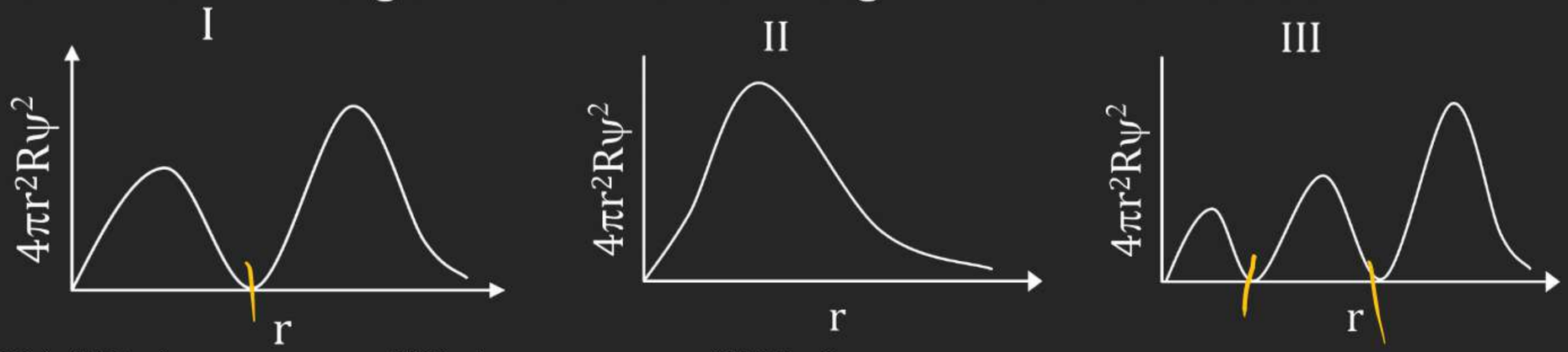
PAPER - 1

1. Which of following has correct matching of curve and orbital



(A) I(2p)	II(1s)	III(4p)
(B) I(3p)	II(3d)	III(3s)
(C) I(4d)	II(2p)	III(3d)
(D) I(2s)	II(4f)	III(3d)

2. 1 mol of N_2 and 4 mol of H_2 are allowed to react in a vessel and after reaction, H_2O is added. Aqueous solution required 1 mol of HCl. Mole fraction of H_2 in the gaseous mixture after reaction is:

(A) $\frac{1}{6}$ (B) $\frac{5}{6}$ (C) $\frac{1}{3}$ (D) none of these

$N_2 + 3H_2 \rightarrow 2NH_3$

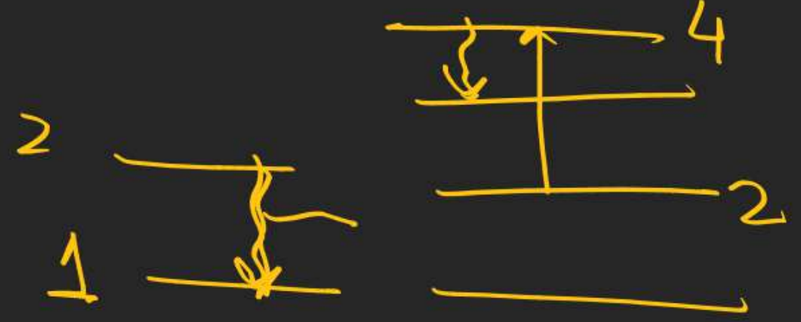
$1-x \quad 4-3x \quad 2x = 1$

$1/2 \quad 2.5 \quad 1$

Q.3 & 4

In a mixture of $H - He^+$ gas (He^+ is singly ionized He atom), H atoms and He^+ ions are excited to their respective first excited states. Subsequently, H atoms transfer their total excitation energy to He^+ ions (by collisions). Assuming that the Bohr model of atom is applicable, answer the following questions.

