ARJUNA NEET BATCH

Structure of Atom

DPP-04

1. What is the work function (W_0) of the metal whose threshold frequency (v_0) is $5.2 \times 10^{14} s^{-1}$?

~~(A)~~ 3.44×10^{-19} J

(B) 4.98×10^{-19} J

(C) 5.67×10^{14} J

(D) 9.96×10^{19} J

v_0 = threshold frequency
h = planck's constant
$h = 6.626 \times 10^{-34}$ Js

Work function $(W_0) = h v_0$

$W_0 = 6.626 \times 10^{-34}\ \text{Js} \times 5.2 \times 10^{14}\ s^{-1}$

$$\boxed{W_0 = 3.44 \times 10^{-19}\ J}$$ Ans

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2. A 100 watt bulb emits monochromatic light of wavelength 400 nm. Calculate the number of photons emitted per second by the bulb.

Power ... λ

(A) 1.6×10^{19}

(B) 2.9×10^{16}

(C) 2.012×10^{20}

(D) 4.42×10^{19}

$$\text{Power} = 100 \text{ watt} = 100\ J\,s^{-1} \qquad (1 \text{ watt} = 1\ J\,s^{-1})$$

Energy = 100 J in 1 second.

$$E = \frac{nhc}{\lambda}$$

n = no. of photons per second

h = planck's constant

c = speed of light $= 3 \times 10^8\ m/s$

$\lambda = 400\ nm$

$1\ nm = 10^{-9}\ m$

$\lambda = 400 \times 10^{-9}\ m$

$$100 = \frac{n \times 6.626 \times 10^{-34} \times 3 \times 10^8}{400 \times 10^{-9}}$$

$$n = \frac{100}{4.969 \times 10^{-19}}$$

$n = 2.012 \times 10^{20}$ photons per second

K.E.

3. Calculate the maximum kinetic energy of photoelectrons emitted when a light the frequency 2×10^{16} Hz irradiated on a metal surface with threshold frequency (v_0) equal to 8.68×10^{15} Hz.

(A) 7.5×10^{-18} J (B) 4.2×10^{19} J

(C) 2.9×10^{14} J (D) 10.6×10^{4} J

$\nu = 2 \times 10^{16}$ Hz (s^{-1})

$\nu_0 = 8.68 \times 10^{15}$ Hz (s^{-1})

Acc. to photoelectric effect :

$$h\nu = h\nu_0 + K.E.$$

$$K.E. = h\nu - h\nu_0$$

$$K.E. = h(\nu - \nu_0)$$

$$K.E. = 6.626 \times 10^{-34}\left[(2 \times 10^{16}) - (8.68 \times 10^{15})\right]$$

$$\boxed{K.E. = 7.5 \times 10^{-18}\ J}$$

4. **The threshold frequency ν_0 for a metal is $8 \times 10^{14}\ s^{-1}$. What is the kinetic energy of an electron emitted having frequency $\nu = 1.0 \times 10^{15}\ s^{-1}$.**

K.E.

Photoelectric effect

$$K.E. = h(\nu - \nu_0)$$

$$= 6.626 \times 10^{-34} \left[(10^{15}) - (8 \times 10^{14}) \right]$$

$$= 6.626 \times 10^{-34} \times 2 \times 10^{14}$$

$$\boxed{K.E. = 1.2 \times 10^{-19}\ J}$$

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5. **A hot metal emits photons of light with energy 3.0×10^{-19} J. Calculate the frequency and wavelength of the photon?**

E

ν λ

$E = h\nu$

$3 \times 10^{-19} = 6.626 \times 10^{-34} \times \nu$

$\nu = \dfrac{3 \times 10^{-19}\ \text{J}}{6.626 \times 10^{-34}\ \text{Js}}$

$\boxed{\nu = 4.53 \times 10^{14}\ s^{-1}}$

$\lambda = \dfrac{c}{\nu}$ → speed of light $= 3 \times 10^{8}$ m/s

$\lambda = \dfrac{3 \times 10^{8}}{4.5 \times 10^{14}}$

$\boxed{\lambda = 6.626 \times 10^{-7}\ m}$

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6. **Calculate the energy of photon of light having frequency of 2.7 × 10^{13} s^{-1}**

$E = h\nu$

$E = 6.626 \times 10^{-34} \times 2.7 \times 10^{13}$

$\boxed{E = 1.78 \times 10^{-20}\ J}$

for 1 photon

1 mole

7. **Calculate the energy of one mole of photons of radiation whose frequency is 5×10^{14} Hz** (s^{-1})

ν

Energy of 1 photon $= h\nu$

$= 6.626 \times 10^{-34} \times 5 \times 10^{14}$

$= 3.314 \times 10^{-19}$ J

1 mole $= 6.022 \times 10^{23}$ photons $\Rightarrow (N_A)$ photons

Energy of 1 mole photon $= 3.314 \times 10^{-19} \times 6.022 \times 10^{23}$

$= 199508.86$ J/mole

$= 199.5$ KJ/mole

$\left(1 \text{ J} = \frac{1}{1000} \text{ KJ}\right)$ $\simeq 199$ KJ/mole

8. **Photoelectrons are removed with kinetic energy 1.8664×10^{-21} J, when photons of light with energy 4.23×10^{-19} J fall on the metal. What is the minimum energy required per mole to remove an electron from potassium metal?**

E

K.E.

work function.

