18. The light of two different frequencies whose photons have energies 3.8 eV and 1.4 eV respectively, illuminate a metallic surface whose work function is 0.6 eV successively. The ratio of maximum speeds of emitted electrons for the two frequencies respectivly will be :

(A) 1 : 1 (B) 2 : 1

(C) 4 : 1 (D) 1 : 4

Ans. (B)

Sol. $\sqrt{\frac{3.8-0.6}{1.4-0.6}}=\sqrt{\frac{3.2}{0.8}}=2$

19. Two light beams of intensities in the ratio of 9 : 4 are allowed to interfere. The .ratio of the intensity of maxima and minima will be :

(A) 2 : 3 (B) 16 : 81

(C) 25 : 169 (D) 25 : 1

Ans. (D)

Sol. $\sqrt{\frac{I_1}{I_2}}=\sqrt{\frac{9}{4}}=\frac{3}{2}$

$$\left(\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right)^2=5^2=25$$

20. In Bohr's atomic model of hydrogen, let K. P and E are the kinetic energy, potential energy and total energy of the electron respectively. Choose the correct option when the electron undergoes transitions to a higher level :

(A) All K. P and E increase.

(B) K decreases. P and E increase.

(C) P decreases. K and E increase.

(D) K increases. P and E decrease.

Ans. (B)

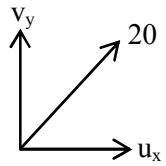
Sol. Based on theory

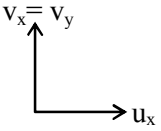
SECTION-B

1. A body is projected from the ground at an angle of 45° with the horizontal. Its velocity after 2s is 20 ms^{-1}. The maximum height reached by the body during its motion is _____m. (use g = 10ms^{-2})

Ans. (20)

Sol.





$v_y = v_x - 20$

$\sqrt{(u_x-20)^2+u_x^2}=20$

$\Rightarrow 2u_x^2-40u_x=0$

$\therefore\ u_x = 20$

2. An antenna is placed in a dielectric medium of dielectric constant 6.25. If the maximum size of that antenna is 5.0 mm. it can radiate a signal of minimum frequency of _____GHz.

(Given $\mu_r = 1$ for dielectric medium)

Ans. (6)

Sol. $C'=\frac{C}{\sqrt{\mu_r\varepsilon_r}}=\frac{3\times10^8}{\sqrt{6.25}}=\frac{3\times10^8}{2.5}$

$f\lambda = 1.25\times10^8$ s

$\Rightarrow f\left(5\times10^{-3}\times4\right)=1.25\times10^8$

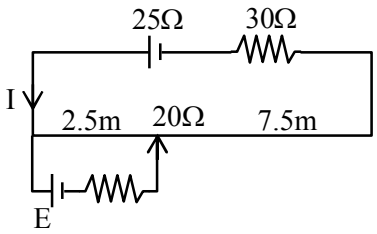
f = 6.25 GHz

So $f\approx6$

3. A potentiometer wire of length 10 m and resistance 20 Ω is connected in series with a 25 V battery and an external resistance 30 Ω . A cell of emf E in secondary circuit is balanced by 250 cm long potentiometer wire. The value of E (in volt) is $\frac{x}{10}$. The value of x is _____.

Ans. (25)

Sol.



$I = \frac{25}{50} = \frac{1}{2}A$

$\therefore \Delta V = 10\ V$

$10\ m \rightarrow 10V$

$2.5m \rightarrow 2.5V$

4. Two travelling waves of equal amplitudes and equal frequencies move in opposite directions along a string. They interfere to produce a stationary wave whose equation is given by

$y = (10 \cos \pi x \sin \frac{2\pi t}{T})$ cm

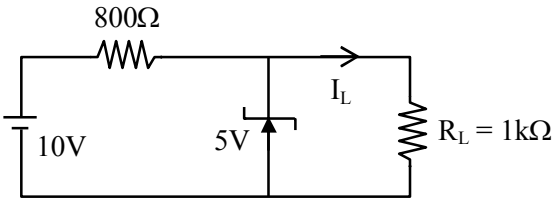
The amplitude of the particle at $x = \frac{4}{3}$ cm will be _____ cm.

