# ARJUNA NEET BATCH

## Structure of Atom

DPP-05

1. An isotone of $^{76}_{32}Ge$ is

(A) $^{77}_{32}Ge$ (B) ~~$^{77}_{33}As$~~

(C) $^{77}_{34}Se$ (D) $^{80}_{34}Se$

$^{A}_{Z}E$

A = Mass number
Z = Atomic number

Isotones : Atoms of different elements with the same no. of neutrons but different mass number.

No. of neutrons = A − Z

$^{76}_{32}Ge \Rightarrow \boxed{A = 76}$
no. of neutrons = 76 − 32 = 44

(A) $^{77}_{32}Ge \Rightarrow$ A = 77
no. of neutrons = 77 − 32 = 45

~~(B)~~ $^{77}_{33}As \Rightarrow \boxed{A = 77}$
no. of neutrons = 77 − 33 = 44

(C) $^{77}_{34}Se \Rightarrow$ A = 77
A − Z = 77 − 34 = 45

(D) $^{80}_{34}Se \Rightarrow$ A = 80
A − Z → neutrons
= 80 − 34
= 46

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2. The ratio of specific charge of an electron to that of a proton is

(A) 1:1 (B) 1837: 1

(C) 1:1837 (D) 2:1

Specific Charge = $\frac{\text{Charge}}{\text{Mass}}$

Relative charge of proton = +1

" " " electron = −1

Mass of electron (u) = 0.00054 = $\frac{1}{1837}$

" " proton (u) = 1

specific charge of electron = $\frac{1 \times 1837}{1}$

" " " proton = $\frac{1}{1}$

Ratio of specific charge of electron to that of proton

$= \frac{1837 \times 1}{1 \times 1}$

$\Rightarrow \boxed{1837:1}$

3. **Atomic number and mass number of an element M are 25 and 52 respectively. The number of electrons, protons and neutrons in $M^{2+}$ ion are respectively**

(A) ~~25, 25 and 27~~ (B) ~~25, 27 and 25~~

(C) ~~27, 25 and 27~~ (D) 23, 25 and 27 ✓

(Z) Atomic no. = no. of protons = no. of electrons in neutral atom

$M^{2+} \longrightarrow$ It has lost 2 electrons

No. of electrons in $M^{2+}$ = $25 - 2 = \boxed{23}$

No. of protons = Z = $\boxed{25}$

No. of Neutrons = Mass number (A) − Atomic Number (Z)

= 52 − 25

= $\boxed{27}$

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4. The frequency of a wave is $6 \times 10^{15}\ s^{-1}$. Its wave number would be

(A) $105\ cm^{-1}$

(B) $2 \times 10^{7}\ m^{-1}$

(C) $2 \times 10^{7}\ cm^{-1}$

(D) $2 \times 10^{5}\ m^{-1}$

wave number $(\bar{\nu}) = \frac{1}{\lambda}$

$$\boxed{\lambda = \frac{c}{\nu}}$$

$$\frac{1}{\lambda} = \frac{\nu}{c}$$

c = speed of light

$c = 3 \times 10^{8}\ m/s$

$$\bar{\nu} = \frac{\nu}{c}$$

$$= \frac{\cancel{6}^{2} \times 10^{15}\ \cancel{s^{-1}}}{\cancel{3} \times 10^{8}\ m\ \cancel{s^{-1}}}$$

$$\boxed{\bar{\nu} = 2 \times 10^{7}\ m^{-1}}$$

$\rightarrow$ 1 m = 100 cm

$$\boxed{\bar{\nu} = 2 \times 10^{5}\ cm^{-1}}$$

5. The number of photons of light of wavelength 7000 Å equivalent to 1 J are

(A) $3.52 \times 10^{-18}$ ✗ (B) ~~$3.52 \times 10^{18}$~~

(C) 50,000 (D) 10,0000

$$E = \frac{n\,hc}{\lambda}$$

$$1 = \frac{n \times 6.626 \times 10^{-34} \times 3 \times 10^{8}}{7 \times 10^{-7}}$$

$$n = \frac{7 \times 10^{-7}}{6.626 \times 10^{-34} \times 3 \times 10^{8}}$$

$$\boxed{n = 3.52 \times 10^{18}}$$

$1\,\text{Å} = 10^{-10}\,m$

$7000\,\text{Å} = 7000 \times 10^{-10}\,m$

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

$n$ = no. of photons

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

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

$E$ = energy = 1J

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6. **The threshold energy is given as $E_0$ and radiation of energy E falls on metal, then K.E. is given as**

