out the odd point in the following
(a) Proportinal limit (b) Elastic limit (c) Yeild point (d) Fracture point
3. If a material is subjected to two incremental true strains namely ε_1 and ε_2, then the total true strain is
(a) $\varepsilon_1 * \varepsilon_2$ (b) $\varepsilon_1 - \varepsilon_2$ (c) $\varepsilon_1 + \varepsilon_2$ (d) $\varepsilon_1 / \varepsilon_2$
4. Engineering stress-strain curve and True stress-strain curve are equal up to
(a) Proportional limit (b) Elastic limit (c) Yeild point (d) Tensile strength point
5. Value of Poisson's ratio for ionic solids in the range of
(a) 0.1 (b) 0.2 (c) 0.3 (d) 0.4
6. Hydrostatic stress results in the following
(a) Linear strain (b) Shear strain (c) Both linear and shear strains (d) None
7. High elastic modulus in materials arises from
(a) High strength of bonds (b) Weak bonds (c) combination of bonds (d) None
8. Change in elastic modulus for ordinary materials between 0K and melting point is
(a) 10-20% increase (b) 10-20% decrease (c) 80-90% decrease (d) 80-90% increase
9. Bauschinger effect
(a) Hysteresis loss during loading and unloading (b) Anelastic deformation
(c) Dependence of yield stress on path and direction (d) None
10. Shape of true stress-strain curve for a material depends on
(a) Strain (b) Strain rate (c) Temperature (d) All
11. Toughness of a material is equal to area under _____ part of the stress-strain curve.
(a) Elastic (b) Plastic (c) Both (d) None
12. True stress-strain curve need to be corrected after
(a) Elastic limit (b) Yield limit (c) Tensile strength (d) no need to correct
13. Following condition represents onset of necking
(a) $\varepsilon_u = n$ (b) $\varepsilon_u = 1-n$ (c) $\varepsilon_u = 1+n$ (d) $\varepsilon_u = ln\ (1+n)$
14. As compared with conventional stress-strain curve, the true stress-strain curve is
(a) Above and right (b) Below and right (c) Above and left (d) Below and left
15. According to distortion-energy criterion, yielding occurs when
(a) Distortion energy reaches a critical value
(b) Second invariant of the stress deviator exceeded some critical value
(c) Octahedral shear stress reaches a critical value
(d) All
16. von Mises and Tresca criteria give different yield stress for
(a) Uni-axial stress (b) Balanced bi-axial stress (c) Pure shear stress (d) All
17. Plastic deformation results from the following
(a) Slip (b) Twinning (c) Both (d) None
18. Time dependent recoverable deformation under load is called _____ deformation.
(a) Elastic (b) Anelastic (c) Elastic after-effect (d) Visco-elastic

Answers:

1. c
2. d
3. c
4. c
5. b
6. d
7. a
8. b
9. c
10. d
11. c
12. c
13. a
14. c
15. d
16. c
17. c
18. b

Multiple Choice Questions:

1. Diffusion can occur in _____ materials.
(a) Solid (b) Liquid (c) Gaseous (d) All
2. Probably the fastest diffusing species in Fe is
(a) H (b) Ni (c) W (d) C
3. The value of error function for '∞' is
(a) - ∞ (b) -1 (c) 1 (d) ∞
4. The value of error function for '0' is
(a) -1 (b) 0 (c) 1 (d) None
5. The units for diffusivity, *D*, are
(a) m^2sec^1 (b) m^2sec^{-1} (c) $m^{-2}sec^{-1}$ (d) $m^{-2}sec^1$
6. The following mechanism contributes very little the diffusivity
(a) Vacancy (b) Interstitial (c) Substitutional (d) Self-interstitial
7. Not an example for short-circuit path
(a) Vacancy (b) Dislocations (c) Grain boundaries (d) External surfaces
8. Example for steady-state diffusion
(a) Hydrogen purification by palladium sheet
(b) Doping semi-conductors
(c) Corrosion resistance of duralumin
(d) Decarburization of steel
9. The most influencing factor of diffusivity
(a) Diffusing species (b) Temperature (c) Lattice structure (d) Presence of defects
10. The following phenomena are useful in zone-refining process
(a) Coring (b) Segregation (c) Both (d) None
11. Macro-segregation can be removed by
(a) Annealing (b) Hot working (c) Both (d) None
12. The following enhances the coring
(a) Minute difference between liquidus and solidus
(b) Marked difference between liquids and solids
(c) Either (d) None

Answers:

1. d
2. a
3. c
4. b
5. b
6. d
7. a
8. a
9. b
10. c
11. d
12. b

Multiple Choice Questions:

