JEE Main - 2018 (CBT)
Exam Test Date: 16/04/2018

Part - A (Physics)

1. The relative uncertainty in the period of a satellite orbiting around the earth is 10^{-2}. If the relative uncertainty in the radius of the orbit is negligible the relative uncertainty in the mass of the earth is :

(1) 2×10^{-2} (2) 6×10^{-2} (3) 3×10^{-2} (4) 10^{-2}

Ans. **(1)**

Sol. From kepler's Law

$$T^2 = \frac{4\pi^2}{GM} r^3$$

$$\left|\frac{\Delta M}{M}\right| = 2\frac{\Delta T}{T} = 2 \times 10^{-2}$$

2. At some instant a radioactive sample S_1 having an activity 5 μCi has twice the number of nuclei as another sample S_2 which has an activity of 10 μCi. The half lives of S_1 and S_2 are :

(1) 5 years and 20 years, respectively (2) 20 years and 5 years, respectively

(3) 20 years and 10 years, respectively (4) 10 years and 20 years, respectively

Ans. **(1)**

Sol. Given : $N_1 = 2N_2$

$$\lambda_1 N_1 = \frac{\ell n 2}{t_1} \times N_1 = 5\mu c_i$$

$$\lambda_2 N_2 = \frac{\ell n 2}{t_2} \times N_2 = 10\mu c_i$$

$$\frac{t_2}{t_1} \times \frac{N_1}{N_2} = \frac{1}{2}$$

$$\frac{t_2}{t_1} = \frac{1}{4}$$

Hence 5years and 20 year

3. Two moles of helium are mixed with an moles of hydrogen. If $\frac{C_P}{C_V} = \frac{3}{2}$ for the mixture then the value of n is

(1) 1 (2) 3 (3) 2 (4) 3/2

Ans. **(3)**

Sol. $$\frac{C_p}{C_v} = \frac{f_{mix} + 2}{f_{mix}} = \frac{3}{2}$$

$\Rightarrow$ $f_{mix} = 4$

$$f_{mix} = \frac{n_1 f_1 + n_2 f_2}{n_1 + n_2}$$

$\Rightarrow$ $\dfrac{4 = 2 \times 3 + n_2 \times 5}{2 + n_2}$ $\Rightarrow$ n_2 = 2mole

4. Unpolarized light of intensity I is incident on a system of two polarizers, A followed by B. The intensity of emergent light is I/2. If a third polarizer C is placed between A and B the intensity of emergent light is reduced to I/3. The angle between the polarizers A and C is θ, then

(1) $\cos\theta = \left(\frac{2}{3}\right)^{1/4}$ (2) $\cos\theta = \left(\frac{1}{3}\right)^{1/4}$ (3) $\cos\theta = \left(\frac{1}{3}\right)^{1/2}$ (4) $\cos\theta = \left(\frac{2}{3}\right)^{1/2}$

Ans. **(1)**

Sol. A and B have same alignment of transmission axis.

Lets assume c is introduced at θ angle

$$\frac{I}{2}\cos^2\theta \times \cos^2\theta = \frac{I}{3}$$

$$\cos^4\theta = \frac{2}{3} \quad \Rightarrow \quad \cos\theta = \left(\frac{2}{3}\right)^{1/4}$$

5. The de-Broglie wavelength (λ_B) associated with the electron orbiting in the second excited state of hydrogen atom is related to that in the ground state (λ_G) by :

(1) $\lambda_B = 3\lambda_G$ (2) $\lambda_B = 2\lambda_G$ (3) $\lambda_B = 3\lambda_{G/3}$ (4) $\lambda_B = 3\lambda_{G/2}$

Ans. **(1)**

Sol. $$\frac{\lambda_B}{\lambda_G} = \frac{P_a}{P_B} = \frac{mv_G}{mv_B}$$

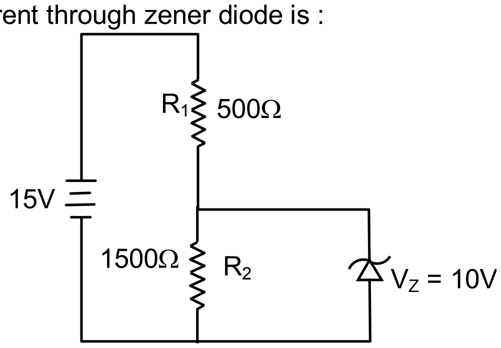
$$V \times \frac{z}{n} \qquad \text{So } \frac{\lambda_B}{\lambda_G} = \frac{n_B}{n_G} = \frac{3}{1}$$

$\lambda_B = 3\,\lambda_G$

Length of Orbit = n × λ

$$\lambda = \frac{2\pi r}{n} \quad \Rightarrow \quad \lambda \propto \frac{1}{n}$$

6. In the given circuit the current through zener diode is :



(1) 3.3mA (2) 2.5mA (3) 5.5mA (4) 6.7mA

Ans. **(1)**

Sol. Current in $R_1 = I_1 = \frac{5}{500}$

$I_1 = 10$ mA

Current in $R_2 = I_2 = \frac{10}{1500} \quad \Rightarrow \quad I_2 = \frac{20}{3}$mA

Current in zener diode $= I_1 - I_2 = \left(10 - \frac{20}{3}\right)\text{mA} = \frac{10}{3}\text{mA}$