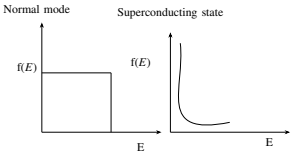
GATE-2015-PH

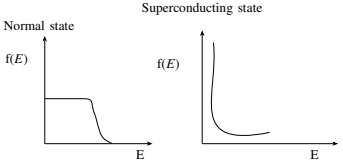
EE24BTECH11017-D.KARTHIK

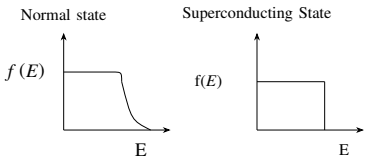
40) The band gap of an intrinsic semiconductor is $E_g = 0.72eV$ and $m_h^* = 6m_e^*$. At $300K$, the Fermi level with respect to the valence band (in eV) is at _____ (upto three decimal places) $k_B = 1.38x10^{-23}JK^{-1}$ [GATE 2015]

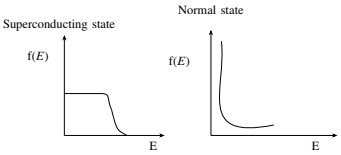
41) The number of permitted transitions from $^2P_{3/2} \rightarrow {}^2S_{1/2}$ in the presence of a weak magnetic field is _____ [GATE 2015]

42) Which one of the following represents the electron occupancy for a superconductor in its normal and superconducting states? [GATE 2015]

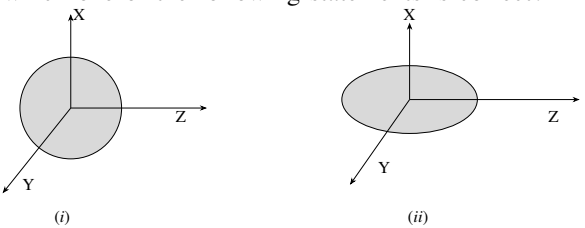
a)


b)


c)


d)


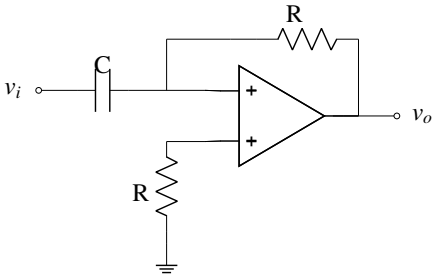
43) A charge $-q$ is distributed uniformly over a sphere, with a positive charge q at its center in (i). Also in (ii), a charge $-q$ is distributed uniformly over an ellipsoid with a positive charge q at its center. With respect to the origin of the coordinate system, which one of the following statements is correct? [GATE 2015]

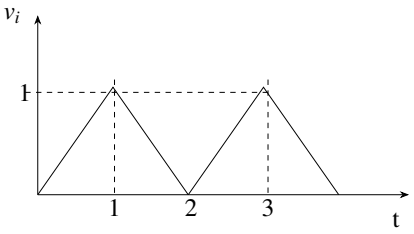


(i) (ii)

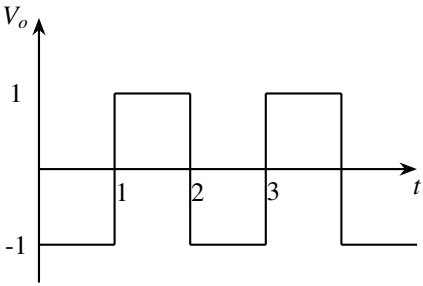
a) The dipole moment is zero in both (i) and (ii)
b) The dipole moment is non-zero in (i) but zero in (ii)
c) The dipole moment is zero in (i) but non-zero in (ii)
d) The dipole moment is non-zero in both (i) and (ii)

44) Consider the circuit shown in the figure, where $RC = 1$. For an input signal V_1 shown below, choose the correct V_o from the options: [GATE 2015]

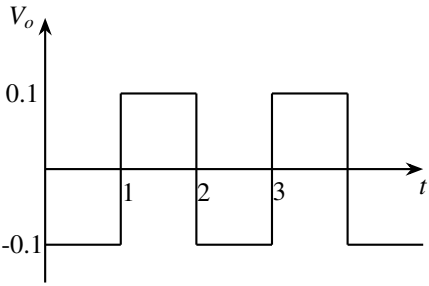




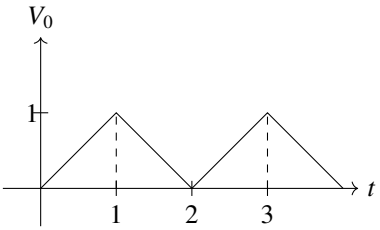
a)



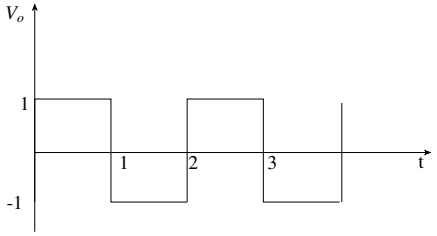
c)



b)



d)



