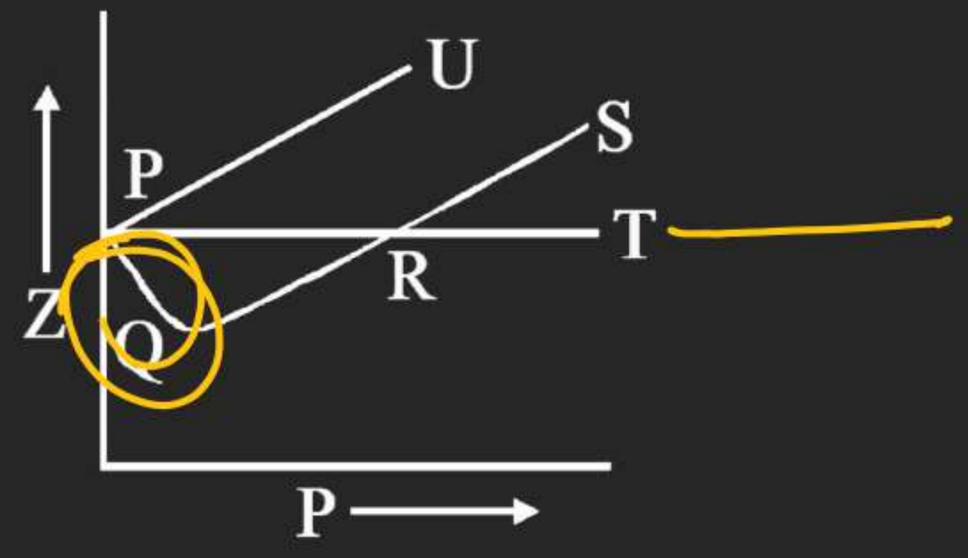
36. The figure shows the effect of pressure on the compressibility factor Z of a gas.

The correct conclusion is-



(A) The curve PU and RS can be explained by PVm = RT + Pb

(B) The curve PT can be explained by PVm = RT

(C) The curve PQ can be explained by $PV_m = RT - \frac{a}{V_m}$

(D) PQ shows that the gas is less compressible than ideal gas.

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38. Count the number of correct formulae /equations for Vander Waal's gas -

(i) $\cancel{\left(P - \frac{an^2}{V}\right)}(V - nb) = nRT$

(ii) $T_C = \frac{a}{27b^2}$

(iii) $V_C = 3b$

(iv) $Z = \frac{PV}{nRT}$

(v) $PM = dRT$

(vi) Boyle's temp $= \frac{a}{Rb}$

(A) 2 (B) 3 (C) 4 (D) 5

40. Three closed vessels A, B and C are at the same temperature T and contain gases which obey the Maxwellian distribution of velocities. Vessel A contains only O_2, B only N_2 and C a mixture of equal quantities of O_2 and N_2. If the average speed of the O_2 molecules in vessel A is V_1, that of the N_2 molecules in vessel B is V_2, the average speed of the O_2 molecules in vessel C is -

(A) $\frac{(V_1+V_2)}{2}$ (B) V_1 (C) $(V_1 V_2)^{1/2}$ (D) $\sqrt{3kT/M}$

$$\sqrt{\frac{8RT}{\pi M}}$$

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42. The Vander Waal's constant for a gas are $a = 1.92$ atm L^2 mol^{-2}, $b = 0.06L$ mol^{-1}. If $R = 0.08$ L atm K^{-1} mol^{-1}, what is the Boyle's temperature of this gas.

