

# PRACTICE PAPER **2**\*

Time allowed : 2 hours

Maximum marks : 35

**General Instructions :** Read the following instructions carefully.

- There are 16 questions in this question paper. All questions are compulsory.
- Section A : Q. No. 1 to 8 are objective type questions. Q. No. 1 is passage based question carrying 4 marks while Q. No. 2 to 8 carry 1 mark each.
- Section B : Q. No. 9 to 12 are short answer questions and carry 2 marks each.
- Section C : Q. No. 13 and 14 are short answer questions and carry 3 marks each.
- Section D : Q. No. 15 and 16 are long answer questions carrying 5 marks each.
- There is no overall choice. However, internal choices have been provided.
- Use of calculators and log tables is not permitted.

## SECTION - A (OBJECTIVE TYPE)

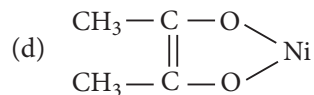
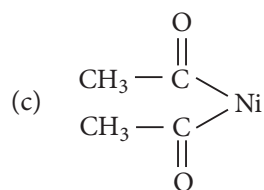
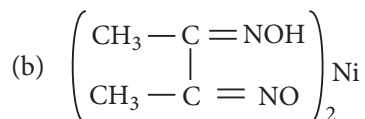
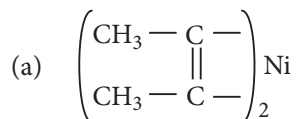
### 1. Read the passage given below and answer the following questions :

The molecular compounds which are formed from the combination of two or more simple stable compounds and retain their identity in the solid as well as in the dissolved state are called coordination compounds. Their properties are completely different from the constituents. In coordination compounds, the central metal atom or ion is linked to a number of ions or neutral molecules, called ligands, by coordinate bonds. For example, Dimethyl glyoxime (dmg) is a bidentate ligand chelating large amounts of metals.

When dimethyl glyoxime is added to alcoholic solution of  $\text{NiCl}_2$  and ammonium hydroxide is slowly added to it, a rosy red precipitate of a complex is formed.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) The structure of the complex is



(ii) Oxidation number of Ni in the given complex is

- +3
- +1
- +2
- zero.

(iii) Hybridisation and structure of the complex is

- $sp^3$ , tetrahedral
- $dsp^2$ , square planar
- $sp^3$ , square planar
- $sp^3d$ , trigonal bipyramidal.

OR

Which of the following is true about this complex?

- (a) It is paramagnetic, containing 2 unpaired electrons.  
 (b) It is paramagnetic, containing 1 unpaired electron.  
 (c) It is paramagnetic, containing 4 unpaired electrons.  
 (d) It is diamagnetic with no unpaired electron.

(iv) Which one will give test for  $\text{Fe}^{3+}$  ions in the solution?

- (a)  $[\text{Fe}(\text{CN})_6]^{3-}$  (b)  $[\text{Fe}(\text{CN})_6]^{2-}$   
 (c)  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{FeSO}_4 \cdot 6\text{H}_2\text{O}$  (d)  $\text{Fe}_2(\text{SO}_4)_3$

The following questions are multiple choice questions. Choose the most appropriate answer :

2. The carboxylic acid which does not undergo Hell - Volhard - Zelinsky reaction is

- (a)  $\text{CH}_3\text{COOH}$  (b)  $(\text{CH}_3)_2\text{CHCOOH}$   
 (c)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$  (d)  $(\text{CH}_3)_3\text{CCOOH}$

3. The strongest base among the following is

- (a)  (b)  (c)  (d) 

OR

The order of basic strength among the following amines in benzene solution is

- (a)  $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH}$  (b)  $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2$   
 (c)  $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N}$  (d)  $(\text{CH}_3)_3\text{N} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH}$

4. How many 'd' electrons are present in  $\text{Cr}^{2+}$  ion?

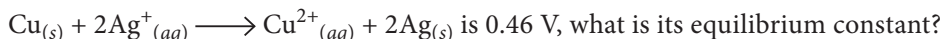
- (a) 4 (b) 5 (c) 6 (d) 3

OR

Compound that is both paramagnetic and coloured is

- (a)  $\text{K}_2\text{Cr}_2\text{O}_7$  (b)  $(\text{NH}_4)_2[\text{TiCl}_6]$   
 (c)  $\text{VOSO}_4$  (d)  $\text{K}_3[\text{Cu}(\text{CN})_4]$

5. The  $E^\circ$  for the cell reaction,



- is 0.46 V, what is its equilibrium constant?