1. Sharp break in dislocation line that is in slip plane _____.
(a) Jog (b) Kink (c) Either jog or kink (d) None
2. Minimum number of slip systems that must be operative during plastic deformation
(a) 3 (b) 4 (c) 5 (d) 6
3. Following strengthening mechanism applies to multi-phase material
(a) Grain size reduction (b) Dispersion hardening
(c) Solid solution strengthening (d) Strain hardening
4. If ASTM grain size number is 1, approximate grain diameter (in mm)
(a) 0.1 (b) 0.2 (c) 0.25 (d) 10
5. If volume fraction of spherical shaped second phase particles is 50% with radius of 3 μm, interspacing of particles is (in μm)
(a) 1 (b) 2 (c) 3 (d) 4
6. Characteristic shape of Martensite platelets
(a) Disc (b) Lenticular (c) Cylindrical (d) Spheroids
7. Recrystallization temperature of pure materials _____ (in terms of homologous temperature)
(a) 0.1 (b) 0.2 (c) 0.3 (d) 0.4
8. Example for strengthening mechanism in single-phase material
(a) Strain hardening (b) Precipitation hardening
(c) Fiber strengthening (d) Dispersion strengthening
9. Higher the degree of deformation, recrystallization temperature is
(a) Higher (b) Lower (c) No effect (d) Either higher or lower
10. Recrystallization rate varies in the following manner with temperature
(a) Linearly increasing (b) Linearly decreasing
(c) Exponential (d) Logarithmic
11. Methods to retard grain growth
(a) Solute drag (b) Pinning action of particles (c) Both (d) None
12. Driving force for recrystallization process
(a) Stored energy of cold work (b) Grain boundary energy
(c) Both (d) Stacking-fault energy
13. Driving force for grain growth process
(a) Stored energy of cold work (b) Grain boundary energy
(c) Both (d) Stacking-fault energy
14. Fine grain size, usually, can not be obtained during the following process
(a) Slow cooling (b) increasing nucleation rate (c) retarding grain growth (d) fast cooling
15. Hardness during over-aging
(a) Decreases (b) Increases (c) Constant (d) Decreases abruptly
16. Decrease in free energy during recrystallization is attributed to
(a) Excess point defects (b) Excess dislocations
(c) Grain boundaries (d) All
17. Decrease in free energy during recovery is attributed to
(a) Excess point defects (b) Excess dislocations
(c) Grain boundaries (d) All

Answers:

1. b
2. c
3. b
4. c
5. d
6. b
7. c
8. a
9. b
10. c
11. c
12. a
13. b
14. a
15. a
16. b
17. a

Multiple Choice Questions:

1. Gibbs phase rule for general system:
(a) P+F=C-1 (b) P+F=C+1 (c) P+F=C-2 (d) P+F=C+2
2. In a single-component condensed system, if degree of freedom is zero, maximum number of phases that can co-exist _____.
(a) 0 (b) 1 (c) 2 (d) 3
3. The degree of freedom at triple point in unary diagram for water _____.
(a) 0 (b) 1 (c) 2 (d) 3
4. Above the following line, liquid phase exist for all compositions in a phase diagram.
(a) Tie-line (b) Solvus (c) Solidus (d) Liquidus
5. Following is wrong about a phase diagram.
(a) It gives information on transformation rates.
(b) Relative amount of different phases can be found under given equilibrium conditions.
(c) It indicates the temperature at which different phases start to melt.
(d) Solid solubility limits are depicted by it.
6. Not a Hume-Ruthery condition:
(a) Crystal structure of each element of solid solution must be the same.
(b) Size of atoms of each two elements must not differ by more than 15%.
(c) Elements should form compounds with each other.
(d) Elements should have the same valence.
7. Pick the odd one in the following:
(a) Isomorphous alloy (b) Terminal solid solution
(c) Intermediate solid solution (d) Compound
8. The boundary line between (liquid) and (liquid+solid) regions must be part of _____.
(a) Solvus (b) Solidus (c) Liquidus (d) Tie-line
9. The boundary line between (liquid+solid) and (solid) regions must be part of _____.
(a) Solvus (b) Solidus (c) Liquidus (d) Tie-line
10. The boundary line between (alpha) and (alpha+beta) regions must be part of _____.
(a) Solvus (b) Solidus (c) Liquidus (d) Tie-line
11. Horizontal arrest in a cooling curve represents:
(a) Continuous cooling (b) Invariant reaction (c) Both (d) None
12. Relative amounts of phases in a region can be deduced using
(a) Phase rule (b) Lever rule (c) Either (d) None
13. An invariant reaction that produces a solid up on cooling two liquids:
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
14. A solid + a liquid result in a liquid up on heating during _____ reaction.
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
15. A solid + a liquid result in a solid up on cooling during _____ reaction.
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
16. On heating, one solid phase results in another solid phase plus on liquid phase during ___ reaction.
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
17. A solid phase results in a solid plus another solid phase up on cooling during _____ reaction.
(a) Eutectoid (b) Peritectoid (c) Eutectic (d) Peritectic
18. A solid phase results in a solid plus another solid phase up on heating during _____ reaction.
(a) Eutectoid (b) Peritectoid (c) Monotectoid (d) None
19. A liquid phase produces two solid phases during _____ reaction up on cooling.
(a) Eutectic (b) Eutectoid (c) Peritectic (d) Peritectoid
20. Liquid phase is involved in the following reaction:
(a) Eutectoid (b) Peritectoid (c) Monotectoid (d) None
21. Not a basic step of precipitation strengthening
(a) Solutionizing (b) Mixing and compacting (c) Quenching (d) Aging

