



GGSRDN

Educational Services Private Limited

9th, 10th, NEET, JEE(Main/Advanced)

अभ्यास ही सबसे बड़ा गुरु है।

CLASS : XII (PHYSICAL CHEMISTRY)

D P P

DAILY PRACTICE PROBLEM

DPP-1 to 36

GGSRDN
NEET, JEE(MAIN + ADVANCED)

PHYSICAL CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 1

Total Marks : 28

Max. Time : 30 min.

Topic : Mole Concept

Type of Questions

| Type of Questions | M.M., Min. |
|--|----------------------------|
| Single choice Objective ('-1' negative marking) Q.5, 6, 8 | (3 marks, 3 min.) [9, 9] |
| Multiple choice objective ('-1' negative marking) Q.1 to Q.2 | (4 marks, 4 min.) [8, 8] |
| Short Subjective Questions ('-1' negative marking) Q.3 | (3 marks, 3 min.) [3, 3] |
| Match the Following (no negative marking) (2 × 4) Q.7 | (8 marks, 10 min.) [8, 10] |

- 1.* 124 amu of P_4 will contain : (At. mass of P = 31)
 (A) $4N_A$ atoms of phosphorus (B) 4 atoms of phosphorus
 (C) 1 molecule of phosphorus (D) N_A molecules of phosphorus
- 2.* In which of the following pairs do 1 g of each have an equal number of molecules :
 (A) N_2O and CO (B) N_2 and C_3O_2 (C) N_2 and CO (D) N_2O and CO_2
- 3._ How many atoms are present in '64 amu' of oxygen.
4. Fill the blanks in the table (where N_A is Avogadro number)

| S.No. | Sample | Gram Atomic mass of sample | Moles of sample | No. of atoms present in the sample | Mass removed from the sample | Mole removed from the sample | Atoms removed from the sample | Mass of same no. of C atom as no. of atoms present in the original sample |
|-------|-------------|----------------------------|--------------------|------------------------------------|------------------------------|------------------------------|-------------------------------|---|
| 1. | 8 g O | --- | --- | --- | --- | --- | --- | --- |
| | For Example | 16 g | $\frac{1}{2}$ mole | $\frac{N_A}{2}$ | 2 g | $\frac{1}{8}$ mole | $\frac{N_A}{8}$ | 6 g |
| 2. | 230 g Na | | | | 46 g | | | |
| 3. | 60 g Ca | | | | | 1 mole | | |
| 4. | 20 g He | | | | | 3 mole | | |
| 5. | 56 g N | | | | | $\frac{1}{2}$ mole | | |
| 6. | 12 g Mg | | | | | | $\frac{N_A}{4}$ | |
| 7. | 128 g S | | | | | | N_A | |
| 8. | 93 g P | | | | | | $\frac{3N_A}{2}$ | |

5. If the mass of 0.25 moles of an element X is 2.25 g, the mass of one atom of X is about :
 (A) 1.5×10^{-24} g (B) 2.5×10^{-23} g (C) 1.5×10^{-23} g (D) 2.5×10^{-24} g
6. From 392 mg of H_2SO_4 , 1.204×10^{21} molecules of H_2SO_4 are removed. How many moles of H_2SO_4 are left:
 (A) 2×10^{-3} (B) 1.2×10^{-3} (C) 4×10^{-3} (D) 1.5×10^{-3} .
7. **Column - I** (A) 49 g H_2SO_4 (B) 20 g NaOH (C) 11.2 L of CO_2 at STP (D) 6.022×10^{23} atoms of Oxygen
- Column - II** (p) 0.5 mole of given unit (q) $1.5 N_A$ atoms (r) $0.5 N_A$ molecules (s) 2 mole of 'O' atom
8. If all the O-atoms from 4.4 g CO_2 , 6.022×10^{22} molecules of N_2O_5 , 0.2 moles of CO and 1.12 L of SO_2 gas at NTP are removed and combined to form O_2 gas, then the resulting gas occupies a volume of at NTP.
 (A) 22.4 L (B) 44.8 L (C) 33.6 L (D) 11.2 L

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 2
Total Marks : 33
Max. Time : 33 min.
Topic : Mole Concept

| Type of Questions | M.M., Min. |
|--|-----------------------------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.11 | (3 marks, 3 min.) [33, 33] |
| 1. The mass of half mole of electrons is about : (Given : Mass of electron = 9.109×10^{-28} g) (A) 0.548 mg (B) 0.274 mg (C) 1.096 mg (D) 9.109 mg | |
| 2. 39.4 kg of gold was recovered from a smuggler. The number of atoms of gold recovered are : (A) 200 (B) 1.2044×10^{25} (C) 6.022×10^{25} (D) 1.2044×10^{26} | |
| 3. The mass of Magnesium that contains the same number of atoms as are present in 2g of Calcium is : (A) 1.2 g (B) 2.4 g (C) 0.6 g (D) 1.8 g | |
| 4. The number of gram-atoms present in 288g of sulphur is : (A) 18 (B) 9 (C) 4.5 (D) 13.5 | |
| 5. 1.5×10^{22} atoms of an element weigh 0.9 g. The atomic mass of the element (in amu) is : (A) 36 (B) 18 (C) 54 (D) 72 | |
| 6. The ratio of mass of a Titanium atom to the mass of a Carbon atom is 4 : 1. Then, the molar mass of Titanium is : (A) 3 g (B) 48 g (C) 12 g (D) 24 g | |
| 7. A hypothetical element Z exists in nature as two isotopes Z^{65} and Z^{67} with their relative abundances 25% and 75% respectively. Then, the average atomic mass (in u) of element Z is : (A) 65.5 (B) 66 (C) 66.25 (D) 66.5 | |
| 8. The mass of a molecule of water is : (A) 3×10^{-26} kg (B) 3×10^{-25} kg (C) 1.5×10^{-26} kg (D) 2.5×10^{-26} kg | |
| 9. The weight of 1×10^{22} molecules of $MgSO_4 \cdot 7H_2O$ is : (A) 4.1 g (B) 41 g (C) 410 g (D) 0.41 g | |
| 10. Among the following samples, the largest number of molecules is in : (A) 28 g of CO (B) 46 g of C_2H_5OH (C) 36 g of H_2O (D) 54 g of N_2O_5 | |
| 11. 124 g of P_4 will contain which of the following : (1) 4 atoms of Phosphorus (2) $4N_A$ atoms of Phosphorus (3) N_A molecules of Phosphorus (4) 1 molecule of Phosphorus (A) 1 and 4 (B) 2 and 3 (C) 1 and 3 (D) 2 and 4 | |

PHYSICAL CHEMISTRY
DPP
DAILY PRACTICE PROBLEMS
DPP No. 3
Total Marks : 41
Max. Time : 43 min.
Topic : Mole Concept
Type of Questions

| | | M.M., Min. |
|---|---------------------------|-------------------|
| Single choice Objective ('-1' negative marking) Q.1,2,4 to 9,11,12 | (3 marks, 3 min.) | [30, 30] |
| Short Subjective Questions ('-1' negative marking) Q.10 | (3 marks, 3 min.) | [3, 3] |
| Match the Following (no negative marking) (2 × 4) Q.3 | (8 marks, 10 min.) | [8, 10] |

- Number of gold atoms in 300 mg of a gold ring of 20 carat gold (pure gold is 24 carat) are :
 (A) 4.5×10^{20} (B) 6.8×10^{15} (C) 7.6×10^{20} (D) 9.5×10^{20}
- From a container having 64 g Oxygen, 11.2 L Oxygen gas at S.T.P. and 6.022×10^{23} Oxygen atoms are removed. Find the mass of the oxygen gas left :
 (A) zero (B) 32 g (C) 16 g (D) none
- | Column-I | Column-II |
|--|-------------------------------|
| (A) 32 g each of O_2 and S | (p) 2 moles of Fe |
| (B) 2 gram-molecules of $K_3[Fe(CN)_6]$ | (q) 3 moles of ozone molecule |
| (C) 144 g of Oxygen atom | (r) one mole of given unit |
| (D) From 168 g of iron, 6.022×10^{23} atoms of iron are removed, then the iron left | (s) 12 moles of carbon atoms |
- If a sample of Ferric sulphate $Fe_2(SO_4)_3$ contains 7.2 moles of O-atoms, then the number of S-atoms in the given sample are :
 (A) $1.8 N_A$ (B) $1.2 N_A$ (C) $1.6 N_A$ (D) $1.4 N_A$
- 10 moles of CO_2 do not contain :
 (A) 120 g of C (B) 6.022×10^{24} atoms of O
 (C) $10 N_A$ molecules of CO_2 (D) 20 gram-atoms of O.
- A compound has the molecular formula X_4O_6 . If 11 g of X_4O_6 has 6.2 g of X, then atomic mass of X is :
 (A) 31 amu (B) 37 amu (C) 42 amu (D) 98 amu
- A sample of $CaCO_3$ has Ca = 40%, C = 12% and O = 48% by mass. If the law of constant proportions is true, then the mass of Ca in 5 g of $CaCO_3$ from another source will be:
 (A) 2 g (B) 0.2 g (C) 0.02 g (D) 20 g
- In compound A, 1 g nitrogen combine with 0.57 g oxygen. In compound B, 2 g nitrogen combine with 2.28 g oxygen and in compound C, 3 g nitrogen combine with 5.13 g oxygen. These results obey the law of:
 (A) multiple proportions (B) constant proportions
 (C) mixed proportions (D) none of these
- The respective ratio of weight of oxygen in samples of pure CuO and Cu_2O , if both samples contain the same mass of copper, is :
 (A) 1 : 2 (B) 1 : 1 (C) 2 : 1 (D) none of these
- Find the relative density of SO_3 gas with respect to methane.
- The density of air at STP is $0.001287 \text{ g mL}^{-1}$. Its vapour density is :
 (A) 143 (B) 14.3 (C) 1.43 (D) 0.143
[Hint : Divide with the density of hydrogen at STP, i.e., $0.00009 \text{ g mL}^{-1}$]
- The atomic mass of a metal is 27. If its valency is 3, the vapour density of the volatile metal chloride will be:
 (A) 66.75 (B) 6.675 (C) 667.5 (D) 81

Topic : Mole Concept

Type of Questions

| Type of Questions | M.M., Min. |
|---|----------------------------|
| Single choice Objective ('-1' negative marking) Q.3,4,6,7 | (3 marks, 3 min.) [12, 12] |
| Multiple choice objective ('-1' negative marking) Q.1,8 | (4 marks, 4 min.) [8, 8] |
| Short Subjective Questions ('-1' negative marking) Q.2 | (3 marks, 3 min.) [3, 3] |
| Match the Following (no negative marking) (2 × 4) Q.5 | (8 marks, 10 min.) [8, 10] |

- 1.* 11.2 L of a gas at STP weighs 14 g The gas could be :
(A) N₂O (B) NO₂ (C) N₂ (D) CO
2. A compound of Mg contains 6% of Mg by mass. If the minimum molar mass of the compound is n × 10² g/mol then determine value of 'n'.
3. A sample of a compound contains 9.75 g Zn, 1.8 × 10²³ atoms of Cr and 0.6 gram-atoms of O. What is empirical formula of compound ? (Atomic Mass Zn = 65)
(A) ZnCrO₄ (B) ZnCr₂O₄ (C) Zn₂CrO₄ (D) ZnCr₂O₂
4. An organic compound on analysis was found to contain 0.032% of sulphur by mass. The molecular mass of the compound, if its one molecule contains two sulphur atoms, is :
(A) 100000 u (B) 10000 u (C) 20000 u (D) 200000 u
5. **Column - I** **Column - II**
- (A) A compound containing 5 g 'S' and 5 g oxygen (p) Empirical formula is CH₂
- (B) A hydrocarbon containing $\frac{600}{7}$ % 'C' by mass (q) Molecular formula is C₂H₄
- (C) A compound containing $\frac{300}{11}$ % of 'C' and $\frac{800}{11}$ % of 'O' by mass (r) Empirical formula is SO₂
- (D) A hydrocarbon containing $\frac{100}{7}$ % H by mass (Molecular mass = 28) (s) Empirical formula is CO₂
6. 0.1 mole of a carbohydrate with empirical formula CH₂O contains 1 g of hydrogen. What is its molecular formula?
(A) C₅H₁₀O₅ (B) C₆H₁₂O₆ (C) C₄H₈O₄ (D) C₃H₆O₃
7. The number of moles of oxygen obtained by the electrolytic decomposition of 90 g water is :
$$(2\text{H}_2\text{O} \xrightarrow{\text{elec.}} 2\text{H}_2 + \text{O}_2)$$

(A) 2.5 (B) 5 (C) 7.5 (D) 10
- 8.* In a gaseous reaction of type :
$$xA(g) + yB(g) \longrightarrow pC(g) + qD(g)$$

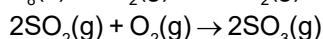
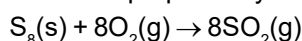
where x, y, p and q are stoichiometric coefficients.
Which of the following statements is/are correct :
(A) At STP, x litre of A combine with y litre of B to give C and D
(B) x mole of A combine with y mole of B to give C and D
(C) x g of A combine with y g of B to give C and D.
(D) x molecules of A combine with y molecules of B to give C and D.

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 5
Total Marks : 33
Max. Time : 34 min.
Topic : Mole Concept
Type of Questions

| Type of Questions | M.M., Min. |
|---|----------------------------|
| Single choice Objective ('-1' negative marking) Q.1,2,3,5 | (3 marks, 3 min.) [12, 12] |
| Multiple choice objective ('-1' negative marking) Q.4,6 | (4 marks, 4 min.) [8, 8] |
| Subjective Questions ('-1' negative marking) Q.7 | (4 marks, 5 min.) [4, 5] |
| Comprehension ('-1' negative marking) Q.8 to 10 | (3 marks, 3 min.) [9, 9] |

1. Sulphur trioxide is prepared by the following two reactions :



How many grams of SO_3 are produced from 1 mole of S_8 :

- (A) 1280 (B) 640 (C) 960 (D) 320

2. 3L of N_2 gas are mixed with 6L of H_2 gas to form NH_3 gas. What volume of NH_3 gas can be produced, if all volumes are measured under same temperature and pressure conditions :

- (A) 6L (B) 4L (C) 9L (D) 2L

3. Zinc and hydrochloric acid react according to the reaction :



If 0.30 mole of Zn are added to hydrochloric acid containing 0.52 mole HCl, how many moles of H_2 are produced:

- (A) 0.26 (B) 0.52 (C) 0.14 (D) 0.30

- 4.* 3 moles of gas C_2H_6 are mixed with 60 g of this gas and 2.4×10^{24} molecules of the gas are then removed. The left over gas is burnt in the presence of excess oxygen.

Then : ($N_A = 6 \times 10^{23}$) (Density of water = 1g/mL)

- (A) 2 moles of C_2H_6 are left for combustion.
 (B) Volume of CO_2 at S.T.P. produced after combustion is 44.8 litre.
 (C) Volume of liquid water produced is 54 mL.
 (D) None of these

5. 3.68 g of a mixture of $CaCO_3$ and $MgCO_3$ is heated to liberate 0.04 mole of CO_2 . The mole % of $CaCO_3$ and $MgCO_3$ in the mixture is respectively :

- (A) 50%, 50% (B) 60%, 40% (C) 40%, 60% (D) 30%, 70%

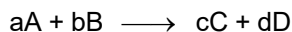
- 6.* Amongst the following, select the **false** statements :

- (A) Limiting reagent must have the least moles among all the reactants available in a chemical reaction.
 (B) If equal masses of aluminium and oxygen are made to combine to produce Al_2O_3 , then aluminium will be the limiting reagent.
 (C) A 2 : 3 molar ratio mixture of Na_2CO_3 and $MgCO_3$ produces 0.3 mole of CO_2 per mole of the initial mixture upon strong heating.
 (D) All of these

7. 120 g Mg was burnt in air to give a mixture of MgO and Mg_3N_2 . The mixture is now dissolved in HCl to form $MgCl_2$ and NH_4Cl . If 107 grams NH_4Cl is produced, then determine the moles of $MgCl_2$ formed.

Comprehension # (Q. 8 to Q. 10)

For a reaction :



Three students stated different ways of determining limiting reagent.

Student 1 : Calculate the minimum moles of 'A' needed to completely consume 'B', and if available amount of 'A' exceeds what is needed, then 'B' is limiting reagent, otherwise 'A' will be limiting reagent.

Student 2 : Calculate the mole ratio (ratio of moles of the reactants initially taken) of reactant, then compare it with theoretical mole ratio (according to stoichiometry of the reaction). If the theoretical ratio exceeds ratio of moles actually taken, then reactant in denominator will be limiting reagent.

Student 3 : Calculate the amount of product (any one of the product) that can be obtained if each reactant is completely consumed and that reactant is limiting reagent, which has produced least mass of product.

8. Which student(s) has/have defined limiting reagent correctly :
- (A) Student – 1 (B) Student – 2
 (C) Student – 3 (D) All are correct
9. If student 1 in first experiment finds that, when 1 mole of 'A' reacted with excess of reagent 'B' and in second experiment when 1 mole of 'B' reacted with excess of reagent 'A', then in the later experiment, mass of the product produced was greater. Then which should be the limiting reagent :
- (A) A (B) B
 (C) None of these (D) Cannot be predicted
10. If initially 'x' moles of 'A' are taken with 'y' moles of 'B', which of the following is correct :
- (i) If $\frac{a}{b} = \frac{x}{y}$, then no reactant is left over
- (ii) If $\frac{a}{b} > \frac{x}{y}$, then 'B' reactant is limiting reagent
- (iii) If $\frac{a}{b} < \frac{x}{y}$, then 'B' is limiting reagent
- (iv) If $\frac{x}{y} > \frac{a}{b}$, then 'A' is limiting reagent.
- (A) i & iv (B) i & iii (C) Only i (D) i, ii & iv

PHYSICAL CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 6

Total Marks : 32

Max. Time : 32 min.