3. The wavelength of light emitted in the visible region by He^+ ions after collisions with H atoms is _____ 10^{-7} m.



$$TE \propto \frac{Z^2}{n^2}$$

$$\frac{TE_H}{TE_{He^+}} = \frac{Z_H^2}{Z_{He^+}^2} = \frac{1}{4}$$

	2p	3p	4p	5p
Q.4 & 5	0	1	2	3

The wave function for an atomic orbital of single electron atom or ion is

$$\Psi(r,\theta,f) = \frac{2}{3}\left(\frac{Z}{3a_o}\right)^{\frac{3}{2}}(1-\sigma)(12-8\sigma+\sigma^2)\times\sigma\times e^{-\frac{\sigma}{2}}\times\cos\theta$$

5 p_z

where $\sigma = \frac{2Zr}{na_o}$ and a_o = 0.529 Å. All other parameters have their usual meaning.

4. The sum of number of radial and angular nodes for the orbital is.

$n-1$

5. Choose the correct statement(s)-

T (A) Radial wave function $[\psi(r)]$ of $2P_x$ & $2P_y$ orbitals are same

T (B) Angular wave function $[\psi(\theta, \phi))$ of $2P_x$ & $2P_y$ are different

F (C) Angular wave function $[\psi(\theta, \phi))$ of $2P_x$ & $3P_y$ are same

T (D) Angular wave function $[\psi(\theta, \phi))$ of $2P_y$ & $3P_y$ are same

$R(r)$ $f(\theta, \phi)$

n, ℓ ℓ, m

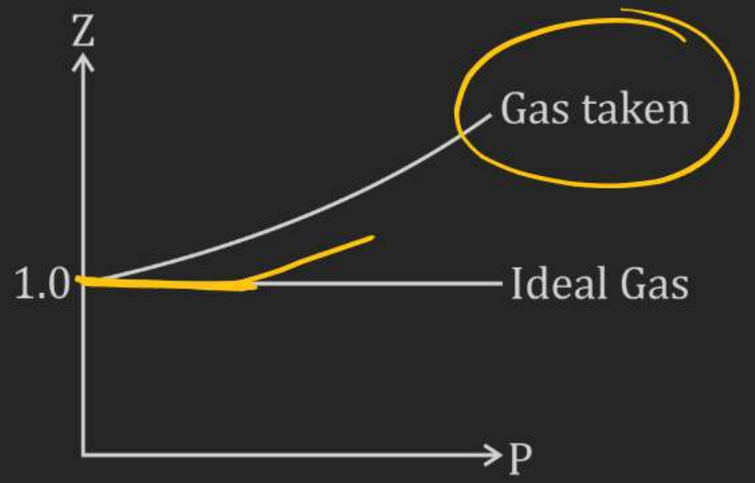
6. Which of the following statement(s) is / are correct for the gas taken?

F (A) It is H_2 or He gas at any temperature.

T (B) It is any non-ideal gas at temperature above its Boyle's temperature.

F (C) It is any non-ideal gas at Boyle's temperature.

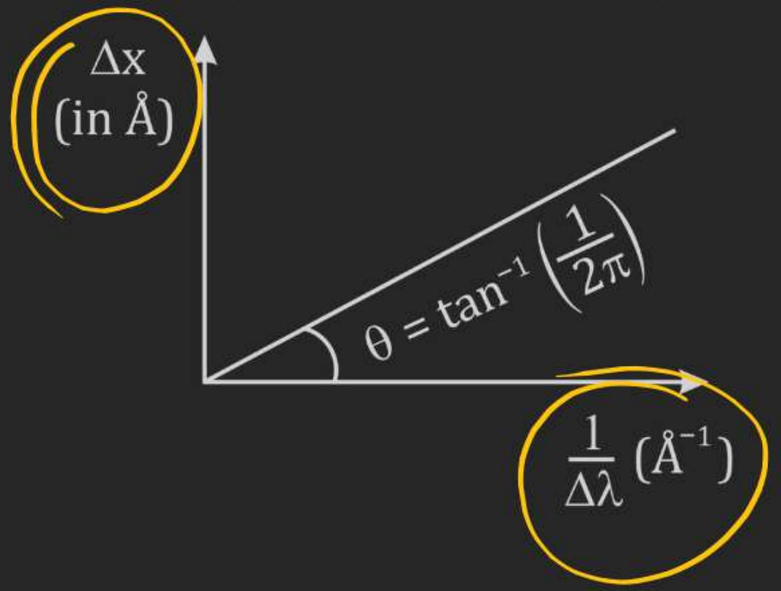
T (D) It is H_2 or He gas at $0^\circ C$.