22. Both nucleation and growth require change in free energy to be _____.
(a) –ve (b) zero (c) +ve (d) Any
23. During homogeneous nucleation, critical size of a particle _____ with increase in under-cooling.
(a) Increases (b) Decreases (c) Won't change (d) Not related
24. Not a typical site for nucleation during solid state transformation
(a) Container wall (b) Grain boundaries (c) Stacking faults (d) Dislocations
25. Growth occurs by
(a) Diffusion controlled individual movement of atoms
(b) Diffusion-less collective movement of atoms
(c) Both (d) None
26. Overall transformation rate changes with temperature as follows:
(a) Monotonically decreases with temperature (b) First increases, then decreases
(c) Initially it is slow, and then picks-up (d) Monotonically increases with temperature
27. wt.% of carbon in mild steels
(a) <0.008 (b) 0.008-0.3 (c) 03-0.8 (d) 0.8-2.11
28. Eutectic product in Fe-C system is called
(a) Pearlite (b) Bainite (c) Ledeburite (d) Spheroidite
29. Eutectoid product in Fe-C system is called
(a) Pearlite (b) Bainite (c) Ledeburite (d) Spheroidite
30. Phases that exist on left side of an invariant reaction line are called
(a) Pro-phase (b) Hypo-phase (c) Hyper-phase (d) None
31. Alloying element that decreases eutectoid temperature in Fe-C system
(a) Mo (b) Si (c) Ti (d) Ni
32. Nose of a C-curve represents
(a) Shortest time required for specified fraction of transformation
(b) Longest time required for specified fraction of transformation
(c) Average time required for specified fraction of transformation
(d) No information regarding time required for specified fraction of transformation
33. Phase formed of diffusion-less reaction:
(a) Pearlite (b) Lower Bainite (c) Upper bainite (d) Martensite
34. Ms for Fe-C system is round _____ ℃.
(a) 725 (b) 550 (c) 450 (d) 210
35. Impurity not responsible for temper embrittlement
(a) Sn (b) Sb (c) Si (d) As

Answers:

1. d
2. c
3. a
4. c
5. a
6. c
7. a
8. c
9. b
10. a
11. b
12. b
13. d
14. c
15. b
16. b
17. a
18. b
19. a
20. d
21. b
22. a
23. b
24. a
25. c
26. b
27. b
28. c
29. a
30. c
31. d
32. a
33. d
34. d
35. c

Multiple Choice Questions:

1. Failure due to excessive deformation is controlled by _____.
(a) Material properties (b) Design & Dimensions (c) Both (d) None
2. Failure due to excessive deformation is controlled by _____.
(a) Yield strength (b) Tensile strength (c) Young's modulus (d) All
3. Time dependent yield is known as
(a) Fracture (b) Fatigue (c) Buckling (d) Creep
4. Cleavage fracture appears
(a) Bright (b) Dull (c) Difficult to identify (d) None
5. Usually materials with following crystal structure fail in ductile mode
(a) FCC (b) BCC (c) HCP (d) None
6. Brittle fracture is more dangerous than ductile fracture because _____.
(a) No warning sign
(b) Crack propagates at very high speeds
(c) No need for extra stress during crack propagation
(d) All
7. Fracture voids usually form at
(a) Inclusions (b) Second phase particles (c) Grain boundary triple points (d) All
8. Fracture stress (σ_f) is proportional to
(a) crack length (b) 1/crack length (c) (crack length)$^{1/2}$ (d) (crack length)$^{-1/2}$
9. Fracture toughness is measured in terms of
(a) Strain energy release rate (b) Stress concentration factor (c) Both (d) None
10. In fracture mode-II, fracture surfaces
(a) shear parallel to edge of crack
(b) shear perpendicular to edge of crack
(c) displace normal to each other
(d) None
11. Fracture toughness, K_{IC}, decreases with
(a) increasing temperature
(b) increasing strain rate
(c) increase in yield strength
(d) increase in grain size
12. DBTT for ceramics is in the range of _____ X T_m.
(a) 0.1-0.2 (b) 0.2-0.3 (c) 0.3-0.5 (d) 0.5-0.7
13. Following impurity decreases DBTT for steels
(a) Mn (b) P (c) Si (d) Mo
14. Fatigue strength for non-ferrous materials in defined at _____ stress cycles.
(a) 10^3 (b) 10^5 (c) 10^7 (d) 10^9
15. The following equation defines S-N curve
(a) Paris equation (b) Basquin equation (c) Andrede equation (d) Garofalo equation
16. Creep rate in ternary stage _____.
(a) Decreases (b) Constant (c) Increases (d) None
17. Ternary stage creep is associated with _____.
(a) Strain hardening (b) Recovery (c) Necking (d) None
18. Total strain range in a creep test
(a) <1% (b) around 10% (c) around 50% (d) > >50%
19. Creep mechanism that is operational at stresses $10^{-2} > \sigma/G > 10^{-4}$ _____.
(a) Dislocation creep (b) Dislocation glide (c) Diffusion creep (d) GB sliding
20. Most often machine components fail by
(a) Buckling (b) Creep (c) Fatigue (d) All