Topic : Mole Concept

Type of Questions

| Type of Questions | M.M., Min. |
|---|----------------------------|
| Single choice Objective ('-1' negative marking) Q.1,2,9,7 | (3 marks, 3 min.) [12, 12] |
| Multiple choice objective ('-1' negative marking) Q.6,10 | (4 marks, 4 min.) [8, 8] |
| Short Subjective Questions ('-1' negative marking) Q.8 | (3 marks, 3 min.) [3, 3] |
| Comprehension ('-1' negative marking) Q.3 to 5 | (3 marks, 3 min.) [9, 9] |

- The oxidation number of sulphur in S_8 , S_2F_2 and H_2S respectively are :
(A) 0, + 1 and - 2 (B) + 2, + 1 and - 2 (C) 0, + 1 and + 2 (D) - 2, + 1 and - 2
- Which of the following compounds have sulphur atom in its maximum oxidation state :
X = H_2SO_4 ; Y = H_2SO_5 ; Z = $H_2S_2O_8$
(A) Z only (B) Y and Z only (C) Y only (D) X, Y and Z

Comprehension # (Q. 3 to Q. 5)

Oxidation state of an element in a particular species (atom, molecule or ion) is the number of electrons gained or lost by that element during its change from free state into combined state. For example, the oxidation state of Na in NaCl is +1, calcium in $Ca_3(PO_4)_2$ is +2, and chlorine in Cl_2 is zero.

(1) Oxidation number is given positive sign if electrons are lost and oxidation number is given negative sign if electrons are gained.

(2) Oxidation number represents charge in case of ionic compounds. However, in covalent compounds, it represents imaginary charge. Now answer the following questions (3-5) :

- Identify the **correct** statement :
(A) Halogens always have -1 oxidation state in their compounds.
(B) Oxidation number can be zero, negative, positive, integer or fractional.
(C) In OF_2 , the oxidation number of F is +1.
(D) Hydrogen is always given + 1 oxidation number in its compounds.
- When $KMnO_4$ reacts with $FeSO_4$ in acidic medium, it is converted into $MnSO_4$. Then change in oxidation number for Mn in the above process is :
(A) 7 (B) 2 (C) 5 (D) 0
- $K_2Cr_2O_7 + C_2O_4^{2-} + H_2SO_4 \longrightarrow K_2SO_4 + CO_2 + Cr_2(SO_4)_3 + H_2O$
In above reaction, identify the elements which do not undergo change in their oxidation state :
(A) C (B) S & Cr (C) K, O, S & H (D) C & O
- * Which of the following changes involve either oxidation or reduction :
(A) $VO^{2+} \rightarrow V_2O_3$ (B) $Na \rightarrow Na^+$ (C) $Zn^{+2} \rightarrow Zn$ (D) $CrO_4^{-2} \rightarrow Cr_2O_7^{-2}$
- Which of the following is not a redox reaction :
(A) $Mg + N_2 \longrightarrow Mg_3N_2$ (B) $MnO_4^- + C_2O_4^{2-} \longrightarrow Mn^{2+} + CO_2$
(C) $CuSO_4 + KI \longrightarrow 2CuI + I_2 + K_2SO_4$ (D) $AgCl + NH_3 \longrightarrow [Ag(NH_3)_2] Cl$
- $Zn + NO_3^- \longrightarrow Zn^{2+} + NH_4^+ + H_2O$
How many moles of electrons, per mole of NO_3^- ion, are gained in the above reaction ?
- Arsenic estimation can be done by Bettendorff's process. The reaction is given below :
 $As_4O_6 + SnCl_2 + HCl \longrightarrow As_4 + SnCl_4 + H_2O$
Find out the exact stoichiometric coefficient of the reactants respectively :
(in the order as given in question)
(A) 2, 4, 6 (B) 1, 6, 12 (C) 2, 8, 20 (D) None of these
- * Which of the following can show disproportionation reaction :
(A) ClO_4^- (B) Cl^- (C) ClO_2^- (D) ClO_3^-

PHYSICAL CHEMISTRY
DPP
DAILY PRACTICE PROBLEMS
DPP No. 7
Total Marks : 15
Max. Time : 15 min.
Topic : Mole Concept
Type of Questions
M.M., Min.
Single choice Objective ('-1' negative marking) Q.1 to Q.3
(3 marks, 3 min.)
[9, 9]
Short Subjective Questions ('-1' negative marking) Q.4 to Q.5 (3 marks, 3 min.)
[6, 6]

- When white phosphorus reacts with caustic soda, the products are PH_3 and NaH_2PO_2 . This reaction is an example of :

| | |
|------------------------|--------------------|
| (A) Oxidation | (B) Reduction |
| (C) Disproportionation | (D) Neutralisation |
- Which of the following changes does not involve either oxidation or reduction :

| | |
|---|--|
| (A) $\text{VO}^{2+} \rightarrow \text{V}_2\text{O}_3$ | (B) $\text{Na} \rightarrow \text{Na}^+$ |
| (C) $\text{Zn}^{+2} \rightarrow \text{Zn}$ | (D) $\text{CrO}_4^{-2} \rightarrow \text{Cr}_2\text{O}_7^{-2}$ |
- Which of the following is not a redox reaction :

| | |
|--|---|
| (A) $\text{Mg} + \text{N}_2 \longrightarrow \text{Mg}_3\text{N}_2$ | (B) $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} \longrightarrow \text{Mn}^{2+} + \text{CO}_2$ |
| (C) $\text{CuSO}_4 + \text{KI} \longrightarrow 2\text{CuI} + \text{I}_2 + \text{K}_2\text{SO}_4$ | (D) $\text{AgCl} + \text{NH}_3 \longrightarrow [\text{Ag}(\text{NH}_3)_2]\text{Cl}$ |
- Identify the oxidant and the reductant in the following reactions :
 - $\text{KMnO}_4 + \text{KCl} + \text{H}_2\text{SO}_4 \longrightarrow \text{MnSO}_4 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O} + \text{Cl}_2$
 - $\text{FeCl}_2 + \text{H}_2\text{O}_2 + \text{HCl} \longrightarrow \text{FeCl}_3 + \text{H}_2\text{O}$
 - $\text{Cu} + \text{HNO}_3 (\text{dil}) \longrightarrow \text{Cu}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{NO}$
 - $\text{Na}_2\text{HAsO}_3 + \text{KBrO}_3 + \text{HCl} \longrightarrow \text{NaCl} + \text{KBr} + \text{H}_3\text{AsO}_4$
 - $\text{I}_2 + \text{Na}_2\text{S}_2\text{O}_3 \longrightarrow \text{Na}_2\text{S}_4\text{O}_6 + \text{NaI}$
- Balance the following redox equations :
 - $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{K}_2\text{SO}_4 + \text{Cr}_2(\text{SO}_4)_3 + \text{H}_2\text{O} + \text{O}_2$
 - $\text{Zn} + \text{NaNO}_3 + \text{NaOH} \longrightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2\text{O} + \text{NH}_3$
 - $\text{Al} \longrightarrow [\text{Al}(\text{OH})_4]^- + \text{H}_2$ (basic)
 - $\text{Cu}_3\text{P} + \text{Cr}_2\text{O}_7^{2-} \longrightarrow \text{Cu}^{2+} + \text{H}_3\text{PO}_4 + \text{Cr}^{3+} + \text{H}_2\text{O}$
 - $\text{ClO}_3^- + \text{Fe}^{2+} + \text{H}^+ \longrightarrow \text{Cl}^- + \text{Fe}^{3+} + \text{H}_2\text{O}$
 - $\text{N}_2\text{O}_4 + \text{BrO}_3^- \longrightarrow \text{NO}_3^- + \text{Br}^-$ (in acidic medium)
 - $\text{S}_2\text{O}_3^{2-} + \text{Sb}_2\text{O}_5 \longrightarrow \text{SbO} + \text{H}_2\text{SO}_3$
 - $\text{Cr}_2\text{O}_7^{2-} + \text{I}^- + \text{H}^+ \longrightarrow \text{Cr}^{3+} + \text{I}_2 + \text{H}_2\text{O}$
 - $\text{IO}_4^- + \text{I}^- + \text{H}^+ \longrightarrow \text{I}_2 + \text{H}_2\text{O}$

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 8
Total Marks : 32
Max. Time : 32 min.
Topic : Mole Concept
Type of Questions

| Type of Questions | M.M., Min. |
|---|----------------------------|
| Single choice Objective ('-1' negative marking) Q.1,3,4 | (3 marks, 3 min.) [9, 9] |
| Multiple choice objective ('-1' negative marking) Q.5,6 | (4 marks, 4 min.) [8, 8] |
| Short Subjective Questions ('-1' negative marking) Q.2 | (3 marks, 3 min.) [3, 3] |
| Comprehension ('-1' negative marking) Q.7 to 10 | (3 marks, 3 min.) [12, 12] |

- What volume of a 0.8 M solution contains 100 millimoles of the solute :
 (A) 100 mL (B) 125 mL (C) 500 mL (D) 62.5 mL
- Calculate the volume in litre of 1M solution of HCl, which contains 36.5 g HCl.
- The molarity of the KOH solution which is 2.8% (mass/volume) solution is :
 (A) M/10 (B) M/2 (C) M/5 (D) 1 M
- 75 ml of H_2SO_4 (specific gravity = 1.18) containing 49% H_2SO_4 by mass is diluted to 590 ml. Calculate molarity of the diluted solution :
 (A) 0.7 M (B) 7.5 M (C) 0.75 M (D) 0.25 M
- If 100 ml of 1M H_2SO_4 solution is mixed with 100 ml of 9.8%(w/w) H_2SO_4 solution (d = 1 g/ml), then :
 (A) concentration of solution remains same (B) volume of solution become 200 ml
 (C) mass of H_2SO_4 in the solution is 98 g (D) mass of H_2SO_4 in the solution is 19.6 g
- For 100 ml of 0.3 M $CaCl_2$ solution + 400 ml of 0.1 M HCl solution, correct datas is/are :
 (A) Total concentration of cation(s) = 0.14 M (B) Total concentration of cation(s) = 0.07 M
 (C) $[Cl^-] = 0.1 M$ (D) $[Cl^-] = 0.2 M$

Comprehension # (Q.7 to Q.10)

The concentrations of solutions can be expressed in number of ways; viz : mass fraction of solute (or mass percent), Molar concentration (Molarity) and Molal concentration (molality). These terms are known as concentration terms and also they are related with each other i.e. knowing one concentration term for the solution, we can find other concentration terms also. The definition of different concentration terms are given below :

Molarity : It is number of moles of solute present in one litre of the solution.

Molality : It is the number of moles of solute present in one kg of the solvent.

$$\text{Mole Fraction} = \frac{\text{moles of solute}}{\text{moles of solute} + \text{moles of solvent}}$$

If molality of the solution is given as 'a', then mole fraction of the solute can be calculated by :

$$\text{Mole Fraction} = \frac{a}{a + \frac{1000}{M_{\text{solvent}}}} = \frac{a \times M_{\text{solvent}}}{(a \times M_{\text{solvent}} + 1000)}$$

where a = molality and M_{solvent} = Molar mass of solvent.

We can change : Mole fraction \leftrightarrow Molality \leftrightarrow Molarity.

- 120 g of solution containing 40% by mass of NaCl is mixed with 200 g of a solution containing 15% by mass NaCl. Determine the mass percent of sodium chloride in the final solution :
 (A) 24.4% (B) 78% (C) 48.8% (D) 19.68%
- What is the molality of the above final solution :
 (A) 4.4 m (B) 5.5 m (C) 24.4 m (D) none of these
- What is the mole fraction of the solute in the above final solution :
 (A) 0.18 (B) 0.75 (C) 0.09 (D) 0.25
- What is the molarity of above final solution if density of solution is 1.6 g/ml :
 (A) 5.5 M (B) 6.6 M (C) 2.59 M (D) None of these

PHYSICAL CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 9

Total Marks : 49

Max. Time : 54 min.

Topic : Mole Concept

Type of Questions

| Type of Questions | | M.M., Min. |
|---|--------------------|------------|
| Single choice Objective ('-1' negative marking) Q.2,4,5 | (3 marks, 3 min.) | [9, 9] |
| True or False (no negative marking) Q.6 | (2 marks, 2 min.) | [2, 2] |
| Subjective Questions ('-1' negative marking) Q.7, 8 & 10 | (4 marks, 5 min.) | [12, 15] |
| Short Subjective Questions ('-1' negative marking) Q.1,3,6,10 | (3 marks, 3 min.) | [9, 9] |
| Match the Following (no negative marking) (2 × 4) Q.9 | (8 marks, 10 min.) | [8, 10] |
| Comprehension ('-1' negative marking) Q.11 to Q.13 | (3 marks, 3 min.) | [9, 9] |

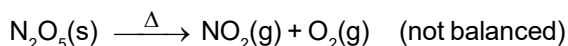
- If the mass of one atom of an element X is about 6×10^{-23} g, how many moles of X are equivalent to 144 g of X ?
- The atomic weight of an element is 'a'. If this element occurs in nature as a triatomic gas, then the correct formula for the number of moles of gas in its 'w' g is :

(A) $\frac{3w}{a}$ (B) $\frac{w}{3a}$ (C) 3wa (D) $\frac{a}{3w}$
- Find the total number of protons in 11.2 L of phosphine (PH_3) gas under NTP conditions.
- The density of water at 4°C is $1 \times 10^3 \text{ kg m}^{-3}$. Assuming no empty space to be present between water molecules, the volume occupied by one molecule of water is approximately :

(A) $3 \times 10^{-23} \text{ mL}$ (B) $6 \times 10^{-22} \text{ mL}$ (C) $3 \times 10^{-21} \text{ mL}$ (D) $9 \times 10^{-23} \text{ mL}$
- The density of air at STP is $0.001277 \text{ g mL}^{-1}$. Its vapour density is about :

(A) 143 (B) 14.3 (C) 1.43 (D) 0.143
- State whether the following statements are true or false :
 - According to law of definite proportions, two elements always combine in the same ratio by mass.
 - Different proportions of oxygen for a fixed mass of nitrogen in the various oxides of nitrogen prove the law of multiple proportions.
 - If 2.8 L of an unknown gas at NTP weighs 5.5 g, then the gas could be CO_2 or N_2O .
 - 5 g urea (NH_2CONH_2) and 5 g Acetic acid (CH_3COOH), both contain the same total number of atoms.
- An oxide of Osmium (symbol Os) is pale yellow solid. If 2.794 g of the compound contains 2.09 g of osmium, what is its empirical formula ? (At. wt. of Os = 190)
- When Dinitrogen pentoxide (N_2O_5 , a white solid) is heated, it decomposes into nitrogen dioxide and oxygen.

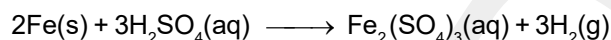
If a sample of N_2O_5 produces 1.6 g O_2 , then how many grams of NO_2 are formed ?



9. Match the following :

| Column-I | Column-II |
|---|---------------------------------------|
| For 1 mole of reactant placed in an open container in each reaction | Product |
| (A) $\text{PCl}_5(\text{g}) \xrightarrow{\Delta} \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ | (p) $2N_A$ molecules are produced |
| (B) $\text{CaCO}_3(\text{s}) \xrightarrow{\Delta} \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ | (q) 67.2 litre gaseous product at STP |
| (C) $2\text{HCl}(\text{g}) \xrightarrow{\Delta} \text{H}_2(\text{g}) + \text{Cl}_2(\text{g})$ | (r) 22.4 litre gaseous product at STP |
| (D) $\text{NH}_4\text{COONH}_2(\text{s}) \xrightarrow{\Delta} 2\text{NH}_3(\text{g}) + \text{CO}_2(\text{g})$ | 44.8 litre gaseous product at STP |

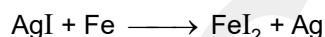
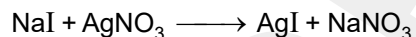
10. An alloy of iron and carbon was treated with sulfuric acid, in which only iron reacts :



If a sample of alloy weighing 140 g gave 6 g of hydrogen, what is the percentage of iron in the alloy ?

Comprehension # (Q. 11 to Q. 13)

Iodine is an important substance needed by the body of a human being. We consume it in the form of salt, which has very-very small % content of I_2 . Iodine has various industrial applications also. The following process has been used to obtain iodine from oil-field brines in California :



11. If 381 kg of iodine is produced per hour, then mass of AgNO_3 required per hour will be :

- (A) 170 kg (B) 340 kg (C) 255 kg (D) 510 kg

12. If above reaction is carried out by taking 150 kg of NaI and 85 kg of AgNO_3 , then number of moles of iodine formed is :

- (A) 0.5 (B) 500 (C) 250 (D) 0.25

13. If 324 g of Ag is recovered in pure form, then minimum amount of NaI required will be :

- (A) 450 g (B) 150 g (C) 300 g (D) 600 g

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 10
Total Marks : 52
Max. Time : 62 min.
Topic : Mole Concept

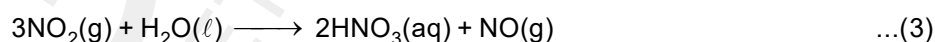
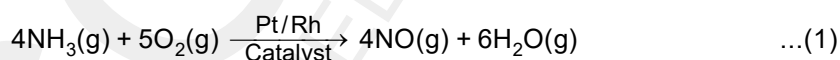
| Type of Questions | | M.M., Min. |
|---|--------------------|------------|
| Subjective Questions ('-1' negative marking) Q.1 to 3 , 7 to 11, 13 | (4 marks, 5 min.) | [32, 40] |
| Short Subjective Questions ('-1' negative marking) Q.12 | (3 marks, 3 min.) | [3, 3] |
| Comprehension ('-1' negative marking) Q.4 to 6 | (3 marks, 3 min.) | [9, 9] |
| Match the Following (no negative marking) (2 × 4) Q.14 | (8 marks, 10 min.) | [8, 10] |

- An alloy has Fe, Co and Mo equal to 60%, 29.5% and 10.5% by mass respectively. How many cobalt atoms are there in a cylinder made from same alloy, having radius 2.1 cm and a length of 10 cm ? The density of alloy is $\frac{100}{21}$ g/mL. Atomic weight of cobalt = 59 u.
- What weight of CO is required to form $\text{Re}_2(\text{CO})_{10}$ from 2.42 g of Re_2O_7 according to the given unbalanced reaction ?

$$\text{Re}_2\text{O}_7 + \text{CO} \longrightarrow \text{Re}_2(\text{CO})_{10} + \text{CO}_2$$
 (Atomic mass of Re = 186 u)
- Haemoglobin contains 0.25% iron by weight. The molecular weight of Haemoglobin is 89600 u. Calculate the weight of $\text{K}_4[\text{Fe}(\text{CN})_6]$ that can be produced, if all the iron atoms from 4.48 kg haemoglobin are converted into $\text{K}_4[\text{Fe}(\text{CN})_6]$ through a series of reactions.

