gate 2

EE24Btech11041 - Mohit

Q.1 - Q.25 carry one mark each

1) Consider an anti-symmetric tensor P_{ij} with the indices i and j running from 1 to 5. The number of independent components of the tensor is (PH 2010)

a) 3 b) 10 c) 9 d) 6

2) The value of the integral $\int_c \frac{e^z \sin z}{z^2} dz$, where the contour C is the unit circle: $|z-2| = 1$, is (PH 2010)

a) $2\pi i$ b) $4\pi i$ c) πi d) 0

3) The eigenvalues of the matrix $\begin{pmatrix} 2 & 3 & 0 \\ 3 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ are (PH 2010)

a) 5,2,-2 b) -5,-1,-1 c) 5,1,-1 d) -5,1,1

4) If $f(x) = \begin{cases} 0 & \text{for} \quad x < 3, \\ x-3 & \text{for} \quad x \geq 3, \end{cases}$
then the Laplace transform of $f(x)$ is (PH 2010)

a) $s^{-2}e^{3x}$ b) $s^2 e^{-3x}$ c) s^{-2} d) $s^{-2}e^{-3x}$

5) The valence electrons do not directly determine the following property of a metal. (PH 2010)

a) Electrical conductivity
b) Thermal conductivity
c) Shear modulus
d) Metallic lustre

6) Consider X-ray diffraction from a crystal with a face-centered-cubic (fcc) lattice. The lattice plane for which there is NO diffraction peak is (PH 2010)

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

7) The Hall coefficient, R_H, of sodium depends on (PH 2010)

a) The effective charge carrier mass and carrier density
b) The charge carrier density and relaxation time
c) The charge carrier density only
d) The effective charge carrier mass

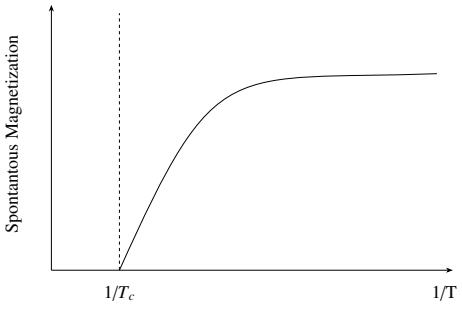
8) The Bloch theorem states that within a crystal, the wavefunction, $\psi(\mathbf{r})$, of an electron has the form (PH 2010)

a) $\psi(\mathbf{r}) = u(\mathbf{r})e^{i\mathbf{k}\cdot\mathbf{r}}$ where $u(\mathbf{r})$ is an arbitrary function and $\mathbf{k}$ is an arbitrary vector
b) $\psi(\mathbf{r}) = u(\mathbf{r})e^{i\mathbf{G}\cdot\mathbf{r}}$ where $u(\mathbf{r})$ is an arbitrary function and $\mathbf{G}$ is a reciprocal lattice vector
c) $\psi(\mathbf{r}) = u(\mathbf{r}+\mathbf{\Lambda})e^{i\mathbf{G}\cdot\mathbf{r}}$ where $u(\mathbf{r}) = u(\mathbf{r}+\mathbf{\Lambda})$, $\mathbf{\Lambda}$ is a lattice vector and $\mathbf{G}$ is a reciprocal lattice vector
d) $\psi(\mathbf{r}) = u(\mathbf{r}+\mathbf{\Lambda})e^{i\mathbf{k}\cdot\mathbf{r}}$ where $u(\mathbf{r}) = u(\mathbf{r}+\mathbf{\Lambda})$, $\mathbf{\Lambda}$ is a lattice vector and $\mathbf{k}$ is an arbitrary vector

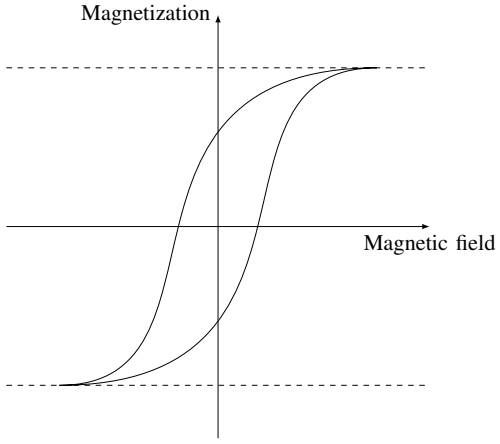
9) In an experiment involving a ferromagnetic medium, the following observations were made. Which one of the plots does NOT correctly represent the property of the medium? (T_c is the Curie temperature)

(PH 2010)

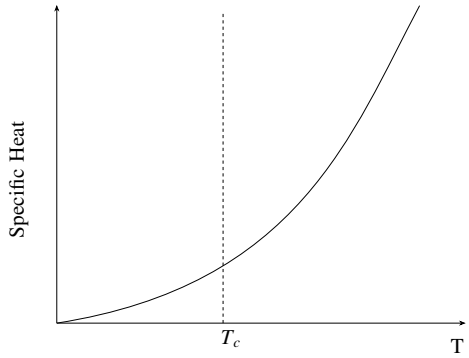
a)



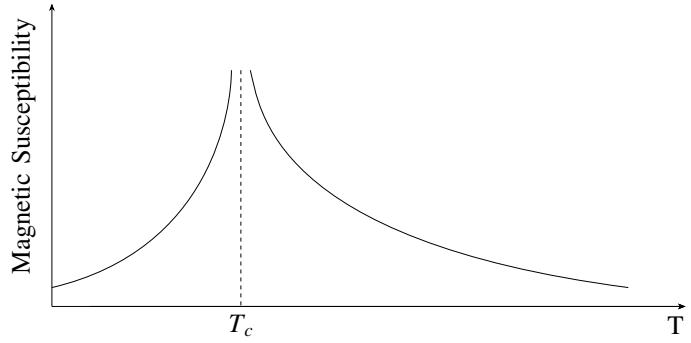
b)



c)



d)



10) The thermal conductivity of a given material reduces when it undergoes a transition from its normal state to the superconducting state. The reason is:

(PH 2010)

a) The Cooper pairs cannot transfer energy to the lattice
b) Upon the formation of Cooper pairs, the lattice becomes less efficient in heat transfer
c) The electrons in the normal state lose their ability to transfer heat because of their coupling to the Cooper pairs
d) The heat capacity increases on transition to the superconducting state leading to a reduction in thermal conductivity

11) The basic process underlying the neutron β- decay is

(PH 2010)

a) $d \rightarrow u + e^- + \overline{\nu}_e$
b) $d \rightarrow u + e^-$
c) $s \rightarrow u + e^- + \overline{\nu}_e$
d) $u \rightarrow d + e^- + \overline{\nu}_e$

12) In the nuclear shell model, the spin parity of ^{15}N is given by

(PH 2010)

a) $\frac{1}{2}^-$ b) $\frac{1}{2}^+$ c) $\frac{3}{2}^-$ d) $\frac{3}{2}^+$

13) Match the reactions on the left with the associated interactions on the right.

(1) $\pi^+ \rightarrow \mu^+ + \nu_\mu$	(i) Strong
(2) $\pi^0 \rightarrow \gamma + \gamma$	(ii) Electromagnetic
(3) $\pi^0 + n \rightarrow \pi^- + p$	(iii) Weak

(PH 2010)

a) (1, iii), (2, ii), (3, i)
b) (1, i), (2, ii), (3, iii)
c) (1, ii), (2, i), (3, iii)
d) (1, iii), (2, i), (3, ii)