Q1 2021 (01 Sep Shift 2)

A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is $x \times 10^{20}$. The value of x is ____.
[Given : $h = 6.63 \times 10^{-34}$Js and $c = 3.0 \times 10^{8}$ ms^{-1}]

Q2 2021 (31 Aug Shift 2)

The value of magnetic quantum number of the outermost electron of Zn^{+}ion is ____.

Q3 2021 (31 Aug Shift 1)

Ge(Z = 32) in its ground state electronic configuration has x completely filled orbitals with $m_l = 0$. The value of x is ____.

Q4 2021 (27 Aug Shift 2)

The number of photons emitted by a monochromatic (single frequency) infrared range finder of power 1 mW and wavelength of 1000 nm, in 0.1 second is $x \times 10^{13}$. The value of x is ____. (Nearest integer)
$(h = 6.63 \times 10^{-34}$Js, $c = 3.00 \times 10^{8}$ $ms^{-1})$

Q5 2021 (27 Aug Shift 1)

The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is equal to $\frac{h^2}{xma_0^2}$. The value of 10x is ____. (a_0 is radius of Bohr's orbit)

(Nearest integer) [Given : $\pi = 3.14$]

Q6 2021 (26 Aug Shift 2)

A metal surface is exposed to 500 nm radiation. The threshold frequency of the metal for photoelectric current is 4.3×10^{14} Hz. The velocity of ejected electron is ____$\times 10^{5}$ ms^{-1} (Nearest integer)
[Use : $h = 6.63 \times 10^{-34}$Js, $m_e = 9.0 \times 10^{-31}$ kg]

Q7 2021 (26 Aug Shift 1)

Given below are two statements.

Statement I: According to Bohr's model of an atom, qualitatively the magnitude of velocity of electron increases with decrease in positive charges on the nucleus as there is no strong hold on the electron by the nucleus.

Statement II: According to Bohr's model of an atom, qualitatively the magnitude of velocity of electron increases with decrease in principal quantum number.

In the light of the above statements, choose the *most appropriate* answer from the options given below:

(1) Both *Statement* I and *Statement* II are false

(2) Both *Statement* I and *Statement* II are true

(3) *Statement* I is false but *Statement* II is true

(4) *Statement* I is true but *Statement* II is false

Answer Key

Q1 (2) **Q2** (0) **Q3** (7) **Q4** (50)

Q5 (3155) **Q6** (5) **Q7** (3)

Q1 (2)

Total energy per sec. $= 50$ J

$50 = \frac{n \times 6.63 \times 10^{-34} \times 3 \times 10^{8}}{795 \times 10^{-9}}$

$n = 1998.49 \times 10^{17}$ [n = no. of photons per second]

$= 1.998 \times 10^{20}$

$\simeq 2 \times 10^{20}$

$= x \times 10^{20}$

$x = 2$

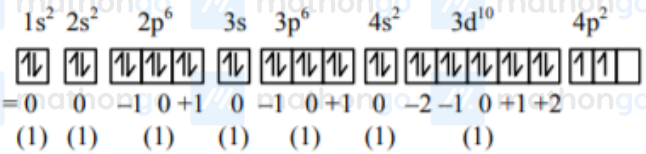
Q2 (0)

$Zn^{+} \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$

Outermost electron is in 4 s subshell

$m = 0$

Q3 (7)



Completely filled orbital with $m_\ell = 0$ are

$= 1 + 1 + 1 + 1 + 1 + 1 + 1$

$= 7$

So Answer is 7

Q4 (50)

Energy emitted in 0.1sec.

$= 0.1 \text{ sec.} \times 10^{-3} \frac{J}{s}$

$= 10^{-4}$ J

If $'n'$ photons of $\lambda = 1000$ nm are emitted,

$\text{then}\ ; 10^{-4} = \text{n} \times \frac{\text{hc}}{\lambda}$

$\Rightarrow 10^{-4} = \frac{\text{n} \times 6.63 \times 10^{-34} \times 3 \times 10^{8}}{1000 \times 10^{-9}}$

$\Rightarrow \text{n} = 5.02 \times 10^{14} = 50.2 \times 10^{13}$

$\Rightarrow 50$ (nearest integer)

Q5 (3155)

$\text{mvr} = \frac{\text{nh}}{2\pi}$

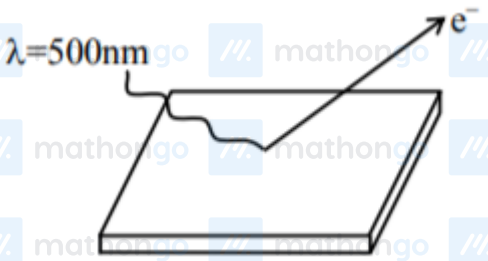
$\text{K.E.} = \frac{n^2h^2}{8\pi^2mr^2} = \frac{4h^2}{8\pi^2m(4a_0)^2}$

$= \left(\frac{4}{8\pi^2 \times 16}\right) \frac{\text{h}^2}{\text{ma}_0^2}$

$\Rightarrow \text{x} = 315.507$

$\Rightarrow 10\text{x} = 3155$ (nearest integer)

Q6 (5)



v : speed of electron having max. K. E.

$\Rightarrow$ from Einstein equation : $\text{E} = \phi + \text{K.E.}_{\text{max}}$

$\Rightarrow \frac{\text{hc}}{\lambda} = \text{hv}_0 + \frac{1}{2}\text{mv}^2$

$\Rightarrow \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{500 \times 10^{-9}} = 6.63 \times 10^{-34} \times 4.3 \times 10^{14} + \frac{1}{2}\text{mv}^2$

$\Rightarrow \frac{6.63 \times 30 \times 10^{-20}}{5} = 6.63 \times 4.3 \times 10^{-20} + \frac{1}{2}\text{mv}^2$

$\Rightarrow 11.271 \times 10^{-20}\ \text{J} = \frac{1}{2} \times 9 \times 10^{-31} \times \text{v}^2$

$\Rightarrow \text{v} = 5 \times 10^{5}\ \text{m/sec}$

Q7 (3)

Velocity of electron in Bohr's atom is given by

$V \propto \frac{Z}{n}$

Z = atomic number of atom, corresponds to +ve charge so as Z increase velocity increases so $Statement-\mathrm{I}$ is wrong.

and as $'n'$ decreases velocity increases so $Statement-\mathrm{II}$ is correct.