Gate-ASSIGNMENT-2

EE24BTECH11043 - Murra Rajesh Kumar Reddy

1) Which one of the following is a solution of $\frac{d^2u(x)}{dx^2} = k^2 u(x)$, for k real?
   a) e^{-kx}
   b) $\sin kx$
   c) $\cos kx$
   d) $\sinh x$
2) A real, invertible 3×3 matrix M has eigenvalues $\lambda, (i = 1, 2, 3)$ and the corresponding eigenvectors are $|e_i\rangle, (i = 1, 2, 3)$ respectively. Which one of the following is correct?
   a) $M|e_i\rangle = \frac{1}{\lambda_i}|e_i\rangle$, for $i = 1, 2, 3$
   b) $M^{-1}|e_i\rangle = \frac{1}{\lambda_i}|e_i\rangle$, for $i = 1, 2, 3$
   c) $M^{-1}|e_i\rangle = \lambda_i|e_i\rangle$, for $i = 1, 2, 3$
   d) The eigenvalues of M and M^{-1} are not related.
3) A quantum particle is subjected to the potential
   $$V(x) = \begin{cases} \infty, & x \leq -\frac{a}{2} \\ 0, & -\frac{a}{2} < x < \frac{a}{2} \\ \infty, & x \geq \frac{a}{2} \end{cases}$$
   The ground state wave function of the particle is proportional to
   a) $\sin\left(\frac{\pi x}{2a}\right)$
   b) $\sin\left(\frac{\pi x}{a}\right)$
   c) $\cos\left(\frac{\pi x}{2a}\right)$
   d) $\cos\left(\frac{\pi x}{a}\right)$
4) Let $\hat{a}$ and $\hat{a}^+$, respectively denote the lowering and raising operators of a one-dimensional simple harmonic oscillator. Let $|n\rangle$ be the energy eigenstate of the simple harmonic oscillator. Given that $|n\rangle$ is also an eigen state of $\hat{a}^+\hat{a}^+\hat{a}\hat{a}$, the corresponding eigenvalue is
   a) $n(n-1)$
   b) $n(n+1)$
   c) $(n+1)^2$
   d) n^2
5) Which one of the following is a universal logic gate?
   a) AND
   b) NOT
   c) OR
   d) NAND
6) Which one of the following is the correct binary equivalent of the hexadecimal $F6C$?
   a) 0110 1111 1100
   b) 1111 0110 1100
   c) 1100 0110 1111
   d) 0110 1100 0111
7) The total angular momentum j of the ground state of the ${}^{17}_{8}O$ nucleus is
   a) $\frac{1}{2}$

b) 1
c) $\frac{3}{2}$
d) $\frac{5}{2}$

8) A particle X is produced in the process $\pi^+ + p \to K^+ + X$ via the strong interaction. If the quark content of the K^+ is $u\bar{s}$, the quark content of X is

a) $c\bar{s}$
b) uud
c) uus
d) $u\bar{d}$

9) A medium $(\epsilon_r > 1, \mu_r = 1, \sigma > 0)$ is semi-transparent to an electromagnetic wave when

a) Conduction current >> Displacement current
b) Conduction current << Displacement current
c) Conduction current = Displacement current
d) Both Conduction current and Displacement current are zero

10) A particle is moving in a central force field given by $\hat{F} = -\frac{k}{r^3}$, where $\hat{r}$ is the unit vector pointing away from the center of the field. The potential energy of the particle is given by

a) $\frac{k}{r^2}$
b) $\frac{k}{2r^2}$
c) $-\frac{k}{r^2}$
d) $-\frac{k}{2r^2}$

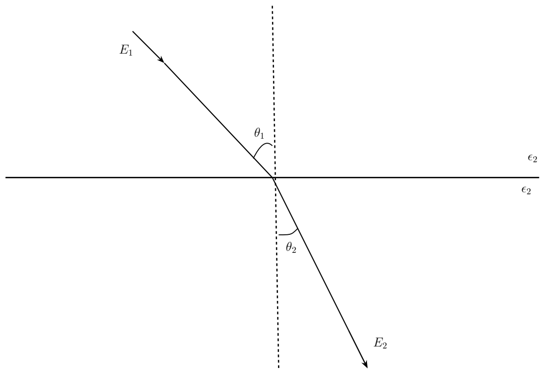
11) Choose the correct statement related to the Fermi energy (E_F) and the chemical potential (μ) of a metal

a) $\mu = E_F$ only at $0k$
b) $\mu = E_F$ at finite temperature
c) $\mu < E_F$ at $0K$
d) $\mu > E_F$ at finite temparature

12) Consider a diatomic molecule formed by identical atoms. If E_V and E_C represent the energy of the vibrational nuclear motion and electronic motion respectively, then in terms of the electronic mass m and nuclear mass M , $\frac{E_V}{E_C}$ is proportional to

a) $\left(\frac{m}{M}\right)^{1/2}$
b) $\frac{m}{M}$
c) $\left(\frac{m}{M}\right)^{3/2}$
d) $\left(\frac{m}{M}\right)^2$

13) Which one of the following relations determines the manner in which the electric field lines are refracted across the interface between two dielectric media having (see figure)?



a) $\epsilon_1 \sin\theta_1 = \epsilon_2 \sin\theta_2$
b) $\epsilon_1 \cos\theta_1 = \epsilon_2 \cos\theta_2$
c) $\epsilon_1 \tan\theta_1 = \epsilon_2 \tan\theta_2$
d) $\epsilon_1 \cot\theta_1 = \epsilon_2 \cot\theta_2$