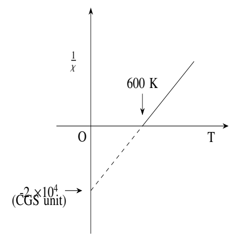
2012-PH-27-39

AI24BTECH11023 - Tarun Reddy Pakala

27) Inverse susceptibility $\left(\frac{1}{\chi}\right)$ as a function of temperature, T for material undergoing paramagnetic to ferromagnetic transition is given in the figure, where O is the origin. The values of the Curie constant, C, and the Weiss molecular field constant, λ, in CGS units, are



a) $C = 5 \times 10^{-5},\ \lambda = 3 \times 10^{-2}$
b) $C = 3 \times 10^{-2},\ \lambda = 5 \times 10^{-5}$
c) $C = 3 \times 10^{-2},\ \lambda = 2 \times 10^{4}$
d) $C = 2 \times 10^{4},\ \lambda = 3 \times 10^{-2}$

28) A plane polarized electromagnetic wave in free space at time $t = 0$ is given by $\overrightarrow{E}(x,z) = 10j \exp\left[i(6x + 8z)\right]$. The magnetic field $\overrightarrow{B}(x,z,t)$ is given by
a) $\overrightarrow{B}(x,z,t) = \frac{1}{c}\left(6k - 8\hat{i}\right)\exp\left[i(6x + 8z - 10ct)\right]$
b) $\overrightarrow{B}(x,z,t) = \frac{1}{c}\left(6k + 8\hat{i}\right)\exp\left[i(6x + 8z - 10ct)\right]$
c) $\overrightarrow{B}(x,z,t) = \frac{1}{c}\left(6k - 8\hat{i}\right)\exp\left[i(6x + 8z - ct)\right]$
d) $\overrightarrow{B}(x,z,t) = \frac{1}{c}\left(6k + 8\hat{i}\right)\exp\left[i(6x + 8z + ct)\right]$

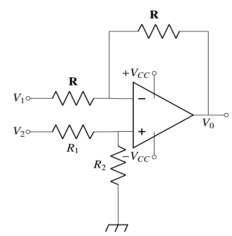
29) The eigenvalues of the matrix $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ are
a) $0, 1, 1$
b) 0, - $\sqrt{2}$, $\sqrt{2}$
c) $\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0$
d) $\sqrt{2}, \sqrt{2}, 0$

30) Match the typical spectroscopic regions specified in **Group I** with the corresponding type of transitions in **Group II.**

Group I	**Group II**
(P) Infra-red region	(i) electronic transitions involving valence electrons
(Q) Ultraviolet-visible region	(ii) nuclear transitions
(R) X-ray region	(iii) vibrational transitions of molecules
(S) γ-ray region	(iv) transitions involving inner shell electrons

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

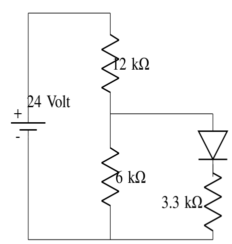
31) In the following circuit, for the output voltage to be $V_o = \left(-V_1 + \frac{V_2}{2}\right)$, the ratio $\frac{R_1}{R_2}$ is



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

32) The terms $\{j_1, j_2\}_J$ arising from $2s^1 3d^1$ electronic configuration in j-j coupling scheme are
a) $\{\frac{1}{2}, \frac{3}{2}\}_{2,1}and\{\frac{1}{2}, \frac{5}{2}\}_{3,2}$
b) $\{\frac{1}{2}, \frac{1}{2}\}_{1,0}and\{\frac{1}{2}, \frac{3}{2}\}_{2,1}$
c) $\{\frac{1}{2}, \frac{1}{2}\}_{1,0}and\{\frac{1}{2}, \frac{5}{2}\}_{3,2}$
d) $\{\frac{3}{2}, \frac{1}{2}\}_{2,1}and\{\frac{1}{2}, \frac{5}{2}\}_{3,2}$

