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Rajasthan RVUNL

Electrical Engineering

Material Science

Top 50
Most Expected Questions

1. Which one of following statement is not correct for the dielectric strength?

A. Dielectric strength is the maximum value of filled intensity that a dielectric can sustain without breakdown.

B. It is the major of ability of material to hold energy at high voltage.

C. It is inversely proportional to the operating temperature and humidity.

D. It is directly proportional to the thickness of specimen and frequency.

Ans. D

Sol.: Dielectric strength is inversely proportional to frequency.

2. Reluctance is the property of material such that

A. Some materials are good or bad conductor of electricity.

B. Some materials are good or bad conductors of magnetism.

C. Material is multiferroic

D. None

Ans. B

Sol.: The property of material having good or bad conductor of magnetism is known as reluctance. Or the resistance of the magnetic circuit is called reluctance. Good magnetic materials have low reluctance and non-magnetic materials have high reluctance of flux.

3. Galvanic Cell

1) Forms in the presence of two similar electrodes and an electrolyte.

2) Have anode and cathode.

The correct choice is

A. 1 only B. 2 only

C. Both D. None

Ans. B

Sol.: Galvanic cell forms in the presence of two dissimilar electrodes or metals and an electrolyte. So, option 1 is incorrect. Out of the two electrodes, one become anode which is positive end the other cathode, which is negative end. So, option 2 is correct.

4. In Ionic materials electrical conductivity

A. Is very high B. Depends upon material

C. Depends upon temp. D. Practically zero

Ans. D

Sol.: In Ionic materials electrical conductivity is Practically zero.

5. The best conductor of electricity is

A. Filtered hot water B. Distilled water

C. Filtered water at room temperature D. Salt water

Ans. D

Sol.: Salt water is best conductor of electricity.

6. In general, for a superconductor, which of the following statements is true?

A. A superconductor is a perfect paramagnetic material with the magnetic susceptibility equals to positive unity

B. A superconductor is a perfect diamagneticmaterial with the magnetic susceptibility equals to negative one

C. A superconductor is a perfect ferromagnetic material with the magnetic susceptibility equals to positive one

D. A superconductor is a perfect piezoelectric material with the magnetic susceptibility equals to negative unity

Ans. B

Sol.: $B = \mu_0(H + M)$

In case of superconductors

$B = 0, H = -M$

$\Rightarrow XH = H$

$\Rightarrow X = -L$

So, material is diamagnetic.

7. The magnetic field require to reduce the residual magnetization to zero is called

A. Retentivity B. Coercivity

C. Hysteresis D. Saturation magnetization

Ans. B

Sol.: Magnetic field required (applied) in reverse direction to reduce residual magnetization (spontaneous magnetization) is called coercive magnetic field and this phenomenon is called coercivity.

8. The hardness of nanomaterial increases linearly with:

A. increase of grain size B. decrease of particle size

C. decrease of strength D. increase in strength

Ans. B

Sol.: Generally, hardness of metal increases linearly with increase of grain size, but in case of nano-material, the hardness of the nano-metal increases linearly with decrease in particle size.

9. A material is said to have Positive temperature coefficient if _____

A. the material experiences a decrease in electrical resistance when their temperature is raised

B. the material experiences an increase in electrical resistance when their temperature is raised

C. the material experiences no change in electrical resistance when their temperature is raised

D. the materials experiences an increase in magnetic flux when their temperature is raised

Ans. B

Sol.: A positive coefficient for a material means that its resistance increases with an increase in temperature. Pure metals typically have positive temperature coefficients of resistance.

10. Magnetostriction is a phenomenon of

A. generation of electricity in ferro-magnetic material

B. generation of magnetism in conductors

C. change in permeability of ferrro-magnetic materials during magnetization

D. change in physical dimensions ferro-magnetic materials during magnetization

Ans. D

Sol.: Magnetostriction is phenomenon of charge in dimension of ferromagnetic material due to magnetization Reverse of this effect is called as vellori effect.

11. Elements can reach a stable atomic structure by

A. losing electrons only

B. gaining electrons only

C. losing or gaining or sharing electrons

D. collisions between atoms

Ans. C

Sol.: Elements can reach a stable state by losing or gaining or sharing of e^{-s} so as to complete its octate.