43. Calculate compressibility factor for the He gas at 50K & 1atm. b for He = 200cm³/mol [R = 0.08 atm-L/mol-K]

$$Z = 1 + \frac{Pb}{RT}$$

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44. Calculate the amount of He (in gm) present in the 10 litre container at 222 atm and 300K. Given value of "b" for He is 0.08 $dm^3\ mol^{-1}$; R=0.08 atm lit $mol^{-1}\ K^{-1}$.

$$Z = 1 + \frac{Pb}{RT} = \frac{PV}{nRT}$$

$$\frac{PV}{n} = RT + Pb$$

$$= 0.08 \times 300 + 222 \times 0.08$$

$$\frac{222 \times 10}{n} = 0.08 \times 522$$

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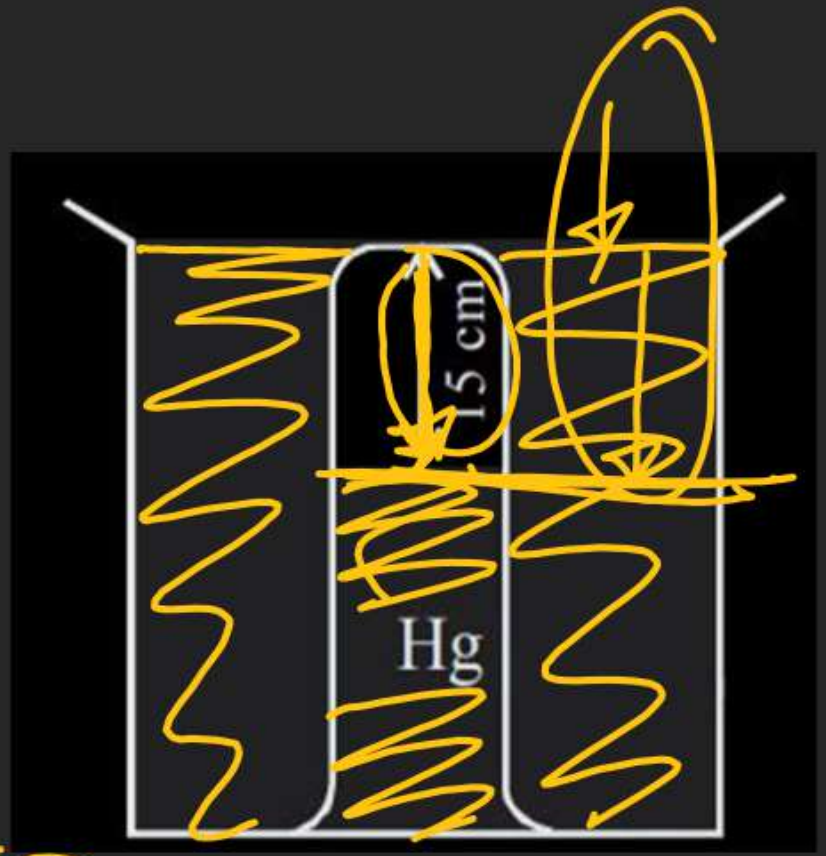
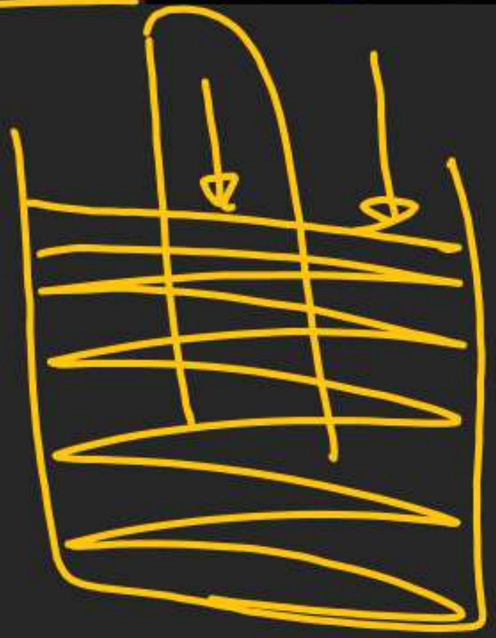
45. A glass tube with a sealed end is completely submerged in a vessel with Hg vertically. The air column is 15 cm long (As shown in figure). To what height must the upper end be raised above the level of Hg, so that the level of Hg inside the tube is at level of Hg in the vessel

(Atmospheric pressure =75 cm of Hg.)