- (a) 15.6 (b)  $4 \times 10^{16}$  (c)  $4 \times 10^{15}$  (d)  $1.56 \times 10^{15}$

6. The time taken for 90% of a first order reaction to complete is approximately

- (a) 1.1 times that of half-life (b) 2.2 times that of half-life  
 (c) 3.3 times that of half-life (d) 4.4 times that of half-life.

In the following questions (Q. No. 7 and 8), a statement of assertion followed by a statement of reason is given.

Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.  
 (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.  
 (c) Assertion is correct statement but reason is wrong statement.  
 (d) Assertion is wrong statement but reason is correct statement.

7. **Assertion :** In complex  $[\text{Cr}(\text{NH}_3)_4\text{BrCl}]\text{Cl}$ , the 'spin only' magnetic moment is close to 2.83 B.M.

**Reason:** Mononuclear complexes of chromium(III) in strong field ligand have three unpaired electrons.

8. **Assertion :** Hofmann degradation of benzamide gives aniline.

**Reason :** Hofmann bromamide degradation reaction can be used for descending amine series.

OR

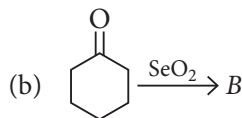
**Assertion :** Ammonolysis of alkyl halides involves reaction between alkyl halides and alcoholic ammonia.

**Reason :** Ammonolysis of alkyl halides mainly produces 2° amines.

## SECTION - B

The following questions, Q. No. (9 to 12) are short answer type and carry 2 marks each.

9. Write the IUPAC names of the products (A) and (B) in the following reactions :



10. Calculate the cell emf at 25°C for the following cell :  $\text{Mg}_{(s)} \mid \text{Mg}^{2+} (0.01 \text{ M}) \parallel \text{Sn}^{2+} (0.10 \text{ M}) \mid \text{Sn}_{(s)}$   
[Given :  $E^\circ_{(\text{Mg}^{2+}/\text{Mg})} = -2.34 \text{ V}$ ,  $E^\circ_{(\text{Sn}^{2+}/\text{Sn})} = -0.136 \text{ V}$ ,  $1 \text{ F} = 96500 \text{ C mol}^{-1}$ ].

11. Calculate the order of the reaction for the decomposition of  $\text{N}_2\text{O}_5$  at 30°C from the following rate data.

S. No.	Rate of reaction ( $\text{mol L}^{-1} \text{ hr}^{-1}$ )	Concentration of $\text{N}_2\text{O}_5$ ( $\text{mol L}^{-1}$ )
1.	0.10	0.34
2.	0.20	0.68
3.	0.40	1.36

OR

Hydrogen peroxide,  $\text{H}_2\text{O}_{2(aq)}$  decomposes to  $\text{H}_2\text{O}_{(l)}$  and  $\text{O}_{2(g)}$  in a reaction that is first order in  $\text{H}_2\text{O}_2$  and has a rate constant  $k = 1.06 \times 10^{-3} \text{ min}^{-1}$ . How long will it take for 15% of a sample of  $\text{H}_2\text{O}_2$  to decompose?

12. Write two differences between physisorption and chemisorption.

OR

Write one difference between each of the following :

- (i) Multimolecular colloid and macromolecular colloid
- (ii) Sol and gel

## SECTION - C

Q. No. (13 and 14) are short answer type II carrying 3 marks each.

13. Account for the following :

- (i) Zirconium and hafnium exhibit almost similar properties.
- (ii) Zinc salts are white while copper II salts are coloured [At. nos. Zn = 30, Cu = 29].
- (iii) Europium (II) is more stable than cerium (II).

14. How will you convert :

- (i) Ethanoic acid into methanamine
- (ii) Ethanamine into methanamine

OR

Give reasons :

- (i) Acetylation of aniline reduces its activation effect.
- (ii)  $\text{CH}_3\text{NH}_2$  is more basic than  $\text{C}_6\text{H}_5\text{NH}_2$ .
- (iii) Although  $-\text{NH}_2$  is *o/p* directing group, yet aniline on nitration gives a significant amount of *m*-nitroaniline.