Photoelectric effect : $h\nu = h\nu_0 + KE.$

$h\nu_0 = h\nu - K.E.$

$w_0 = E - K.E.$

$= (4.23 \times 10^{-19}) - (1.8664 \times 10^{-21})$

$W_0 = 4.211 \times 10^{-19}$ J $\rightarrow$ for 1 photoelectron.

1 mole = N_A electrons = 6.022×10^{23} photo electrons

W_0 for 1 mole = $4.211 \times 10^{-19} \times 6.022 \times 10^{23}$

$W_0 = 253608$ J/mol

$\boxed{W_0 = 253.60 \text{ KJ/mol.}}$

$\left(1J = \frac{1}{1000} kJ\right)$

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9. The correct sequence of frequency of the electromagnetic radiations in electromagnetic spectrum is

(A) X-rays > UV rays > Microwaves >Radio waves

(B) Radio waves > Microwaves > UV rays > X-rays

(C) UV rays > X-rays > Radio waves > Microwaves

(D) Radio waves > Microwaves > X-rays UV rays

$\xleftarrow{\text{frequency}}$

γ-rays	X-rays	UV	IR	Microwave	Radiowaves.

frequency increases from Radiowaves to γ-rays.

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10. **The kinetic energy of the photoelectrons depends upon the**

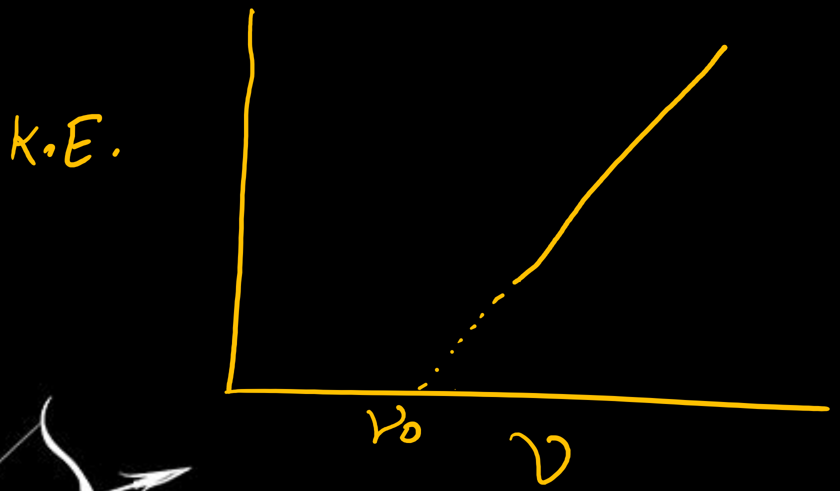
(A) Intensity of striking light

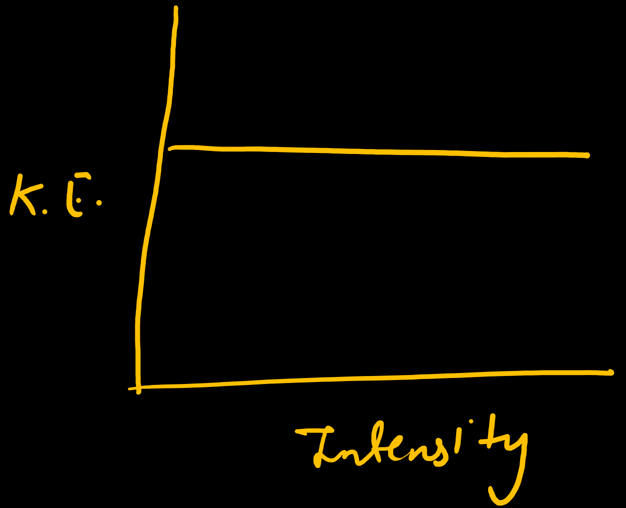
(B) Number of photons striking

(C) Frequency of striking light

(D) Number of photoelectrons ejected

K.E. → depends on frequency of light (photoelectrons)





ν_0 : Threshold frequency.

Thank You