$P_{gas} = 90\text{ cm}$

$90 \times \cancel{15} = \cancel{75}^{5} \times l$



48. Column-I | Column-II

(1) attractive tendency dominates Z<1 | (P) $Z = 3/8$

(2) at the Boyle's temperature in the high pressure region Z>1 | (Q) $Z < 1$

(3) For a gas at very very low pressure and very very high temperature Z=1 | (R) $Z > 1$

(4) At the critical point $Z = 3/8$ | (S) $Z = 1$

(A) $1 \rightarrow P$; $2 \rightarrow S$; $3 \rightarrow Q$; $4 \rightarrow R$

(B) $1 \rightarrow Q$; $2 \rightarrow P$; $3 \rightarrow R$; $4 \rightarrow S$

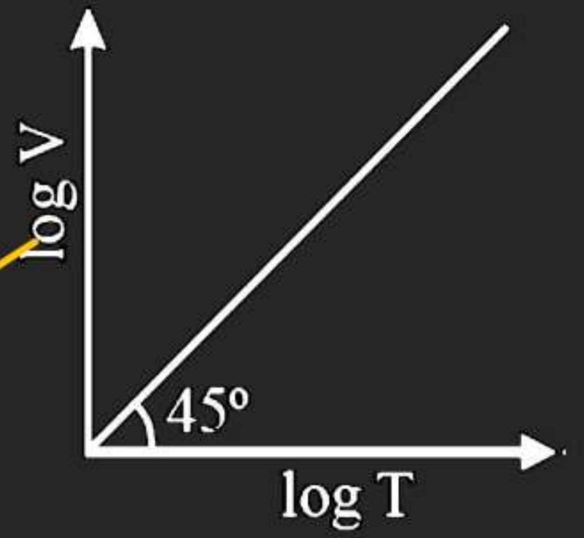
(C) $1 \rightarrow R$; $2 \rightarrow P$; $3 \rightarrow S$; $4 \rightarrow Q$

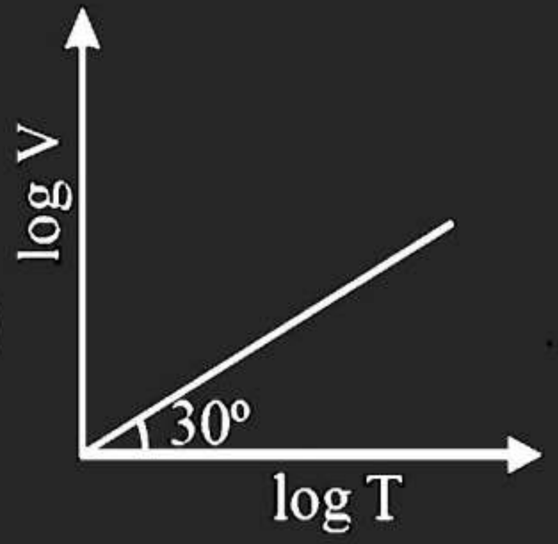
(D) $1 \rightarrow Q$; $2 \rightarrow R$; $3 \rightarrow S$; $4 \rightarrow P$

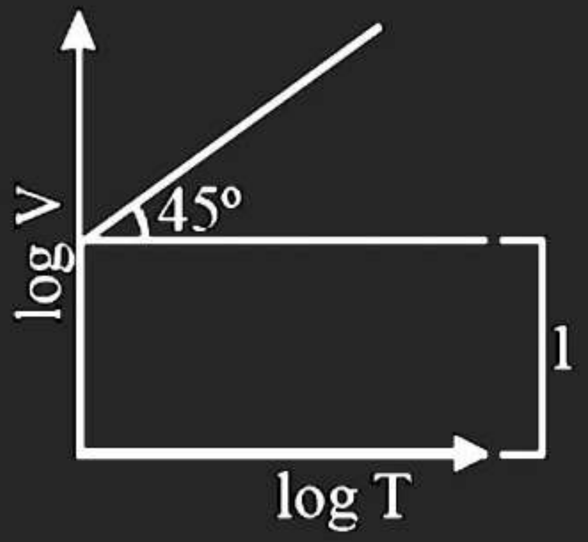
36. For a closed (not rigid) container n = 10 moles of an ideal gas, fitted with movable, frictionless, weightless piston operating such that pressure of gas remains constant at 0.821 atm, Which graph represents correct variation of log V vs log T where V is in lit. & T in Kelvin.

