PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 13

Total Marks : 31

Max. Time : 35 min.

Topic : Atomic Structure

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.4,9	(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.1,6,7,8	(4 marks, 5 min.)	[16, 20]
Short Subjective Questions ('–1' negative marking) Q.2,3,5	(3 marks, 3 min.)	[9, 9]

1. Visible spectrum contains light of following colours "Violet - Indigo - Blue - Green - Yellow - Orange - Red" (VIBGYOR).
Its frequency ranges from Violet (7.5×10^{14} Hz) to Red (4×10^{14} Hz). Find out the maximum wavelength (in Å) in this range.

2. For a broadcasted electromagnetic wave having frequency of 1200 KHz, calculate number of waves that will be formed in 1 km distance (wave number per km).

3. **(a)** If volume of nucleus of an atom V is related to its mass number A as $V \propto A^n$, find the value of n.
(b) If the frequency of violet radiation is 7.5×10^{14} Hz, find the value of wavenumber ($\bar{v}$) (in m^{-1}) for it.

4. The ratio of the energy of a photon of wavelength 3000 Å to that of a photon of wavelength 6000Å respectively is:
(A) 1 : 2 (B) 2 : 1 (C) 3 : 1 (D) 1 : 3

5. Assume that 10^{-17} J of light energy is needed by the interior of the human eye to see an object. How many photons of green light (λ = 310 nm) are needed to generate this minimum energy ?

6. A photon of 300 nm is absorbed by a gas and then, it re-emits two photons and attains the same initial energy level. One re-emitted photon has wavelength 500 nm. Calculate the wavelength of other photon re-emitted out.

7. Find out the number of photons emitted by a 60 watt bulb in one minute, if wavelength of an emitted photon is 620 nm.

8. If a photon having wavelength 620 nm is used to break the bond of A_2 molecule having bond energy 144 KJ mol^{-1}, then find the % of energy of photon that is converted into kinetic energy of A atoms.
[hc = 12400 eVÅ ,1 eV/atom = 96 KJ/mol]

9. A certain dye absorbs light of certain wavelength and then fluorescence light of wavelength 5000 Å. Assuming that under given conditions, 50% of the absorbed energy is re-emitted out as fluorescence and the ratio of number of quanta emitted out to the number of quanta absorbed is 5 : 8, find the wavelength of absorbed light (in Å) : [hc = 12400 eVÅ]
(A) 4000 Å (B) 3000 Å (C) 2000 Å (D) 1000 Å

Answer Key

DPP No. # 13

1.	7500 Å.	**2.**	4	**3.**	(a) n =1 ; (b) 2.5×10^6 m^{-1}	**4.**	(B)		
5.	n = 16.	**6.**	750 nm	**7.**	1.125×10^{22}	**8.**	25 %	**9.**(A)	

Hints & Solutions

DPP No. # 13

1. Maximum wave length will correspond to minimum frequency as $\lambda \propto \frac{1}{\nu}$, and that is given for red light in the spectrum.

$$\lambda_{max.} = \frac{C}{\nu_{min.}} = \frac{3\times10^8 m/s}{4\times10^{14} m} = 750 \times 10^{-9} \text{ m}.$$

$\Rightarrow$ 7500 Å.

2. $\lambda = \frac{C}{\nu} = \frac{3\times10^8 \text{ m/s}}{1200\times10^3 \text{ s}^{-1}} = 250 \text{ m} = 0.25 \text{ km}.$

$\bar{\nu}$ = Wave no. = $\frac{1}{\lambda} = \frac{1 \text{ km}}{0.25 \text{ km}}$ = 4 wave per km.

3. **(a)** $R = R_0A^{1/3}$ $\therefore$ $\frac{4}{3}\pi R^3 = \frac{4}{3}\pi R_0{}^3 A$

$\therefore$ $V \propto A$ $\therefore$ n =1

(b) $\bar{\nu} = \frac{\nu}{c} = \frac{7.5\times10^{14}}{3\times10^8} = 2.5 \times 10^6 \text{ m}^{-1}$

4. $\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = \frac{6000}{3000} = 2.$

5. Use $E = \frac{nhc}{\lambda}$, Here n is number of protons.

6. Photon absorb = $\frac{hc}{300\times10^{-9}} = \frac{6.6\times10^{-34}\times3\times10^8}{300\times10^{-9}} = 6.6 \times 10^{-19}$ Joule

One re-emitted photon energy = $\frac{hc}{500\times10^{-9}} = 3.96 \times 10^{-19}$ Joule

other photon have energy = $6.6 \times 10^{-19} - 3.93 \times 10^{-19} = 2.65 \times 10^{-19}$ Joule.

7. Use $E = \frac{nhc}{\lambda}$

$$60 \times 60 = \frac{n \times 6.64 \times 10^{-34} \times 3 \times 10^{8}}{620 \times 10^{-9}}$$

$n = 1.125 \times 10^{22}$

8. Energy of one photon = $\frac{12400}{6200}$ = 2 eV = 2 × 96 = 192 KJ mol^{-1}

$\therefore$ % of energy of photon converted to K.E. of A atoms = $\frac{192 - 144}{192} \times 100 = \frac{48}{192} \times 100 = 25\%$

9. $E_{emitted} = \frac{50}{100} \times E_{absorbed}$

No. of emitted photons × Energy of emitted photon = $\frac{50}{100}$ × No. of absorbed photon × Energy of absorbed photon.

$$\therefore \quad 5x \times \frac{12400}{5000} = \frac{50}{100} \times 8x \times \frac{12400}{\lambda(\text{Å})}.$$

$\lambda(\text{Å}) = 4000$ Å