For e.g. in NaCI, Na → loses electron for completing its octate

CI gain e^- for completing its octate

In Si csystal→ one Si atom shares its outer $4e^-$ with other 4 Si atoms to complete its octate.

12. Controlled addition of group III element to an elemental semiconductor results in the formation of

A. Intrinsic semicondurtor

B. n-type semiconductor

C. p-type semiconductor

D. Degenerate semiconductor

Ans. C

Sol.: 3rd group element like B are accepters so addition of these to SC like Si or Ge result in p-type SC.

13. The property of materials by which they can be drawn into thin sheets is:

A. ductility

B. malleability

C. creep

D. elasticity

Ans. B

Sol.: Malleability, is the material's ability to deform under compressive stress which is characterized by material's ability to form a thin sheet by hammering or rolling.

14. Soft iron is used in the manufacture of electromagnets because of its
    A. Low saturation magnetization only
    B. High retentivity only
    C. High coercive field only
    D. high saturation magnetization, low reten-tivity and low coercive field

Ans. D

Sol.: Magnetic materials which have low coercive field are known as soft materials.Soft iron is used when the electromagnet is made for for temporary magnets. They act like a magnet as long as the current passes through them and demagnetized when the current flow stops. So soft iron is used due to its magnetic saturation limit is high but retentivity and coercive force are small.

15. A superconductor may be used for generating
    A. Voltage
    B. Pressure
    C. Temperature
    D. Magnetic field

Ans. D

Sol.: A superconductor may be used for generation of magnetic field.

16. Hall effect is used to determine
    A. Type of semiconductor
    B. Carrier concentration
    C. Carrier mobility
    D. All of the above

Ans. D

Sol.: Hall effect occurs when a transverse magnetic field is applied to a specimen carrying a current. Under these conditions, a transverse electric field is produced. The effect thus produces a measurable transverse voltage across the specimen. Applications of hall effect includes the determination of Type of semiconductor, Carrier concentration and Carrier mobility.

17. The best definition of a superconductor is
    A. It is a material showing perfect conductivity and Meissner effect below a critical temperature
    B. It is conductor having zero resistance
    C. It is a perfect conductor with highest diamagnetic susceptibility
    D. It is a perfect conductor but becomes resistive when the current density through it exceeds a critical value

Ans. A

Sol.: Superconductors are elements or metallic alloys that will have the highest conductivity below a certain temperature. If a closed loop is made with superconductors, current will continue flowing forever in the loop. Meissner effect is generally defined as the removal of magnetic field from superconductors when it is moving towards superconducting state.

18. At very high temperature, an n-type semiconductor behave like

A. a p-type semiconductor

B. an intrinsic semiconductor

C. a superconductor

D. an n-type semiconductor

Ans. B

Sol.: As we know that in a degenerated (extrinsic) semiconductor the minority carrier are proportional to the temperature where as majority carriers are almost independent of temperature thus, in an n-type semiconductor when temperature increases the concentration of minority carriers (holes) also increases and at a particular temperature called Curie temperature, the concentration of minority carriers becomes equal to the concentration of majority carriers and semiconductor starts behaving like an intrinsic semiconductor.

19. **Direction:** Each of the question consist of two statements, one labeled as the 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answer to these items using the codes given below:

Statement (I): A superconductor is a perfect diamagnetic material.

Statement (II): A superconductor is a perfect conductor.

A. Both Statement (I) and Statements (II) are individually true and Statements (II) is the correct explanation of Statement (I)

B. Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I)

C. Statement (I) is true but Statement (II) is false

D. Statement (I) is false but Statement (II) is true

Ans. C

Sol.: A superconductor is a perfect diamagnetic material. In **perfect conductors**, the interior magnetic field must remain fixed but can have a zero or nonzero value. In real **superconductors**, all magnetic flux is expelled during the phase transition to **superconductivity** (the Meissner effect), and the magnetic field is always zero within the bulk of the **superconductor**.