21. If the surface crack causing fracture in a brittle material is made twice as deep, the fracture strength will
(a) decrease by a factor of $\sqrt{2}$
(b) decrease by a factor of 2
(c) decrease by a factor of 2^2
(d) No change

Answers:

1. c
2. c
3. d
4. a
5. a
6. d
7. d
8. d
9. c
10. b
11. b
12. a
13. a
14. c
15. b
16. c
17. c
18. a
19. a
20. c
21. a

Multiple Choice Questions:

1. % C in medium carbon steels ranges from _____.
(a) 0.3 – 0.4 (b) 0.3 – 0.5 (c) 0.3 – 0.6 (d) None
2. Stainless steel is so called because of its _____.
(a) High strength (b) High corrosion resistance (c) High ductility (d) Brittleness
3. In white cast irons, carbon present as _____.
(a) Graphite flakes (b) Graphite nodules (c) Cementite (d) Carbon does not exist
4. Refractory metal
(a) Ag (b) W (c) Pt (d) Ni
5. Not a noble metal
(a) Cu (b) Ag (c) Au (d) Pt
6. Noble metal
(a) Al (b) Ag (c) Mo (d) W
7. Usual casting method for making dental crowns
(a) Sand casting (b) Die casting (c) Continuous casting (d) Investment casting
8. Prime structural disadvantage of P/M products
(a) Low density (b) Porosity (c) High damping capacity (d) None
9. Not an important heat treatment process parameter
(a) Heating rate (b) Temperature (c) Cooling rate (d) Atmosphere
10. Final structure of austempered steel
(a) Pearlite (b) Ferrite + graphite (c) Bainite (d) Martensite

Answers:

1. c
2. b
3. c
4. b
5. a
6. b
7. d
8. b
9. a
10. c

Multiple Choice Questions:

1. The word ‘ceramic’ meant for _____.
(a) soft material (b) hard material (c) burnt material (d) dry material
2. Not a characteristic property of ceramic material
(a) high temperature stability (b) high mechanical strength
(c) low elongation (d) low hardness
3. Major ingredients of traditional ceramics
(a) silica (b) clay (c) feldspar (d) all
4. Not a major contributor of engineering ceramics
(a) SiC (b) SiO_2 (c) Si_3N_4 (d) Al_2O_3
5. The following ceramic product is mostly used as pigment in paints
(a) TiO_2 (b) SiO_2 (c) UO_2 (d) ZrO_2
6. Most commercial glasses consist of
(a) lime (b) soda (c) silica (d) all
7. Hot isostatic pressing is not a viable option if the chief criterion is
(a) strength without grain growth (b) lost cost
(c) zero porosity (d) processing refractory ceramics
8. During sintering densification is not due to
(a) atomic diffusion (b) surface diffusion (c) bulk diffusion (d) grain growth

Answers:

1. c
2. d
3. d
4. b
5. a
6. d
7. b
8. b

Multiple Choice Questions:

1. Time dependent permanent deformation is called _____.
(a) Plastic deformation (b) Elastic deformation
(c) Creep (d) Anelastic deformation
2. Figure-out the odd point in the following
(a) Proportinal limit (b) Elastic limit (c) Yeild point (d) Fracture point
3. If a material is subjected to two incremental true strains namely ε_1 and ε_2, then the total true strain is
(a) $\varepsilon_1 * \varepsilon_2$ (b) $\varepsilon_1 - \varepsilon_2$ (c) $\varepsilon_1 + \varepsilon_2$ (d) $\varepsilon_1 / \varepsilon_2$
4. Engineering stress-strain curve and True stress-strain curve are equal up to
(a) Proportional limit (b) Elastic limit (c) Yeild point (d) Tensile strength point
5. Value of Poisson's ratio for ionic solids in the range of
(a) 0.1 (b) 0.2 (c) 0.3 (d) 0.4
6. Hydrostatic stress results in the following
(a) Linear strain (b) Shear strain (c) Both linear and shear strains (d) None
7. High elastic modulus in materials arises from
(a) High strength of bonds (b) Weak bonds (c) combination of bonds (d) None
8. Change in elastic modulus for ordinary materials between 0K and melting point is
(a) 10-20% increase (b) 10-20% decrease (c) 80-90% decrease (d) 80-90% increase
9. Bauschinger effect
(a) Hysteresis loss during loading and unloading (b) Anelastic deformation
(c) Dependence of yield stress on path and direction (d) None
10. Shape of true stress-strain curve for a material depends on
(a) Strain (b) Strain rate (c) Temperature (d) All
11. Toughness of a material is equal to area under _____ part of the stress-strain curve.
(a) Elastic (b) Plastic (c) Both (d) None
12. True stress-strain curve need to be corrected after
(a) Elastic limit (b) Yield limit (c) Tensile strength (d) no need to correct
13. Following condition represents onset of necking
(a) $\varepsilon_u = n$ (b) $\varepsilon_u = 1-n$ (c) $\varepsilon_u = 1+n$ (d) $\varepsilon_u = ln\ (1+n)$
14. As compared with conventional stress-strain curve, the true stress-strain curve is
(a) Above and right (b) Below and right (c) Above and left (d) Below and left
15. According to distortion-energy criterion, yielding occurs when
(a) Distortion energy reaches a critical value
(b) Second invariant of the stress deviator exceeded some critical value
(c) Octahedral shear stress reaches a critical value
(d) All
16. von Mises and Tresca criteria give different yield stress for
(a) Uni-axial stress (b) Balanced bi-axial stress (c) Pure shear stress (d) All
17. Plastic deformation results from the following
(a) Slip (b) Twinning (c) Both (d) None
18. Time dependent recoverable deformation under load is called _____ deformation.
(a) Elastic (b) Anelastic (c) Elastic after-effect (d) Visco-elastic

Answers:

1. c
2. d
3. c
4. c
5. b
6. d
7. a
8. b
9. c
10. d
11. c
12. c
13. a
14. c
15. d
16. c
17. c
18. b

Multiple Choice Questions:

1. Gibbs phase rule for general system:
(a) P+F=C-1 (b) P+F=C+1 (c) P+F=C-2 (d) P+F=C+2
2. In a single-component condensed system, if degree of freedom is zero, maximum number of phases that can co-exist _____.
(a) 0 (b) 1 (c) 2 (d) 3
3. The degree of freedom at triple point in unary diagram for water _____.
(a) 0 (b) 1 (c) 2 (d) 3
4. Above the following line, liquid phase exist for all compositions in a phase diagram.
(a) Tie-line (b) Solvus (c) Solidus (d) Liquidus
5. Following is wrong about a phase diagram.
(a) It gives information on transformation rates.
(b) Relative amount of different phases can be found under given equilibrium conditions.
(c) It indicates the temperature at which different phases start to melt.
(d) Solid solubility limits are depicted by it.
6. Not a Hume-Ruthery condition:
(a) Crystal structure of each element of solid solution must be the same.
(b) Size of atoms of each two elements must not differ by more than 15%.
(c) Elements should form compounds with each other.
(d) Elements should have the same valence.
7. Pick the odd one in the following:
(a) Isomorphous alloy (b) Terminal solid solution
(c) Intermediate solid solution (d) Compound
8. The boundary line between (liquid) and (liquid+solid) regions must be part of _____.
(a) Solvus (b) Solidus (c) Liquidus (d) Tie-line
9. The boundary line between (liquid+solid) and (solid) regions must be part of _____.
(a) Solvus (b) Solidus (c) Liquidus (d) Tie-line
10. The boundary line between (alpha) and (alpha+beta) regions must be part of _____.
(a) Solvus (b) Solidus (c) Liquidus (d) Tie-line
11. Horizontal arrest in a cooling curve represents:
(a) Continuous cooling (b) Invariant reaction (c) Both (d) None
12. Relative amounts of phases in a region can be deduced using
(a) Phase rule (b) Lever rule (c) Either (d) None
13. An invariant reaction that produces a solid up on cooling two liquids:
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
14. A solid + a liquid result in a liquid up on heating during _____ reaction.
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
15. A solid + a liquid result in a solid up on cooling during _____ reaction.
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
16. On heating, one solid phase results in another solid phase plus on liquid phase during ___ reaction.
(a) Eutectic (b) Peritectic (c) Monotectic (d) Syntectic
17. A solid phase results in a solid plus another solid phase up on cooling during _____ reaction.
(a) Eutectoid (b) Peritectoid (c) Eutectic (d) Peritectic
18. A solid phase results in a solid plus another solid phase up on heating during _____ reaction.
(a) Eutectoid (b) Peritectoid (c) Monotectoid (d) None
19. A liquid phase produces two solid phases during _____ reaction up on cooling.
(a) Eutectic (b) Eutectoid (c) Peritectic (d) Peritectoid
20. Liquid phase is involved in the following reaction:
(a) Eutectoid (b) Peritectoid (c) Monotectoid (d) None
21. Not a basic step of precipitation strengthening
(a) Solutionizing (b) Mixing and compacting (c) Quenching (d) Aging