33) In the following circuit, the voltage drop across the ideal diode in forward bias condition is $0.7V$. The current passing through the diode is



a) 0.5 mA
b) 1.0 mA
c) 1.5 mA
d) 2.0 mA

34) Choose the CORRECT statement from the following.
a) Neutron interacts through electromagnetic interaction
b) Electron does not interact through weak interaction
c) Neutrino interacts through weak and electromagnetic interaction
d) Quark interacts through strong interaction but not through weak interaction

35) A rod of proper length l_o oriented parallel to the x-axis moves with speed $\frac{2c}{3}$ along the x-axis in the S-frame, where c is the speed of the light in free space. The observer is also moving along the x-axis with speed $\frac{c}{2}$ with respect to the S-frame. The length of the rod as measured by the observer is
a) $0.35l_o$
b) $0.48l_o$
c) $0.87l_o$
d) $0.97l_o$

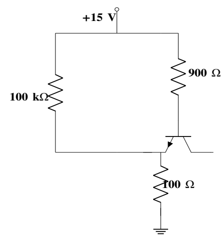
36) A simple cubic crystal with lattice parameter a_c undergoes transition into a tetragonal structure with lattice parameters $a_t = b_t = \sqrt{2}a_c$ and $c_t = 2a_c$, below a certain temperature. The ratio of the interplanar spacings of (1 0 1) planes for the cubic and the tetragonal structure is
a) $\sqrt{\frac{1}{6}}$

b) $\frac{1}{6}$

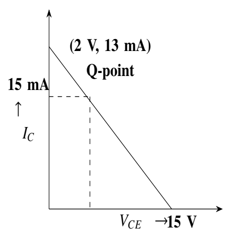
c) $\sqrt{\frac{3}{8}}$

d) $\frac{3}{8}$

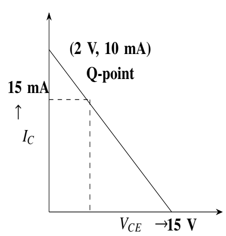
37) Consider the following circuit in which the current gain β_{dc} of the transistor is 100. Which one of



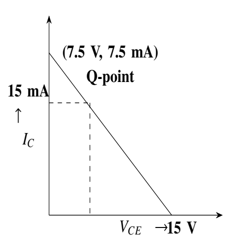
the following correctly represents the load line (collector current I_C with respect to collector-emitter voltage V_{CE}) and Q-point of this circuit?



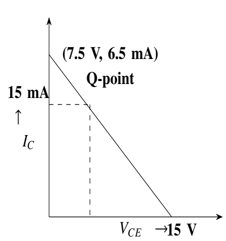
a)



b)



c)

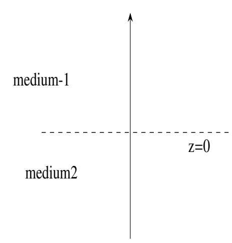


d)

38) Consider a system whose three energy levels are given by 0, ϵ and 2ϵ. The energy level ϵ is two-fold degenerate and the other two are non-degenerate. The partition function of the system with $\beta = \frac{1}{k_B T}$

a) $1 + 2e^{-\beta\epsilon}$
b) $2e^{-\beta\epsilon} + e^{-2\beta\epsilon}$
c) $\left(1 + e^{-\beta\epsilon}\right)^2$
d) $1 + e^{-\beta\epsilon} + e^{-2\beta\epsilon}$

39) Two infinitely extended homogeneous isotropic dielectric media (medium-1 and medium-2 with dielectric constants $\frac{\epsilon_1}{\epsilon_2} = 2$ and $\frac{\epsilon_2}{\epsilon_0} = 5$, respectively) meet at the $z = 0$ plane as shown in the figure . A uniform electric field exists everywhere. For $z \geq 0$, the electric field is given by $\overrightarrow{E_1} = 2\hat{\imath} - 3j + 5k$. The interface separating the two media is charge free.
The electric displacement vector in the medium-2 is given by



a) $\overrightarrow{D_2} = \epsilon_0\left[10\hat{i} + 15j + 10k\right]$
b) $\overrightarrow{D_2} = \epsilon_0\left[10\hat{i} - 15j + 10k\right]$
c) $\overrightarrow{D_2} = \epsilon_0\left[4\hat{i} - 6j + 10k\right]$
d) $\overrightarrow{D_2} = \epsilon_0\left[4\hat{i} + 6j + 10k\right]$