20. Semiconductor material at 0 K temperature will work as?

A. Conductor

B. Insulator

C. Intrinsic semiconductor

D. Can not be determined

Ans. B

Sol.:

21. Soft magnetic materials should have

A. Large saturation magnetization and large permeability

B. Low saturation magnetization and large permeability

C. Large saturation magnetization and low permeability

D. Low saturation magnetization and low permeability

Ans. A

Sol.: Soft magnetic material would have zero coercivity (Hc), a very large saturation magnetization, zero remanent mag¬netization (Br), zero hysteresis loss.

22. Which of the following material is a insulator?

A. Dry air B. Water

C. Graphite D. None of the above

Ans. A

Sol.: Air is an insulator. Dry air is a good dielectric insulator. At very high voltages, there is dielectric breakdown, and we have sparks and conduction through ait.

23. In a semiconductor, the resistivity

A. depends on temperature B. depends on voltage

C. depends on current through it D. None of the above

Ans. A

Sol.: Resistivity of the material is Resistance to flow of current. And it is given by formula,

R = ρl/a

R = Rref [1+ A(T – Tref)]

So we can say tha Resistivity depends on temperature.

24. The temperature coefficient of resistance of a wire is 0.0008/°C. If the resistance of the wire is 8 ohm at 0°C, what is the resistance at 100°C?

A. 8.64 Ohm B. 8.08 Ohm

C. 7.92 Ohm D. 7.20 Ohm

Ans. A

Sol.: $R = R_0(1 + \alpha\Delta t) = 8(1 + 0.0008 \times 100) = 8.64\Omega$

25. If the domain walls in a magnetic materials can easily be moved, the material displays

A. high flux density

B. high permeability

C. Permanent magnetic behaviour

D. High permittivity

Ans. B

Sol.: Domain walls in magnetic material can be easily moved in case of ferromagnetic materials which has high value of permeability.

26. Behaviourof conductors, semicondurctors and insulators is explained on the basis of

A. atomic structure
B. molecular structure
C. energy band structure
D. all of the above

Ans. C

Sol.: Based on energy band structure conductors. Semiconductor and insulator is classified.

27. As temperature falls below the transition temperature, the value of critical magnetic field of a superconductor

A. Remains unchanged
B. Increases
C. Decreases
D. First increases, reaches a peak and then decreases

Ans. B

Sol.: Critical field required for destroying superconductivity is zero above transition temperature as above transition temperature material is in normal state. And below transition temperature critical field required is

$$H_C = H_0\left[1-\left(\frac{T}{T_C}\right)^2\right]$$

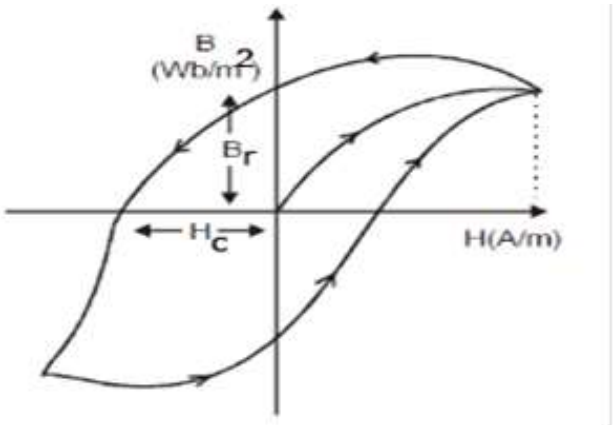
H_0 critical field required at as $T = 0^\circ K(\text{max.})$ fall below T_C, H_C increases.

28. The magnetic field required to reduce the residual magnetization to zero is called

A. retentivity
B. coercivity
C. hysteresis
D. saturation

Ans. B

Sol.: The magnetic field required to reduce the residual magnetization to zero is called 'coercivity' This magnetic field is applied externally in the opposite direction.



In the B-H curve shown above, B_r is residual magnetization and H_C is coercivity.

