DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 3

Topic :- Dual nature of radiation and matter

2 **(b)**

With the increase in intensity of light photoelectric current increases, but kinetic energy of ejected electron, stopping potential and work function remains unchanged

3 **(c)**

The wavelength of X-ray lines is given by Rydberg

Formula $\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

For K_α line, $n_1 = 1$ and $n_2 = 2$

$\therefore \frac{1}{\lambda} = RZ^2\left(\frac{3}{4}\right) \Rightarrow Z = \left(\frac{4}{3R\lambda}\right)^{1/2}$

$= \left[\frac{4}{3(1.097 \times 10^7 m^{-1})(0.76 \times 10^{-10} m)}\right]^{1/2} = 39.99 \approx 40$

4 **(d)**

$\Delta\lambda = \lambda_{K_\alpha} - \lambda_{\min}$ When V is halved $\lambda_{\min}$ becomes two time but λ_{K_α} remains the same.

$\therefore \Delta\lambda' = \lambda_{K_\alpha} - 2\lambda_{\min} = 2(\Delta\lambda) - \lambda_{K_\alpha}$

$\therefore \Delta\lambda' < 2(\Delta\lambda)$

5 **(c)**

X-rays are electromagnetic waves of wavelength ranging from 0.1 to 100Å

6 **(d)**

$qE = mg$ ... (i)

$6\pi\eta rv = mg$

$\frac{4}{3}\pi r^3 \rho g = mg$ ... (ii) $\therefore$

$r = \left(\frac{3mg}{4\pi\rho g}\right)^{1/3}$ ... (iii)

Substituting the value of r in Eq. (ii), we get

$$6\pi\eta v\left(\frac{3mg}{4\pi\rho g}\right)^{1/3} = mg$$

or $$(6\pi\eta v)^3\left(\frac{3mg}{4\pi\rho g}\right) = (mg)^3$$

Again substituting $mg = qE$, we get

$$(qE)^2 = \left(\frac{3}{4\pi\rho g}\right)(6\pi\eta v)^3$$

Or $$qE = \left(\frac{3}{4\pi\rho g}\right)^{1/2}(6\pi\eta g)^{3/2}$$

$\therefore$ $$q = \frac{1}{E}\left(\frac{3}{4\pi\rho g}\right)^{\frac{1}{2}}(6\pi\eta v)^{3/2}$$

Substituting the values, we get

$$q=\frac{7}{81\pi\times 10^5}\sqrt{\frac{3}{4\pi\times 900\times 9.8}\times 216\pi^3}\times\sqrt{(1.8\times 10^{-5}\times 2\times 10^{-3})^3}=8.0\times 10^{-19}\text{ C}$$

7 **(c)**

$$K.E.=2\,E_0-E_0=E_0\text{ (for }0\le x\le 1)\Rightarrow\lambda_1=\frac{h}{\sqrt{2mE_0}}$$

$$K.E.=2E_0(\text{for }x>1)\Rightarrow\lambda_2=\frac{h}{\sqrt{4mE_0}}\Rightarrow\frac{\lambda_1}{\lambda_2}=\sqrt{2}$$

8 **(c)**

Among the given metals, aluminium thermionically emits an electron at a relatively lowest temperature

9 **(c)**

Speed obtained by the particle after falling through a potential difference of V volt is

$$v_A=\sqrt{\frac{2Vq}{m}}\ \dots(i)$$

And $$v_B=\sqrt{\frac{2V\times 4q}{m}}\ \dots\text{(ii)}$$

Now dividing Eq. (i) by Eq. (ii), we get

$$\frac{v_A}{v_B}=\sqrt{\frac{1}{4}}=\frac{1}{2}$$

So, $v_A:v_B=1:2$

10 **(a)**

$$\frac{u_1}{u_2}=\frac{1}{2}$$

Accelerations of cathode rays in electric field, $\vec{a}=\frac{eE}{m}$

It is same for both the cathode rays

As displacement, $s=ut+\frac{1}{2}at^2$

So for a given value of a and $t, s\times u$

So, $\frac{s_1}{s_2}=\frac{u_1}{u_2}=\frac{1}{2}$

11 **(b)**

Here, $\lambda_0=200\text{nm};\ \lambda=100\text{nm};$

$hc/e\ =\ 1240\text{eV nm}$

maximum KE $=\frac{hc}{\lambda e}-\frac{hc}{\lambda_0 e}$ (in eV)

$$=\frac{hc}{e}\left(\frac{1}{\lambda}-\frac{1}{\lambda_0}\right)$$

$$=1240\left(\frac{1}{100}-\frac{1}{200}\right)$$

$$=6.2\text{ eV}$$

12 **(c)**

According to J. J. Thomson's cathode ray tube experiment the e/m of electrons is much greater than thee/m of protons.

14 **(b)**

Maximum KE= $\frac{hc}{\lambda} - \phi_0$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{400 \times 10^{-10}} \times \frac{1}{1.6 \times 10^{-19}} - 2 = 1.1 \text{ eV}$$

15 **(c)**

$\lambda = \frac{h}{\sqrt{2mE}} = \frac{h}{\sqrt{2m}} \cdot \frac{1}{\sqrt{E}}$. Taking log of both sides

$$\log \lambda = \log \frac{h}{\sqrt{2m}} + \log \frac{1}{\sqrt{E}} \Rightarrow \log \lambda = \log \frac{h}{\sqrt{2m}} - \frac{1}{2} \log E$$

$$\Rightarrow \log \lambda = -\frac{1}{2} \log E + \log \frac{h}{\sqrt{2m}}$$

This is the euation of straight line having slope $(-1/2)$ and positive intercept on $\log \lambda$ axis

16 **(b)**

Cut-off wavelength depends on the applied voltage not on the atomic number of the target. Characteristic wavelengths depends on the atomic number of target.

17 **(c)**

For k_α emission
transition L shell to $k -$ shell
For k_β emission
transition M shell to $k -$ shell
For L_α emission
transition M shell to $L -$ shell

$E_M - E_K = (E_M - E_L) + (E_L - E_K)$

$\Rightarrow hf_2 = hf_3 + hf_1 \Rightarrow f_2 = f_1 + f_3$

18 **(a)**

Number of photons emitted per second

$$n = \frac{p}{hv} = \frac{10 \times 10^3}{6.6 \times 10^{-34} \times 880 \times 10^3} = 1.72 \times 10^{31}$$

19 **(a)**

$$p = \frac{h}{\lambda} = \frac{6.6 \times 10^{-34}}{4400 \times 10^{-10}} = 1.5 \times 10^{-27} kg.m/s$$

and mass $m = \frac{p}{c} = \frac{1.5 \times 10^{-27}}{3 \times 10^8} = 5 \times 10^{-36} kg$

20 **(a)**

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

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