TEST ID: 610

ACE Engineering Academy

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ESE- 2019 (Prelims) - Offline Test Series Test-20

GENERAL STUDIES AND ENGINEERING APTITUDE

SUBJECT: BASICS OF MATERIAL SCIENCE AND ENGINEERING SOLUTIONS

01. Ans: (d)

Sol: The superconductivity of material is destroyed by

1. Increasing temperature above critical temperature
2. Increasing magnetic field above critical magnetic field
3. Increasing current above critical above critical current

02. Ans: (c)

Sol: Critical transition temperature $= \frac{1}{\sqrt{\mu_{isotope}}}$

With increase in mass of isotope, critical transition temperature is decreases.

03. Ans: (c)

Sol: The retentivity is the retained magnetic flux density, when applied field is zero.

04. Ans: (a)

Sol: $B = \mu_0\mu_R H$

$$\mu_R = \frac{B}{\mu_o H} = \frac{88\times10^{-4}}{4\pi\times10^{-7}\times100} = 70$$

05. Ans: (a)

Sol: Advantages of ceramics with other material

1. Ceramics are harder and stiffer than steel
2. Ceramics are less dense than most of the metals and their alloys
3. Ceramics, raw materials are both plentiful and inexpensive
4. Ceramics are more heat and corrosion resistance than metals and polymers.

06. Ans: (a)

Sol: Glass transition Temperature: It is a polymer characteristic temperature, above which polymer is soft and below which hard.

1. Above glass transition temperature, polymer is soft and pliable.
2. The glass transition temperature of thermoplastic polymer is above room temperature.
3. The glass transition temperature of an elastomer is below room temperature

07. Ans: (a)

Sol: The fabrication of integrated circuits and VLSI, microprocessors are developed by

1. Lithography
2. Epitaxial technique
3. Chemical vapour deposition
4. Pulse laser vaporization
5. Electrochemical deposition

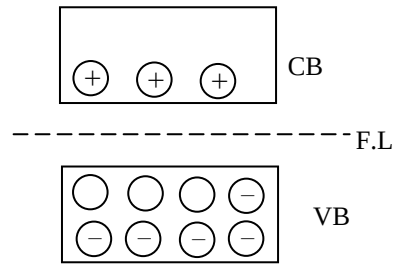
08. Ans: (a)

Sol: Area of hysteresis loop represent Hysteresis.

$$B \times H = \frac{1}{2} \times 4 \times 800 + \frac{1}{2} \times 4 \times 800 = 3200 \text{ J/m}^3$$

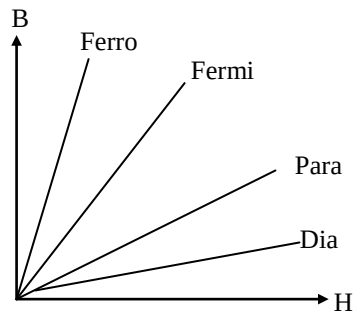
09. Ans: (a)

Sol:
1. At 0 K, intrinsic i-semiconductor is an insulator
2. Number of holes equal to number of electrons and no majority carriers
3. Fermi level is located at middle of conduction band and valences band



10. Ans: (b)

Sol:



11. Ans: (c)

Sol: Constantan is an alloy of 60% copper and 40% Nickel.

This alloy used in thermocouples and standard Rheostats'.

12. Ans: (c)

Sol: $\text{Resistivity } (\rho) = \frac{R \times A}{\ell}$

$$= \frac{0.171 \times 0.1 \times \left(10^{-3}\right)^2}{1}$$

$$= 1.71 \times 10^{-8} \ \Omega\text{m}$$

13. Ans: (a)

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14. Ans: (a)

Sol: The ferromagnetic material (Ferrites) are used in high frequency transformers, because ferrites spinel structure ceramics with high resistivity and low eddy current losses.

15. Ans: (a)

Sol: Piezoelectric materials are ability to convert electric signals into mechanical signals.