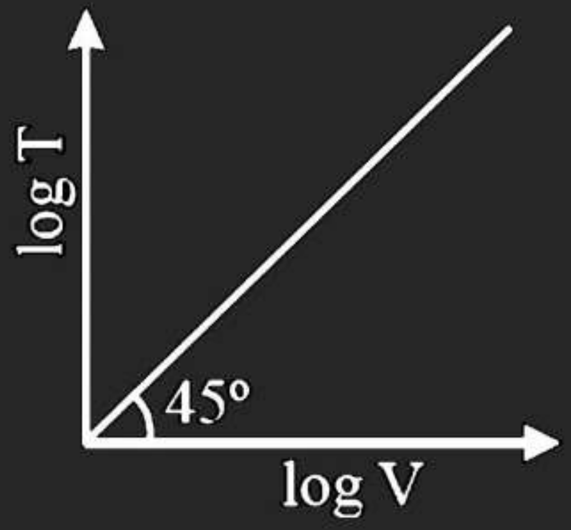
$$\log V = \log \frac{nR}{P} + \log T$$

$$= \log \frac{10 \times 0.0821}{0.82} + \log T$$

(A)


(B)


(C)


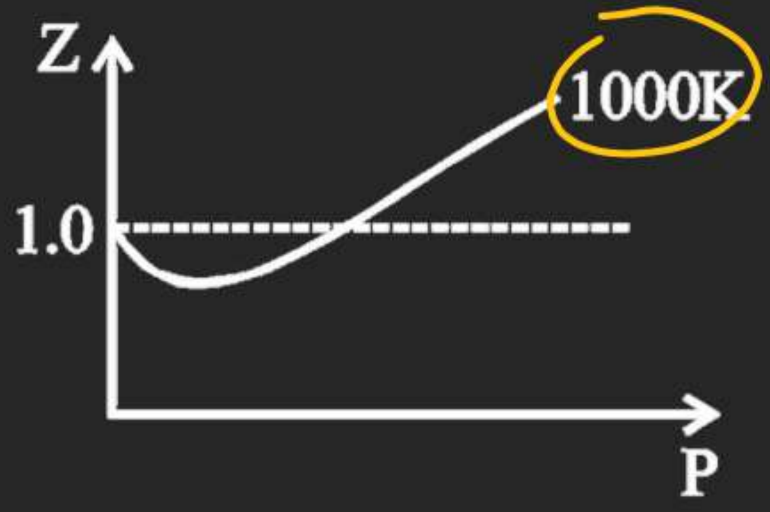
(D)


40. For a van der waal gas, a=4 atm-l^2 /mol^2 and b=0.02 l/ mol.

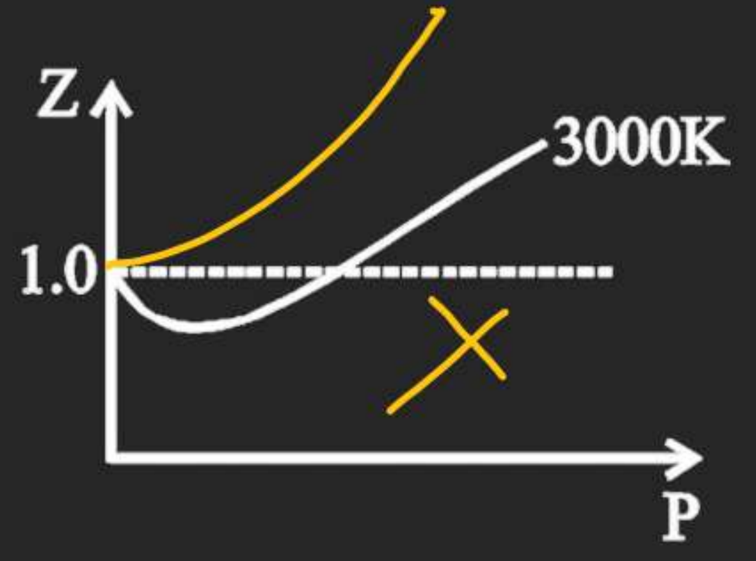
Select the correct possible graph(s) [Given : R = 0.08 L-atm/mol-K]