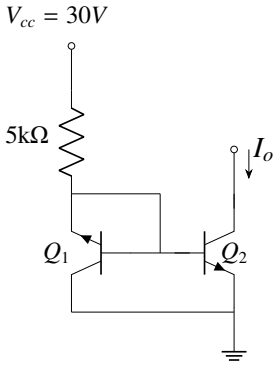
45) A long solenoid is embedded in a conducting medium and is insulated from the medium. If the current through the solenoid is increased at a constant rate, the induced current in the medium as a function of the radial distance r from the axis of the solenoid is proportional to [GATE 2015]

a) r^2 inside the solenoid and $\frac{1}{r}$ outside
b) r inside the solenoid and $\frac{1}{r^2}$ outside
c) r^2 inside the solenoid and $\frac{1}{r^2}$ outside
d) r inside the solenoid and $\frac{1}{r}$ outside

46) In the simple current source in the figure, Q_1 and Q_2 are identical transistors with current gain $\beta = 100$ and $V_{BE} = 0.7V$ [GATE 2015]

47) Match the phrases in Group I and Group II and identify the correct option.

a) (P-i), (Q-ii), (R-iii), (S-iv)
b) (P-ii), (Q-i), (R-iv), (S-iii)
c) (P-iii), (Q-iv), (R-i), (S-ii)
d) (P-iii), (Q-i), (R-iv), (S-ii)



The cuurent I_0 (in mA) is _____ (upto two decimal places) [GATE 2015]

Group I	**Group II**
(P) Electron spin resonance (ESR)	(i) radio frequency
(Q) Nuclear magnetic resonance (NMR)	(ii) visible range frequency
(R) Transition between vibrational states of a molecule	(iii) microwave frequency
(S) Electronic transition	(iv) far-infrared range Â

48) Consider the motion of the Sun with respect to the rotation of the Earth about its axis. If $\overrightarrow{F_c}$ and $\overrightarrow{F}_{\mathbf{Co}}$ denote the centrifugal and the Coriolis forces, respectively, acting on the Sun, then [GATE 2015]

a) $\overrightarrow{F_c}$ is radially outward and $\overrightarrow{F}_{\mathbf{Co}} = \overrightarrow{F_c}$
b) $\overrightarrow{F_c}$ is radially inward and $\overrightarrow{F}_{\mathbf{Co}} = -\mathbf{2}\overrightarrow{F_c}$
c) $\overrightarrow{F_c}$ is radially outward and $\overrightarrow{F}_{\mathbf{Co}} = -\mathbf{2}\overrightarrow{F_c}$
d) $\overrightarrow{F_c}$ is radially outward and $\overrightarrow{F}_{\mathbf{Co}} = \mathbf{2}\overrightarrow{F_c}$

49) In a rigid-rotator of mass M, if the energy of the first excited state is $1meV$, then the fourth excited state energy (in meV) is _____

50) A plane wave $(\hat{x} + i\hat{y})\,\mathbf{E}_0 \exp[i(kz - \omega t)]$ after passing through an optical element emerges as $\left(\hat{x} - i\hat{y}\right)\mathbf{E}_0 \exp[i(kz - \omega t)]$, where k and ω are the wavevector and the angular frequency, respectively. The optical element is a [GATE 2015]

a) quarter wave plate
b) half wave plate
c) polarizer
d) Faraday rotator

51) The Lagrangian for a particle of mass m at a position $\overrightarrow{r}$ moving with a velocity $\overrightarrow{v}$ is given by $L = \frac{m}{2}\overrightarrow{v}^{\mathbf{2}} + C\overrightarrow{r}.\overrightarrow{v} - \mathbf{V}(\mathbf{r})$, where $V(r)$is a potential and C is a constant. If $\overrightarrow{p}_{\mathbf{c}}$ is the canonical momentum, then its Hamiltonian is given by [GATE 2015]

a) $\frac{1}{2m}\left(\overrightarrow{p}_{\mathbf{c}} + C\overrightarrow{r}\right)^2 + V(r)$
b) $\frac{1}{2m}\left(\overrightarrow{p}_{\mathbf{c}} - C\overrightarrow{r}\right)^2 + V(r)$
c) $\frac{p_c^2}{2m} + V(r)$
d) $\frac{1}{2m}p_c^2 + C^2r^2 + V(r)$

52) The Hamiltonian for a system of two particles of masses m_1 and m_2 at $\overrightarrow{r}_1$ and $\overrightarrow{r}_2$ having velocities $\overrightarrow{v}_1$ and $\overrightarrow{v}_2$ is given by $H = \frac{1}{2}m_1 v_1^2 + \frac{1}{2}m_2 v_2^2 + \frac{C}{(\overrightarrow{r}_1 - \overrightarrow{r}_2)^2}\hat{z}.\left(\overrightarrow{r}_1 \times \overrightarrow{r}_2\right)$,where C is a constant. Which one of the following statements is correct? [GATE 2015]

a) The total energy and total momentum are conserved
b) Only the total energy is conserved
c) Only the total energy and the $z-$component of the total angular momentum are conserved
d) The total energy and total angular momentum are conserved