(A) $\frac{E - E_0}{2}$

(B) $E - E_0$

(C) $E_0 - E$

(D) $\frac{E}{E_0}$

According to photoelectric effect

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

$E = E_0 + K.E.$

$$\boxed{K.E. = E - E_0}$$

$\nu$ = frequency

$h\nu$ = Energy = E

$\nu_0$ = Threshold frequency

$h\nu_0$ = Threshold energy (work function) = $E_0$

K.E. = kinetic energy

7. If threshold wavelength ($\lambda_0$) for ejection of electron from metal is 330 nm, then work function for the photoelectric emission is

(A) $6 \times 10^{-10}$ J ✗ (B) $1.2 \times 10^{-18}$ J ✗

(C) $3 \times 10^{-19}$ J ✗ (D) $6 \times 10^{-19}$ J

$\lambda_0 = 330\,nm$

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

$$\boxed{\lambda_0 = 330 \times 10^{-9}\,m}$$

$(w_0)$ work function $= h\nu_0 = \dfrac{hc}{\lambda_0}$

$$= \frac{6.626 \times 10^{-34}\,Js \times 3 \times 10^{8}\,ms^{-1}}{330 \times 10^{-9}\,m}$$

$$= 6.02 \times 10^{-19}\,J$$

$$\boxed{w_0 \approx 6 \times 10^{19}\,J}$$

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8. A certain metal when irradiated with light ($\nu = 3.2 \times 10^{16}$ Hz) emits photo electrons with twice kinetic energy as did photo electrons when the same metal is irradiated by light ($\nu = 2.0 \times 10^{16}$ Hz). Calculate $\nu 0$ of electron ?

frequency

$\rightarrow \nu_0$ is same

K.E 1

(A) $1.2 \times 10^{14}$ Hz ✗

(B) $8 \times 10^{15}$ Hz

(C) $1.2 \times 10^{16}$ Hz ✗

(D) $4 \times 10^{12}$ Hz ✗

According to photoelectric effect $\Rightarrow$ $K.E. = h\nu - h\nu_0 \Rightarrow K.E. = h(\nu - \nu_0)$

$K.E_1 = y$ , $K.E._2 = 2y$

$\nu_1 = 2 \times 10^{16}$ Hz, $\nu_2 = 3.2 \times 10^{16}$ Hz

$K.E_1 = h(\nu_1 - \nu_0)$ —— (1)

$K.E._2 = h(\nu_2 - \nu_0)$ — (2)

Divide (1) and (2) and put values

$$\frac{\cancel{y}}{2\cancel{y}} = \frac{\cancel{h}(2 \times 10^{16} - \nu_0)}{\cancel{h}(3.2 \times 10^{16} - \nu_0)}$$

$$\frac{1}{2} = \frac{(2 \times 10^{16}) - \nu_0}{(3.2 \times 10^{16}) - \nu_0}$$