$$\frac{\cancel{4} \times 100 \times 100}{0.02 \times 0.\cancel{08}_{2}} = 2500$$

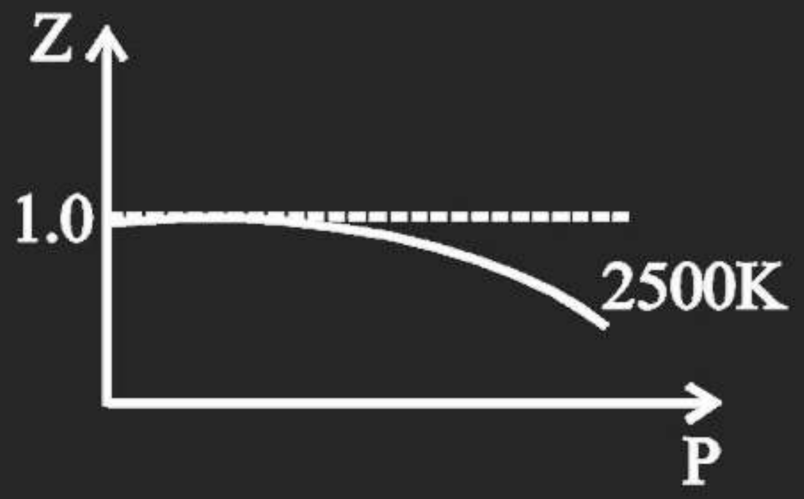
(A)



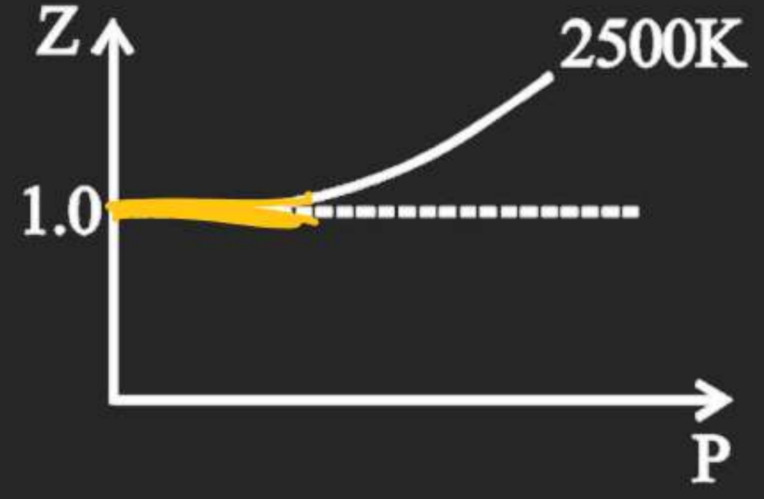
(B)



(C)



(D)



AD

Paragraph 1

Reaction-1

$2H_2 + O_2 \rightarrow 2H_2O$

Reaction-2

$3SiF_4 + 4H_2O \rightarrow Si(OH)_4 + 2H_2SiF_6$

In a container 36×10^{22} molecules of H_2 and 4480 ml of O_2 at 1 atm 273K is added to form H_2O. After H_2O is completely formed, 52 gm of SiF_4 is added. (Atomic masses of Si = 28, F = 19)

(Take: $N_A = 6 \times 10^{23}$)