22. Both nucleation and growth require change in free energy to be _____.
(a) –ve (b) zero (c) +ve (d) Any
23. During homogeneous nucleation, critical size of a particle _____ with increase in under-cooling.
(a) Increases (b) Decreases (c) Won't change (d) Not related
24. Not a typical site for nucleation during solid state transformation
(a) Container wall (b) Grain boundaries (c) Stacking faults (d) Dislocations
25. Growth occurs by
(a) Diffusion controlled individual movement of atoms
(b) Diffusion-less collective movement of atoms
(c) Both (d) None
26. Overall transformation rate changes with temperature as follows:
(a) Monotonically decreases with temperature (b) First increases, then decreases
(c) Initially it is slow, and then picks-up (d) Monotonically increases with temperature
27. wt.% of carbon in mild steels
(a) <0.008 (b) 0.008-0.3 (c) 03-0.8 (d) 0.8-2.11
28. Eutectic product in Fe-C system is called
(a) Pearlite (b) Bainite (c) Ledeburite (d) Spheroidite
29. Eutectoid product in Fe-C system is called
(a) Pearlite (b) Bainite (c) Ledeburite (d) Spheroidite
30. Phases that exist on left side of an invariant reaction line are called
(a) Pro-phase (b) Hypo-phase (c) Hyper-phase (d) None
31. Alloying element that decreases eutectoid temperature in Fe-C system
(a) Mo (b) Si (c) Ti (d) Ni
32. Nose of a C-curve represents
(a) Shortest time required for specified fraction of transformation
(b) Longest time required for specified fraction of transformation
(c) Average time required for specified fraction of transformation
(d) No information regarding time required for specified fraction of transformation
33. Phase formed of diffusion-less reaction:
(a) Pearlite (b) Lower Bainite (c) Upper bainite (d) Martensite
34. Ms for Fe-C system is round _____ ℃.
(a) 725 (b) 550 (c) 450 (d) 210
35. Impurity not responsible for temper embrittlement
(a) Sn (b) Sb (c) Si (d) As

Answers:

1. d
2. c
3. a
4. c
5. a
6. c
7. a
8. c
9. b
10. a
11. b
12. b
13. d
14. c
15. b
16. b
17. a
18. b
19. a
20. d
21. b
22. a
23. b
24. a
25. c
26. b
27. b
28. c
29. a
30. c
31. d
32. a
33. d
34. d
35. c

MCQ Question Bank for Unit 1

Q. No	Description	Marks	Attainment of			
			CO	PO	BL	GA
1	Repeatable entity of a crystal structure is known as (a) Crystal (b) Lattice **(c) Unit cell** (d) Miller indices	1	CO1	POa		
2	Coordination number for closest packed crystal structure (a) 16 **(b) 12** (c) 8 (d) 4	1	CO1	POa		
3	Atomic packing factor is (a) Distance between two adjacent atoms (b) Projected area fraction of atoms on a plane **(c) Volume fraction of atoms in cell** (d) None	1	CO1	POa		
4	Coordination number in simple cubic crystal structure (a) 1 **(b) 2** (c) 3 (d) 4	1	CO1	POa		
5	5. The atomic diameter of an BCC crystal (if *a* is lattice parameter) is (a) *a* (b) *a*/2 **(c) *a*/(4/√3)** (d) *a*/(4/√2)	1	CO1	POa		
6	A family of directions is represented by (a) (*hkl*) **(b) <*uvw*>** (c) {*hkl*} (d) [*uvw*]	1	CO1	POa		

7	Miller indices for Octahedral plane in cubic crystal (a) (100) (b) (110) **(c) (111)** (d) None	**1**	CO1	POa		
8	The plane (1–11) is parallel to **(a) (–11–1)** (b) (–1–11) (c) (111) (d) (1–11)	**1**	CO1	POa		
9	The angle between [111] and [11–2] directions in a cubic crystal is (in degrees) (a) 0 (b) 45 **(c) 90** (d) 180	**1**	CO1	POa		
10	Miller indices of the line of intersection of (–1–11) and (110) are (a) [110] (b) [101] (c) [10–1] **(d) [–110]**	**1**	CO1	POa		
11	How do crystals and amorphous solids differ? (a)Crystals have poorly formed patterns and amorphous solids do not. (b)Crystals produce regular shaped fragments when shattered and amorphous solids do not. (c)Crystals have particles that are separated by irregular distances and amorphous solids d (d)Crystals have broad melting point ranges a amorphous solids do not.	**1**	CO1	POa		
12	Which unit cell has eight particles located in the corners, has sides that are all the same length, and has angles of only 90°?	**1**	CO1	POa		

