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EE24BTECH11003 - Akshara Sarma Chennubhatla

- 14) If the half-life of an elementary particle moving with speed $0.9c$ in the laboratory frame is 5×10^{-8} s, then the proper half-life is _____ $\times 10^{-8}$ s. ($c = 3 \times 10^8$ m/s) (2014)
- 15) An unpolarized light wave is incident from air on a glass surface at the Brewster angle. The angle between the reflected and the refracted wave is (2014)
- 0°
 - 45°
 - 90°
 - 120°
- 16) Two masses m and $3m$ are attached to the two ends of a massless spring with force constant K . If $m = 100$ g and $K = 0.3$ N/m, then the natural angular frequency of oscillation is _____ Hz. (2014)
- 17) The electric field of a uniform plane wave propagating in a dielectric, non-conducting medium is given by,

$$\mathbf{E} = \mathbf{x}10 \cos(6\pi \times 10^7 t - 0.4\pi z) \text{ V/m.}$$

The phase velocity of the wave is _____ $\times 10^8$ m/s. (2014)

- 18) The matrix $A = \frac{1}{\sqrt{3}} \begin{pmatrix} 1 & 1+i \\ 1-i & -1 \end{pmatrix}$ is (2014)
- orthogonal
 - symmetric
 - anti-symmetric
 - unitary
- 19) The recoil momentum of an atom is p_A when it emits an infrared photon of wavelength 1500 nm, and it is p_B when it emits a photon of visible wavelength 500 nm. The ratio $\frac{p_A}{p_B}$ is (2014)
- 1 : 1
 - 1 : $\sqrt{3}$
 - 1 : 3
 - 3 : 2
- 20) For a gas under isothermal conditions, its pressure P varies with volume V as $P \propto V^{-\frac{5}{3}}$. The bulk modulus B is proportional to (2014)
- $V^{-\frac{1}{2}}$
 - $V^{-\frac{2}{3}}$
 - $V^{-\frac{3}{5}}$
 - $V^{-\frac{5}{3}}$
- 21) Which one of the following high energy processes is allowed by conservation laws? (2014)
- $p + \bar{p} \rightarrow \Lambda^0 + \Lambda^0$
 - $\pi^- + p \rightarrow \pi^0 + n$
 - $n \rightarrow p + e^- + \nu_e$
 - $\mu^+ \rightarrow e^+ + \gamma$
- 22) The length element ds of an arc is given by, $(ds)^2 = 2(dx^2)^2 + \sqrt{3}dx^1 dx^2$. The metric tensor g_g is (2014)

- a) $\begin{pmatrix} 2 & \sqrt{3} \\ \sqrt{3} & 1 \end{pmatrix}$
 b) $\begin{pmatrix} 2 & \sqrt{\frac{3}{2}} \\ \sqrt{\frac{3}{2}} & 1 \end{pmatrix}$
 c) $\begin{pmatrix} 2 & 1 \\ \sqrt{\frac{3}{2}} & \sqrt{\frac{3}{2}} \end{pmatrix}$
 d) $\begin{pmatrix} 1 & \sqrt{\frac{3}{2}} \\ \sqrt{\frac{3}{2}} & 2 \end{pmatrix}$

23) The ground state and the first excited state wave functions of a one dimensional infinite potential well are ψ_1 and ψ_2 , respectively. When two spin-up electrons are placed in this potential, which one of the following, with x_1 and x_2 denoting the position of the two electrons, correctly represents the space part of the ground state wave function of the system? (2014)

- a) $\frac{1}{\sqrt{2}} [\psi_1(x_1)\psi_2(x_1) - \psi_1(x_2)\psi_2(x_2)]$
 b) $\frac{1}{\sqrt{2}} [\psi_1(x_1)\psi_2(x_2) + \psi_1(x_2)\psi_2(x_1)]$
 c) $\frac{1}{\sqrt{2}} [\psi_1(x_1)\psi_2(x_1) + \psi_1(x_2)\psi_2(x_2)]$
 d) $\frac{1}{\sqrt{2}} [\psi_1(x_1)\psi_2(x_2) - \psi_1(x_2)\psi_2(x_1)]$

24) If the vector potential

$$\mathbf{A} = \alpha x\mathbf{x} + 2y\mathbf{y} - 3z\mathbf{z},$$

satisfies the Colomb gauge, the value of the constant α is _____ (2014)

25) At a given temperature, T , the average energy per particle of a non-interacting gas of two-dimensional classical harmonic oscillators is _____ $k_B T$ (k_B is the Boltzmann constant). (2014)

26) Which of the following is a fermion? (2014)

- a) α particle
 b) Be_4^7 nucleus
 c) Hydrogen atom
 d) Deuteron