48. Limiting reagent in reaction-1 & reaction-2 respectively will be

(A) O_2, H_2O (B) O_2, SiF_4 (C) H_2, H_2O (D) H_2, SiF_4

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0–I 5–11

5–T 9–16

$r = 0.529 \frac{n^2}{Z}$

$= 0.529 \, A^\circ$

(9) $-3.02 = PE$

$-1.51 = T.E$

$E_n = -13.6 \frac{Z^2}{n^2} = -\frac{13.6}{n^2}$

$E_n = -\frac{13.6}{n^2} \times Z^2$

——— -1.51 2nd excited $n=3$

——— -3.4 ← 1st excited $n=2$

——— -13.6

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S-2

$$\frac{hc}{5080} \times n_2 = \frac{47}{100} \times \frac{hc}{4530} \times n_1$$

100 % 0.2

$$0.01\,\text{mol} \times \frac{100}{20}$$

12

H–H

$$KE = \frac{hc}{\lambda} - \frac{436.53 \times 10^3}{N_A}$$

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$$H \begin{cases} 2 - 1 = 10.2\ eV = h\nu = \dfrac{hc}{\lambda} \\ 3 - 2 = 1.89\ eV \\ 3 - 1 = 12.09\ eV \end{cases}$$

$$He^{+} \begin{cases} 2 - 1 = 40.8\ eV \\ 3 - 1 = 48.36\ eV \end{cases}$$

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$\frac{hc}{\lambda} = h\nu = E_{higher} - E_{lower}$

$$= -\frac{13.6 Z^2}{n_2^2} + \frac{13.6 Z^2}{n_1^2}$$

$$\frac{hc}{\lambda} = h\nu = 13.6 Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] eV$$