6. An electron is accelerated from rest, by ' V ' volts. Uncertainty in position (Δx) is plotted against minimum uncertainty in de-broglie wavelength $(\Delta\lambda)$ as following

The value of ' V ' is -

(A) 75 (B) 37.5 (C) 150 (D) 7.5



$$\Delta x \left(\frac{h}{\lambda^2}\Delta\lambda\right) = \frac{h}{4\pi}$$

$$\Delta x = \frac{\lambda^2}{4\pi}\left(\frac{1}{\Delta\lambda}\right)$$

$$\frac{\lambda^2}{4\pi} = \frac{1}{2\pi}$$

$$\lambda = \sqrt{2} = \sqrt{\frac{150}{V}}$$

7. $500\ \text{mL}$ of methane (CH_4) effuses through a small hole in 48sec. How much time (in sec) will be taken by same volume of helium to effuse out of the same orifice?

24

8. When a beam of photon having wavelength $155\ \mathrm{nm}$ falls on a metal which has a work function of $5.6\mathrm{eV}$, the maximum KE of the photoelectrons (in eV) possible is...[Given : $\mathrm{hc} = 1240\mathrm{eV} - \mathrm{nm}$]

2.4

PAPER - 2

1. Which of the following statements is/are INCORRECT :

(A) All spectral lines belonging to Balmer series in hydrogen spectrum lie in visible region.

(B) If a light of frequency v falls on a metal surface having work function hv_0, photoelectric effect will take place only if $v \leq v_0$.

(C) The number of photoelectrons ejected from a metal surface in photoelectric effect depends upon the frequency of incident radiations.

(D) The series limit wavelength of Balmer series of H-atom is $\frac{4}{R}$, where R is Rydberg's constant.

2. For a real gas, Andrew's isotherm is given as

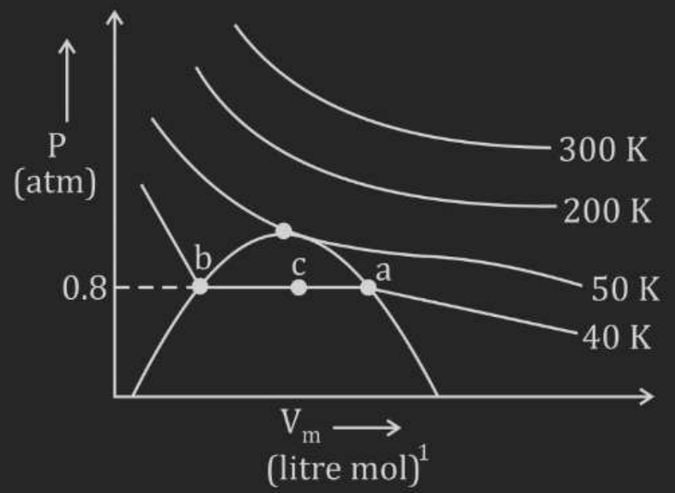
Select the correct options :

(A) At $40\ \mathrm{K}$, vapour pressure of liquified gas is $0.8\ \mathrm{atm}$.

(B) At $40\ \mathrm{K}$, from point 'a' to 'b' no. of moles of liquid will decrease in the mixture.

(C) At $35\ \mathrm{K}$ and $0.8\ \mathrm{atm}$, gas exist in liquid phase only.

(D) At $200\ \mathrm{K}$, gas can't be liquified.



3. Mark out the incorrect statement(s) [Atomic mass : $S = 32$]

(A) At same temperature, average speed of O_2 is greater than that of SO_2

(B) If absolute temperature of O_2 gas is half to that of SO_2 gas, then the speed distribution curves will be different

(C) At given temperature, a gas with low molar mass has less K.E. than a gas with high molar mass

(D) The real gas having higher value of Vander waal's constant " a " will be more compressible then one having lower value of "a", provided Vander waal's constant "b" is same for both the gases.

