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Mechanical Department

SUBJECT: MATERIAL SCIENCE AND METALLURGY

Chapter 1
Introduction to Engineering Materials

1. Which of the following has a non-crystalline structure?
   a) Iron
   b) Quartz
   c) Silica glass
   d) Tungsten

2. Which of the following is a characteristic of crystalline structure?
   a) High density
   b) Low density
   c) Range of melting point
   d) Short range of order

3. Which of the following is characteristic of non-crystalline structures?
   a) Long range of periodicity
   b) Well defined structure and geometry
   c) Low density
   d) Sharp diffraction pattern

4. Effective number of atoms in a simple cubic (SC) unit cell is equal to _____
   a) 4
   b) 1
   c) 8
   d) 2

5. Effective number of atoms in a face centered cubic (FCC) unit cell is equal to _____
   a) 4
   b) 1
   c) 8
   d) 2

6. Effective number of atoms in a body centered cubic (BCC) unit cell is equal to _____
   a) 4
   b) 6
   c) 1
   d) 2

7. The atomic packing fraction in a simple cubic unit cell is _____
    a) 0.74
    b) 0.52
    c) 0.68
    d) 0.66
8. The atomic packing fraction in a body centered cubic unit is cell is _____
    a) 0.74
    b) 0.52
    c) 0.68
    d) 0.66
9. The atomic packing fraction in a face centered cubic unit is?
    a) 0.74
    b) 0.52
    c) 0.68
    d) 0.66
10. Vacancy defects in solids is a sub type of _____
    a) Point imperfections
    b) Line imperfections
    c) Volume imperfections
    d) Surface imperfections
11. Substitution of a foreign atom in the site of parent atom in the crystal is a?
    a) Vacancy defect
    b) Substitution impurity
    c) Volume imperfection
    d) Vacancy defect
12. Edge dislocation imperfection is a sub type of _____
    a) Point imperfections
    b) Line imperfections
    c) Volume imperfections
    d) Surface imperfections
13. Displacement of an ion from regular location to interstitial location is known as _____
    a) Vacancy defect
    b) Line imperfection
    c) Schottky's defect
    d) Frenkel defect
14. When a pair of cation and anion are missing in a crystal, it is called _____
    a) Vacancy defect
    b) Line imperfection
    c) Schottky's defect
    d) Frenkel defect
15. As the grain size of a metal increases, its strength _____
    a) Decreases
    b) Increases
    c) Remains constant
    d) No effect of grain size on strength

16. As the grain size of a meal increases, its ductility _____
    a) Decreases
    b) Increases
    c) Remains constant
    d) No effect of grain size on ductility
17. Phenomenon of cross slip occurs in _____
    a) Point imperfections
    b) Line imperfections
    c) Volume imperfections
    d) Surface imperfections

18. 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

19. 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

20. Grain boundaries are one of the causes of corrosion of metals.
    a) True
    b) False

21. Which of the following is a secondary bond?
    a) Metallic bond
    b) Hydrogen bond
    c) Covalent bond
    d) Ionic bond

22. For covalent molecules, van der Waals radius is always greater than a covalent radius.
    a) True
    b) False

23. 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

24. 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

25. 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

26. Specify the sequence correctly

    a) Grain growth, recrystallisation, stress relief
    b) Stress relief, grain growth, recrystallisation
    c) Stress relief, recrystallisation, grain growth
    d) Grain growth, stress relief, recrystallisation

27. Which of the following material has maximum ductility?

    a) Mild steel
    b) Copper
    c) Nickel
    d) Aluminium

28. The hardness is the property of a material due to which it

    a) can be drawn into wires
    b) breaks with little permanent distortion
    c) can cut another metal
    d) can be rolled or hammered into thin sheets

29. The ability of a material to absorb energy in the plastic range is called

    a) resilience
    b) creep
    c) fatigue strength
    d) toughness

30. Closed packed hexagonal space lattice is found in

a) zinc, magnesium, cobalt, cadmium, antimony and bismuth
b) gamma-iron, aluminium, copper, lead, silver and nickel
c) alpha-iron, tungsten, chromium and molybdenum
d) none of the above

31. The unit cells

a) contain the smallest number of atoms which when taken together have all the properties of the crystals of the particular metal
b) have the same orientation and their similar faces are parallel
c) may be defined as the smallest parallelepiped which could be transposed in three coordinate directions to build up the space lattice
d) all of the above

32. Crystal structure of a material is, generally, examined by

a) naked eye
b) optical microscope
c) metallurgical microscope
d) X-ray techniques