## SECTION - D

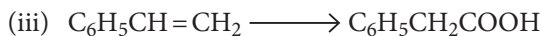
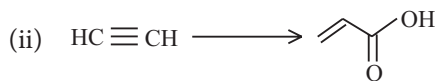
Q. No. (15 and 16) are long answer type carrying 5 marks each.

15. (a) Write the complete reaction for each of the following conversions stating the conditions necessary :

- (i) Toluene to benzaldehyde
- (ii) Aldehyde to acetal
- (b) Describe the preparation of acetic acid from acetylene.
- (c) How can the following be obtained from acetic acid?
  - (i) Acetaldehyde
  - (ii) Acetone

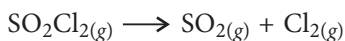
OR

(a) Carry out the following transformations.



(b) Out of nitrobenzoic acid and chlorobenzoic acid which one is a stronger acid and why?

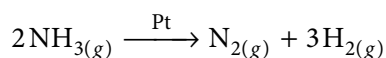
(c) The C - O bond in carboxylic acid is shorter than that in alcohol. Explain.

16. (a) The following data were obtained during the first order thermal decomposition of  $SO_2Cl_2$  at a constant volume :

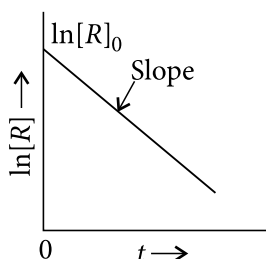
Calculate the rate constant.

(Given :  $\log 4 = 0.6021$ ,  $\log 2 = 0.3010$ )

Experiment	Time/s	Total pressure/atm
1	0	0.4
2	100	0.7

(b) The decomposition of  $NH_3$  on platinum surfaceis a zero order reaction with  $k = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$ . What are the rates of production of  $N_2$  and  $H_2$ ?

OR

(a) For a certain chemical reaction variation of  $\ln[R]$  vs. time (s) plot is given below :

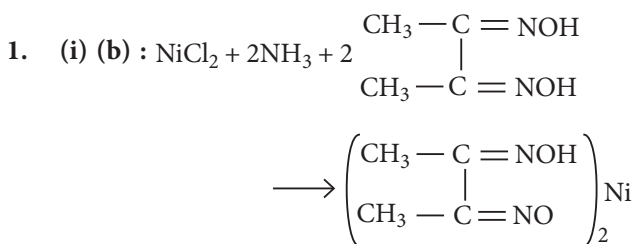
(i) Predict the order of the given reaction.

(ii) What does the slope of the line and intercept indicate?

(iii) What is the unit of rate constant  $k$ ?

(b) A first order reaction takes 160 minutes time for 20% completion. Calculate time required for half completion of reaction.

## ANSWERS



(ii) (c)

(iii) (b)

OR

(d) : It has no unpaired electrons hence, it is diamagnetic.

(iv) (d): (a) and (b) are coordination compounds

hence cannot give free  $Fe^{2+}$  or  $Fe^{3+}$  ions in solution.

(c) and (d) represent simple compounds hence are free

to give ions in solution, but only  $Fe_2(SO_4)_3$  contains  $Fe^{3+}$  ions.  $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$  contains  $Fe^{2+}$  ions not  $Fe^{3+}$  ions.2. (d) : The acid does not contain  $\alpha$ -hydrogen atom.3. (c) :  $2^\circ$  amines are more basic than  $1^\circ$  and  $3^\circ$  amines. Among the  $2^\circ$  amines, (b) and (c), (b) is less basic since the lone pair of electrons on the nitrogen atom is contributed towards the aromatic sextet formation. Hence, piperidine, *i.e.*, option (c) is correct.

OR

(b) : In non-aqueous solvents and in vapour phase basic strength of alkyl amines follows the order :

Tertiary amines &gt; secondary amines &gt; primary amines

4. (a): Cr ( $Z = 24$ )  $\rightarrow 3d^5 4s^1$  thus  $Cr^{2+} \rightarrow 3d^4$   
i.e., No. of  $d$ -electrons = 4

OR

(c):  $K_2Cr_2O_7$  contains  $Cr^{6+}(3d^0)$  which is diamagnetic but coloured due to charge transfer spectra.