Comprehension # (Q. 4 to Q. 6).

Nitric acid is the most important oxyacid formed by nitrogen. It is one of the major industrial chemicals and is widely used. Nitric acid is manufactured by the catalytic oxidation of ammonia, that is known as Ostwald process, which can be represented by the sequence of reactions shown below :



The aqueous nitric acid obtained by this method can be concentrated by distillation to $\approx 68.5\%$ by weight. Further concentration to 98% acid can be achieved by dehydration with concentrated sulfuric acid.

- 85 kg of NH_3 (g) was heated with 320 kg oxygen in the first step and HNO_3 is prepared according to the above reactions. If the final solution has volume 500 L, then molarity of HNO_3 solution is :
 (A) 2M (B) 8M (C) 3.33 M (D) 6.66 M
- If 180 L of water completely reacts with NO_2 produced to form nitric acid according to the above reactions, then the volume of air required at STP containing 20% of NH_3 by volume is : ($\rho_{\text{H}_2\text{O}} = 1\text{g/mL}$)
 (A) 1.56×10^6 L (B) 6.72×10^4 L (C) 3.36×10^6 L (D) None of these

6. If 170 kg of NH_3 is heated in excess of oxygen, then the volume of H_2O (ℓ) produced in 1st reaction at STP is : ($\rho_{\text{H}_2\text{O}} = 1 \text{ g/mL}$)
 (A) $336 \times 10^3 \text{ L}$ (B) 270 L (C) $224 \times 10^3 \text{ L}$ (D) 170 L
7. How many grams of Sodium dichromate ($\text{Na}_2\text{Cr}_2\text{O}_7$) should be added to a 50 mL volumetric flask to prepare 0.025 M $\text{Na}_2\text{Cr}_2\text{O}_7$ solution, when the flask is filled upto the mark with water ?
8. What volume of 0.25 M HNO_3 (nitric acid) solution reacts with 50 mL of 0.15 M Na_2CO_3 (sodium carbonate) solution in the following reaction :

$$2\text{HNO}_3(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \longrightarrow 2\text{NaNO}_3(\text{aq}) + \text{H}_2\text{O}(\ell) + \text{CO}_2(\text{g})$$
9. How would you prepare exactly 3 litre of 1 M NaOH solution by mixing proportions of stock solutions of 2.5 M NaOH and 0.4 M NaOH, if no water is to be used. Find the ratio of the volume (v_1/v_2).
10. A sample of H_2SO_4 (density 1.4 g mL^{-1}) solution is labelled as 84% by weight. What is molarity of acid solution? What volume of this acid solution has to be used to make 1 litre of 0.2 M H_2SO_4 solution ?
11. 10 mL of sulphuric acid solution (sp. gr. = 1.84) contains 98% by weight of pure acid. Calculate the volume of 2.5 M NaOH solution required to just neutralize the above acid solution.
12. When 10 g NaOH is added with 90 g of H_2O , a solution having density 1.2 g/mL is obtained. Then, calculate the following for this solution :
 (i) % w/w (ii) % w/v (iii) mole fraction of NaOH (iv) molarity (M) (v) molality (m)
13. Out of 5.85% w/v aq. NaCl solution and 5.55% w/v aq. CaCl_2 solution, which solution has more number of Cl^- ions per mL of solution ?
14. **Match the following :**
- | Column-I | Column-II |
|---|--------------------------------------|
| (A) 1 M glucose solution | (p) 1 mole solute per litre solution |
| (B) 3 M urea solution | (q) 180 g solute per litre solution |
| (C) 3 M CH_3COOH solution | (r) % w/v = 18% (solution) |
| (D) 1 M H_2SO_4 solution | (s) % w/v = 9.8% (solution) |

PHYSICAL CHEMISTRY
DPP
DAILY PRACTICE PROBLEMS
DPP No. 11
Total Marks : 25
Max. Time : 26 min.
Topic : Atomic Structure

| Type of Questions | | M.M., Min. |
|--|-------------------|------------|
| Single choice Objective ('-1' negative marking) Q.1 to 3,6,7 | (3 marks, 3 min.) | [15, 15] |
| Subjective Questions ('-1' negative marking) Q.8 | (4 marks, 5 min.) | [4, 5] |
| Short Subjective Questions ('-1' negative marking) Q.4,5 | (3 marks, 3 min.) | [6, 6] |

1. The mass of a neutron is than the mass of a proton :
 (A) slightly less (B) slightly more
 (C) exactly equal (D) their masses cannot be compared
2. The ratio of the number of neutrons present in one atom each of C and Si with respect to mass number of 12 and 28 respectively is :
 (A) 3 : 7 (B) 7 : 3 (C) 3 : 4 (D) 6 : 28
3. An atom consist of electrons, protons and neutrons. If the mass attributed to neutron was halved and that attributed to the electron was doubled, the atomic mass of ${}_6\text{C}^{12}$ would be approximately :
 (A) Same (B) Doubled (C) Halved (D) Reduced by 25%
4. There are 11 protons and 12 neutrons in the nucleus of an atom. Find the atomic number (Z), mass number (A), number of electrons and the symbol of the element.
5. Calculate the number of protons, electrons and neutrons in ${}^{15}_8\text{O}^{2-}$.
6. The total number of electrons in a nitrate ion is :
 (A) 31 (B) 62 (C) 32 (D) 63
7. Atomic radius is of the order of 10^{-8} cm and nuclear radius is of the order of 10^{-13} cm. The fraction of atom that is occupied by nucleus is :
 (A) 10^{-5} (B) 10^5 (C) 10^{-15} (D) None of these
8. If an atom of an element X contains equal number of protons, neutrons and electrons, and its atomic number (Z) and mass number (A) are related as : $2A + 3Z = 140$, then find the total number of nucleons present in one atom of element X. Also identify the element.

Topic : Atomic Structure

| Type of Questions | M.M., Min. |
|--|----------------------------|
| Single choice Objective ('-1' negative marking) Q.1,3,5 | (3 marks, 3 min.) [9, 9] |
| Multiple choice objective ('-1' negative marking) Q.2, 4,6 | (4 marks, 4 min.) [12, 12] |
| Short Subjective Questions ('-1' negative marking) Q.10,12 | (3 marks, 3 min.) [6, 6] |
| Comprehension ('-1' negative marking) Q.7 to 9 | (3 marks, 3 min.) [9, 9] |
| Match the Following (no negative marking) (2 × 4) Q.11 | (8 marks, 10 min.) [8, 10] |

1. The potential energy of the electron present in the ground state of Li^{2+} ion is represented by :

(r = Radius of ground state)

(A) $+\frac{3e^2}{4\pi\epsilon_0 r}$ (B) $-\frac{3e}{4\pi\epsilon_0 r}$ (C) $-\frac{3e^2}{4\pi\epsilon_0 r^2}$ (D) $-\frac{3e^2}{4\pi\epsilon_0 r}$

2. Which of the following are isotopes :

- (i) Atom, whose nucleus contains $20p + 15n$ (ii) Atom, whose nucleus contains $20p + 17n$
 (iii) Atom, whose nucleus contains $18p + 22n$ (iv) Atom, whose nucleus contains $18p + 21n$
 (A) (i) and (iii) (B) (i) and (ii) (C) (ii) and (iii) (D) (iii) and (iv)

3. Which of the following are isobars :

- (i) Atom, whose nucleus contains $20p + 15n$ (ii) Atom, whose nucleus contains $20p + 20n$
 (iii) Atom, whose nucleus contains $18p + 17n$ (iv) Atom, whose nucleus contains $18p + 22n$
 (A) (i) and (iii) (B) (ii) and (iii) (C) (iii) and (iv) (D) (i) and (iv)

4. Which of the following is/are isotones :

(A) ${}^2_1\text{H}, {}^3_1\text{H}$ (B) ${}^{15}_7\text{N}, {}^{16}_8\text{O}$ (C) ${}^{40}_{18}\text{Ar}, {}^{40}_{20}\text{Ca}$ (D) ${}^3_1\text{H}, {}^4_2\text{He}$

5. Which of the following are isoelectronic :

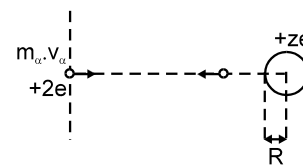
- (I) CH_3^+ (II) H_3O^+ (III) NH_3 (IV) CH_3^-
 (A) I and III (B) III and IV (C) I and II (D) II, III and IV

6.* Which of the following are isoelectronic species :

(A) $\text{CO}_3^{2-}, \text{NO}_3^-$ (B) $\text{SO}_4^{2-}, \text{PO}_4^{3-}$ (C) $\text{CO}_2, \text{N}_2\text{O}$ (D) $\text{N}^{3-}, \text{Al}^{3+}$

Comprehension # (Q.7 to Q.9)

The approximate size of the nucleus can be calculated by using energy conservation theorem in Rutherford's α -scattering experiment. If an α -particle is projected from infinity with speed v , towards the nucleus having z protons, then the α -particle which is reflected back or which is deflected by 180° must have approached closest to the nucleus. It can be approximated that α -particle collides with the nucleus and gets back. Now, if we apply the energy conservation equation at initial point and collision point, then :



$$\begin{aligned} (\text{Total Energy})_{\text{initial}} &= (\text{Total Energy})_{\text{final}} \\ (\text{K.E.})_i + (\text{P.E.})_i &= (\text{K.E.})_f + (\text{P.E.})_f \end{aligned}$$

$(\text{P.E.})_i = 0$, since P.E. of two charge system separated by infinite distance is zero. Finally the particle stops and then starts coming back.

$$\frac{1}{2} m_\alpha v_\alpha^2 + 0 = 0 + \frac{Kq_1q_2}{R} \Rightarrow \frac{1}{2} m_\alpha v_\alpha^2 = K \frac{2e \times ze}{R} \Rightarrow R = \frac{4Kze^2}{m_\alpha v_\alpha^2}$$

Thus the radius of nucleus can be calculated using above equation. The nucleus is so small a particle that we can't define a sharp boundary for it. Experiments show that the average radius R of a nucleus may be written as:

$$R = R_0(A)^{1/3}$$

where $R_0 = 1.2 \times 10^{-15} \text{ m}$

A – mass number of atom

R – radius of nucleus

7. If the diameter of two different nuclei are in the ratio 1:2, then their mass number are in the ratio :
 (A) 1:2 (B) 8:1 (C) 1:8 (D) 1:4
8. An α -particle with speed v_0 is projected from infinity and it approaches up to r_0 distance from a nuclei. Then, the speed of α -particle which approaches upto $2r_0$ distance from the nucleus is :
 (A) $\sqrt{2} v_0$ (B) $\frac{v_0}{\sqrt{2}}$ (C) $2v_0$ (D) $\frac{v_0}{2}$
9. Radius of a particular nucleus is calculated by the projection of α -particle from infinity at a particular speed. Let this radius is the true radius. If the radius calculation for the same nucleus is made by another α -particle with half of the earlier speed, then the percentage error involved in the radius calculation is :
 (A) 75% (B) 100% (C) 300% (D) 400%
10. With what velocity should an α -particle travel towards the nucleus of a Copper atom, so as to arrive at a distance of 10^{-13} m from the nucleus of Copper atom. (At. No. of Cu = 29). (Take $\sqrt{40} = 6.32$)
11.

| Column-I | Column-II |
|-----------------|--|
| (A) Frequency | (p) Linear distance travelled by a wave per unit time. |
| (B) Wavelength | (q) Number of waves passing through a point in one second. |
| (C) Time period | (r) Linear distance between starting and end point of one complete wave. |
| (D) Speed | (s) Time taken for one complete wave to pass through a point. |
12. For a wave, frequency is 10 Hz and wavelength is 2.5 m. How much linear distance will it travel in 40 seconds ?

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] |

- 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.
- 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).
- (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 ($\bar{\nu}$) (in m^{-1}) for it.
- The ratio of the energy of a photon of wavelength 3000 Å to that of a photon of wavelength 6000 Å respectively is:
(A) 1 : 2 (B) 2 : 1 (C) 3 : 1 (D) 1 : 3
- 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 ($\lambda = 310$ nm) are needed to generate this minimum energy ?
- 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.
- Find out the number of photons emitted by a 60 watt bulb in one minute, if wavelength of an emitted photon is 620 nm.
- 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.
[$hc = 12400 \text{ eVÅ}$, $1 \text{ eV/atom} = 96 \text{ KJ/mol}$]
- 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) : [$hc = 12400 \text{ eVÅ}$]
(A) 4000 Å (B) 3000 Å (C) 2000 Å (D) 1000 Å

Topic : Atomic Structure

Type of Questions

Single choice Objective ('-1' negative marking) Q.3 to Q.9

(3 marks, 3 min.)

M.M., Min.

[21, 21]

Subjective Questions ('-1' negative marking) Q.1 to Q.2

(4 marks, 5 min.)

[8, 10]

Match the Following (no negative marking) (2 × 4) Q.10

(8 marks, 10 min.)

[8, 10]

- In I experiment, electromagnetic radiations of a certain frequency are irradiated on a metal surface ejecting photoelectrons having a certain value of maximum kinetic energy. However, in II experiment, on doubling the frequency of incident electromagnetic radiations, the maximum kinetic energy of ejected photoelectrons becomes three times. What percentage of incident energy is converted into maximum kinetic energy of photoelectrons in II experiment ?
- The potential difference applied on the metal surface to reduce the velocity of photoelectron to zero is known as Stopping Potential. When a beam of photons of wavelength 40 nm was incident on a surface of a particular pure metal, some emitted photoelectrons had stopping potential equal to 18.6 V, some had 12 V and rest had lower values. Calculate the threshold wavelength (λ_0) of the metal (in Å) assuming that at least one photoelectron is ejected with maximum possible kinetic energy. ($hc = 12400 \text{ eVÅ}$)
- For which of the following species, Bohr model is not valid :
(A) He^+ (B) H (C) Li^{2+} (D) H^+
- Wavelength of radiations emitted when an electron in a H-like atom jumps from a state A to C is 2000 Å and it is 6000 Å, when the electron jumps from state B to state C. Wavelength of the radiations emitted when an electron jumps from state A to B will be :
(A) 2000 Å (B) 3000 Å (C) 4000 Å (D) 6000 Å
- If the radius of the first Bohr orbit of the H atom is r, then for Li^{2+} ion, it will be :
(A) 3r (B) 9r (C) r/3 (D) r/9
- In a certain electronic transition in the Hydrogen atom from an initial state i to a final state f, the difference in the orbit radius ($r_i - r_f$) is seven times the first Bohr radius. Identify the transition :
(A) $4 \rightarrow 1$ (B) $4 \rightarrow 2$ (C) $4 \rightarrow 3$ (D) $3 \rightarrow 1$
- The velocity of electron in the ground state of H atom is $2.184 \times 10^8 \text{ cm/sec}$. The velocity of electron in the second orbit of Li^{2+} ion in cm/sec would be :
(A) 3.276×10^8 (B) 2.185×10^8 (C) 4.91×10^8 (D) 1.638×10^8
- The potential energy of the electron present in the ground state of Li^{2+} ion is represented by :
(A) $+\frac{3e^2}{4\pi\epsilon_0 r}$ (B) $-\frac{3e}{4\pi\epsilon_0 r}$ (C) $-\frac{3e^2}{4\pi\epsilon_0 r^2}$ (D) $-\frac{3e^2}{4\pi\epsilon_0 r}$
- If the angular momentum of an electron in a Bohr orbit is $\frac{2h}{\pi}$, then the value of potential energy of this electron present in He^+ ion is :
(A) -13.6 eV (B) -3.4 eV (C) -6.8 eV (D) -27.2 eV.
- Match the following :**

| | |
|---|--------------------|
| $E_n = \text{total energy}$, $\ell_n = \text{angular momentum}$, $K_n = \text{K.E.}$, $V_n = \text{P.E.}$, $T_n = \text{time period}$, $r_n = \text{radius of } n^{\text{th}} \text{ orbit}$ | |
| Column (I) | Column (II) |
| (A) $E_n^{-y} \propto r_n/Z$, then y is | (p) 1/2 |
| (B) $\ell_n \propto n^x$, then x is | (q) -2 |
| (C) Value of $\frac{E_n}{V_n}$ is | (r) -3 |
| (D) $T_n \propto \frac{Z^t}{n^m}$, t & m are respectively | (s) 1 |

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 15
Total Marks : 25
Max. Time : 25 min.
Topic : Atomic Structure
Type of Questions
Single choice Objective ('-1' negative marking) Q.1 to Q.6,8
(3 marks, 3 min.)
M.M., Min.
[21, 21]
Multiple choice objective ('-1' negative marking) Q.7
(4 marks, 4 min.)
[4, 4]

- An electron in a H-like atom jumps from a higher energy level 'n' to ground state by emitting two successive photons of wave numbers $5.25 \times 10^8 \text{ m}^{-1}$ and $7.25 \times 10^8 \text{ m}^{-1}$. If the same electron undergoes the same transition by emitting a single photon, then the wavelength of this photon is :

(A) 32.84 Å (B) 8 Å (C) 0.125 Å (D) 0.03 Å
- The ratio of the difference in energy between the first and second Bohr orbit to that between the second and third Bohr orbit in a H-like species is :

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$ (C) $\frac{4}{9}$ (D) $\frac{27}{5}$
- The radii of two of the first four Bohr orbits of the Hydrogen atom are in the ratio 1 : 4. The energy difference between them may be :