	(a)body-centered cubic unit cell (b)triclinic unit cell (c)face-centered cubic unit cell (d)simple cubic unit cell					
13	Copper has a face-centered cubic unit cell. How many copper atoms are in each unit cell? A. 6 B. 4 C. 8 D. 2	**1**	CO1	POa		
14	A particular metal has a simple cubic unit cell. How many atoms of the metal are in each unit cell? A. 1 B. 4 C. 6 D. 2	**1**	CO1	POa		
15	What is the coordination number for a hexagonal close packed unit cell? A. 6 B. 4 C. 12 D. 8	**1**	CO1	POa		
16	3. Number lattice points in an unit cell is i) One ii) Two iii) Four iv) Depends on type of bravais lattice	**1**	CO1	POa		

17	Number lattice points in a primitive cell is i) One ii) Two iii) Four iv) Depends on type of bravais lattice	**1**	CO1	POa		
18	Atomic packing factor for BCC is i) 0.52 (SC) ii) 0.74 (FCC) iii) 0.68 (BCC) iv) None of these	**1**	CO1	POa		
19	Co-ordination number in case of Simple cubicstructureis i) 12 (FCC) ii) 6 (SC) iii) 2 iv)8 (BCC)	**1**	CO1	POa		
20	Crystal type CsCl belongs to i) BCC ii) SC iii) HCP iv)FCC	**1**	CO1	POa		
21	8. Intercepts of a plane in crystal is given by a, b/2, 3c in a simple cubic unit cell, Miller indicesare, i) (1 3 2) ii) (2 6 1)	**1**	CO1	POa		

	iii) (1 2 3) iv)(361)					
22	9. The miller indices of plane parallel to x and y axes are i) (1 0 0) ii) (0 1 0) iii) (1 1 1) iv)(001)	**1**	CO1	POa		
23	Repeatable entity of a crystal structure is known as a) Crystal b) Lattice c) Unit cell d) Miller indices	**1**	CO1	POa		
24	Coordination number for closest packed crystal structure a) 16 b) 12 c) 8 d) 4	**1**	CO1	POa		
25	Atomic packing factor is a) Distance between two adjacent atoms b) Projected area fraction of atoms on a	**1**	CO1	POa		

	plane c) Volume fraction of atoms in cell d) None					
26	Coordination number in simple cubic crystal structure a) 1 b) 6 c) 3 d) 4	**1**	CO1	POa		
27	The atomic diameter of an BCC crystal (if a is lattice parameter) is a) a b) a/2 c) a/(4/√3) d) a/(4/√2)	**1**	CO1	POa		
28	A family of directions is represented by a) (hkl) b) <uvw> c) {hkl} d) [uvw]	**1**	CO1	POa		
29	Miller indices for Octahedral plane in cubic crystal a) (100) b) (110)	**1**	CO1	POa		

	c) (111) d) None					
30	The plane (111) is parallel to a) (1 1 1) b) b) (1 1 1) c) c) (111) d) d) (1 1 1)	**1**	CO1	POa		
31	The angle between [111] and [112] directions in a cubic crystal is (in degrees) a) 0 b) 45 c) 90 d) 180	**1**	CO1	POa		
32	Miller indices of the line of intersection of (111) and (110) are a) [110] b) [101] c) [1 0 1] d) [1 1 0]	**1**	CO1	POa		
33	The minimum number of ions in the unit cell of an ionic crystal with FCC space lattice is a) 4 b) 8 c) 12	**1**	CO1	POa		

	d) 16					
34	If the radius of an atom in a simple cubic crystal is r, the body diagonal of the unit cell is a) r/√3 b) 2r/ √3 c) 4r/√3 d) 3r/4	**1**	CO1	POa		
35	Which one of the following statements about the (241) and (241) planes is false? a **They are perpendicular.** b They are part of the same set of planes. c They are part of the same family of plane d They are parallel.	**1**	CO1	POa		
36	When writing the index for a set of symmetrically related planes, which type of brackets should be used? a (Round) b **{Curly}** c <Triangular> d [Square]	**2**	CO1	POa		

37	When writing the index for a set of symmetrically related planes, which type of brackets should be used? a (Round) **b {Curly}** c <Triangular> d [Square]	**2**	CO1	POb		
38	Does the [122] direction lie in the (301) plane? a Yes b **No**	**2**	CO1	POb		