Ex: Quartz

16. Ans: (d)

Sol:

- Polarization increases with applied field.
- Elemental polarization generated inside the atom by separation of positive charge and negative change by applying field.
- Elemental polarization is independent of temperature.

17. Ans: (c)

Sol: The fracture toughness of Brittle materials are measured by impact test.

It is of two types

1. Izod test
2. Chorpy test

18. Ans: (a)

Sol:

1. A ductile material exhibits high fracture strain, that is, it undergoes significant plastic deformation before fracture.
2. A brittle material is the one which exists little or no plastic deformation before fracture .
3. A ductility of material is measured by fracture strain or reduction in area at fracture.

Ductility is measured by

1. % elongation = $\frac{\ell_F - \ell_i}{\ell_i} \times 100$

2. % reduction in area = $\frac{A_i - A_f}{A_i} \times 100$

19. Ans: (c)

Sol: Strength and hardness of Fe-C alloy increases with increase in percentage of carbon and due to that Machinability decreases.

20. Ans: (a)

Sol: Franz Lorentz law states that ratio of thermal conductivity to electrical conductivity is directly proportional to temperature

$$\frac{K}{\sigma} \propto T$$

21. Ans: (c)

Sol:

Type of ceramic	Name of ceramic	Example
AX-type	Rocksalt	MnO, NaCl, MgO
AX_2 – type	Fluorite	CaF_2, VO_2, ThO_2
ABX_3	Perovskite	$BaTiO_3$, $MnFeO_3$
Ab_2X_4	Spinel	$MnFe_2O_4$, $ZnFe_2O_4$

22. Ans: (c)

Sol:

Non-Destructive Testing Methods

Metals	Concrete
1. Magnetic particle method	1. Rebound hammer method
2. Liquid penetration method	2. False ultrasonic
3. Eddy current method	Wave velocity method
4. Ultrasonic wave velocity method	
5. Radiography method	

23. Ans: (a)

Sol: Monel metal

1. It is an alloy of two third of Nickel and one third of copper with small percentage of Fe, Si, Mn and carbon.
2. Excellent corrosion resistance properties, so it is widely used for parts of water pumps, propellers domestic water storage tanks.

24. Ans: (a)

Sol: Teflon (or) Polytetrafluoroethylene (PTFE)

1. The one of PTFE is represented by $CF_2 = CF_2$
2. PTFE is manufactured by addition polymerization technique

$$CF_2 = CF_2 \xrightarrow[\text{polymeritation}]{\text{addition}} \left(-CF_2 - CF_2 -\right)_n$$

3. It has excellent resistance to most chemicals and solvents.
4. It is a good electrical insulator

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25. Ans: (b)

Sol: The thermosetting polymers are produced by condensation process

Examples:

1. Phenol formaldehyde (Bakelite)
2. Amine formaldehyde (Urea)
3. Polysters
4. Epoxy resigns

26. Ans: (c)

Sol: 1. Trade names of nylon is zytel, plaskon
2. Nylon is a thermosplastic polymer material
3. It is produced by Addition Polymerization
4. Nylon polymer used in making of bearings, covers, gears

27. Ans: (c)

Sol: Given

$V_f = 605 = D.\ b$; $E_f = 84\ kN/mm^2$

$E_m = 5.25\ kN/mm^2$

Tensile modulus of composite

$= E_fV_f + E_mV_m$

$= 84 \times 0.6 + 5.25 \times 0.4$

$= 52.5\ kN/mm^2$

28. Ans: (b)

Sol: Brag's law

$n\lambda = 2d \sin\theta$

$n = 1,\ \theta = 6.7°$

$d = 3A°$

$$\lambda = \frac{2d\sin\theta}{1} = \frac{2\times 3\times 0.1167}{1} = 0.7\ A°$$

29. Ans: (c)

Sol: Heat treatment is a secondary process after production of material, to obtain desirable properties by heating and cooling in a solid state.