(A) Either 12.09 eV or 3.4 eV (B) Either 2.55 eV or 10.2 eV
 (C) Either 13.6 eV or 3.4 eV (D) Either 3.4 eV or 0.85 eV
- The ratio of radius of two different orbits in a H-atom is 4 : 9. Then, the ratio of the frequency of revolution of electron in these orbits is :

(A) 2 : 3 (B) 27 : 8 (C) 3 : 2 (D) 8 : 27
- According to Bohr's theory, the ratio of electrostatic force of attraction acting on electron in 3rd orbit of He⁺ ion and 2nd orbit of Li²⁺ ion is $\left(\frac{3}{2}\right)^x$. Then, the value of x is :

(A) 7 (B) -6 (C) 6 (D) -7
- Suppose a hypothetical H-like atom produces a blue, yellow, red and violet line in emission spectrum. Match the above lines with their corresponding possible electronic transition :

| Colour of spectral lines | Possible corresponding transitions |
|--------------------------|------------------------------------|
| (A) Blue | (p) 6 → 3 |
| (B) Yellow | (q) 2 → 1 |
| (C) Red | (r) 5 → 2 |
| (D) Violet | (s) 4 → 3 |

(A) (A) → r, (B) → p, (C) → s, (D) → q (B) (A) → r, (B) → s, (C) → q, (D) → p
 (C) (A) → p, (B) → r, (C) → s, (D) → q (D) (A) → p, (B) → r, (C) → q, (D) → s
- If the binding energy of 2nd excited state of a hypothetical H-like atom is 12 eV, then :

(A) I excitation potential = 81 V (B) II Excitation energy = 96 eV
 (C) Ionisation potential = 192 V (D) Binding energy of 2nd state = 27 eV
- Wave number of a spectral line for a given transition is x cm⁻¹ for He⁺ ion. Then, its value for Be³⁺ ion (isoelectronic of He⁺) for same transition is :

(A) x cm⁻¹ (B) 4x cm⁻¹ (C) $\frac{x}{4}$ cm⁻¹ (D) 2x cm⁻¹

Topic : Atomic Structure
Type of Questions

| | | M.M., Min. |
|--|--------------------|------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.3 | (3 marks, 3 min.) | [9, 9] |
| Multiple choice objective ('-1' negative marking) Q.4 | (4 marks, 4 min.) | [4, 4] |
| Subjective Questions ('-1' negative marking) Q.5,6,8,9 | (4 marks, 5 min.) | [16, 20] |
| Match the Following (no negative marking) (2 × 4) Q.7 | (8 marks, 10 min.) | [8, 10] |

- If numerical value of mass and velocity are equal for a particle, then its de-Broglie wavelength in terms of K.E. is :
 (A) $\frac{mh}{2K.E.}$ (B) $\frac{h}{2mK.E.}$ (C) both are correct (D) none is correct.
- A wavelength of 400 nm of electromagnetic radiation corresponds to :
 (A) frequency (ν) = 7.5×10^{14} Hz (B) wave number ($\bar{\nu}$) = 2.5×10^6 m⁻¹.
 (C) momentum of photon = 1.66×10^{-27} kg ms⁻¹ (D) all are correct values.
- In one experiment, a proton having initial kinetic energy of 1 eV is accelerated through a potential difference of 3 V. In another experiment, an α -particle having initial kinetic energy 20 eV is retarded by a potential difference of 2 V. The ratio of de-Broglie wavelengths of proton and α -particle is :
 (A) $2\sqrt{6} : 1$ (B) 8 : 1 (C) 4 : 1 (D) $2\sqrt{2} : 1$
- * When photons of energy 4.25 eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy (K.E)_A and de-Broglie wavelength is λ_A . The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.7 eV is (KE)_B, where (KE)_B = (KE)_A - 1.5 eV. If the de-Broglie wavelength of these photoelectrons is λ_B (= $2\lambda_A$), then :
 (A) The work function of metal A is 2.25 eV (B) The work function of metal B is 4.20 eV
 (C) (KE)_A = 2 eV (D) (KE)_B = 2.75 eV
- Average life time of an electron in hydrogen atom excited to n = 2 state is 10⁻⁸ s. Find the number of revolutions made by the electron on the average, before it jumps to the ground state.
- The ionisation energy of He⁺ ion is 19.6×10^{-18} J per ion. Calculate the energy of the first stationary state of Li²⁺ ion.
- Match the following :**

| Column (I) | Column (II) |
|--|-------------|
| (A) Binding energy of 5 th excited state of Li ²⁺ sample | (p) 10.2 V |
| (B) 1 st excitation potential of H-atom | (q) 3.4 eV |
| (C) 2 nd excitation potential of He ⁺ ion | (r) 13.6 eV |
| (D) I.E. of H-atom | (s) 48.4 V |
- The IP of H-atom is 13.6 V. It is exposed to electromagnetic waves of wavelength 1026 Å and then, it gives out induced radiations. Find the wavelength of all possible induced radiations.
- The ionization energy of a Hydrogen like species is 4 Rydberg. What is the radius of the first orbit of this atom ? (Given : Bohr radius of hydrogen = 5.3×10^{-11} m; 1 Rydberg = 2.2×10^{-18} J)

Topic : Atomic Structure

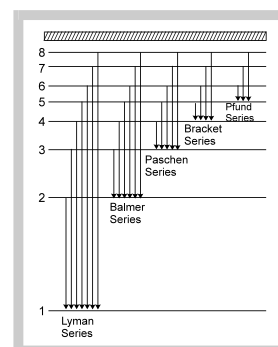
Type of Questions

| Type of Questions | M.M., Min. |
|---|----------------------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.4,10 | (3 marks, 3 min.) [15, 15] |
| Multiple choice objective ('-1' negative marking) Q.5 | (4 marks, 4 min.) [4, 4] |
| Comprehension ('-1' negative marking) Q.6 to Q.8 | (3 marks, 3 min.) [9, 9] |
| Match the Following (no negative marking)(2 × 4) Q.9 | (8 marks, 10 min.) [8, 10] |

- The wavenumber of the spectral line of shortest wavelength of Balmer series of He^+ ion is :
(R = Rydberg's constant)
(A) R (B) 3R (C) 4R (D) 4R/9
- Last line of the Lyman series of H-atom has frequency ν_1 , last line of Lyman series of He^+ ion has frequency ν_2 and 1st line of Lyman series of He^+ ion has frequency ν_3 . Then :
(A) $4\nu_1 = \nu_2 + \nu_3$ (B) $\nu_1 = 4\nu_2 + \nu_3$ (C) $\nu_2 = \nu_3 - \nu_1$ (D) $\nu_2 = \nu_1 + \nu_3$
- If λ_1 and λ_2 are respectively the wavelengths of the series limit of Lyman and Balmer series of Hydrogen atom, then the wavelength of the first line of the Lyman series of the H-atom is :
(A) $\lambda_1 - \lambda_2$ (B) $\sqrt{\lambda_1 \lambda_2}$ (C) $\frac{\lambda_2 - \lambda_1}{\lambda_1 \lambda_2}$ (D) $\frac{\lambda_1 \lambda_2}{\lambda_2 - \lambda_1}$
- STATEMENT -1:** We can use two photons successively of 1240 Å and 2000 Å wavelength in order to ionise a H atom from ground state.
STATEMENT -2: Sum of the energies of both the photons is greater than IE of H atom.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True
- 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 ν falls on a metal surface having work function $h\nu_0$, photoelectric effect will take place only if $\nu \leq \nu_0$.
(C) The number of photoelectrons ejected from a metal surface in photoelectric effect depends upon the intensity of incident radiations.
(D) The series limit wavelength of Balmer series for H-atom is $\frac{4}{R}$, where R is Rydberg's constant.

Comprehension # (Q.6 to Q.8)]

The only electron in the hydrogen atom resides under ordinary conditions in the first orbit. When energy is supplied, the electron moves to higher energy orbit depending on the amount of energy absorbed. When this electron returns to any of the lower orbits, it emits energy. Lyman series is formed when the electron returns to the lowest orbit, while Balmer series is formed when the electron returns to second orbit. Similarly, Paschen, Brackett and Pfund series are formed when electron returns to the third, fourth and fifth orbits from higher energy orbits respectively (as shown in figure)



Maximum number of lines produced when an electron jumps from n th level to ground level is equal to $\frac{n(n-1)}{2}$. For example, in the case of $n = 4$, number of lines produced is 6. ($4 \rightarrow 3, 4 \rightarrow 2, 4 \rightarrow 1, 3 \rightarrow 2, 3 \rightarrow 1, 2 \rightarrow 1$). When an electron returns from n_2 to n_1 state, the number of lines in the spectrum will be equal to :

$$\frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$$

If the electron comes back from energy level having energy E_2 to energy level having energy E_1 , then the difference may be expressed in terms of energy of photon as :

$$E_2 - E_1 = \Delta E, \quad \lambda = \frac{hc}{\Delta E}, \quad \Delta E = h\nu \quad (\nu - \text{frequency})$$

Since h and c are constants, ΔE corresponds to definite energy; thus each transition from one energy level to another will produce a light of definite wavelength. This is actually observed as a line in the spectrum of hydrogen atom.

Wave number of line is given by the formula $\bar{\nu} = RZ^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$.

where R is Rydberg constant ($R = 1.1 \times 10^7 \text{ m}^{-1}$)

(i) First line of a series : It is called 'line of longest wavelength' or 'line of lowest energy'.

(ii) Series limit or last line of a series : It is the line of shortest wavelength or line of highest energy.

6. In a hydrogen like sample, electrons are in a particular excited state. If electrons make transition upto 1st excited state, then it produces maximum 15 different types of spectral lines. Then, electrons were initially in :
 (A) 5th state (B) 6th state (C) 7th state (D) 8th state
7. The difference between the wave number of 1st line of Balmer series and last line of Paschen series for Li^{2+} ion is :
 (A) $\frac{R}{36}$ (B) $\frac{5R}{36}$ (C) $4R$ (D) $\frac{R}{4}$
8. In a single isolated atom of hydrogen, electrons make transition from 4th excited state to ground state producing maximum possible number of wavelengths. If the 2nd lowest energy photon is used to further excite an already excited sample of Li^{2+} ion, then transition will be :
 (A) $12 \rightarrow 15$ (B) $9 \rightarrow 12$ (C) $6 \rightarrow 9$ (D) $3 \rightarrow 6$
9. **Match the following :**
- | List-I | List-II |
|--|---------------------------------------|
| (A) From $n = 6$ upto $n = 3$ (In H-atom sample) | (p) 10 lines in the spectrum |
| (B) From $n = 7$ upto $n = 3$ (In H-atom sample) | (q) Spectral lines in visible region |
| (C) From $n = 5$ upto $n = 2$ (In H-atom sample) | (r) 6 lines in the spectrum |
| (D) From $n = 6$ upto $n = 2$ (In H-atom sample) | (s) Spectral lines in infrared region |
10. A photon of frequency $\frac{3Rc}{4}$ cannot be emitted from which of the following transitions :
 (Given : R = Rydberg's constant, c = speed of light)
 (A) From 5 upto 1 transition in a sample of H-atom.
 (B) From 6 upto 1 transition in a sample of He^+ ion.
 (C) From 7 upto 3 transition in a sample of Li^{2+} ion.
 (D) From 8 upto 3 transition in a sample of He^+ ion.

PHYSICAL CHEMISTRY
DPP
DAILY PRACTICE PROBLEMS
DPP No. 19
Total Marks : 27
Max. Time : 27 min.
Topic : Atomic Structure
Type of Questions
M.M., Min.
Single choice Objective ('-1' negative marking) Q.1 to Q.9
(3 marks, 3 min.)
[27, 27]

- Which of the following quantum numbers has not been derived from Schrodinger wave equation :
 (A) Principal quantum number (n) (B) Subsidiary quantum number (ℓ)
 (C) Magnetic quantum number (m) (D) Spin quantum number (s)
- Which d-orbital does not have four lobes :
 (A) $d_{x^2-y^2}$ (B) d_{xy} (C) d_{yz} (D) d_{z^2}
- The total number of subshells in n^{th} main energy level are :
 (A) n^2 (B) $2n^2$ (C) $(n-1)$ (D) n .
- Which of the following orbital does not make sense :
 (A) $3d$ (B) $3f$ (C) $5p$ (D) $7s$.
- The maximum number of electrons that can be accommodated in s, p and d-subshells respectively are :
 (A) 2 in each (B) 2, 6 and 6 (C) 2, 6 and 10 (D) 2, 6 and 12.
- Any p-orbital can accommodate upto :
 (A) four electrons (B) two electrons with parallel spin
 (C) six electrons (D) two electrons with opposite spin.
- In which transition, the change in de-Broglie wavelength of electron is maximum :
 (A) $n = 8 \rightarrow n = 6$ (B) $n = 5 \rightarrow n = 4$ (C) $n = 3 \rightarrow n = 2$ (D) $n = 2 \rightarrow n = 1$
- S₁** : Photoelectric effect can be explained on the basis of wave nature of electromagnetic radiations.

S₂ : An orbital represented by $n = 2, \ell = 1$ is dumb-bell shaped.

S₃ : d_{xy} orbital has zero probability of finding electrons along X-axis and Y-axis.

 (A) FTF (B) FTT (C) TFT (D) TFF
- S₁** : According to Bohr model, the angular momentum of revolving electron is directly proportional to the atomic number of H-like species bearing the electron.

S₂ : An orbital cannot accommodate more than 2 electrons.

S₃ : All orbitals have directional character.

 (A) FTF (B) TFF (C) FFT (D) TTF

Topic : Atomic Structure
Type of Questions
M.M., Min.

| | | |
|--|-------------------|----------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.4 | (3 marks, 3 min.) | [12, 12] |
| Comprehension ('-1' negative marking) Q.5 to Q.9 | (3 marks, 3 min.) | [15, 15] |
| Subjective Questions ('-1' negative marking) Q.10 to Q.11 | (4 marks, 5 min.) | [8, 10] |

- The orbital angular momentum corresponding to $n = 4$ and $m = -3$ is :
 (A) 0 (B) $\frac{h}{\sqrt{2\pi}}$ (C) $\frac{\sqrt{6}h}{2\pi}$ (D) $\frac{\sqrt{3}h}{\pi}$
- Spin magnetic moment of X^{n+} ($Z = 26$) is $\sqrt{24}$ B.M. Hence number of unpaired electrons and value of n respectively are :
 (A) 4, 2 (B) 2, 4 (C) 3, 1 (D) 0, 2
- Spin magnetic moments of V ($Z = 23$), Cr ($Z = 24$), Mn ($Z = 25$) are x, y, z respectively. Hence :
 (A) $x = y = z$ (B) $x < y < z$ (C) $x < z < y$ (D) $z < y < x$
- Which of the following sets of quantum numbers can be correct for an electron in 4f-orbital :
 (A) $n = 3, \ell = 2, m = -2, s = +\frac{1}{2}$ (B) $n = 4, \ell = 4, m = -4, s = -\frac{1}{2}$
 (C) $n = 4, \ell = 3, m = +1, s = +\frac{1}{2}$ (D) $n = 4, \ell = 3, m = +4, s = +\frac{1}{2}$

Comprehension # (Q.5 to Q.9)

Azimuthal quantum number (ℓ) : It describes the shape of electron cloud and the number of subshells in a shell.

* It can have values from 0 to $(n - 1)$

| * value of ℓ | subshell |
|-------------------|----------|
| 0 | s |
| 1 | p |
| 2 | d |
| 3 | f |

* Number of orbitals in a subshell = $2\ell + 1$

* Orbital angular momentum $L = \frac{h}{2\pi} \sqrt{\ell(\ell+1)} = \hbar \sqrt{\ell(\ell+1)}$ $\left[\hbar = \frac{h}{2\pi} \right]$

Magnetic quantum number (m) : It describes the orientations of the subshells. It can have values from $-l$ to $+l$ including zero, i.e., total $(2l + 1)$ values. Each value corresponds to an orbital. s-subshell has one orbital, p-

subshell three orbitals (p_x, p_y and p_z), d-subshell five orbitals ($d_{xy}, d_{yz}, d_{zx}, d_{x^2-y^2}, d_{z^2}$) and f-subshell has seven orbitals.

Spin quantum number (s) : It describes the spin of the electron. It has values $+1/2$ and $-1/2$ signifying clockwise spinning and anticlockwise rotation of electron about its own axis.

Spin of the electron produces angular momentum equal to $S = \sqrt{s(s+1)} \frac{h}{2\pi}$ where $s = +\frac{1}{2}$.

Total spin of an atom = $+\frac{n}{2}$ or $-\frac{n}{2}$

where n is the number of unpaired electron.

The magnetic moment of an atom, $\mu_s = \sqrt{n(n+2)}$ B.M.

n – number of unpaired electrons, B.M. (Bohr magneton)

5. A d-block element has total spin value of $+3$ or -3 . Then, the spin only magnetic moment of the element is approximately :
- (A) 2.83 B.M. (B) 3.87 B.M. (C) 5.9 B.M. (D) 6.93 B.M.
6. Spin only magnetic moment of ${}_{25}\text{Mn}^{x+}$ ion is $\sqrt{15}$ B.M. Then, the value of x is :
- (A) 1 (B) 2 (C) 3 (D) 4
7. Spin only magnetic moment of ${}_{26}\text{Fe}^{2+}$ ion is same as :
- (A) ${}_{26}\text{Fe}$ (B) ${}_{24}\text{Cr}^{2+}$ (C) ${}_{28}\text{Ni}^{4+}$ (D) All of these
8. Orbital angular momentum of an electron is $\sqrt{3} \frac{h}{\pi}$. Then, the number of orientations of this orbital in space are :
- (A) 3 (B) 5 (C) 7 (D) 9
9. The correct order of the magnetic moment of [${}_{25}\text{Mn}^{4+}, {}_{24}\text{Cr}^{3+}, {}_{26}\text{Fe}^{3+}$] is :
- (A) $\text{Fe}^{3+} > \text{Cr}^{3+} = \text{Mn}^{4+}$ (B) $\text{Fe}^{3+} > \text{Cr}^{3+} > \text{Mn}^{4+}$
 (C) $\text{Cr}^{3+} = \text{Mn}^{4+} > \text{Fe}^{3+}$ (D) $\text{Fe}^{3+} > \text{Mn}^{4+} > \text{Cr}^{3+}$
10. What is the maximum possible number of electrons in an atom with $(n + \ell = 7)$?
11. Predict total spin for each configuration :
- (a) $1s^2$ (b) $1s^2 2s^2 2p^6$ (c) $1s^2 2s^2 2p^5$
 (d) $1s^2 2s^2 2p^3$ (e) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$.