$3.2 \times 10^{16} - \nu_0 = 4 \times 10^{16} - 2\nu_0$

$2\nu_0 - \nu_0 = 4 \times 10^{16} - 3.2 \times 10^{16}$

$\nu_0 = (4 - 3.2)10^{16}$

$\nu_0 = 0.8 \times 10^{16}$ Hz

$$\boxed{\nu_0 = 8 \times 10^{15} \text{ Hz}}$$

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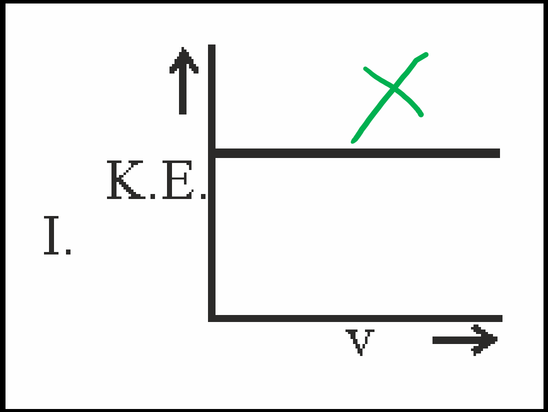
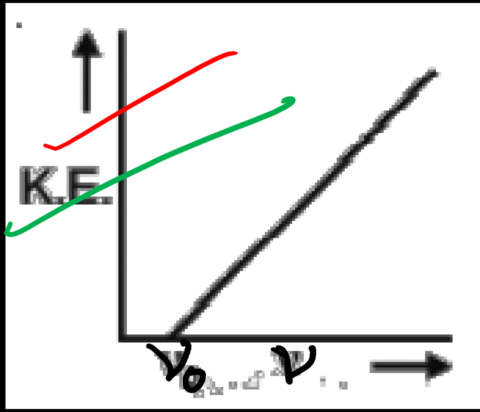
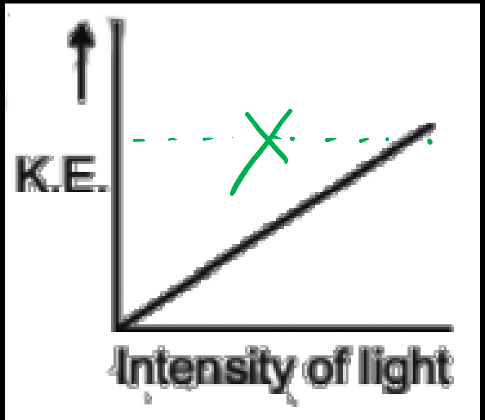
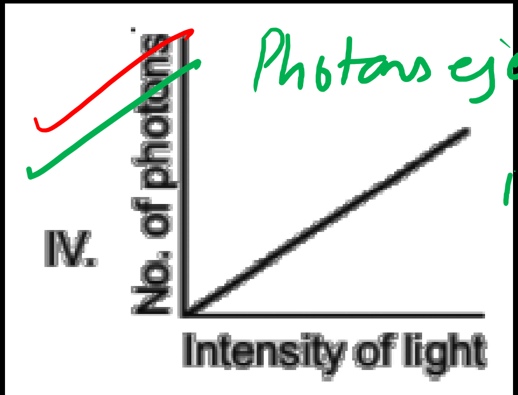
9. **Which is the correct graphical representation based on photoelectric effect?**




Photons ejected $\propto$ Intensity

(A) I & II

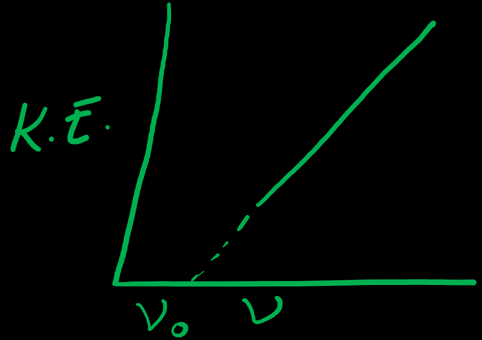
(B) II & III

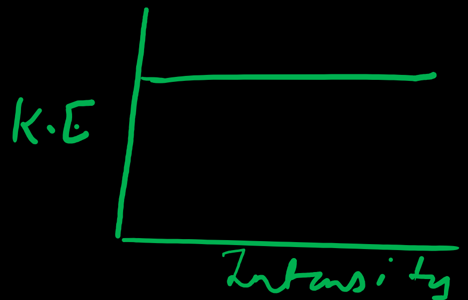
(C) III & IV

(D) II & IV

K.E. of ejected electrons depends on the frequency of light used.

K.E. doesnot depends on intensity.




No. of photons $\propto$ Intensity but does not depends on frequency

10. Which one of the following is not isoelectronic with $O^{2-}$

(A) $Mg^+$ (B) $Na^+$

(C) $N^{3-}$ (D) $F^-$

Isoelectronic → same no. of electrons

$Z$ = Atomic no. = no. of electrons in neutral atom

$O^{2-}$ → 2- charge means it has gained 2 electrons

no. of electrons = $Z + 2 = 8 + 2 = \boxed{10}$

(A) $Mg^+$ → lost an electron

No. of $e^-$ = $Z - 1 = 12 - 1 = \boxed{11}$ → not isoelectronic with $O^{2-}$

(B) $Na^+$ → lost an electron

no. of $e^-$ = $Z - 1 = 11 - 1 = \boxed{10}$

(C) $N^{3-}$ → gained 3 electrons

no. of $e^-$s = $Z + 3 = 7 + 3 = \boxed{10}$

(D) $F^-$ = gained 1 electron

no. of $e^-$ = $9 + 1 = \boxed{10}$

Isoelectronic with $O^{2-}$

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Thank You