30. Ans: (b)

Sol: Fatigue is a type of failure due to dynamic loads or cyclic load.

Ex: Failure of Bridge, Aero plane wings.

31. Ans: (b)

Sol: Statement (3) is incorrect, only some of piezo electric material are ferro electric material.

32. Ans: (b)

Sol: The residual polarization can be eliminate by

1. Applying field in opposite direction
2. Heating material above curie temperature.

33. Ans: (b)

Sol: All polarizations decreases with increase in frequency.

34. Ans: (c)

Sol: Dielectric constant depends on frequency and temperature.

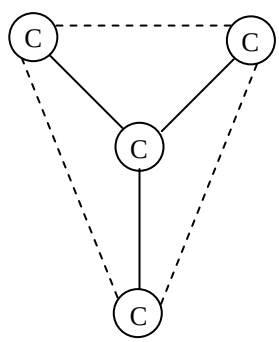
35. Ans: (c) **36. Ans: (a)**

37. Ans: (d)

Sol: Ceramics are good electrical and thermal insulators became of no free electrons ceramics are briffle in nature due to high porosity and hence low fracture toughness.

38. Ans: (a)

Sol: Graphite:



In graphite, each carbon atom is covalently bonded with other three atoms and one free electrons is present is each carbon, so it is good electrical and thermal conductor. It is used as a solid lubricant because graphite sheets are bonded with vander waal's bond.

39. Ans: (b)

Sol: $APF = \frac{\text{Total volume of atoms}}{\text{Volume of unit cell}}$

$$= \frac{n \times \frac{4}{3}\pi R^3}{a^3} = \frac{2 \times \frac{4}{3}\pi R^3}{\left(\frac{4R}{\sqrt{3}}\right)^3} = \frac{\frac{8}{3}\pi R^3}{\frac{64R^3}{3\sqrt{3}}}$$

$$= \frac{\sqrt{3}\pi}{8}$$

40. Ans: (a)

Sol: Plane fractions $= \frac{a}{3}, \frac{a}{2}, a = \frac{1}{3}, \frac{1}{2}, 1$

Reciprocals = 3 2 1

Miller Indices = (321)

41. Ans: (b)

42. Ans: (b)

Sol: The atomic size of chromium is nearly same as iron, so it occupies at substitutional positions and forms stainless steel substitutional alloy and this is increase corrosion resistance.

43. Ans: (a)

Sol: Entropy and thermal conductivity decreases with decreasing temperature.

44. Ans: (c)

Sol: Carbon atoms occupies at internstitial with increase position of Iron and it forms an interstitial solid solution.

45. Ans: (a)

Sol: In semiconductors, the energy gap is 1 eV. At absolute zero temperature electrons are not having sufficient energy so they are not move into conduction band.

Hence, semiconductors are insulators at 0 k.

46. Ans: (b)

47. Ans: (d)

48. Ans: (b)

Sol: Statement (I) and statement (II) are correct, but statement (II) is not correct explanation for statement (I).

When load exceeds the elastic limit, dislocation moves out of grain and generate plastic deformation.

Hook's law is valid upto proportionality limit.

49. Ans: (a)

Sol: Statement (I) and statement (II) are correct and statement (II) is correct explanation for statement (I) it Hall Petch equation.

$$\sigma_o = \sigma_i + \frac{1}{\sqrt{d}}$$

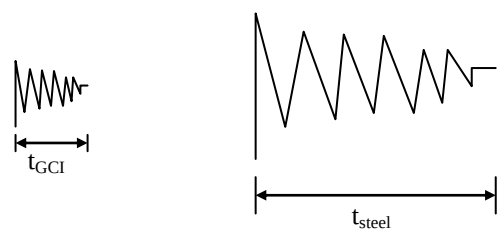
σ_o = yield strength

σ_i , k = constant for a material

d = grain size

50. Ans: (a)

Sol: In gray cast iron, graphite is present in flakey form and due to that more damping capacity and that can absorb vibrations and hence used in machine bed and engine blocks.



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