

31. Starting with a sample of pure ${}^{66}\text{Cu}$, $\frac{7}{8}$ of it decays into Zn in 15 minutes. The corresponding half-life is

- 1) 15 minutes 2) 10 minutes 3) $7\frac{1}{2}$ minutes 4) 5 minutes

Sol: 4)

$$\frac{7}{8} \text{ days} \quad \therefore \text{remains undecayed} = N = 1 - \frac{7}{8}$$

$$= \frac{1}{8} = \left(\frac{1}{2}\right)^3$$

3 is the no. of half times.

$$n = \frac{t}{T}; \quad 3 = \frac{15}{T}$$

$$T = \text{half life period} = \frac{15}{3} = 5 \text{ minutes}$$

32. A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed $\frac{1}{2}$ m away, the number of electrons emitted by photocathode would

- 1) increase by a factor of 4 2) decrease by a factor of 4
3) increase by a factor of 2 4) decrease by a factor of 2

Sol: 1)

$$I \propto \frac{1}{r^2}; \quad \frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2 = \frac{1}{4}$$

$I_2 \rightarrow 4$ times

When intensity is 4 times, No. of photoelectron limited would increase by 4 times.

33. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm is incident on it. The band gap in (eV) for the semiconductor is

- 1) 2.5 eV 2) 1.1 eV 3) 0.7 eV 4) 0.5 eV

Sol: 4)

$$\Delta E = \frac{hc}{\lambda} = \left(\frac{6.63 \times 10^{-34} \times 3 \times 10^8}{2480 \times 10^{-8}}\right) \times \frac{1}{1.6 \times 10^{-19}} \text{ eV}$$

$$= 0.5 \text{ eV}$$

34. The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to $\frac{I}{8}$.

The thickness of lead which will reduce the intensity to $\frac{I}{2}$ will be

- 1) 9 mm 2) 6 mm 3) 12 mm 4) 18 mm

Sol: 3)

$$I = I_0 \cdot e^{-\mu d}, \text{ applying logarithm both sides}$$

$$-\mu d = \log\left(\frac{I}{I_0}\right)$$

$$-\mu \times 36 = \log \left(\frac{I}{\frac{8}{I}} \right) \quad \dots(1)$$

$$-\mu \times d = \log \left(\frac{I}{\frac{2}{I}} \right) \quad \dots(2)$$

$$\frac{36}{d} = \frac{\log \left(\frac{1}{8} \right)}{\log \left(\frac{1}{2} \right)} = \frac{3 \log \left(\frac{1}{2} \right)}{\log \left(\frac{1}{2} \right)} = 3$$

$$d = \frac{36}{3} = 12 \text{ mm}$$

35. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio $\frac{C_p}{C_v}$ of the mixture is

- 1) 1.62 2) 1.59 3) 1.54 4) 1.4

Sol: 1)

$$\left(\frac{C_p}{C_v} \right)_{m+x} = \frac{x_1 r_1 + x_2 r_2}{x_1 + x_2}$$

$$= \frac{\frac{16}{4} \times \frac{5}{3} + \frac{16}{32} \times \frac{7}{5}}{\frac{16}{4} + \frac{16}{32}}$$

$$= 1.63$$

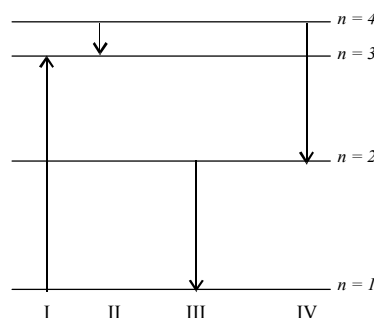
36. In a common base amplifier, the phase difference between the input signal voltage and output voltage is

- 1) π 2) $\frac{\pi}{4}$ 3) $\frac{\pi}{2}$ 4) 0

Sol: 4)

Zero

37. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy?



- 1) IV 2) III 3) II 4) I

41. Two simple harmonic motions are represented by the equations $y_1 = 0.1 \sin \left(100\pi t + \frac{\pi}{3} \right)$ and $y_2 = \cos \pi t$. The phase difference of the velocity of particle 1 with respect to the velocity of particle 2 is

- 1) $\frac{\pi}{3}$ 2) $-\frac{\pi}{6}$ 3) $\frac{\pi}{6}$ 4) $-\frac{\pi}{3}$

Sol: 2)

$$v_1 = 0.1 \times 100\pi \cos \left(100\pi t + \frac{\pi}{3} \right)$$

$$v_2 = -0.1\pi \sin \pi t = 0.1\pi \cos \left(\pi t + \frac{\pi}{2} \right)$$

$$\therefore \text{Phase diff} = \phi_1 - \phi_2$$

$$= \frac{\pi}{3} - \frac{\pi}{2}$$

$$= \frac{2\pi - 3\pi}{6}$$

$$= -\frac{\pi}{6}$$

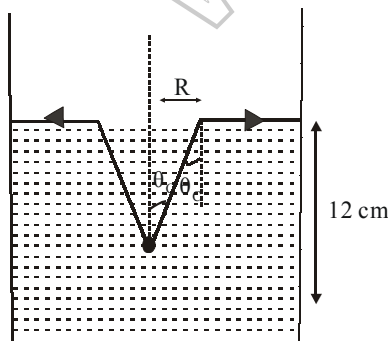
42. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is $\frac{4}{3}$ and the fish is 12 cm below the surface, the radius of this circle in cm is

- 1) $\frac{36}{\sqrt{7}}$ 2) $36\sqrt{7}$ 3) $4\sqrt{5}$ 4) $36\sqrt{5}$

Sol: 1)

$$\sin \theta_c = \frac{1}{\mu} = \frac{3}{4}$$

$$\tan \theta_c = \frac{3}{\sqrt{7}} = \frac{R}{12}$$



$$\Rightarrow R = \frac{36}{\sqrt{7}} \text{ cm}$$

\therefore (1) is correct