29. Match List-I with List-II and select the correct answer using the code given below the lists:

List-I

A) No eddy current loss

B) Small hysteresis loss

C) Large hysteresis loss

List-II

1) Ferrimagnetic material

2) Soft magnetic material

3) Hard magnetic material

4) non-ferrous material

A. A-2; B-1; C-3

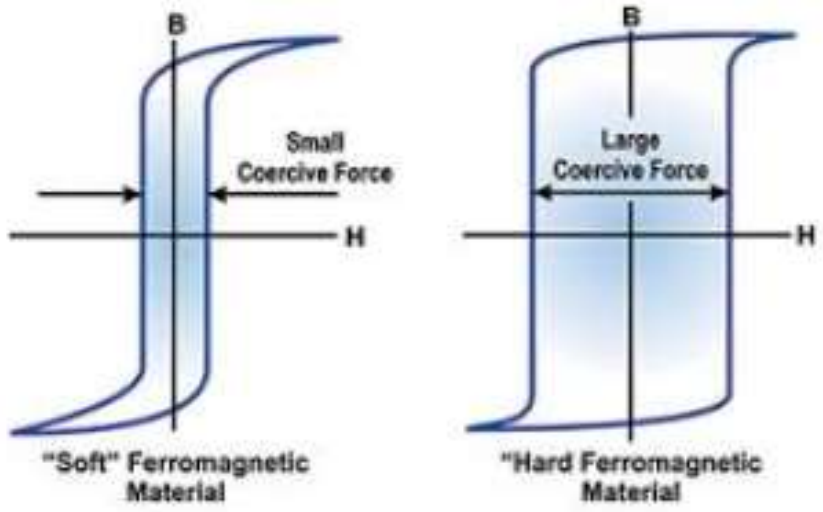
B. A-2; B-3; C-4

C. A-1; B-3; C-4

D. A-1; B-2; C-3

Ans. D

Sol.:



Hard Magnets	Soft Magnets
Materials which retain their magnetism and are difficult to demagnetize are called hard magnetic materials.	Soft magnetic materials are easy to magnetize and demagnetize.
These materials retain their magnetism even after the removal of the applied magnetic field. Hence these materials are used for making permanent magnets.	These materials are used for making temporary magnets.
They have large hysteresis loss due to large hysteresis loop area.	They have low hysteresis loss due to small hysteresis area.
Susceptibility and permeability are low.	Susceptibility and permeability are high.
Coercivity and retentivity values are large.	Coercivity and retentivity values are less.

	Since they have low retentivity and coercivity, they are not used for making permanent magnets.
Magnetic energy stored is high.	Magnetic energy stored is less.
They possess high value of BH product. The eddy current loss is high.	The eddy current loss is less because of high resistivity.

Ferrites are non-conductive ferrimagnetic materials with high permeability and high resistance; that makes them very good as the core of an inductor when you want to minimize losses due to eddy currents (conduction in the core).

30. The current flow in a semiconductor is due to

1) Drift current
2) Displacement current
3) Diffusion current

A. 1, 2 and 3 B. 1 and 2 only
C. 1 and 3 only D. 2 and 3 only

Ans. C

Sol.: In SC current flow due to frift and diffusion, displacement current flows in a dielectric or (conductor not perfect) under alternative field.

31. Ferrimagnetic material have:

A. Low resistivity B. High eddy current loss
C. Low curie temperature D. High permeability

Ans. D

Sol.: Ferrimagnetic have

1. High resistivity
2. Low eddy current loss
3. High Permeability
4. High Dielectric constant
5. High curie Temperature
6. Low Dielectric losses

32. Which one of the following is not a permanent magnetic material?

A. Chromium steel B. Silicon iron
C. Cobalt steel D. Alnico

Ans. B

Sol.: 4% Si – Fe is a soft magnetic material having coercive field

H_c = 40amp-m^{-1}

33. For high-speed reading and storing of information in a computer, the material used is

A. ferrite
B. piezoelectric
C. pyroelectric
D. ferromagnetic above 768°C

Ans. A

Sol.: Ferrite in used in computer memory.

34. On both ends of carbon-nanotubes (CNT), which carbon nanostructure is placed?

A. Graphite
B. Diamond
C. C_{60}
D. Benzene

Ans. C

Sol.: The structure of CNT consists of single sheet of graphite rolled into a tube. The ends of CNT are capped with C_{60} hemispheres.