Topic : Atomic Structure

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.4

(3 marks, 3 min.)

M.M., Min.

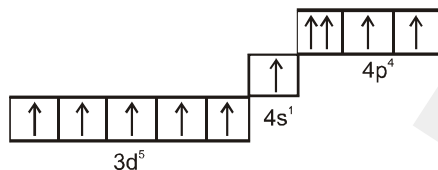
[12, 12]

Subjective Questions ('-1' negative marking) Q.5 to Q.8

(4 marks, 5 min.)

[16, 20]

1. In the following electronic configuration, some rules have been violated :



I : Hund

II : Pauli's exclusion

III : Aufbau

(A) I and II

(B) I and III

(C) II and III

(D) I, II and III

2. What is the potential difference through which an electron, with a de Broglie wavelength of 1.5 \AA should be accelerated, if its de Broglie wavelength has to be reduced to 1 \AA :

(A) 110 volts

(B) 70 volts

(C) 83 volts

(D) 55 volts

3. X^{2+} is isoelectronic with sulphur and has $(Z + 2)$ neutrons (Z is atomic no. of element X). Hence, mass number of X^{2+} is :

(A) 34

(B) 36

(C) 38

(D) 40

4. Which of the following compounds is isoelectronic with $[\text{NH}_3 \rightarrow \text{BH}_3]$:

(A) B_2H_6

(B) C_2H_6

(C) C_2H_4

(D) C_3H_6

5. A neutral atom of an element has 2K, 8L, 9M and 2N electrons. Find out the following :

(a) Atomic number of element

(b) Total number of s electrons

(c) Total number of p electrons

(d) Total number of d electrons

(e) Number of unpaired electrons in element

6. Calculate :

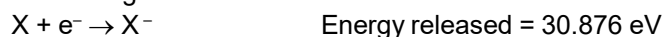
(a) the value of spin only magnetic moment of Co^{3+} ion (in BM).

(b) the number of radial nodes in a 3p-orbital.

(c) the number of electrons with $(m = 0)$ in Mn^{2+} ion.

(d) the orbital angular momentum for the unpaired electron in V^{4+} .

7. An element undergoes a reaction as shown :



The energy released, is used to dissociate 8 g of H_2 molecules equally into H^+ and H^* , where H^* is in an excited state, in which the electron travels a path length equal to four times its de Broglie wavelength.

(a) Determine the least amount (moles) of 'X' that would be required.

Given: I.E. of $\text{H} = 13.6 \text{ eV/atom}$

Bond energy of $\text{H}_2 = 4.526 \text{ eV/molecule}$.

(b) Why is the amount of X calculated in the above question 'least'?

8. A compound of Vanadium has a spin magnetic moment 1.73 BM. Work out the electronic configuration of the Vanadium ion in the compound.

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 22

Total Marks : 58

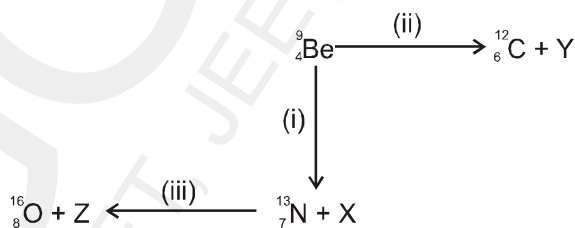
Max. Time : 65 min.

Topic : Atomic Structure

Type of Questions

| | | M.M., Min. |
|--|--------------------|------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.4,10,13 | (3 marks, 3 min.) | [18, 18] |
| Multiple choice objective ('-1' negative marking) Q.5 to Q.7 | (4 marks, 4 min.) | [12, 12] |
| Subjective Questions ('-1' negative marking) Q.8,11,12,14,15 | (4 marks, 5 min.) | [20, 25] |
| Match the Following (no negative marking) (2 × 4) Q.9 | (8 marks, 10 min.) | [8, 10] |

- The number of neutrons in the atom left after emission of 1 α -particle from ${}_{92}\text{U}^{238}$ is :
 (A) 144 (B) 140 (C) 120 (D) 146
- Which of the following is not a natural decay series :
 (A) 4n series (B) 4n + 1 series (C) 4n + 2 series (D) 4n + 3 series
- ${}_{95}\text{Am}^{241}$ and ${}_{90}\text{Th}^{234}$ belong respectively to :
 (A) 4n and 4n + 1 radioactive disintegration series
 (B) 4n + 1 and 4n + 2 radioactive disintegration series
 (C) 4n + 1 and 4n + 3 radioactive disintegration series
 (D) 4n + 1 and 4n radioactive disintegration series
- Bombardment by α -particle leads to artificial disintegration in three ways, (I), (II) and (III) as shown. Products X, Y and Z respectively are :

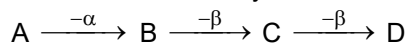


- (A) β -particle, proton, positron (B) positron, neutron, proton
 (C) β -particle, neutron, proton (D) positron, proton, neutron
- Decrease in atomic number is observed during :
 (A) Alpha emission (B) Beta emission (C) Positron emission (D) Electron capture
 - Atomic number of a radioactive element is 100. It first decays into an element Y, which then decays into Z. In both the processes, a charged particle is emitted. Which of the following can be true :
 (A) Y has atomic number 102 (B) Y has atomic number 101
 (C) Z has atomic number 100 (D) Z has atomic number 99

7.* Assuming that the charged particles emitted during natural decay of ${}_{92}\text{U}^{235}$ atoms are α and β particles only, which of the following products is/are not possible :

- (A) ${}_{89}\text{Ac}^{231}$ (B) ${}_{89}\text{Ac}^{227}$ (C) ${}_{89}\text{Ac}^{225}$ (D) ${}_{82}\text{Pb}^{207}$

8. A radioactive element A decays as follows :



Identify the isotopes and isobars among A, B, C and D.

9. **Column-I**

- (i) Velocity
(ii) Ionisation power
(iii) Penetrating power
(iv) mass

Column-II

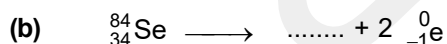
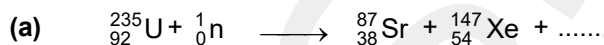
- (p) $\alpha < \beta < \gamma$
(q) $\alpha > \beta > \gamma$
(r) $\gamma < \beta < \alpha$
(s) $\gamma > \beta > \alpha$

10. ${}^{23}\text{Na}$ is more stable isotope of Na. Find out the process by which ${}^{24}_{11}\text{Na}$ can undergo radioactive decay :

- (A) β^- emission (B) α emission (C) β^+ emission (D) K electron capture

11. ${}_{92}\text{X}^{234} \xrightarrow[-6\beta]{-8\alpha} \text{Y}$. Find out atomic number & mass number of Y and identify it.

12. Complete the following equations :



13. A positron is emitted from ${}^{23}_{11}\text{Na}$. The ratio of the mass number and atomic number of the resulting nuclide is:

- (A) 22/10 (B) 22/11 (C) 23/10 (D) 23/12

14. The total number of α and β particles emitted in the nuclear reaction ${}^{238}_{92}\text{U} \rightarrow {}^{214}_{82}\text{Pb}$ is :

15. The number of neutrons emitted when ${}^{235}_{92}\text{U}$ undergoes controlled nuclear fission to ${}^{142}_{54}\text{Xe}$ and ${}^{90}_{38}\text{Sr}$ is :

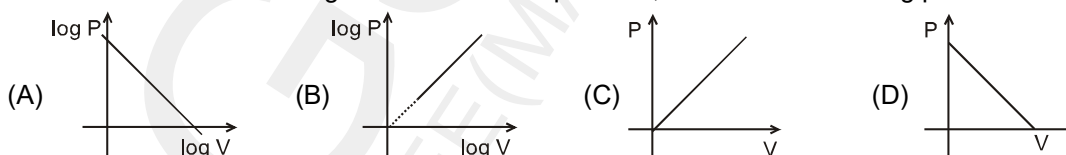
Topic : Gaseous State

Type of Questions

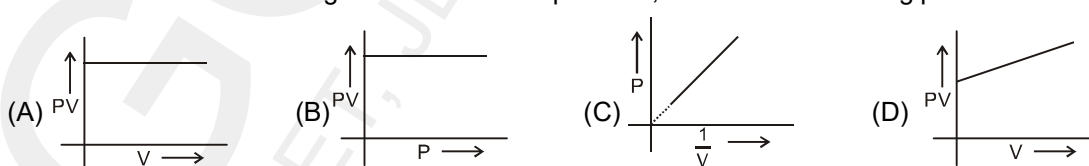
| | | |
|---|--------------------------|-------------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.5,8,9 (3 marks, 3 min.) | [21, 21] | M.M., Min. |
| Multiple choice objective ('-1' negative marking) Q.6 | (4 marks, 4 min.) | [4, 4] |
| Short Subjective Questions ('-1' negative marking) Q.7 | (3 marks, 3 min.) | [3, 3] |

- If P, V, T represents the pressure, volume and temperature of gas respectively, then according to Boyle's law, which is correct for a fixed amount of ideal gas :
 (A) $V \propto \frac{1}{T}$ (At constant P) (B) $V \propto P$ (At constant T)
 (C) $V \propto \frac{1}{P}$ (At constant T) (D) $PV = nRT$
- If an ideal gas at 1 atmospheric pressure, is spreading from 20 cm³ to 50 cm³ at constant temperature, then find the final pressure :
 (A) 0.4 atm (B) 2.5 atm (C) 5 atm (D) None of these.
- A vessel of 120 mL capacity contains a certain mass of an ideal gas at 20°C and 750 mm pressure. The gas was transferred to another vessel, whose volume is 180 mL. Then the pressure of gas at 20°C is :
 (A) 500 mm (B) 250 mm (C) 1000 mm (D) None of these
- 5 L of a sample of a gas at 27°C and 1 bar pressure is compressed to a volume of 1000 mL keeping the temperature constant. The percentage increase in pressure is :
 (A) 100 % (B) 400 % (C) 500% (D) 80%

- For a fixed amount of ideal gas at constant temperature, which of the following plots is correct :



- For a fixed amount of ideal gas at constant temperature, which of the following plots is/are correct :

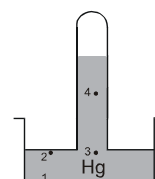


- What should be the percentage increase in pressure for a 5% decrease in volume of an ideal gas at constant temperature ?
- In which of the following cases is the pressure of air in air column maximum : (Assume same length of Hg column in each case) :



- Compare the values of pressure at different points in the given diagram :

- (A) $P_1 > P_2 > P_3 > P_4$ (B) $P_1 < P_2 < P_3 < P_4$
 (C) $P_1 > P_2 = P_3 > P_4$ (D) $P_1 < P_2 = P_3 < P_4$



Topic : Gaseous State

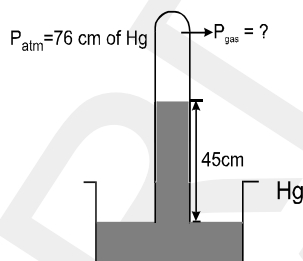
Type of Questions

Single choice Objective ('-1' negative marking) Q.1
Subjective Questions ('-1' negative marking) Q.2 to Q.8

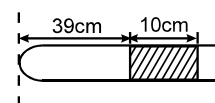
(3 marks, 3 min.)
(4 marks, 5 min.)

M.M., Min.
[3, 3]
[28, 35]

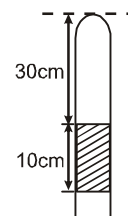
- If some gas is trapped above the mercury column in a Barometer during measurement of atmospheric pressure, the height of Hg column is observed to be h . Then :
 (A) $h > 76$ cm (B) $h < 76$ cm (C) $h = 76$ cm (D) cannot be predicted.
- In the following arrangement, find the pressure of the confined gas (in cm of Hg).



- Given a one meter long glass tube closed at one end having a uniform cross-section containing a mercury column of 10 cm length, at a distance of 39 cm from the closed end. By what distance would this column move down, if the tube is held vertical with the open end downwards ? [Take atmospheric pressure to be 75 cm of Hg]

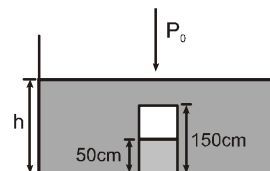


- If another liquid L ($\rho = 10.2$ g/cm³) is used in place of mercury, then what should be the minimum length of Barometer tube to measure normal atmospheric pressure ? (Take normal atmospheric pressure to be 76 cm of Hg).

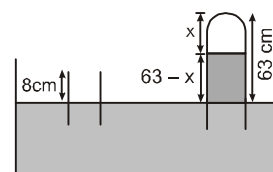


- Given a long glass tube closed at one end having a uniform cross-section containing a mercury column of 10 cm length, at a distance of 30 cm from the closed end when held vertically as shown. The air trapped above the Hg column has pressure 85 cm of Hg. What will be the length of air column if the glass tube is held horizontally ?

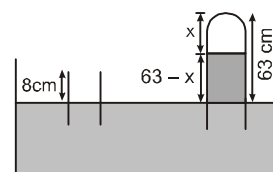
- A glass tube with a sealed end is completely submerged in a vessel with mercury vertically. The air column is 15 cm long. To what height must the upper end be raised above the level of Hg, so that the level of Hg inside the tube is at the level of Hg in the vessel ? [Atmospheric pressure = 75 cm of Hg column]



- A cylindrical diving bell (initially in open air), whose length is 150 cm, is lowered to the bottom of a tank. The water is found to rise 50 cm in the bell. Find the depth of the tank. Assume the atmospheric pressure at the surface as equivalent to 1000 cm height of water and the temperature as constant



- An open glass tube is immersed in mercury in such a way that a length of 8 cm extends above the mercury level. The open end of the tube is then closed and raised further by 55 cm. What will be the length of air column above mercury in the tube ? [Atmospheric pressure = 76 cm of Hg]



Topic : Gaseous State

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.4

(3 marks, 3 min.)

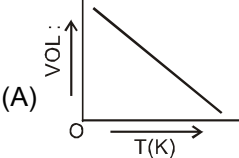
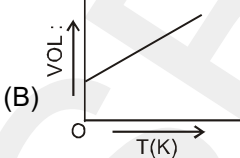
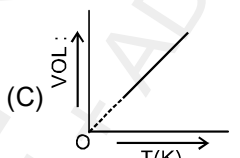
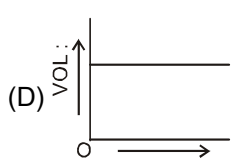
M.M., Min.

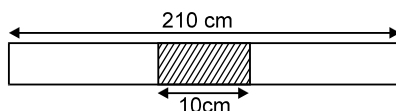
[12, 12]

Subjective Questions ('-1' negative marking) Q.5 to Q.9

(4 marks, 5 min.)

[20, 25]

- At constant pressure for a fixed amount of gas, which of the following represents Charles law :
 (A) $V \propto \frac{1}{T}$ (B) $V \propto T$ (C) $V \propto \frac{1}{T^2}$ (D) $V \propto d$
- If V_0 is the volume of a given mass of gas at 273 K at constant pressure, then according to Charles law, the volume at 10°C will be :
 (A) $10 V_0$ (B) $\frac{1}{273} (V_0 + 10)$ (C) $V_0 + \frac{10}{273}$ (D) $\frac{283}{273} V_0$
- The correct representation of Charles law is given by :
 (A)  (B)  (C)  (D) 
- Which of the following shows explicitly the relationship between Boyles law and Charles law :
 (A) $\frac{P_1}{P_2} = \frac{T_1}{T_2}$ (B) $PV = K$ (C) $\frac{P_2}{P_1} = \frac{V_1}{V_2}$ (D) $\frac{V_2}{V_1} = \frac{P_1}{P_2} \times \frac{T_2}{T_1}$
- 20 mL of hydrogen gas measured at 7°C is heated to 77°C. What is the new volume of gas at the same pressure?
- At what temperature in centigrade, will the volume of a gas at 0°C double itself, pressure remaining constant ?
- A flask is of capacity one litre. What volume of air will escape from the open flask, if it is heated from 27°C to 37°C? Assume pressure to be constant.
- A balloon blown up with 1 mole of gas has a volume of 480 mL at 14°C. At this stage, the balloon is filled to (7/8)th of its maximum capacity. Suggest :
 (a) Will the balloon burst at 30°C ? (b) The minimum temperature at which it will burst.
- A mercury column with a length 10 cm is in the middle of a horizontal tube with a length 210 cm closed at both ends . If the tube is placed vertically, the mercury column will shift through a distance 10 cm from its initial position .



- At what distance will the centre of the column be from the middle of the tube,
- if one end of the tube placed horizontally is opened to atmosphere.
 - if the upper end of the tube placed vertically is opened to atmosphere.
 - if the lower end of the tube placed vertically opened to atmosphere.

[Take atmospheric pressure = 100 cm of Hg]

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 26

Total Marks : 30

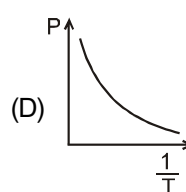
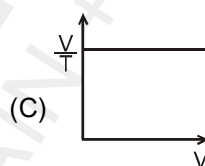
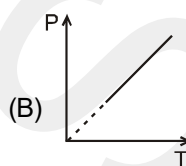
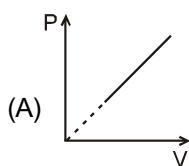
Max. Time : 35 min.