33. The property of a material due to which it breaks with little permanent distortion, is called

a) brittleness
b) ductility
c) malleability
d) plasticity

34. The ability of a material to undergo large permanent deformation with the application of a tensile force, is called ductility.

a) Correct
b) Incorrect

35. The strength is the ability of a material to resist

a) deformation under stress
b) externally applied forces with breakdown or yielding
c) fracture due to high impact loads
d) none of these

36. The stiffness is the ability of a material to resist

a) deformation under stress
b) fracture due to high impact loads
c) externally applied forces with breakdown or yielding
d) none of the above

37. The ability of a material to resist fracture due to high impact loads, is called

a) strength
b) stiffness
c) toughness
d) brittleness

38. In a unit cell of close packed hexagonal space lattice, there are twenty-four atoms.

a) Correct
b) Incorrect

39. The bond formed by transferring electrons from one atom to another is called

a) ionic bond
b) covalent bond
c) metallic bond
d) none of these

40. Which of the following property is desirable in parts subjected to shock and impact loads?

a) Strength
b) Stiffness
c) Brittleness
d) Toughness

41. There are fourteen atoms in a unit cell of

a) body centred cubic space lattice
b) face centred cubic space lattice
c) close packed hexagonal space lattice
d) none of these

42. The ratio of the volume occupied by the atoms to the total volume of the unit cell is called

a) coordination number
b) atomic packing factor
c) space lattice
d) none of these

43. In a body centred cubic space lattice, there are nine atoms out of which eight atoms are located at the corners of the cube and one atom at its centre.

a) Yes
b) No

44. In a crystalline material, atoms are arranged in definite and orderly manner and form.

a) Agree
b) Disagree

45. In a close packed hexagonal space lattice, there are

a) nine atoms out of which eight atoms are located at the corners of the cube and one atom at its centre
b) twelve atoms, all of which are located at the twelve corners of a hexagonal prism
c) fourteen atoms out of which eight atoms are located at the corners of the cube and six atoms at the centres of six faces
d) none of the above

46. The malleability is the property of a material due to which it can be rolled or hammered into thin sheets.

a) Agree
b) Disagree

47. In a face centred cubic space lattice, there are

a) nine atoms out of which eight atoms are located at the corners of the cube and one atom at its centre
b) fourteen atoms out of which eight atoms are located at the corners of the cube and six atoms at the centres of six faces
c) seventeen atoms out of which twelve atoms are located at the twelve corners of the hexagonal prism, one atom at the centre of each of the two hexagonal faces and three atoms are symmetrically arranged in the body of the cell
d) none of the above

48. Which of the following is a point imperfection?

a) Vacancy
b) Interstitial imperfection
c) Frenkel imperfection
d) all of these

49. The malleability is the property of a material by virtue of which a material

a) regains its shape and size after the removal of external forces
b) retains the deformation produced under load permanently
c) can be drawn into wires with the application of a tensile force
d) can be rolled or hammered into thin sheets

50. The property of a material necessary for forgings, in stamping images on coins and in ornamental work, is

a) elasticity
b) plasticity
c) ductility
d) malleability

51. Micro-structure of a material is, generally, examined by

a) naked eye
b) optical microscope
c) X-ray techniques
d) none of these

Chapter 2
Phase Diagram

1. A eutectoid steel consists of

a) wholly pearlite
b) wholly austenite
c) pearlite and ferrite
d) pearlite and cementite

2. The percentage of carbon in cast iron varies from

a) 0 to 0.5
b) 0.5 to 1
c) to 1.7
d) 1.7 to 4.5

3. The hardness and tensile strength in austenitic stainless steel can be increased by

a) hardening and cold working
b) normalising
c) martempering
d) full annealing

4. The quenching of steel from the upper critical point results in a fine-grained structure.

a) Agree
b) Disagree

5. The lower critical point for all steels is

a) 600°C
b) 700°C
c) 723°C
d) 913°C

6. Iron-carbon alloys containing 1.7 to 4.3% carbon are known as

a) eutectic cast irons
b) hypo-eutectic cast irons
c) hyper-eutectic cast irons
d) none of these

7. The heat treatment process used for softening hardened steel is

a) carburising
b) normalising
c) annealing
d) tempering

8. The hardness of steel increases if it contains

a) pearlite
b) ferrite
c) cementite
d) martensite

9. In full annealing, the hypo-eutectoid steel is heated from 30° C to 50° C above the upper critical temperature and then cooled

a) in still air
b) slowly in the furnace
c) suddenly in a suitable cooling medium
d) any one of these