35. When the temperature of a ferromagnetic material exceeds the Curie temperature, it behaves similar to a

A. Diamagnetic material
B. Ferromagnetic material
C. Paramagnetic material
D. Antiferromagnetic material

Ans. C

Sol.: Below the Curie temperature, the atoms are aligned and parallel, causing spontaneous magnetism; the material is ferromagnetic. Above the Curie temperature the material is paramagnetic, as the atoms lose their ordered magnetic moments when the material undergoes a phase transition.

36. Match elements with their correct crystal structure?

A. Titanium	1. Body-centered cubic
B. Gamma iron	2. Hexagonal closed packed
C. Sulfur	3. Face Centered Orthorhombic
D. Vanadium	4. Face-centered cubic

A. A-3, B-2, C-4, D-1
B. A-4, B-1, C-3, D-2
C. A-2, B-4, C-3, D-1
D. A-3, B-1, C-4, D-2

Ans. C

Sol.: Sulfur is a Face Centered Orthorhombic structure, Vanadium is Body Centered Cubic structure, Titanium is Hexagonal Close Packing structural element while Gamma iron is face-centered cubic structure.

37. The temperature coefficient of resistance of a doped semiconductor is

A. always positive
B. always negative
C. zero
D. positive or negative depending upon the level of doping

Ans. D

Sol.: Doped semiconductor or extrinsis semiconductor have very complicated temperature profile. As temperature increases starting from absolute zero, resistance first decreases steeply as the carriers leave the donors or acceptors. After most of the donors or acceptors have lost their carriers, the resistance starts to increase again slightly due to the reducing mobility of carriers. At higher temperatures, they behave like intrinsic semiconductors as the carriers from the donors/ acceptors become insignificant compared to the thermally generated carriers.

38. Which one of the following is the Fermi function f(E)?

A. $\frac{1}{1+e^{(E-E_F)/(kT)}}$ B. $\frac{1}{1-e^{(E-E_F)/(kT)}}$

C. $\frac{1}{1+e^{(E_F-E)/(kT)}}$ D. $\frac{1}{1-e^{(E_F-E)/(kT)}}$

Ans. A

Sol.: Fermi function i.e. probability of finding a e^- in a available energy state E is given by

$$f(E)=\frac{1}{1+\exp\left[(E-E_F)/KT\right]}$$

K → Boltzman constant $\left(\frac{ev}{k}\right)$

T → Temp. in Kelvin

E_F → Fermi level in eV

39. Consider the following statements about superconductors :

1) The temperature at which the conductor becomes a super conductor is called transition temperature.
2) Superconductors repel magnetic flux lines.
3) All superconductors are paramagnetic materials.
4) Superconductors become normal when placed in a magnetic field of certain critical value.

Which of the above statements are correct?

A. 1 and 2 only B. 2 and 4 only

C. 1, 2 and 4 only D. 1, 2, 3 and 4

Ans. C

Sol.: $B=\mu_0(H+M)$

Super conductor repel the magnetic flux

So, B = 0

$0=\mu_0(H+M)$

M = −H

$M = X_m H$

So, $X_m = -1$

Condition for perfect diamagnetic

40. A semiconductor differs from a conductor in that it has

A. Only one path for the free electrons in the valence band

B. Only one path for holes in the conduction band

C. Two paths followed by free electrons and holes, one an ordinary path in the conduction band and the other one an extraordinary path in the valence band, respectively

D. Two paths followed by free electrons and holed, one an extraordinary path in the conduction band and the other one an ordinary path in valence band, respectively

Ans. C

Sol.: In a semiconductor, conduction band and valence band are separated by energy gap. At room temperature, some of the e^- in V.B. gains enough energy to overcome the energy gap and move into C.B. leaving behind an empty space in V.B which is called as Hole. An e^- in the V.B. may fill the hole, leaving another hole in its place. In this way, a hole appears to move.

In the presence of electric field e^- move in one direction and holes appear to move in the opposite direction and both contribute to conductivity of the material.

Hence, e^- moves in ordinary path in C.B. and holes move in extra-ordinary path in V.B.

41. The energy gap of a superconductor

A. is independent of temperature

B. increases with temperature

C. is maximum at a critical temperature

D. is minimum at a critical temperature

Ans. D

Sol.: Energy gap of superconductor is minimum at critical temperature as it inters in infinite conductive stage.

