DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 8

Topic :- Dual nature of radiation and matter

2 **(a)**

According to Einstein's photoelectric equation

$$eV = hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$$

Ist case $3eV_s = hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_0}\right]$ ...(i)

IInd case $eV_s = hc\left[\frac{1}{2\lambda} - \frac{1}{\lambda_0}\right]$ ...(ii)

Dividing Eq. (i)by Eq. (ii), we get

$$\lambda_0 = 4\lambda$$

3 **(d)**

$K_{\max}$ of photoelectrons doesnot depend upon intensity of incident light.

4 **(b)**

$\frac{\lambda_1}{\lambda_2} = \frac{\frac{h}{\sqrt{2mE}}}{\frac{hc}{E}}$ or $\frac{\lambda_1}{\lambda_2} \propto E^{1/2}$

6 **(b)**

$$p = \frac{E}{c} = \frac{hv}{c}$$

7 **(d)**

The mass of electron is about $\frac{1}{1836}$ times that of a neutron and angular momentum of electron is quantised in the hydrogen atoms but not the linear momentum of electron

8 **(d)**

$$hv - W_0 = \frac{1}{2}mv_{\max}^2 \Rightarrow \frac{hc}{\lambda} - \frac{hc}{\lambda_0} = \frac{1}{2}mv_{\max}^2$$

$$\Rightarrow hc\left(\frac{\lambda_0-\lambda}{\lambda\lambda_0}\right)=\frac{1}{2}mv_{\max}^2 \Rightarrow v_{\max}=\sqrt{\frac{2hc}{m}\left(\frac{\lambda_0-\lambda}{\lambda\lambda_0}\right)}$$

When wavelength is λ and velocity is v, then

$$v=\sqrt{\frac{2hc}{m}\left(\frac{\lambda_0-\lambda}{\lambda\lambda_0}\right)} \quad ...(i)$$

When wavelength is $\frac{3\lambda}{4}$ and velocity is v' then

$$v'=\sqrt{\frac{2hc}{m}\left[\frac{\lambda_0-(3\lambda/4)}{(3\lambda/4)\times\lambda_0}\right]} \quad ...(ii)$$

Divide equation (ii) by (i), we get

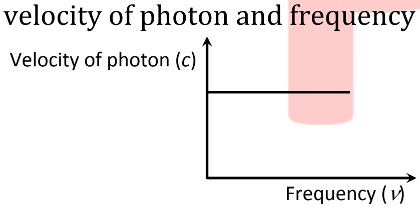
$$\frac{v'}{v}=\sqrt{\frac{[\lambda_0-(3\lambda/4)]}{\frac{3}{4}\lambda\lambda_0}\times\frac{\lambda\lambda_0}{\lambda_0-\lambda}}$$

$$v'=v\left(\frac{4}{3}\right)^{1/2}\sqrt{\frac{[\lambda_0-(3\lambda/4)]}{\lambda_0-\lambda}}$$

$$i.e.\ v'>v\left(\frac{4}{3}\right)^{1/2}$$

9 **(a)**

Velocity of photon (*i.e.* light) does not depend upon frequency. Hence the graph between velocity of photon and frequency will be as follows



10 **(b)**

$$\lambda_{\min}=\frac{hc}{eV}\Rightarrow\lambda_1=\frac{hc}{eV_1} \text{ and } \lambda_2=\frac{hc}{eV_2}$$

$\therefore \Delta\lambda=\lambda_2-\lambda_1=\frac{hc}{e}\left[\frac{1}{V_2}-\frac{1}{V_1}\right]$. Given $V_2=1.5\,V_1$

on solving we get $V_1=16000\ volt=16\ kV$

12 **(a)**

$$\lambda_{\min}=\frac{12375}{40\times10^3}=0.309\ \text{Å}\approx0.31\ \text{Å}$$

13 **(a)**

Energy of photon, $E=h\nu=\frac{hc}{\lambda_{Ph}}$

where λ_{Ph} is the wavelength of a photon $\lambda_{ph} = \frac{hc}{E}$

Wavelength of the electron, $\lambda_e = \frac{h}{\sqrt{2mE}}$

$$\therefore \frac{\lambda_{Ph}}{\lambda_e} = \frac{hc}{E} \times \frac{\sqrt{2mE}}{h} = c\sqrt{\frac{2m}{E}}$$

14 **(b)**

For electron and positron pair production, minimum energy is 1.02 MeV

Energy of photon is given $1.7 \times 10^{-3} J = \frac{1.7 \times 10^{-13}}{1.6 \times 10^{-19}}$

$= 1.06\ MeV$

Since energy of photon is greater than 1.02 MeV

So electron positron pair will be created

15 **(d)**

Velocity of photon $c = v\lambda$

16 **(d)**

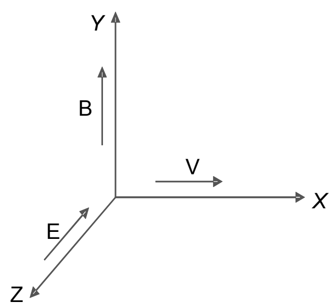
According to Einstein's equation

$$hv = W_o + K_{max} \Rightarrow V_o = \left(\frac{h}{e}\right)v - \frac{W_o}{e}$$

This is the equation of straight line having positive slope (h/e) and intercept on $-V_o$ axis, equal to $\frac{W_o}{e}$

18 **(a)**

The force on a particle is



So, $\boldsymbol{F} = \mathrm{q}(\boldsymbol{E} + \boldsymbol{v} \times \boldsymbol{B})$

or $\mathbf{F} = \mathbf{F}_\mathrm{e} + \mathbf{F}_\mathrm{m}$

$\mathbf{F}_\mathrm{e} = \mathrm{q}\mathbf{E}$

$= -16 \times 10^{-18} \times 10^4(-\hat{k})$

$= 16 \times 10^{-14}\hat{k}$

and $\mathbf{F}_\mathrm{m} = -16 \times 10^{-18}(10\hat{\mathrm{i}} \times B\hat{\mathrm{j}})$

$= -16 \times 10^{-17} \times B(+\hat{\mathrm{k}})$

$= -16 \times 10^{-17} B \times \hat{\mathrm{k}}$

Since, particle will continue to move along $+x$-axis, so resultant force is equal to 0.

$$\mathbf{F}_e + \mathbf{F}_m = 0$$

$\therefore \quad 16 \times 10^{-14} = 16 \times 10^{-17} B$

$\Rightarrow \quad B = \frac{16 \times 10^{-14}}{16 \times 10^{-17}} = 10^3$

$$B = 10^3 \text{Wb-m}^{-2}$$

19 **(c)**

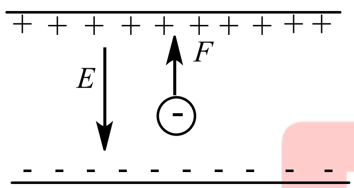
$E = hv/\lambda = \frac{hc}{e\lambda}$ (in eV)

$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 0.21} = 5.9 \times 10^{-6}$ eV

20 **(b)**

Electric force *(F)* is straight forwarded, given by

$$F = qE$$



Where, q is charge and E is electric field.

Given, $\quad q = 3e$

$\therefore \quad F = 3eE \quad$ ...(i)

From Newton's law, force experienced by a particle of mass $2m$ witn acceleration a is

$$F = 2ma \text{....(ii)}$$

Equating Eqs. (i) and (ii) we get

$$3eE = 2ma$$

$\Rightarrow \quad a = \frac{3eE}{2m}$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	A	A	D	B	B	B	D	D	A	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	A	A	B	D	D	A	A	C	B