Topic : Gaseous State

Type of Questions

| Type of Questions | M.M., Min. |
|--|----------------------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.2 | (3 marks, 3 min.) [6, 6] |
| Multiple choice objective ('-1' negative marking) Q.3 | (4 marks, 4 min.) [4, 4] |
| Subjective Questions ('-1' negative marking) Q.4 to Q.8 | (4 marks, 5 min.) [20, 25] |

- A bottle is heated with mouth open to have a final temperature as 125°C from its original value of 25°C . The mole percentage of expelled air is about :
 (A) 50% (B) 25% (C) 33% (D) 40%
- 1 litre of N_2 and $7/8$ litre of O_2 are taken separately at the same temperature and pressure. What is the relation between the masses of the gases :
 (A) $m_{\text{N}_2} = 3 m_{\text{O}_2}$ (B) $m_{\text{N}_2} = 8 m_{\text{O}_2}$ (C) $m_{\text{N}_2} = m_{\text{O}_2}$ (D) $m_{\text{N}_2} = 16 m_{\text{O}_2}$
- Which of the following graphs is /are possible for a fixed amount of gas :



- A student forgot to add the reaction mixture to a round bottomed flask at 27°C but he put it on the flame. After a lapse of time, he realised his mistake. Using a pyrometer, he found that the temperature of the flask was 477°C . What fraction of moles of air would have expelled out ?
- If the volume of a gas contained in a vessel increases by 0.4 % when heated by 1°C , then find the initial temperature of gas in $^{\circ}\text{C}$.
- A gas occupies 300 mL at 27°C and 684 mm pressure. What would be its volume at STP ?
- 2 g of a gas A is introduced into an evacuated flask kept at 27°C . The pressure is found to be 1 atm. If 3 g of another gas B is added to the same flask, the total pressure becomes 1.5 atm. Assuming constant temperature and ideal gas behaviour, calculate :
 (a) the ratio of mol. weight of gases, M_A and M_B . (b) the volume of the vessel, if gas A is He
- Equal volumes of two gases, which do not react together, are enclosed in separate vessels. Their pressures are 100 mm and 400 mm respectively. If the two vessels are joined together, then what will be the pressure of the resulting mixture (temperature remaining constant) :
 (A) 350 mm (B) 500 mm (C) 1000 mm (D) 250 mm

Topic : Gaseous State

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.12

(3 marks, 3 min.)

M.M., Min.

[36, 36]

- At what pressure would a gas sample consisting of 2 mole CO_2 gas occupy a volume of 5.6 L at 273°C :
(A) 32 atm (B) 24 atm (C) 16 atm (D) 8 atm
- A sample of N_2O gas occupies a volume of 0.1m^3 at 684 mm of Hg pressure and 87°C . The number of molecules present in the gas sample is : (Take $R = \frac{1}{12} \text{ L atm K}^{-1} \text{ mol}^{-1}$)
(A) 1.8066×10^{23} (B) 1.2044×10^{24} (C) 6.022×10^{23} (D) 1.8066×10^{24}
- If the volume occupied by x mole of ethane (C_2H_6) gas at 2.46 atm pressure and 27°C temperature is 0.5 L then the value of x is :
(A) 0.5 (B) 0.05 (C) 0.005 (D) 0.0005
- A gas mixture consisting of 0.1 mole each of O_2 and N_2 gases occupies a volume of $1 \times 10^4 \text{ mL}$ at 38 cm of Hg pressure and a certain temperature. Find the value of T :
(A) 300°C (B) 600 K (C) 300 K (D) 600°C
- 32 g of SO_2 is stored in a cylinder at 1 atm pressure and at 27°C temperature. The volume of cylinder is : (Take $R = 1/12 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
(A) 12.5 m^3 (B) 12.5 dm^3 (C) 12.5 cc (D) 12.5 mL
- A cylinder can hold maximum 12.5 L of any liquid when it is fully filled. If ozone gas (O_3) is stored in cylinder at 10^5 Pa pressure and -73°C temperature, then the weight of ozone gas in the cylinder is:
(A) 36 kg (B) 12 g (C) 36 g (D) 12 kg
- A mixture consisting of 54 g N_2O_5 gas, 1.2044×10^{23} molecules of NO gas, 0.2 gram-molecule of N_2O gas and 0.1 mole of N_2 gas would occupy a volume of dm^3 at 760 torr pressure and 27°C temperature :
(A) 22.4 (B) 24.6 (C) 0.0246 (D) 0.0224
- If 66 g of an unknown gas X occupies a volume of about 125 dm^3 at 0.6 bar pressure and 600 K temperature, then the gas X could be :
(A) N_2 (B) N_2O (C) CO (D) CO_2
- Three different containers contain three different gases with the following parameters :
Container I of volume (V_1), containing 6 g of H_2 gas at 273 K, 1 atm.
Container II of volume (V_2), containing 2 mole of CO_2 gas at 273°C , 2 atm.
Container III volume (V_3), containing 24×10^{23} molecules of O_2 gas at 0°C , 760 torr .
The correct order of volume of containers is :
(A) $I > II > III$ (B) $III > I > II$ (C) $I > III > II$ (D) $II > III > I$
- 3.06 L of H_2O vapour is taken at a pressure of 1 atm and 373 K. It is now condensed to $\text{H}_2\text{O} (\ell)$ at 373 K. Calculate the approximate volume occupied by $\text{H}_2\text{O} (\ell)$: (assume density of liquid water at 373 K = 1 g/mL)
(A) 3.06 L (B) 1.8 mL (C) 1.8 L (D) 3.06 mL
- Which of the following relations is correct : (Where T represents temperature and d represents density) :
(A) 1 bar = 1 torr (B) $T (\text{in } ^\circ\text{C}) = T (\text{in K}) + 273$ (C) $1 \text{ m}^3 = 10^{-6} \text{ mL}$ (D) $d_{\text{g/mL}} = \frac{d_{\text{kg/m}^3}}{1000}$
- Two flasks A and B of equal volume contain H_2 gas under same pressure conditions. The temperature in flask A is greater than in flask B. Then :
(A) Flask A contains greater number of moles of H_2 gas than flask B.
(B) Flask B contains greater number of moles of H_2 gas than flask A.
(C) Flask A contains same number of moles of H_2 gas as flask B.
(D) Such a case is not possible.

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 28
Total Marks : 30
Max. Time : 33 min.
Topic : Gaseous State

| Type of Questions | | M.M., Min. |
|--|-------------------|------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.6 | (3 marks, 3 min.) | [18, 18] |
| Subjective Questions ('-1' negative marking) Q.7 to Q.9 | (4 marks, 5 min.) | [12, 15] |

- The density of Nitrogen gas is maximum at :
 (A) STP (B) 273 K and 1 atm (C) 546 K and 2 atm (D) 546 K and 4 atm
- A gas has a density of 1.25 g L^{-1} at STP. Identify it :
 (A) NO_2 (B) O_2 (C) N_2 (D) SO_2
- A sample of impure air contains 80% N_2 , 10% O_2 , 5% CO_2 and 5% Ar by volume. The average molecular weight of the sample is : (At wt. of Ar = 40)
 (A) 29.4 (B) 29.8 (C) 30.0 (D) 29.6
- The density of gas A is twice that of a gas B at the same temperature. The molecular weight of gas B is thrice that of A. The ratio of the pressure exerted on A and B will be :
 (A) 6 : 1 (B) 7 : 8 (C) 2 : 5 (D) 1 : 4
- A mixture of two gases A and B in the mole ratio 2 : 3 is kept in a 2 litre vessel. A second 3 litre vessel has the same two gases in the mole ratio 3 : 5. Both gas mixtures have the same temperature and same pressure. They are allowed to intermix and the final temperature and pressure are the same as the initial values, the final volume being 5 litres. Given that the molar masses are M_A and M_B , what is the mean molar mass of the final mixture :
 (A) $\frac{77M_A+123M_B}{200}$ (B) $\frac{123M_A+77M_B}{200}$ (C) $\frac{77M_A+123M_B}{250}$ (D) $\frac{123M_A+77M_B}{250}$
- Two flasks of equal volume connected by a narrow tube (of negligible volume) contains a certain amount of N_2 gas at 2 atm and 27°C . The Ist flask is then immersed into a bath kept at 47°C while the IInd flask is immersed into a bath kept at 127°C . The ratio of the number of moles of N_2 in Ist flask and II flask respectively after sometime will be :
 (A) 5 : 4 (B) 2 : 3 (C) 3 : 2 (D) 4 : 5
- Two glass bulbs of equal volume and filled with a gas at 500 K and pressure of 76 cm of Hg, are connected by a narrow tube. One of the bulb is then placed in a water bath maintained at 700 K and the other bulb is maintained at 500 K. What is the new value of the pressure inside the bulbs ? The volume of the connecting tube is negligible.
- A certain amount of gas is enclosed in a sphere of volume 5L at pressure 7atm and temperature 327°C . It is then connected to another sphere of volume 2.5 L by a narrow tube and stopcock. The second sphere is initially evacuated and the stopcock is closed. After opening the stopcock, the temperature of gas in the second sphere becomes 127°C , while the first sphere is maintained at 327°C . Find the final gas pressure within the two spheres.
- The stop cock connecting the two bulbs of volume 8 litre and 10 litre containing an ideal gas at 6.25 atm and 4 atm respectively, is opened. What is the final pressure, if the temperature remains same ?

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 29

Total Marks : 36

Max. Time : 40 min.

Topic : Gaseous State

Type of Questions

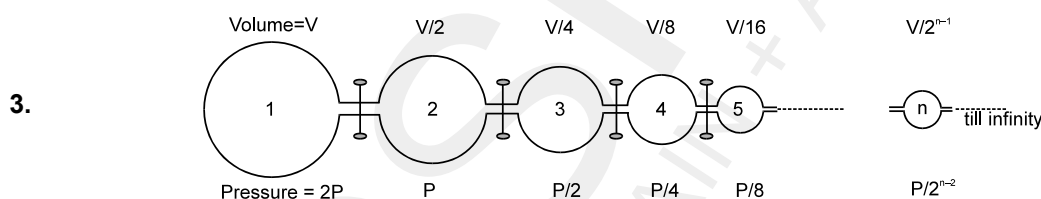
| | | M.M., Min. |
|---|--------------------------|-------------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.3,7 | (3 marks, 3 min.) | [12, 12] |
| Multiple choice objective ('-1' negative marking) Q.1,4 | (4 marks, 4 min.) | [8, 8] |
| Subjective Questions ('-1' negative marking) Q.4,5,6,8 | (4 marks, 5 min.) | [16, 20] |

1. Equal masses of Sulphur dioxide and Oxygen gases are mixed in an empty container at 25°C. The fraction of the total pressure exerted by sulphur dioxide is :

- (A) 1/3 (B) 1/2 (C) 2/3 (D) $\frac{1}{3} \times \frac{273}{298}$

2. A mixture of helium and methane gases at 1.4 bar pressure contains 20% by mole of helium. Partial pressure of helium will be :

- (A) 0.7 bar (B) 0.28 bar (C) 0.56 bar (D) 0.8 bar



Infinite number of flasks are connected to one another as shown above. The volumes and pressures in each flask vary as shown. The stopcocks are initially closed. The common pressure, when all the stopcocks are opened, is : (Assume constant temperature)

- (A) P (B) $\frac{1}{2}P$ (C) $\frac{P}{4}$ (D) $\frac{4}{3}P$

4. The density of a mixture of O_2 and N_2 gases at NTP is 1.3 g litre^{-1} . Calculate partial pressure of O_2 .

5. Two gases A and B having molecular weights 60 and 40 respectively are enclosed in a vessel. The weight of A is 0.6 g and that of B is 0.2 g . The total pressure of the mixture is 750 mm. Calculate the partial pressure of the two gases.

6. A spherical balloon of mass 100 Kg and diameter 21 m is filled with He gas at 168° C and 5 atm pressure. If the density of air is $\frac{14}{11} \text{ g/L}$, find the value of payload of the balloon (in Kg). Take $R = \frac{1}{12} \text{ L atm K}^{-1} \text{ mol}^{-1}$

7. A mixture of He and SO_2 at one bar pressure contains 20% by weight of He. Partial pressure of He will be:
 (A) 0.2 bar (B) 0.4 bar (C) 0.6 bar (D) 0.8 bar

8. A 11 litre flask contains 20g of Neon and an unknown weight of Hydrogen. The gas density is found to be 2g/litre at 0°C. Determine the average molecular weight of the gas mixture.

Topic : Gaseous State

| Type of Questions | | M.M., Min. |
|--|-------------------|------------|
| Single choice Objective ('-1' negative marking) Q.2 to Q.3 | (3 marks, 3 min.) | [6, 6] |
| Multiple choice objective ('-1' negative marking) Q.1,4 | (4 marks, 4 min.) | [8, 8] |
| Subjective Questions ('-1' negative marking) Q.5,9 | (4 marks, 5 min.) | [8, 10] |
| Comprehension ('-1' negative marking) Q.6 to Q.8 | (3 marks, 3 min.) | [9, 9] |

- A gaseous organic compound has a density of 2.5 kg/m^3 at 2 atm and at 273°C . The molecular formula of the compound can be :
 (A) $\text{C}_3\text{H}_4\text{O}$ (B) $\text{C}_4\text{H}_6\text{O}$ (C) C_4H_8 (D) C_5H_{10}
- The ratio of rates of diffusion of SO_2 , O_2 and CH_4 under identical conditions is :
 (A) $1 : \sqrt{2} : 2$ (B) $1 : 2 : 4$ (C) $2 : \sqrt{2} : 1$ (D) $1 : 2 : \sqrt{2}$
- If the number of molecules of SO_2 (molecular weight = 64) effusing through an orifice of unit area of cross-section in unit time at 0°C and 1 atm pressure is n , the number of He molecules (atomic weight = 4) effusing under similar conditions at 273°C and 0.25 atm is :
 (A) $\frac{n}{\sqrt{2}}$ (B) $n\sqrt{2}$ (C) $2n$ (D) $\frac{n}{2}$
- The time taken for effusion of 32 mL of oxygen gas will be the same as the time taken for effusion of which gas sample under identical conditions : (Take $\sqrt{2} = 1.4$, $\sqrt{3} = 1.7$)
 (A) 64 mL of H_2 (B) 50 mL of N_2 (C) 44.8 mL of CH_4 (D) 22.4 mL of SO_2
- 5 mL of He gas diffuses out in 1 second from a hole. Find the volume of SO_2 that will diffuse out from the same hole under identical conditions in 2 seconds.

Comprehension # (Q.6 to Q.8)
Graham's Law :

"Under similar conditions of pressure (partial pressure), the rate of diffusion of different gases is inversely proportional to square root of the density of different gases."

$$\text{rate of diffusion } r \propto \frac{1}{\sqrt{d}} \quad (d = \text{density of gas})$$

Topic : Gaseous State
Type of Questions
Comprehension ('-1' negative marking) Q.1 to Q.6
(3 marks, 3 min.)
M.M., Min.
[18, 18]
Single choice Objective ('-1' negative marking) Q.7 to Q.10
(3 marks, 3 min.)
[12, 12]
Comperhension # (Q.1 to Q.3)

Gas 'A' (Molar Mass = $z128 \text{ g mol}^{-1}$) is taken in a closed container at the initial total pressure of 1000 mm of Hg. Pressure of the gas decreases to 900 torr in 5 seconds due to the diffusion through a square cross-section. Another similar sized container is taken in which gaseous mixture of A and B (Molar Mass = 72 g mol^{-1}) is taken. Initial molar mass of the mixture is $\frac{472}{5}$ (calculated from density data) at the total pressure of 5000 torr. A rectangular cross-section is made in this container and gases are allowed to diffuse. Width of this cross-section is same as the side of the previous square cross section and length of the rectangular cross-section is 50% more than that of its width. Assume that the gases A and B are non-reacting and rate of diffusion of the gases are only dependent upon the initial total pressure and it is independent of the change in the pressure due to diffusion. Assume all other conditions to be identical.

Now answer the following questions :

1. Gas mixture diffused out initially from 2nd container has composition :

(A) $X_A = \frac{3}{7}$ (B) $X_B = \frac{3}{5}$ (C) $X_A = \frac{1}{3}$ (D) $X_B = \frac{1}{4}$

2. Ratio of the number of moles of A and B left in the container after 10 seconds from the start of diffusion, is :

(A) $\frac{7}{9}$ (B) $\frac{2}{3}$ (C) $\frac{8}{11}$ (D) None of the above

3. What is the time after which container will have same number of moles of A and B :

(A) 15 sec. (B) 50 sec. (C) 25 sec. (D) $\frac{50}{3}$ sec.

Comperhension # (Q.4 to Q.6)

Graham's law tells as about rate of effusion or diffusion of gases. In modern form, it simply states that the rate of effusion or diffusion of any ideal gas is inversely proportional to square root of its molar mass.

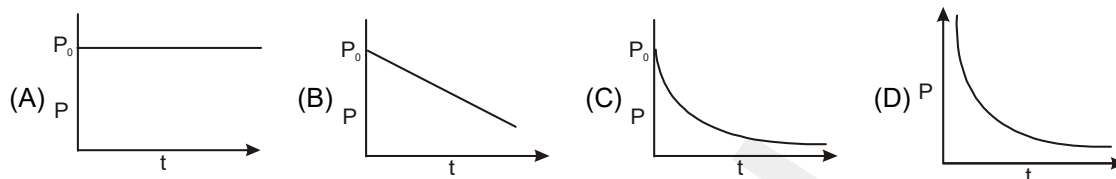
$$\frac{r_1}{r_2} = \frac{P_1}{P_2} \sqrt{\frac{M_2}{M_1}}$$

Also, rate of effusion of a gas mixture is simply the sum of rates of effusion of individual gases, since ideal gases do not affect each other.