42. Schottky defect includes:

A. Vacancy defect

B. Surface defect

C. Composition defect

D. Interstitial defect

Ans. A

Sol.: Schottky defect is a type of vacancy defect where cation vacancy is linked with anion vacancy.

43. For paramagnetic material, the relative permeability is

A. less than unity but magnetic susceptibility is relatively small and positive

B. greater than unity and magnetic susceptibility is relatively small but positive

C. equal to unity and magnetic susceptibility is larger but positive

D. less then unity but magnetic susceptibility is relatively large and positive

Ans. B

Sol.: For paramagnetic materials

$x_m = 10^{-5}$ and $\mu_y = x_m + 1$

i.e., $x_m > 0$ and $\mu_r > 1$

44. Tesla is same as

A. Weber/meter

B. Weber/(meter)^2

C. Farad/meter

D. Henry/(meter)^2

Ans. B

Sol.: Fundamental field B, the auxiliary field H and the magnetization M of the medium is normally rearranged as

$B = \mu_0(H + M)$.

Magnetic flux density has the dimension mass per time squared electric current. The SI derived unit of magnetic flux density is the tesla, which is defined as a weber per square meter.

45. The magnetic field at which a super-conductor remains in its superconducting state at a temperature less than the transition temperature is

A. Zero

B. Greater than the critical field corresponding to the given temperature

C. Less than the critical field corresponding tothe given temperature

D. Equal to the critical field corresponding to the transition temperature

Ans. C

Sol.: If a magnetic field *H* is applied, the material remains supercoducting until a critical field H_C is reached such that for $H>H_C$, the material is in the normal state at a certain temperature as temperature require *H* will be less.

46. The relationship between magnetic susceptibility of diamagnetic materials is _____ to temperature.

A. Directly proportional

B. Independent

C. Inversely proportional

D. Not discovered yet

Ans. B

Sol.: The magnetic susceptibility of diamagnetic materials is practically independent of temperature. This was experimentally discovered by Pierre Curie in 1895.

47. Solid hydrogen forms

A. Co-valent bond
B. Metallic bond
C. Vander wall bond
D. Depends on temperature

Ans. C

Sol.: Vander wall bond is the weaker bond. Ex solid Ar, Solid He, Solid hydrogen.

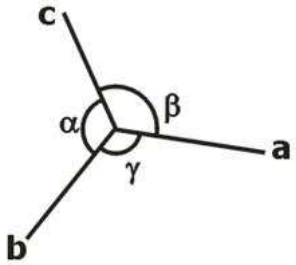
48. Which of the following systems is indicated by $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^\circ$, where symbols have their usual meanings.

A. Tetragonal
B. Triclinic
C. Rhombohedral
D. Monoclinic

Ans. B

Sol.: For triclinic,

a ≠ b ≠ c and α ≠ β ≠ γ ≠ 90°



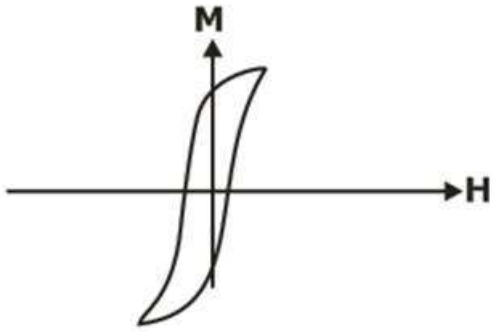
49. Choose the correct option related to soft magnetic materials:

1. These materials have low retentively
2. These materials have low coercively

A. 1 only
B. 2 only
C. Both A & B
D. Neither A nor B

Ans. C

Sol.: Soft magnetic materials are easy to magnetic and diamagnetic. There is rapid magnetization switching to applied field



These materials have

I. Low receptivity
II. Low coactivity
III. High permeability
IV. High magnetic saturation

50. Neel temperature is associated with

A. Ferromagnetic materials
B. Anti-ferromagnetic materials
C. Ferrimagnetic materials
D. Diamagnetic materials

Ans. B

Sol.: Anti-ferromagnetic materials are anti-ferro up to a critical temperature called Neel temperature. Above Neel temperature they behave like paramagnetic.

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