10. Ferrite and pearlite make the steel soft and ductile.

a) Agree
b) Disagree

11. The lower critical temperature

a) decreases as the carbon content in steel increases
b) increases as the carbon content in steel increases
c) is same for all steels
d) depends upon the rate of heating

12. Free carbon in iron makes the metal

a) soft and gives a coarse-grained crystalline structure
b) soft and gives a fine-grained crystalline structure
c) hard and gives a coarse-grained crystalline structure
d) hard and gives a fine-grained crystalline structure

13. The type of space lattice found in gamma-iron is

a) face centred cubic space lattice
b) body centred cubic space lattice
c) close packed hexagonal space lattice
d) none of these

14. The hardness of steel depends upon the

a) amount of cementite it contains
b) amount of carbon it contains
c) contents of alloying elements
d) method of manufacture of steel

15. In flame hardening, oxy-acetylene flame is used.

a) Yes
b) No

16. Which of the following statements are true for annealing of steels?

a) Steels are heated to 500 to 700° C
b) Cooling is done slowly and steadily
c) Internal stresses are relieved
d) all of these

17. Induction hardening is basically a

a) carburising process
b) surface hardening process
c) core-hardening process
d) none of these

18. In induction hardening _____ is high.

a) current
b) voltage
c) frequency
d) temperature

19. A steel with carbon above 0.8% is known as hyper-eutectoid steel.

a) Agree
b) Disagree

20. In normalising process, the hypo-eutectoid steel is heated from 30° C to 50° C above the upper critical temperature and then cooled in still air.

a) True
b) False

21. The type of space lattice found in alpha-iron is

a) face centred cubic space lattice
b) body centred cubic space lattice
c) close packed hexagonal space lattice
d) none of these

22. Martensite has needle like structure and is magnetic.

a) Correct
b) Incorrect

23. In induction hardening, the depth of hardening is controlled by controlling the voltage.

a) Correct
b) Incorrect

24. The austenite is a solid solution of carbon or iron carbide in gamma-iron.

a) Correct
b) Incorrect

25. Pearlite consists of

a) 13% carbon and 87% ferrite
b) 13% cementite and 87% ferrite
c) 13% ferrite and 87% cementite
d) 6.67% carbon and 93.33% iron

26. Quenching is not necessary when hardening is done by

a) case hardening
b) flame hardening
c) nitriding
d) any one of these

27. A steel with carbon _____ is known as hypo-eutectoid steel.

a) 0.8%
b) below 0.8%
c) above 0.8%

28. The purpose of heat treatment is to

a) relieve the stresses set up in the material after hot or cold working
b) modify the structure of the material
c) change grain size
d) any one of these

29. Which of the following iron exist between 910° C and 1403° C?

a) α-iron
b) β-iron
c) γ-iron
d) δ-iron

30. Normalising of steel is done to

a) refine the grain structure
b) remove strains caused by cold working
c) remove dislocations caused in the internal structure due to hot working
d) all of the above

31. When a steel containing more than 0.8% carbon is cooled slowly below the lower critical point, it consists of ferrite and pearlite.

a) True
b) False

32. The temperature required for full annealing in hyper-eutectoid steel is

a) 30° C to 50° C above upper critical temperature
b) 30° C to 50° C below upper critical temperature
c) 30° C to 50° C above lower critical temperature
d) 30° C to 50° C below lower critical temperature

33. A steel containing ferrite and pearlite is

a) hard
b) soft
c) tough
d) hard and tough

34. The upper critical point varies according to the carbon content in steel.

a) True
b) False

35. in process annealing, the hypo-eutectoid steel is

a) heated from 30° C to 50° C above the upper critical temperature and then cooled in still air
b) heated from 30° C to 50° C above the upper critical temperature and then cooled suddenly in a suitable cooling medium
c) heated from 30° C to 50° C above the upper critical temperature and then cooled slowly in the furnace
d) heated below or close to the lower critical temperature and then cooled slowly

36. Delta-iron occurs between the temperature range of

a) 400°C to 600°C
b) 600°C to 900°C
c) 900°C to 1400°C
d) 1400°C to 1530°C

37. Iron-carbon alloys containing carbon more than 4.3% are known as hyper-eutectic cast irons.

a) True
b) False

38. In spheroidising process, the steel is

a) heated below the lower critical temperature and then cooled slowly
b) heated upto the lower critical temperature and then cooled in still air
c) heated slightly above the lower critical temperature and then cooled slowly to a temperature of 600°C
d) none of the above