Q.4 & 5

In a process for producing acetic acid, oxygen gas is bubbled into acetaldehyde, CH_3CHO, under pressure at $60^\circ C$ in presence of suitable catalyst.

$$2CH_3CHO(l) + O_2(g) \longrightarrow 2CH_3COOH(l)$$

In a laboratory test of this reaction, $20.0\ g\ CH_3CHO$ and $10\ g\ O_2$ were put into a reaction vessel.

4. How many gram of acetic acid can be produced by these amounts of reactants?

2.7
2.8

$\frac{10 \times 12}{32 \times 44} \times 32$

2.727

$\frac{20}{44}$

$\frac{10}{32}$

$\left(\frac{10}{32} - \frac{10}{44}\right) \times 32$

$\frac{20}{44} \times 60 = 27.27$

27.2
27.3

Q.6 & 7

A $300\ mL$ sample of hydrogen was collected over water at $27°C$ on a day when the atmospheric pressure was 760 Torr and vapour pressure of water was 76 Torr. (R=0.08)

6. How many moles of H_2O were present?

$$P_{H_2} = \frac{760-76}{760} = \frac{760(1-0.1)}{760} = 0.9\ atm$$

$$\frac{0.9 \times 300/1000}{0.08 \times 300} = \frac{0.9}{800} = 0.01125$$

Nishant Jindal

(4) (C)

$$\overset{+3\ -1}{BCl_3} + \overset{0}{P_4} + \overset{0}{H_2} \longrightarrow \overset{-3}{BP} + \overset{+1\ -1}{HCl}$$

$$\overset{0}{P_4} \longrightarrow 4\overset{-3}{BP}$$

$0 \qquad -12$ Change (12)

$$\left[\overset{0}{H_2} \longrightarrow 2\overset{+1}{H}Cl\right] \times 6$$

$0 \qquad +2$ Change (2)

$$4BCl_3 + P_4 + 6H_2 \longrightarrow 4BP + 12HCl$$

Nishant Jindal

4e

Red^{n}

$\overset{+6}{HSO_4^-} + \overset{0}{As_4} + \overset{8/3}{Pb_3O_4} \longrightarrow \overset{+2}{PbSO_4} + \overset{+5}{H_2AsO_4^-} + H_2O$

$\overset{0}{As_4} \longrightarrow 4\overset{+5}{H_2AsO_4^-}$

0 → 20 (20)

$\left[\overset{8/3}{Pb_3O_4} \longrightarrow 3\overset{+2}{PbSO_4} \right] \times 10$

8 → 6 (2)

$As_4 + 10\,Pb_3O_4 + 30\,HSO_4^- + 26H^+ \longrightarrow 4H_2AsO_4^- + 30\,PbSO_4 + 24H_2O$

SO_4^{2-}

$S_2O_4^{2-}$

PO_4^{3-}

Nishant Jindal

4(f) $\overset{+1}{Ca(OCl)_2} + \overset{-1}{KI} + HCl \rightarrow I_2 + \overset{-1}{CaCl_2} + H_2O + KCl + H_2O$

$CaOCl_2$ $\overset{+1}{Ca(OCl)_2} \rightarrow \overset{-1}{CaCl_2}$ (4)

$\overset{-1}{2KI} \rightarrow \overset{0}{I_2}$ (2) $\times 2$

$Ca(OCl)_2 + 4KI \rightarrow CaCl_2 + 2I_2 + 4KCl$

$+ 4HCl \qquad + 2H_2O$

Nishant Jindal

50

$$\overset{+4}{ClO_2} + \overset{+3}{SbO_2^-} + OH^- \longrightarrow \overset{+3}{ClO_2^-} + \overset{+5}{Sb(OH)_6^-}$$

$$\overset{+4}{ClO_2} \longrightarrow \overset{+3}{ClO_2^-} \quad (1)$$

$$\overset{+3}{SbO_2^-} \longrightarrow \overset{+5}{Sb(OH)_6^-} \quad (2)$$

$x - 6 = -1$

$x = +5$

$$2ClO_2 + SbO_2^- \longrightarrow 2ClO_2^- + Sb(OH)_6^-$$

$$\cancel{+ 4H_2O} + 2OH^-$$

$$2H_2O$$

$+ 2H^+$

$+ 2OH^-$