39	Which of the <110> type directions lie in the (112) plane? a [110] and [110] b [101] and [101] c [011] and [101] d **[1¯10] and [¯110]**	**1**	CO1	POa		
40	Which set of planes in a face centred cubic lattice, is close packed?	**1**	CO1	POa		

	a {110} b {100} c **{111}** d {222}					
41	What is the common direction between the (132) and (133) planes? a [310] b **[$\bar{3}\bar{1}$0]** c [410] d [410]	**1**	CO1	POa		

Question Bank

Theory Question Bank for Unit I

Q. No	Question	Marks	Attainment of			
			CO	PO	BL	GA
1	Explain the effect of the following crystalline defects on properties of materials: i. Points defects ii. Line defects	6	CO1	POa		

2	What is re-crystallization? Define re-crystallization temperature. Explain the factors affecting re-crystallization process	6	CO1	POa		
3	Derive the equation for critical resolve shear stress during slip in single crystal. State the condition for geometrical softening and geometrical hardening.	4	CO1	POa		
4	Maximum shear stress is obtained if slip plane is at 45 degree in a single crystal. Explain	4	CO1	POa		
5	How would a difference in grain size affect the change in mechanical properties due to plastic deformation?	4	CO1	POa		
6	Explain the phenomenon of strain hardening in detail.	4	CO1	POa		
7	What is the role of dislocation in the plastic deformation of metal	4	CO1	POa		
8	How plastic deformation in polycrystalline material is different from single crystal.	4	CO1	POa		
9	Differentiate between cold and hot working?	4	CO1	POa		
10	Why annealing is done after cold working? Explain the changes in mechanical properties that take place during annealing with proper graphs	6	CO1	POa		
11	Define slip plane and slip direction.	3	CO1	POa		
12	What do you mean by the term “unit cell”?. Define various lattice parameters.	4	CO1	POb		
13	Differentiate between cold working and hot working according to temperature, variation in mechanical properties, grain formation and areas of application.	4	CO1	POa		

14	With the help of neat sketches explain about imperfections in crystal.	6	CO1	POa		
15	What is mean by work hardening? Is it good or bad from mechanical engineering point of view? Explain work hardening on the basis of theory of dislocation	6	CO1	POa		
16	Define 'Dislocation'. Explain about the types and role in plastic deformation.	6	CO1	POa		
17	Distinguish between slip and twinning.	4	CO1	POa		
18	Explain the phenomenon of strain hardening with the curve.	4	CO1	POa		
19	Explain following in brief- 1.Recrystalization 2.Polygonization 3.Dislocation	6	CO1	POa		
20	Explain plastic deformation on the besis of dislocation theory.	4	CO1	POa		
21	Define recovery and recrystalization. Discuss factors influencing recrystalization temperature.	6	CO1	POa		
22	Explain structure and property changes during recrystalization and grain growth stages of annealing.	6	CO1	POa		
23	In what respect cold working is superior to hot working.	6	CO1	POb		
24	Copper is more ductile than iron. Do you agree? Justify your choice.	3	CO1	POa		
25	Explain work hardening or strain hardening with curve.	4	CO1	POa		
26	Explain how deformation twinning differs from slip.	6	CO1	POa		
27	Give the classification of crystal	6	CO1	POa		

	imperfection. Explain with neat sketches planar defects.					
28	Explain polygonization , recrystalization and grain growth.	6	CO1	POa		
29	Differentiate between the following 1.Edge Dislocation and Screw dislocation 2. cold working and hot working	6	CO1	POa		
30	Show the self explanatory diagram for point defects .	2	CO1	POa		
31	Compare on FCC,BCC and HCP crystal structure	6	CO1	POa		
32	Obtain Effective number of atoms per unit cell for cubic unit cell and state its significance	5	CO1	POa		
33	Explain how engineering materials are classified. Differentiate between thermo plastic and thermo setting polymers	6	CO1	POa		
34	Explain the effect of grain size on mechanical properties of materials	4	CO1	POa		
35	Represent the following planes and directions in cubic system: i. (2 2 1) ii. ($\bar{2}$ 1 0) iii. (1 $\bar{1}$ 0)	3	CO1	POa		
36	Represent Millers Indices for plane and directions for the following intercepts. i. ($\bar{2}$ 1 0) ii. (1 1 3) iii. (1 $\bar{1}$ 1) iv. (0 1 2)	4	CO1	POa		
37	Represent Millers Indices for plane and directions for the following intercepts. 1. (2 1 2) 2. (1 2 1) 3. [1 2 1]	4	CO1	POa		

38	Represent Millers Indices for plane and directions for the following intercepts. i. (1 0 1) ii. (0 1 0) iii. (2 2 1) iv. [2 1 1]	4	CO1	POa		
39	Represent Millers Indices for plane and directions for the following intercepts.	2	CO1	POa		