$(NH_4)_2[TiCl_6]$  contains  $Ti^{4+}(3d^0)$ , which is diamagnetic and colourless.

$VOSO_4$  contains  $V^{4+}(3d^1)$ , which is paramagnetic and coloured.

$K_3[Cu(CN)_4]$  contains  $Cu^+(3d^{10})$ , which is diamagnetic and colourless.

5. (c):  $E_{cell}^\circ = \frac{0.059}{2} \log K_c$

or  $\log K_c = \frac{0.46 \times 2}{0.059} = 15.6$

$\therefore K_c = 4 \times 10^{15}$

6. (c):  $t_{90\%} = \frac{2.303}{k} \log \frac{a}{a-0.9a} = \frac{2.303}{k} \log 10 = \frac{2.303}{k}$

$t_{1/2} = \frac{2.303}{k} \log \frac{a}{a-a/2} = \frac{2.303}{k} \log 2 = \frac{2.303}{k} \times 0.3010$

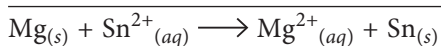
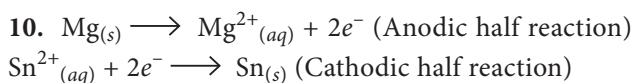
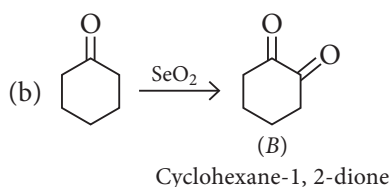
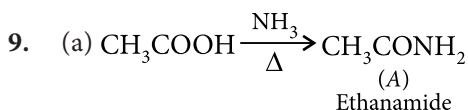
$\frac{t_{90\%}}{t_{1/2}} = \frac{1}{0.3010} = 3.3$  i.e.,  $t_{90\%} = 3.3$  times  $t_{1/2}$

7. (d):  $Cr^{3+}$  having  $3d^3$  configuration always have 3 unpaired electrons with strong field as well as weak field ligands with three unpaired electrons thus, the magnetic moment is 3.83 B.M.

8. (a): In this reaction the amine so formed contains one carbon less than that present in the amide.

OR

(c)



$E_{cell}^\circ = E_{Sn^{2+}/Sn}^\circ - E_{Mg^{2+}/Mg}^\circ$   
 $= -0.136 + 2.34 = 2.204$  V

$E_{cell} = E_{cell}^\circ - \frac{0.0591}{2} \log \frac{0.01}{0.10}$   
 $= 2.24 - (0.0295 \times -1) = 2.2335$  V

11. From the given data,

$r_1 = 0.10 \text{ mol L}^{-1} \text{ hr}^{-1} = k \times (0.34 \text{ mol L}^{-1})^n$

$r_2 = 0.20 \text{ mol L}^{-1} \text{ hr}^{-1} = k \times (0.68 \text{ mol L}^{-1})^n$

$r_3 = 0.40 \text{ mol L}^{-1} \text{ hr}^{-1} = k \times (1.36 \text{ mol L}^{-1})^n$

$\frac{r_1}{r_2} = \frac{0.10 \text{ mol L}^{-1} \text{ hr}^{-1}}{0.20 \text{ mol L}^{-1} \text{ hr}^{-1}} = \frac{k(0.34 \text{ mol L}^{-1})^n}{k(0.68 \text{ mol L}^{-1})^n}$

or  $\frac{1}{2} = \left(\frac{1}{2}\right)^n \Rightarrow n = 1$

OR

$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$

Given  $k = 1.06 \times 10^{-3} \text{ min}^{-1}$ ,  $\frac{[A]_0}{[A]} = \frac{100}{85}$

$t = \frac{2.303}{1.06 \times 10^{-3} \text{ min}^{-1}} \log \frac{100}{85}$

$t = \frac{2303}{1.06} [2 \log 10 - \log 85] \text{ min}$

$t = \frac{2303}{1.06} [2 \times 1 - 1.9294] = \frac{2303 \times 0.0706}{1.06}$

$t = 153.39 \text{ min} \approx 153.4 \text{ min}$

12.