Now answer the following questions :

4. 10 moles of N_2 gas are placed in a vessel of constant volume and temperature. A hole is punctured in the

vessel and left in vacuum. The pressure of N_2 in the vessel will vary with time as :



5. If a mixture of (80 mol %) He and (20 mol%) SO_2 is taken in an isothermal isochoric vessel, as the gases leak through a small hole in the vessel, when placed in vacuum :
- (A) Average molar mass of gas mixture left in vessel increases with time.
 (B) Average molar mass of gas mixture left in vessel remains same with time.
 (C) Average molar mass of gas mixture left in vessel decreases with time.
 (D) Variation of M_{avg} with time depends on temperature as well as area of hole, so it cannot be commented upon, in general.
6. In the previous question, what will be the rate of effusion of the initial gas mixture relative to D_2 under same conditions of total pressure and temperature :
- (A) $1/2$ (B) 0.29 (C) 2 (D) 0.85
7. A helium atom is two times heavier than a hydrogen molecule. At 298 K, the average translational kinetic energy of helium is :
- (A) two times that of hydrogen molecule (B) same as that of hydrogen molecule
 (C) four time that of hydrogen molecule (D) half that of hydrogen molecule
8. At what temperature, will hydrogen molecules have the same average translational kinetic energy as nitrogen molecules have, at $35^\circ C$?
- (A) $\left(\frac{28 \times 35}{2}\right)^\circ C$ (B) $\left(\frac{2 \times 35}{28}\right)^\circ C$ (C) $\left(\frac{2 \times 28}{35}\right)^\circ C$ (D) $35^\circ C$
9. Average translational K.E. of one mole of helium gas at 273 K in calories is :
- (A) 819 Cal (B) 81.9 Cal (C) 8.19 Cal (D) None of these
10. Average translational kinetic energy of 14 grams of nitrogen gas at $127^\circ C$ is nearly : (mol. mass of nitrogen = 28 and gas constant = 8.3 J/mol/K)
- (A) 4980 J (B) 1660 J (C) 2490 J (D) 9960 J

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 32
Total Marks : 35
Max. Time : 36 min.
Topic : Gaseous State
Type of Questions

| | | M.M., Min. |
|--|-------------------|------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.3,5,6,7 | (3 marks, 3 min.) | [18, 18] |
| Multiple choice objective ('-1' negative marking) Q.4 | (4 marks, 4 min.) | [4, 4] |
| Subjective Questions ('-1' negative marking) Q.8 | (4 marks, 5 min.) | [4, 5] |
| Comprehension ('-1' negative marking) Q.9 to Q.11 | (3 marks, 3 min.) | [9, 9] |

- Calculate the temperature at which the R.M.S. velocity of sulphur dioxide molecules is the same as that of oxygen gas molecules at 300 K :
 (A) 600°C (B) 600 K (C) 300 K (D) 300°C
- Suppose that we change the rms speed, v_{rms} , of the gas molecules in closed container of fixed volume from $5 \times 10^4 \text{ cm sec}^{-1}$ to $10 \times 10^4 \text{ cm sec}^{-1}$. Which one of the following statements might correctly explain how this change was accomplished :
 (A) By heating the gas, we double the temperature.
 (B) By pumping out 75% of the gas at constant temperature, we decreased the pressure to one quarter of its original value.
 (C) By heating the gas, we quadrupled the pressure.
 (D) By pumping in more gas at constant temperature, we quadrupled the pressure.
 (E) None of the above.
- Express the average kinetic energy per mole of a monoatomic gas of molar mass M, at temperature T K in terms of the mean speed of the molecules (\bar{c}) :
 (A) $\frac{8M}{3\pi} (\bar{c})^2$ (B) $\frac{3M}{16} (\bar{c})^2$ (C) $\left(\frac{2M}{\pi}\right) (\bar{c})^2$ (D) $\left(\frac{3\pi M}{16}\right) (\bar{c})^2$
- At same temperature and pressure, which of the following gases will have same average translational kinetic energy per mole as N_2O :
 (A) He (B) H_2S (C) CO_2 (D) NO_2
- Which of the following statements is not true :
 (A) The ratio of the mean speed to the rms speed is independent of temperature of gas.
 (B) The square of the mean speed of the molecules is equal to the mean squared speed at a certain temperature.
 (C) Mean translational kinetic energy of the gas molecules at any given temperature is independent of the molecular mass of gas.
 (D) The difference between rms speed and mean speed at any temperature for different gases diminishes as larger and yet larger molar masses are considered.
- A flask of 4.48 L capacity contains a mixture of N_2 and H_2 at 0°C and 1 atm pressure. If the mixture is made to react to form NH_3 gas at the same temperature, the pressure in the flask reduces to 0.75 atm. The partial pressure of NH_3 gas in the final mixture is :
 (A) 0.33 atm (B) 0.50 atm (C) 0.66 atm (D) 0.25 atm
- If the density of a gas sample is 4 g/L at pressure $1.2 \times 10^5 \text{ Pa}$, the value of V_{RMS} will be :
 (A) 600 m/s (B) 300 m/s (C) 150 m/s (D) 450 m/s
- The value of v_{rms} for a gas X at 546° C was found to be equal to the value of v_{mp} for another gas Y at 273° C. Assuming ideal behaviour, find the molecular mass of gas Y (in amu) if the molecular mass of gas X is 9 amu.

Comprehension # (Q.9 to Q.11)

The speed of a molecule of a gas changes continuously as a result of collisions with other molecules and with the walls of the container. The speeds of individual molecules therefore change, but it is expected that the distribution of molecular speeds does not change with time.

A direct consequence of the distribution of speeds is that the average kinetic energy is constant for a given temperature.

The average K.E, is defined as

$$\overline{KE} = \frac{1}{N} \left(\frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2 + \dots + \frac{1}{2}mv_N^2 \right) = \frac{1}{2N} m(v_1^2 + v_2^2 + \dots + v_N^2) = \frac{1}{2} m \overline{V^2}$$

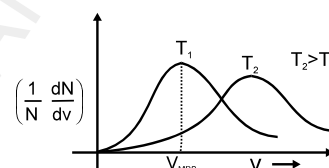
Alternatively it may be defined as $\overline{KE} = \frac{1}{N} \left(\frac{1}{2}m \sum_i dN_i v_i^2 \right) = \frac{1}{2} m \left(\sum_i \frac{dN_i}{N} \cdot v_i^2 \right)$

where $\frac{dN_i}{N}$ is the fraction of molecules having speeds between v_i and v_i

+ dv and as proposed by Maxwell $\frac{dN}{N} = 4\pi \left(\frac{m}{2\pi KT} \right)^{3/2} \exp(-mv^2/$

$2kT) \cdot v^2 \cdot dv$

The plot of $\left(\frac{1}{N} \frac{dN}{dv} \right)$ is plotted for a particular gas at two different



temperatures against 'v' as shown.

The majority of molecules have speeds which cluster around v_{MPS} in the middle of the range of v . There area under the curve between any two speeds v_1 and v_2 is the fraction of molecules having speeds between v_1 and v_2 .

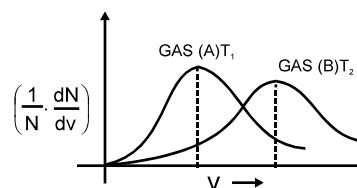
The speed distribution also depends on the mass of the molecule. As the area under the curve is the same (equal to unity) for all gas samples, samples which have the same v_{MPS} will have identical Maxwellian plots. On the basis of the above passage answer the questions that follow.

9. If a gas sample contains a total of 'N' molecules, the area under any given maxwellian plot is equal to:

- (A) infinite (B) N (C) 1 (D) $\int_0^N \left(\frac{dN}{dv} \right) \cdot dv$

10. For the above graph drawn for two different samples of gases at two different temperatures T_1 and T_2 , which of the following statements is necessarily true :

- (A) If $T_2 > T_1$, M_A is necessarily greater than M_B
 (B) If $T_1 > T_2$, M_B is necessarily greater than M_A
 (C) $\frac{T_2}{M_B} > \frac{T_1}{M_A}$
 (D) Nothing can be predicted



11. If two gases 'A' and 'B' and at temperature T_A and T_B respectively have identical Maxwellian plots, then which of the following statements are true :

- (A) $T_B = T_A$
 (B) $M_B = M_A$
 (C) $\frac{T_A}{M_A} = \frac{T_B}{M_B}$
 (D) Gases A and B may be O_2 and SO_2 at $27^\circ C$ and $327^\circ C$ respectively.

Topic : Gaseous State
Type of Questions
Single choice Objective ('-1' negative marking) Q.1 to Q.6
(3 marks, 3 min.)
M.M., Min.
[18, 18]
Subjective Questions ('-1' negative marking) Q.7 to Q.8
(4 marks, 5 min.)
[8, 10]

- The vapour pressure of water depends upon :
 (A) Surface area of water in container (B) Volume of container
 (C) Temperature (D) All of these
- Among the following substances, the maximum vapour pressure is exerted by :
 (A) Water (b.pt. = 100°C) (B) Acetone (b.pt. = 56°C)
 (C) Ethanol (b.pt. = 78°C) (D) Chloroform (b.pt. = 61°C)
- A sample of air is saturated with benzene (vapour pressure = 100 mm Hg at 298 K) at 298K, 750 mm Hg pressure. If it is isothermally compressed to one third of its initial volume, the final pressure of the system is:
 (A) 2250 torr (B) 2150 torr (C) 2050 torr (D) 1950 torr
- A vessel has nitrogen gas and water vapours in equilibrium with liquid water at a total pressure of 1 atm. The partial pressure of water vapours is 0.3 atm. The volume of this vessel is reduced to one third of the original volume, at the same temperature, then total pressure of the system is : (Neglect volume occupied by liquid water)
 (A) 3.0 atm (B) 1 atm (C) 3.33 atm (D) 2.4 atm
- 60 mL of pure dry O₂ is subjected to silent electric discharge. If only 20% of it is converted to O₃, volume of the mixture of gases (O₂ and O₃) after the reaction is V₁ mL and after passing through turpentine oil is V₂ mL. V₁ and V₂ are :
 (A) 56 mL and 52 mL respectively (B) 48 mL and 40 mL respectively
 (C) 48 mL and 44 mL respectively (D) 56 mL and 48 mL respectively
- 15 mL of a gaseous hydrocarbon was exploded with 72 mL of oxygen. The volume of gases on cooling was found to be 57 mL, 30 mL of which was absorbed by KOH and the rest was absorbed in a solution of alkaline pyrogallol. Then the formula of hydrocarbon is :
 (A) C₃H₄ (B) C₂H₄ (C) C₂H₆ (D) C₃H₆
- 1 litre of a mixture of CO and CO₂ is taken. This mixture is passed through a tube containing red hot charcoal, where the following reaction takes place :

$$\text{CO}_2 + \text{C} \longrightarrow 2\text{CO}$$
 The volume now becomes 1.6 litres. Find the volume of gas sample obtained by passing 1 litre of initial gas mixture through KOH solution.
- 1120 mL of ozonised oxygen (O₂ + O₃) at STP weighs 1.76 g. Calculate the reduction in volume on passing this through alkaline pyrogallol solution

Topic : Gaseous State

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.3

(3 marks, 3 min.)

M.M., Min.

[9, 9]

Multiple choice objective ('-1' negative marking) Q.4 to Q.6

(4 marks, 4 min.)

[12, 12]

Subjective Questions ('-1' negative marking) Q.7 to Q.8

(4 marks, 5 min.)

[8, 10]

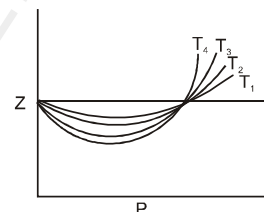
1. Which of the following is correct order of temperature shown in the above graph Z Vs P for the same gas :

(A) $T_4 < T_3 < T_2 < T_1$

(B) $T_1 < T_2 < T_3 < T_4$

(C) $T_1 < T_2 < T_4 < T_3$

(D) $T_3 < T_4 < T_2 < T_1$



2. A real gas most closely approaches the behaviour of an ideal gas at :

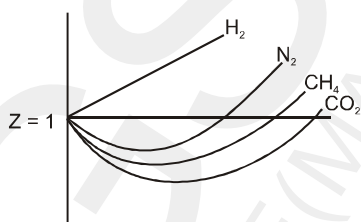
(A) low pressure & low temperature

(B) high pressure & high temperature

(C) low pressure & high temperature

(D) high pressure & low temperature

3. What is the correct increasing order of liquifiability of the gases shown as in above graph :



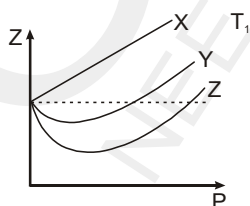
(A) $H_2 < N_2 < CH_4 < CO_2$

(B) $CO_2 < CH_4 < N_2 < H_2$

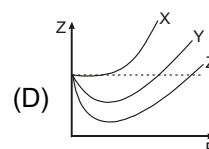
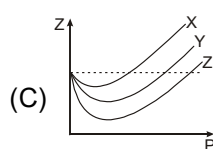
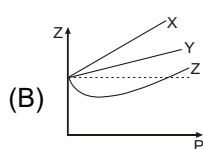
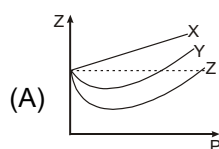
(C) $H_2 < CH_4 < N_2 < CO_2$

(D) $CH_4 < H_2 < N_2 < CO_2$

4.* Z vs P graph is plotted for 1 mole of three different gases X, Y and Z at temperature T_1 .



Then, which of the following may be correct if the above plot is made for 1 mole of each gas at T_2 temperature ($T_2 < T_1$) :

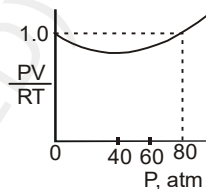


- 5.* Which of the following statements regarding compressibility factor (Z) is/are correct :
- (A) In the lower pressure region, value of Z initially decreases on increasing pressure and then increases, however H_2 and He gases are exception to this.
- (B) Z for an ideal gas is greater than one.
- (C) Z for a non-ideal gas can be greater than or less than unity depending on temperature and pressure.
- (D) When $Z < 1$, intermolecular attraction dominates over intermolecular repulsion.

- 6.* The Vander waal's equation of state for a non-ideal gas can be rearranged

to give $\frac{PV}{RT} = \frac{V}{V-b} - \frac{a}{VRT}$ for 1 mole of gas. The constants a & b are

positive numbers . When applied to H_2 at 80K, the equation gives the curve as shown in the figure. Which one of the following statements is(are) correct :



- (A) At 40 atm, the two terms $V/(V - b)$ & a/VRT are equal.
- (B) At 80 atm, the two terms $V/(V - b)$ & a/VRT are equal.
- (C) At a pressure greater than 80 atm, the term $V/(V - b)$ is greater than a/VRT .
- (D) At 60 atm, the term $V/(V - b)$ is smaller than $1 + \frac{a}{VRT}$.
7. Compressibility factor (Z) for N_2 at $-23^\circ C$ and 820 atm pressure is 1.9. Find the number of moles of N_2 gas required to fill a gas cylinder of 95 L capacity under the given conditions.
8. Find the temperature at which the translational kinetic energy of hydrogen atom is equal to the transition energy of electron between $n_1 = 1$ and $n_2 = 2$ levels. (Take : Boltzmann constant $K = 1.36 \times 10^{-23}$ J/K.)

PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 35

Total Marks : 26

Max. Time : 27 min.

Topic : Gaseous State

| Type of Questions | | M.M., Min. |
|--|-------------------|------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.5,8 | (3 marks, 3 min.) | [18, 18] |
| Multiple choice objective ('-1' negative marking) Q.6 | (4 marks, 4 min.) | [4, 4] |
| Subjective Questions ('-1' negative marking) Q.7 | (4 marks, 5 min.) | [4, 5] |

- Vander waal's equation for 1 mole of a real gas under given conditions :

| | |
|---|------------------------------------|
| (a) high pressure | (i) $PV = RT + Pb$ |
| (b) low pressure | (ii) $PV = RT - a/V$ |
| (c) force of attraction between gas molecules is negligible | (iii) $PV = RT + a/V$ |
| (c) volume of gas molecules is negligible | (iv) $[P - (a/V^2)] (V - b) = RT.$ |

| | |
|--|---|
| (A) (a)-(i), (b)-(ii), (c)-(i), (d)-(ii) | (B) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv) |
| (C) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i) | (D) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i). |

- Four different identical vessels at same temperature contains one mole each of C_2H_6 , CO_2 , Cl_2 and H_2S at pressures P_1 , P_2 , P_3 and P_4 respectively. The value of Vander waal's constant 'a' for C_2H_6 , CO_2 , Cl_2 and H_2S is 5.562, 3.640, 6.579 and 4.490 $atm.L^2.mol^{-2}$ respectively. If value of Vander waal's constant 'b' is taken to be same for all gases, then :

| | | | |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| (A) $P_3 < P_1 < P_4 < P_2$ | (B) $P_1 < P_3 < P_2 < P_4$ | (C) $P_2 < P_4 < P_1 < P_3$ | (D) $P_1 = P_2 = P_3 = P_4$ |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|

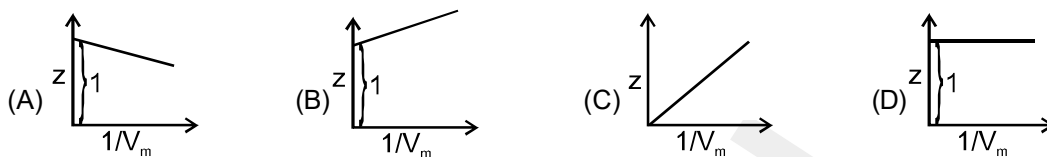
- Consider the following statements :
 - $(a)_{NH_3} > (a)_{H_2O}$ [(a) is Vander waal's constant]
 - Pressure of the real gas is always more than the ideal gas for same temperature and volume of the container.
 - Compressibility factor for H_2 (g) is never less than unity at any temperature.
 The above statements 1, 2, 3 respectively are : (T = True, F = False)

| | | | |
|-----------|-----------|-----------|-----------|
| (A) T F F | (B) F F F | (C) F T F | (D) T T F |
|-----------|-----------|-----------|-----------|

- For a real gas with very large value of molar volume, which of the following equation can most suitably be applied:

| | | | |
|--------------------------------|-----------------|-----------------------------|---------------------------------|
| (A) $Z = 1 - \frac{a}{V_m RT}$ | (B) $PV_m = RT$ | (C) $Z = 1 + \frac{Pb}{RT}$ | (D) $PV_m - RT = \frac{a}{V_m}$ |
|--------------------------------|-----------------|-----------------------------|---------------------------------|

5. For a real gas under low pressure conditions, which of the following graph is correct :



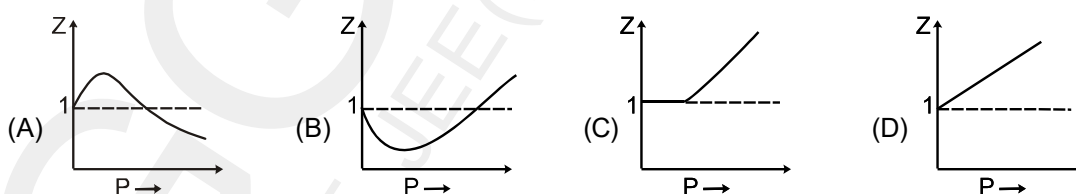
6.* Which of the following statements is/are correct about Boyle temperature (T_B) :

- (A) Temperature at which 1st virial coefficient becomes Zero
- (B) Temperature at which 2nd virial coefficient becomes Zero
- (C) According to Vander waal's equation, value of $T_B = a/Rb$
- (D) T_B of a gas depends upon the nature of gas

7. A hypothetical real gas A, having molar mass 16 g, has a density of 0.8 kg/m^3 at 2 atm pressure and a temperature of 127°C . Determine : [Take $R = 1/12 \text{ L atm K}^{-1} \text{ mol}^{-1}$]

- (i) the value of compressibility factor Z for gas A.
- (ii) which forces are dominating among gas molecules, attractive or repulsive ?

