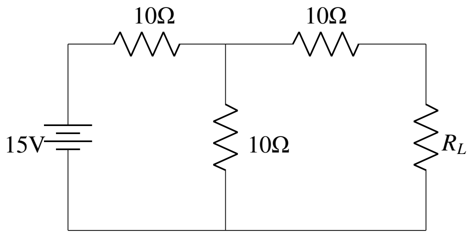
GATE-2009-PH

AI24BTECH11024-Pappuri Prahladha

37)



Assuming an ideal voltage source. Thevenin's resistance and Thevenin's voltage respectively for the above circuit are

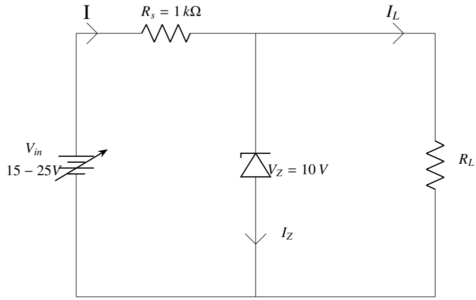
a) 15Ω and 7.5**V** b) 20Ω and 5**V** c) 10Ω and 10**V** d) 30Ω and 15**V**

38) Let $|n\rangle$ and $|p\rangle$ denote the isospin states with $I = \frac{1}{2}$, $I_3 = \frac{1}{2}$ and $I = \frac{1}{2}$, $I_3 = -\frac{1}{2}$ of a nucleon respectively. Which one of the following two-nucleon states has $I = 0, I_3 = 0$?

a) $\frac{1}{\sqrt{2}}(|nn\rangle - |pp\rangle)$
b) $\frac{1}{\sqrt{2}}(|nn\rangle + |pp\rangle)$
c) $\frac{1}{\sqrt{2}}(|np\rangle - |pn\rangle)$
d) $\frac{1}{\sqrt{2}}(|np\rangle + |pn\rangle)$

39) An amplifier of gain 1000 is made into a feedback amplifier by feeding 9.9% of its output voltage in series with the input opposing. If $f_L = 20Hz$ and $f_H = 200kHz$ for the amplifier without feedback, then due to the feedback
a) the gain decreases by 10 times
b) the output resistance increases by 10 times
c) the f_H increases by 100 times
d) the input resistance decreases by 100 times

40)



Pick the correct statement based on the above circuit.

a) The maximum Zener current $I_{Z(max)}$, when $R_L = 10k\Omega$ is 15mA
b) The minimum Zener current $I_{Z(min)}$, when $R_L = 10k\Omega$ is 5mA
c) With $V_{in} = 20V$,$I_L = I_Z$ when $R_L = 2k\Omega$
d) The power dissipated across the Zener when $R_L = 10k\Omega$ and $V_{in} = 20V$ is 100mW

41) The disintegration energy is defined to be the difference in the rest energy between the initial and final states.Consider the following process:
$^{240}_{94}Pu \rightarrow ^{236}_{92}U + ^{4}_{2}He.$
The emitted α particle has a kinetic energy 5.17 MeV.The value of disintegration energy is

a) 5.26 MeV b) 5.17 MeV c) 5.08 MeV d) 2.59 MeV

42) A classical particle is moving in an external potential field $V(x, y, z)$ which is invariant under the following infinitesimal transformations

$$x \rightarrow x' = x + \delta x,$$
$$y \rightarrow y' = y + \delta y,$$
$$\begin{pmatrix} x \\ y \end{pmatrix} \rightarrow \begin{pmatrix} x' \\ y' \end{pmatrix} = R_z \begin{pmatrix} x \\ y \end{pmatrix},$$

where R_z is the matrix corresponding to rotation about the z axis. The conserved quantities are (the symbols have their usual meaning)

a) P_x, P_z, L_z b) P_x, P_y, L_z, E c) P_y, L_z, E d) P_y, P_z, L_x, E

43) The spin function of a free particle, in the basis in which S_z is diagonal, can be written as $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$ with eigenvalues $+\frac{\hbar}{2}$ and $-\frac{\hbar}{2}$, respectively. In the given basis, the normalized eigenfunction of S_y with eigenvalue $-\frac{\hbar}{2}$ is:

a) $\frac{1}{\sqrt{2}}\begin{pmatrix} 1 \\ i \end{pmatrix}$ b) $\frac{1}{\sqrt{2}}\begin{pmatrix} 0 \\ i \end{pmatrix}$ c) $\frac{1}{\sqrt{2}}\begin{pmatrix} i \\ 0 \end{pmatrix}$ d) $\frac{1}{\sqrt{2}}\begin{pmatrix} i \\ 1 \end{pmatrix}$

44) Let $\hat{A}$ and $\hat{B}$ represent two physical characteristics of a quantum system. If $\hat{A}$ is Hermitian, then for the product $\hat{A}\hat{B}$ to be Hermitian, it is sufficient that:

a) $\hat{B}$ is Hermitian
b) $\hat{B}$ is anti-Hermitian
c) $\hat{B}$ Hermitian and $\hat{A}$ and $\hat{B}$ commute
d) $\hat{B}$ is Hermitian and $\hat{A}$ and $\hat{B}$ anti-commute

45) Consider the set of vectors in three-dimensional real vector space $\mathbb{R}^3, S = \{(1,1,1),(1,-1,1),(1,1,-1)\}$. Which one of the following statements is true?

a) S is not a linearly independent set.
b) S is a basis for $\mathbb{R}^3$.
c) The vectors in S are orthogonal.
d) An orthogonal set of vectors cannot be generated from S.

46) For a Fermi gas of N particles in three dimensions at $T = 0k$,the Fermi energy,E_F is proportional to

a) $N_{\frac{2}{3}}$
b) $N_{\frac{3}{2}}$
c) N_3
d) N_3

47) The Lagrangian of a diatomic molecule is given by $L = \frac{m}{2}\left(\dot{x_1}^2 + \dot{x_2}^2\right) - \frac{k}{2}x_1x_2$, where m is the mass of each of the atoms and x_1 and x_2 are the displacements of the atoms measured from the equilibrium position, and $k > 0$. The normal frequencies are

a) $\pm\left(\frac{k}{m}\right)^{1/2}$
b) $\pm\left(\frac{k}{m}\right)^{1/4}$
c) $\pm\left(\frac{k}{2m}\right)^{1/4}$
d) $\pm\left(\frac{k}{2m}\right)^{1/2}$

48) A particle is in the normalized state $|\psi\rangle$, which is a superposition of the energy eigenstates $|E_0 = 10eV\rangle$ and $|E_1 = 30eV\rangle$. The average value of energy of the particle in the state $|\psi\rangle$is 20 eV. The state $|\psi\rangle$ is given by

a) $\frac{1}{2}|E_0 = 10eV\rangle + \frac{\sqrt{3}}{4}|E_1 = 30eV\rangle$
b) $\frac{1}{\sqrt{3}}|E_0 = 10eV\rangle + \frac{\sqrt{2}}{3}|E_1 = 30eV\rangle$
c) $\frac{1}{2}|E_0 = 10eV\rangle - \frac{\sqrt{3}}{4}|E_1 = 30eV\rangle$
d) $\frac{1}{\sqrt{2}}|E_0 = 10eV\rangle - \frac{1}{\sqrt{2}}|E_1 = 30eV\rangle$