39. Pearlite is a combination of 87% ferrite and 13% cementite.

a) Yes
b) No

40. For a steel containing 0.8% carbon

a) there is no critical point
b) there is only one critical point
c) there are two critical points
d) there can be any number of critical points

41. When a steel containing less than 0.8% carbon is cooled slowly from temperatures above or within the critical range, it consists of

a) mainly ferrite
b) mainly pearlite
c) ferrite and pearlite
d) pearlite and cementite

42. Eutectoid reaction occurs at

a) 600°C
b) 723°C
c) 1147°C
d) 1493°C

43. Which of the following statement is wrong?

a) A steel with 0.8% carbon is wholly pearlite
b) The amount of cementite increases with the increase in percentage of carbon in iron
c) A mechanical mixture of 87% cementite and 13% ferrite is called pearlite
d) The cementite is identified as round particles in the structure

44. Cementite consist of

a) 13% carbon and 87% ferrite
b) 13% cementite and 87% ferrite
c) 13% ferrite and 87% cementite
d) 6.67% carbon and 93.33% iron

45. Gamma-iron occurs between the temperature range of

a) 400°C to 600°C
b) 600°C to 900°C
c) 900°C to 1400°C
d) 1400°C to 1530°C

46. Which of the following is a case hardening process?

a) Carburising
b) Cyaniding
c) Nitriding
d) all of these

47. The process used for relieving the internal stresses previously set up in the Metal and for increasing the machinability of steel, is

a) normalising
b) full annealing
c) process annealing
d) spheroidising

48. The process which improves the machinability of steels, but lowers the hardness and tensile strength, is

a) normalising
b) full annealing
c) process annealing
d) spheroidising

49. Which of the following iron exists at 910° C?

a) α-iron
b) β-iron
c) γ-iron
d) δ-iron

50. Iron-carbon alloys containing 4.3% carbon are known as hypo-eutectic cast irons.

a) Correct
b) Incorrect

Chapter 3
Non-Metallic Materials

1. Polyvinylchloride (PVC) is a thermosetting material.

    a) True
    b) False

2. Thermosetting plastics are those materials which

    a) are formed into shape under heat and pressure and results in a permanently hard product
    b) do not become hard with the application of heat and pressure and no chemical change occurs
    c) are flexible and can withstand considerable wear under suitable conditions
    d) are used as a friction lining for clutches and brakes

3. What are thermoplastics?

    a) They are nonlinear polymers, in which rise in temperature increases plasticity
    b) They are linear polymers, in which rise in temperature increases plasticity
    c) They are linear polymers, in which temperature rise has no effect on plasticity
    d) None of the above

4. What happens when thermosetting polymers are heated?

    a) They become soft
    b) They are deformed
    c) They become rigid
    d) All of the above

5. Which among the following is the characteristics of polymers?

    a) High tensile strength
    b) High coefficient of friction
    c) Low density
    d) All of these

6. Which among the following rubbers are used for automobile tyres?

    a) Only Polyurethane rubbers
    b) Only Butadiene rubbers
    c) Both Polyurethane and Butadiene are used
    d) None of these

7. Which of the following is not a property of thermoplastics?
    a) Recyclable
    b) Soft and weak
    c) Easy to mould
    d) Can be used at high temperatures

8. Which of the following is not an example of a commodity thermoplastic?
    a) Polyethylene
    b) Polypropylene
    c) Polystyrene
    d) Phenolic

9. Which of the following are applications of polypropylene?
    a) Buckets, bottle crates
    b) CD cases, food boxes
    c) Wire insulation, piping
    d) Valves, fittings

10. Which of the following is a property of thermosetting plastics?
    a) Can be moulded
    b) Soft
    c) Recyclable
    d) Can be used at high temperatures

11. Which of the following is not an example of a thermoplastic polymer?
    a) Urethane
    b) Melamine
    c) Epoxide
    d) Acetal

12. Which of the following is used as an adhesive?
    a) Epoxide
    b) Polyurethane
    c) Polyester
    d) Phenol formaldehyde

13. Kevlar is a _____ type of material.
    a) Glass
    b) Thermoplastic
    c) Whisker
    d) Polymer
14. Which of the following is not a characteristic trait of composite materials?
    a) High strength, toughness, modulus
    b) Lightweight
    c) Easy to assemble
    d) Sensitive to temperature change