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Rydberg eq^n

$$\frac{1}{\lambda} = R_H Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

R_H ↑ Rydberg

$R_H = 109700 \text{ cm}^{-1}$

$$\left[\frac{1}{R_H} = 912 \text{ Å}\right]$$

Q. in H-atom find λ of photon emitted when an e^- jumps from (i) $2 \rightarrow 1$ 1216
(ii) $\infty - 1$ 912

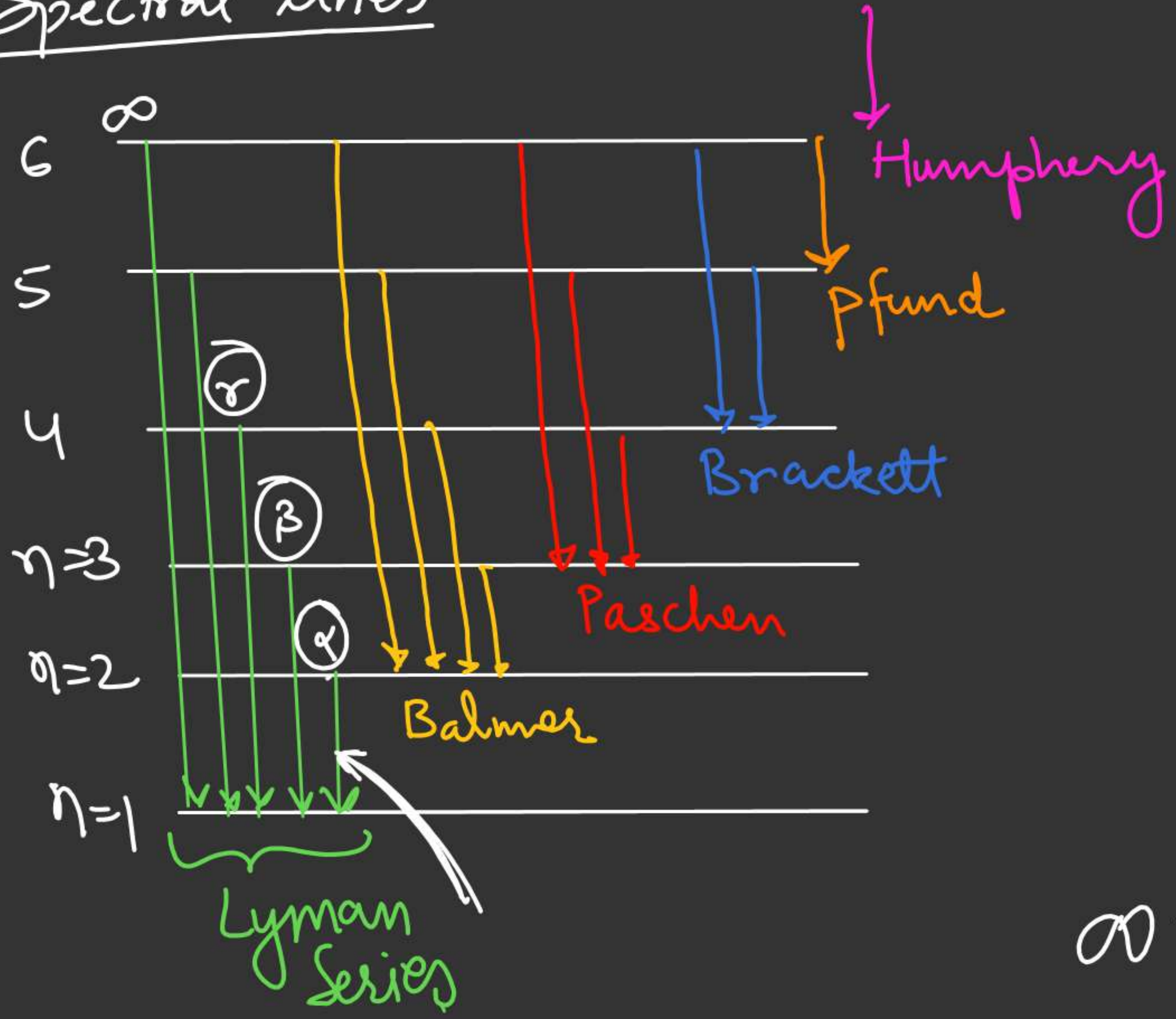
(i) $\frac{1}{\lambda} = \frac{1}{912 \text{ Å}}\left[\frac{1}{1} - \frac{1}{4}\right]$

$\lambda = 912 \times 4/3 = 1216 \text{ Å}$

(ii) $\frac{1}{\lambda} = \frac{1}{912 \text{ Å}}\left[\frac{1}{1} - \frac{1}{\infty}\right]$

$\lambda = 912 \text{ Å}$

Spectral lines



Lyman Series

$2 \rightarrow 1 \rightarrow$ 1st line

→ line of minimum energy

→ line of minimum ν

→ line of max λ

→ α-line of Lyman

$\infty \rightarrow 1 \rightarrow$ last line

→ line of max energy min λ

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Lyman Series

$n_1 = 1$

$n_2 = 2, 3 \, - - - -$

$\lambda_{1st} = 1216 \, A^\circ$

$\lambda_{Last} = 912 \, A^\circ$

lies in U.V range of EM spectrum (for H-atom)

Balmer series

$n_1 = 2$

$n_2 = 3, 4, - - - - -$

$\underline{3 \to 2}$ 1st line = line of min energy = line of max λ

$\lambda_{1st} = 6566.4 \, A^\circ$

$\lambda_{2nd} = 4864 \, A^\circ$

$\lambda_{3rd} = 4342 \, A^\circ$

$\lambda_{4th} = 4104 \, A^\circ$

$\lambda_{5th} = 3972 \, A^\circ$

$\lambda_{last} = 3648 \, A^\circ$

$\underline{4000 - 7500 \, A^\circ}$

first four Balmer series radiation for H-atom lies in visible range of spectrum

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Paschen Series

$n_1 = 3 \qquad n_2 = 4, 5, 6 \ldots$

$\lambda_{1st} = 18761$

$\lambda_{last} = 8208$

I.R

$\boxed{\text{0-I} \quad 12 - 29}$