Ans. (5)

Sol. $10\cos\left(\frac{4\pi}{3}\right)$

5. In the given circuit- the value of current I_L will be _____ mA.

(When $R_L = 1k\Omega$)



Ans. (5)

Sol. $I_L = \frac{5}{1000} = 5mA$

6. A sample contains 10^{-2} kg each of two substances A and B with half lives 4 s and 8 s respectively. The ratio of then atomic weights is 1 : 2. The ratio of the amounts of A and B after 16 s is $\frac{x}{100}$. the value of x is _____.

Ans. (50)

Sol. $N_t = N_0 (0.5)^{\frac{t}{t_{1/2}}}$

$= \frac{m}{M} \times N_A (0.5)^{\frac{t}{t_{1/2}}}$

$\frac{N_1}{N_2} = \frac{M_2}{M_1}(0.5)^{t\left[\frac{1}{T_A} - \frac{1}{T_B}\right]}$

$= 2(0.5)^{16 \times \frac{1}{8}} = \frac{2}{4} = \frac{1}{2} = \frac{x}{100}$

7. A ray of ligh is incident at an angle of incidence 60° on the glass slab of refractive index $\sqrt{3}$. After refraction, the light ray emerges out from other parallel faces and lateral shift between incident ray and emergent ray is $4\sqrt{3}$ cm. The thickness of the glass slab is _____ cm.

Ans. (12)

Sol. $\ell = t\sin i\left[1-\frac{\cos i}{\sqrt{\mu^2-\sin^2 i}}\right]$

$\Rightarrow 4\sqrt{3} = t\sin 60°\left[1-\frac{\cos 60°}{\sqrt{3-\frac{3}{4}}}\right]$

8. A circular coil of 1000 turns each with area $1m^2$ is rotated about its vertical diameter at the rate of one revolution per second in a uniform horizontal magnetic field of 0.07T. The maximum voltage generation will be _____V.

Ans. (440)

Sol. $\in_{max} = BAN\omega$

$= 0.07 \times 1 \times 10^3 \times 2\pi$

$= 140\pi \approx 440$

9. A monoatomic gas performs a work of $\frac{Q}{4}$ where Q is the heat supplied to it. The molar heat capaticy of the gas will be _____R during this transformation.

Where R is the gas constant.

Ans. (2)

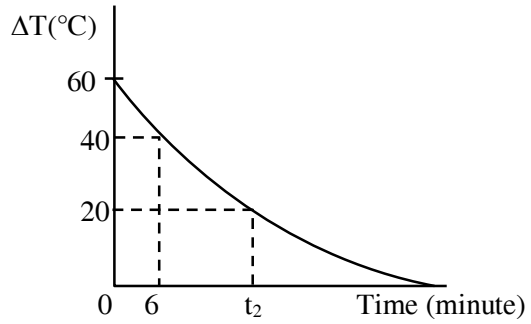
Sol. $\Delta Q = \Delta E + WD \Rightarrow Q = \Delta E + \frac{Q}{4}$

$\Rightarrow n\frac{3R}{2}\Delta T = \Delta E = \frac{3Q}{4}$

$\therefore n\Delta T = \frac{Q}{2R}$

$\therefore C = 2R$

10. In an experment ot verify Newton's law of cooling, a graph is plotted between, the temperature difference (ΔT) of the water and surroundings and time as shown in figure. The initial temperature of water is taken as 80°C. The value of t_2 as mentioned in the graph will be _____.



Ans. (16)

Sol. $T - T_0 (T_i - T_0)\, e^{-\frac{Bt}{ms}}$

$6\lambda = \ln 1.5$

$40 = 60e^{-\lambda(6)} \Rightarrow 6\lambda = \ln 1.5$

$20 = 60e^{-\lambda t_2} \Rightarrow t_2\,\lambda = \ln 3$

$\frac{t_2}{6} = \frac{\ln 3}{\ln 1.5}$

$\therefore t_2 = 16.25$ min

So ≈ 16