8. Plot at Boyle's temperature for a real gas will be :



PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 36
Total Marks : 30
Max. Time : 32 min.
Topic : Gaseous State
Type of Questions

| | | |
|---|---------------------------|-------------------|
| Single choice Objective ('-1' negative marking) Q.1 to Q.6 | (3 marks, 3 min.) | M.M., Min. |
| Multiple choice objective ('-1' negative marking) Q.7 | (4 marks, 4 min.) | [18, 18] |
| Match the Following (no negative marking) (2 × 4) Q.8 | (8 marks, 10 min.) | [4, 4] |
| | | [8, 10] |

- At the critical point for H₂ gas, value of Z = 3/8. Then, the value of Z under the similar conditions for CO₂, O₂, SO₂ at their respective critical points will be :
 (A) greater than 3/8 (B) smaller than 3/8 (C) equal to 3/8 (D) nothing can be said
- Critical temperature of a gas is _____ Boyle temperature :
 (A) higher than (B) equal to (C) lower than (D) no relation between them
- For the four gases A, B, E and D, the value of the excluded volume per mole is same. If the order of the critical temperature is T_B > T_D > T_A > T_E, then the order of their liquefaction pressure at a temperature T (T < T_E) will be :
 (A) P_A < P_B < P_E < P_D (B) P_B < P_D < P_A < P_E (C) P_E < P_A < P_D < P_B (D) P_D < P_E < P_A < P_B
- The critical pressure P_C and critical temperature T_C for a gas obeying Vander Waal's equation are 80 atm and 87°C. Molar mass of the gas is 130 g/mole. The compressibility factor for the above gas will be smaller than unity under the following conditions :
 (A) 1 atm and 800 °C (B) 1 atm and 1200 °C (C) 1 atm and 1000 °C (D) 1 atm and 1100 °C
- Given that the critical temperature of oxygen is 154K and its critical pressure is 50 atm. Which of the following statements is/are true :
 I. In a closed container at 154K and 50 atm, the solid, liquid, and gaseous phase of oxygen are in equilibrium.
 II. Oxygen gas can be liquefied at room temperature.
 III. It can be reasoned that ammonia has a critical temperature above 154 K.
 (A) I is true (B) II and III are true (C) III is true (D) I and III are true
- The virial equation for 1 mole of a real gas is written as : $PV = RT \left[1 + \frac{A}{V} + \frac{B}{V^2} + \frac{C}{V^3} + \dots \text{to higher power of } n \right]$
 Where A, B and C are known as virial coefficients. If Vander waal's equation is written in virial form, then what will be the value of B :
 (A) $a - \frac{b}{RT}$ (B) b³ (C) $b - \frac{a}{RT}$ (D) b²
- * Critical temperature for a particular gas is -177°C. Then for which of the following case, value of compressibility factor of the gas may be more than unity :
 (A) at 0°C and 0.01 atm (B) at 0°C and 2000 atm (C) at 60°C and 0.01 atm (D) at 60°C and 10 atm
- Match the following :**

| | |
|--|--|
| Column I (A) For a gas, repulsive tendency dominates (B) At T _B = -3 °C for a gas in high pressure region (C) At T _C (D) For He gas at 0°C in all pressure region | Column II (p) Effects of 'a' and 'b' compensate each other. (q) There is no difference between physical properties in liquid and gas state. (r) Z > 1 (s) T _C = 80 K |
|--|--|

DPP 1 TO 36 (ANSWER KEY)

PHYSICAL CHEMISTRY

DPP No. # 1

1.* (BC) 2.* (CD) 3. 4

4.

| S.No. | Sample | Relative Atomic Mass for the element | Gram Atomic mass of sample | Moles of sample | No. of atoms of sample | Mass removed from the sample | Mole removed | Atoms removed | Mass of same no. of C atom as no. of atoms present in the original sample |
|-------|-------------|--------------------------------------|----------------------------|-----------------|------------------------|------------------------------|--------------------|------------------|---|
| 1. | 8 g O | 16 | --- | --- | --- | --- | --- | --- | --- |
| | For Example | 16 | 16 g | ½ Mole | $\frac{N_A}{2}$ | 2 g | $\frac{1}{8}$ Mole | $\frac{N_A}{8}$ | 6 g |
| 2. | 230 g Na | 23 | 23g | 10 Mole | 10 N_A | 46 g | 2 Mole | 2 N_A | 120 g |
| 3. | 60 g Ca | 40 | 40 g | 3/2 Mole | 3/2 N_A | 40 g | 1 Mole | N_A | 18 g |
| 4. | 20 g He | 4 | 4 g | 5 Mole | 5 N_A | 12 g | 3 Mole | 3 N_A | 60 g |
| 5. | 56 g N | 14 | 14 g | 4 Mole | 4 N_A | 7 g | ½ Mole | $\frac{N_A}{2}$ | 48 g |
| 6. | 12 g Mg | 24 | 24 g | ½ Mole | $\frac{N_A}{2}$ | 6 g | ¼ Mole | $\frac{N_A}{4}$ | 6 g |
| 7. | 128 g S | 32 | 32 g | 4 Mole | 4 N_A | 32 g | 1 Mole | N_A | 48 g |
| 8. | 93 g P | 31 | 31 g | 3 Mole | 3 N_A | 46.5 g | 3/2 Mole | $\frac{3N_A}{2}$ | 36 g |

5. (C) 6. (A) 7. (A - p, s, r), (B - p, q, r), (C - p, q, r), (d - r).

8. (D)

DPP No. # 2

1. (B) 2. (D) 3. (A) 4. (B) 5. (A)

6. (B) 7. (D) 8. (A) 9. (A) 10. (C)

11. (B)

DPP No. # 3

1. (C) 2. (B) 3. (A - r ; B - p, s ; C - q ; D - p). 4. (A)

5. (B) 6. (A) 7. (A) 8. (A) 9. (C)

10. 5. 11. (B) 12. (A)

DPP No. # 4

1.* (C,D) 2. 4 3. (B) 4. (D)

5. [A - r] ; [B - p] ; [C - s] ; [D - p, q]. 6. (A) 7. (A) 8.* (A,B,D)

DPP No. # 5

1. (B) 2. (B) 3. (A) 4.* (B,C) 5. (A)

6.* (A,C) 7. 5 8. (D) 9. (A) 10. (B)

DPP No. # 6

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

6.* (A,B,C) 7. (D) 8. 8 9. (B) 10.* (C, D)

DPP No. # 7

1. (C) 2. (D) 3. (D)
4. (a) $\overset{(+7)}{\text{KMnO}_4}$ (oxidant) ; $\overset{(-1)}{\text{KCl}}$ (reductant) (b) $\overset{(+2)}{\text{FeCl}_2}$ (reductant) ; $\overset{(-1)}{\text{H}_2\text{O}_2}$ (oxidant)
- (c) $\overset{(0)}{\text{Cu}}$ (reductant) ; $\overset{+5}{\text{HNO}_3}$ (oxidant) (d) $\overset{+3}{\text{Na}_2\text{HAsO}_3}$ (reductant) ; $\overset{+5}{\text{KBrO}_3}$ (oxidant)
- (e) $\overset{0}{\text{I}_2}$ (oxidant) ; $\overset{+2}{\text{Na}_2\text{S}_2\text{O}_3}$ (reductant)
5. (i) $\text{K}_2\text{Cr}_2\text{O}_7 + 3\text{H}_2\text{O}_2 + 4\text{H}_2\text{SO}_4 \longrightarrow \text{K}_2\text{SO}_4 + \text{Cr}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O} + 3\text{O}_2$.
- (ii) $4\text{Zn} + \text{NaNO}_3 + 7\text{NaOH} = 4\text{Na}_2\text{ZnO}_2 + 2\text{H}_2\text{O} + \text{NH}_3$.
- (iii) $2\text{OH}^- + 6\text{H}_2\text{O} + 2\text{Al} \longrightarrow 3\text{H}_2 + 2(\text{Al}(\text{OH})_4)^-$.
- (iv) $6\text{Cu}_3\text{P} + 11\text{Cr}_2\text{O}_7^{2-} + 124\text{H}^+ \longrightarrow 18\text{Cu}^{+2} + 6\text{H}_3\text{PO}_4 + 22\text{Cr}^{+3} + 53\text{H}_2\text{O}$.
- (v) $6\text{H}^+ + \text{ClO}_3^- + 6\text{Fe}^{2+} \longrightarrow \text{Cl}^- + 6\text{Fe}^{3+} + 3\text{H}_2\text{O}$.
- (vi) $3\text{N}_2\text{O}_4 + \text{BrO}_3^- + 3\text{H}_2\text{O} \longrightarrow 6\text{NO}_3^- + \text{Br}^- + 6\text{H}^+$.
- (vii) $3\text{S}_2\text{O}_3^{2-} + 2\text{Sb}_2\text{O}_5 + 6\text{H}^+ + 3\text{H}_2\text{O} \longrightarrow 4\text{SbO} + 6\text{H}_2\text{SO}_3$
- (viii) $\text{Cr}_2\text{O}_7^{2-} + 6\text{I}^- + 14\text{H}^+ \longrightarrow 2\text{Cr}^{3+} + 3\text{I}_2 + 7\text{H}_2\text{O}$.
- (ix) $\text{IO}_4^- + 7\text{I}^- + 8\text{H}^+ \longrightarrow 4\text{I}_2 + 4\text{H}_2\text{O}$.

DPP No. # 8

1. (B) 2. 1 3. (B) 4. (C) 5*. (A,B,D)
- 6*. (A,D) 7. (A) 8. (B) 9. (C) 10. (B)

DPP No. # 9

1. 4 2. (B) 3. $9N_A$ 4. (A) 5. (B)
6. (i) False (ii) True (iii) True (iv) True 7. OsO_4 8. 9.2 g
9. (A - p,s) ; (B - p,r) ; (C - r) ; (D - q). 10. 80%. 11. (D) 12. (C) 13. (A)

DPP No. # 10

1. $3.3N_A$ 2. 2.38 g 3. 73.6 g 4. (D) 5. (C)
6. (B) 7. 0.3375 g. 8. 60 mL 9. 2 : 5
10. 12 M, 16.66 mL 11. 147.2 mL
12. (i) % w/w = 10% (ii) % w/v = 12% (iii) mole fraction of NaOH = 1/21
(iv) molarity (M) = (3M) (v) molality (m) = (2.78 m)
13. Both have equal no. of Cl^- ions per ml. 14. (A - p, q, r) ; (B - q, r) ; (C - q, r) ; (D - p, s)

DPP No. # 11

1. (B) 2. (A) 3. (D) 4. 11, 23, 11, $^{23}_{11}\text{Na}$
5. 8, 10, 7 6. (C) 7. (C) 8. 40, Calcium

DPP No. # 12

1. (D) 2.* (BD) 3. (A) 4.* (BD) 5. (D)
 6.* (ABCD) 7. (C) 8. (B) 9. (C)
 10. 6.32×10^6 m/s. 11. [A – q] ; [B – r] ; [C – s] ; [D – p]. 12. 1000 m

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)

DPP No. # 14

1. 75% 2. 1000 Å 3. (D) 4. (B) 5. (C)
 6. (C) 7. (A) 8. (D) 9. (C)
 10. (A – s) ; (B – s) ; (C – p) ; (D – q, r).

DPP No. # 15

1. (B) 2. (D) 3. (B) 4. (B) 5. (D)
 6. (A) 7.(A,B,D) 8. (B)

DPP No. # 16

1. (A) 2. (D) 3. (C) 4.* (A,B,C)
 5. 8.2×10^6 6. -4.41×10^{-17} J. 7. [A – q] ; [B – p] ; [C – s] ; [D – r].
 8. I induced = 1026 Å , II induced = 1216 Å , III induced = 6568 Å 9. 2.65×10^{-11} m.

DPP No. # 17

1. (A) 2. (D) 3. (D) 4. (D) 5. (A, B)
 6. (C) 7. (D) 8. (B)
 9. [A → r, s] ; [B → p, s] ; [C → q, r, s] ; [D → p, q, s]. 10. (D)

DPP No. # 18

1. (C) 2. (A) 3. (C) 4. (C) 5. 4
 6. $n = 5, Z = 3$. 7. (C) 8. (D) 9. 0.529 Å

DPP No. # 19

1. (D) 2. (D) 3. (D) 4. (B) 5. (C)
 6. (D) 7. (A) 8. (B) 9. (A)

DPP No. # 20

1. (D) 2. (A) 3. (C) 4. (C) 5. (D)
 6. (D) 7. (D) 8. (C) 9. (A) 10. 32
 11. (a) $0 \times (\pm 1/2) = 0$ (b) $0 \times (\pm 1/2) = 0$ (c) $1 \times (\pm 1/2) = \pm 1/2$ (d) $3 \times (\pm 1/2) = \pm 3/2$ (e) $5 \times (\pm 1/2) = \pm 5/2$.

DPP No. # 21

1. (C) 2. (C) 3. (C) 4. (B)

5. (a) 21 (b) 8 (c) 12 (d) 1 (e) 1. 6. (a) $\sqrt{24}$ or 4.9 BM (b) 1 (c) 11 (d) $\frac{\sqrt{6}h}{2\pi}$
 7. (a) a = 4 moles. 8. ${}_{23}\text{V}^{4+} : 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^1$

DPP No. # 22

1. (A) 2. (B) 3. (B) 4. (C)
 5.* (ACD) 6.* (BCD) 7.* (AC)
 8. A and D are isotopes. B, C and D are isobars.
 9. (i) p,s (ii) q,r (iii) p,s (iv) q,r
 10. (A) 11. ${}_{82}\text{Y}^{206}$; (Atomic no. 82, Mass no. 206), Pb
 12. (a) $2\frac{1}{2}n$, (b) 13. (C) 14. 8 15. 3

DPP No. # 23

1. (C) 2. (A) 3. (A) 4. (B) 5. (A)
 6. (ABC) 7. 5.26 8. (A) 9. (C)

DPP No. # 24

1. (B) 2. 31 cm of Hg. 3. x = 6 cm 4. ≈ 101.3 cm.
 5. x = 26.84 cm 6. 18 cm 7. 550 cm 8. 19 cm.

DPP No. # 25

1. (B) 2. (D) 3. (C) 4. (D)
 5. 25 mL. 6. 273°C. 7. 33.3 mL. 8. (a) No, (b) 55°C.
 9. (a) 50.5 cm (b) 55 cm (c) 45 cm.

DPP No. # 26

1. (B) 2. (C) 3. (A,B,C,D) 4. 0.6
 5. -23°C 6. 245.7 mL 7. (a) 1 : 3 (b) 12.3 litre 8. (D)

DPP No. # 27

1. (C) 2. (D) 3. (B) 4. (C) 5. (B)
 6. (C) 7. (B) 8. (B,D) 9. (B) 10. (B)
 11. (D) 12. (B)

DPP No. # 28

1. (D) 2. (C) 3. (B) 4. (A) 5. (A)
 6. (A) 7. 88.67 cm of Hg 8. 4 atm 9. 5 atm

DPP No. # 29

1. (A) 2. (B) 3. (D) 4. 0.28 atm
 5. $p_A = 500$ mm, $p_B = 250$ mm. 6. 3434Kg 7. (D) 8. 11 amu.

DPP No. # 30

1. (A) 2. (A) 3. (A) 4. (CD)

5. 2.5 ml. 6. (B) 7. (B) 8. (C) 9. 9/46

DPP No. # 31

1. (C) 2. (A) 3. (D) 4. (C) 5. (A)
 6. (D) 7. (B) 8. (D) 9. (A) 10. (C)

DPP No. # 32

1. (B) 2. (C) 3. (D) 4. (A,B,C,D) 5. (B)
 6. (D) 7. (B) 8. 4 9. (C) 10. (C)
 11. (C,D)

DPP No. # 33

1. (C) 2. (B) 3. (C) 4. (D) 5. (D)
 6. (B) 7. $CO = 0.4L$ 8. 896 mL.

DPP No. # 34

1. (A) 2. (C) 3. (A) 4.* (ACD)
 5.* (ACD) 6.* (CD) 7. 2000 8. 80000 K

DPP No. # 35

1. (A) 2. (A) 3. (B) 4. (B) 5. (A)
 6.* (B,C,D) 7. (i) $Z = 1.2$ (ii) repulsive forces

DPP No. # 36

1. (C) 2. (C) 3. (B) 4. (A) 5. (C)
 6. (D) 7.* (B,C,D) 8. $[A - r] ; [B - r,s] ; [C - q] ; [D - r].$