15. Which of the following is not a natural abrasive?
    a) Emery
    b) Quartz
    c) Silicon carbide
    d) Sandstone
16. Non-metallic materials are

    a) Cobalt, aluminium, nickel
    b) Gold, silver, platinum
    c) Glass, ceramics, cement
    d) None of above

17. _____ is not a type of plastic

    a) PVC
    b) Polythene
    c) Polystyrene
    d) PBC

18. _____ is not an organic material

a) Thermoplastics
b) Ceramics
c) Thermosetting
d) Elastomers

19. Ceramics are an inorganic material

    a) True
    b) False

20. Elastomers are an inorganic material
    a) True
    b) False

21. _____ is an example of thermoplastics

    a) Polyethylene
    b) Melamine
    c) Polyesters
    d) Alkyds

22. _____ is an example of thermosetting plastics

a) Polyethylene
b) Melamine
c) Polypropylene
d) Polystyrene

23. _____ is an example of elastomers.

a) Polyethylene
b) Melamine
c) Polypropylene
d) Styrene butadiene

24. _____ is not an example of ceramics.

a) Alumina
b) Felspar
c) Cork
d) Silicon carbides

25. _____ is not an example of glasses.

a) Stealite
b) Silica
c) Quartz
d) High lead

26. Mica is an inorganic material.

a) True
b) False

27. Concrete is not an inorganic material.
a) True
b) False
28. Non-metallic materials have

a) Low ductility
b) Low strength
c) Low electrical and thermal conductivity
d) All of above
29. Abrasives are the type of ceramics material.

a) True
b) False

30. _____ is an example of synthetic rubber

a) Butyl rubber
b) Chlorinated rubber
c) Hydrochloride rubber
d) Cyclised rubber

31. _____ is a type of natural rubber.

a) Butyl rubber
b) Chlorinated rubber
c) Buta N
d) Silicon rubber

32. Acrylics are the type of thermoplastic materials.

a) True
b) False

33. Melamine have

a) Greater chemical resistant property
b) Impact resistant property
c) Wear resistant property
d) All of above

34. Polypropylene are

a) Electric resistant
b) Non crystalline
c) Both (A) & (B)
d) None of above

35. Acrylics are used

a) To manufacture battery box, radio parts
b) To prepared car polisher, varnish
c) To manufacture grinding wheels, laminates
d) To manufacture signboards, transparent models

36. Silicones are used

a) To manufacture battery box, radio parts
b) To prepared car polisher, varnish
c) To manufacture grinding wheels, laminates
d) To manufacture signboards, transparent models

37. Polystyrene are used

a) To manufacture battery box, radio parts
b) To prepared car polisher, varnish
c) To manufacture grinding wheels, laminates
d) To manufacture signboards, transparent models

38. Water or fuel tanks are manufactured by _____

a) Polyvinyl butyl
b) Cellulose
c) Poly ethylene
d) Phenol formaldehyde

39. Fountain pens are manufactured by _____

a) Polyvinyl butyl
b) Cellulose
c) Poly ethylene
d) Phenol formaldehyde

40. Electric wires are manufactured by _____

a) Polyvinyl butyl
b) Cellulose
c) Poly ethylene
d) Phenol formaldehyde

41. Full form of PTFE is

a) Poly tri flouro ethyl
b) Poly tetra flouro ethylene
c) Poly tetra flouro ethyl
d) None of above

42. PTFE are

a) Chemically inert
b) Non flammable
c) Low coefficient of friction
d) All of above

43. Type of composites is

a) Layered composites
b) Fibre reinforced composites
c) Particle composites
d) All of above

44. Method used to coat plastic on metals is

a) Depositing
b) Spraying
c) Both (A) & (B)
d) Doping

45. Rubbers are generally used to produce

a) Vehicle tyres, O-rings, wires & cables
b) Gaskets, damping devices
c) Gloves, aprons, seats etc.
d) All of above

46. Bricks, tiles and porcelyn are used as fireclay products.

a) True
b) False

47. _____ is the heat resistant material.

a) Asbestos
b) Glass
c) Mica
d) Ceramics

48. _____ is the electric resistant material.

a) Asbestos
b) Glass wool
c) Thermocole
d) Ceramics

49. Glass wool have

a) Good heat resistant property
b) Chemical resistant property
c) Good tensile strength
d) All of above

50. _____ is used as an alternative of glass wool

a) Cork
b) Asbestos
c) PUF
d) Thermocole