S. No.	Criteria	Physisorption	Chemisorption
(i)	Specificity	It is not specific in nature.	It is highly specific in nature.
(ii)	Temperature dependence	It decreases with increase in temperature. Thus, low temperature is favourable for physisorption.	It increases with increase in temperature. Thus, high temperature is favourable for chemisorption.
(iii)	Reversibility	Reversible in nature.	Irreversible in nature.
(iv)	Enthalpy change	Low enthalpy of adsorption.	High enthalpy of adsorption.

(Any two)

OR

(i) The difference between multimolecular and macromolecular colloids is :

Multimolecular Colloids	Macromolecular Colloids
When a large number of small molecules or atoms (diameter < 1 nm) of a substance combine together in a dispersion medium to form aggregates, having size in the colloidal range, the colloidal solutions thus, formed are known as multimolecular colloids, e.g., gold sol, sulphur sol, etc.	When substances which possess very high molecular masses are dispersed in suitable dispersion medium, the colloidal solutions thus, formed are called macromolecular colloids, e.g., cellulose, starch, etc.

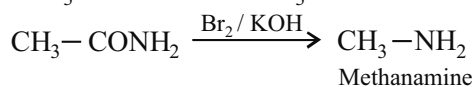
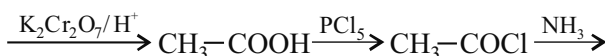
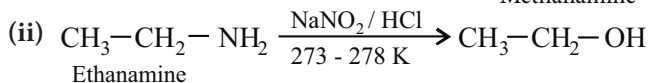
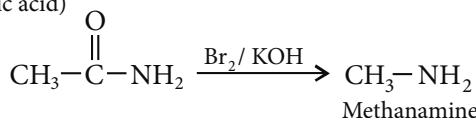
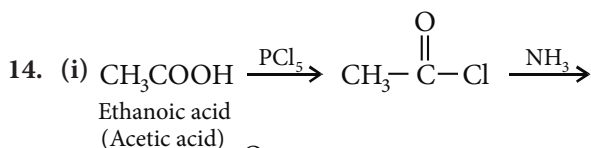
(ii) The difference between sol and gel is :

Sol	Gel
Dispersed phase is solid whereas dispersion medium is liquid.	Dispersed phase is liquid whereas dispersion medium is solid.

13. (i) Due to lanthanoid contraction the elements of 4d and 5d-series have similar atomic radii e.g., Zr = 160 pm and Hf = 159 pm. Thus Zr and Hf have almost identical properties.

(ii) Zn<sup>2+</sup> ion has completely filled d-subshell and no d-d transition is possible. So zinc salts are white. Configuration of Cu<sup>2+</sup> is [Ar] 3d<sup>9</sup>. It has partially filled d-subshell and hence it is coloured due to d-d transition.

(iii) Europium (II) has electronic configuration [Xe] 4f<sup>7</sup> 5d<sup>0</sup> while cerium (II) has electronic configuration [Xe] 4f<sup>1</sup> 5d<sup>1</sup>. In Eu<sup>2+</sup>, 4f subshell is half filled and 5d-subshell is empty. Since, half filled and completely filled electronic configurations are more stable, therefore Eu<sup>2+</sup> ions is more stable than Ce<sup>2+</sup>.



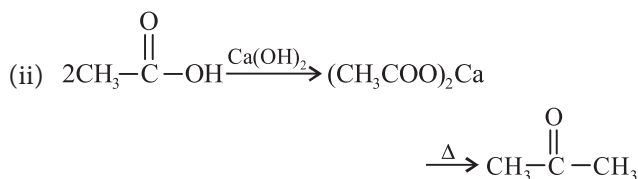
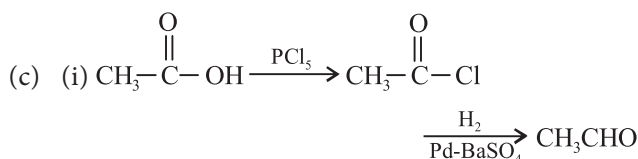
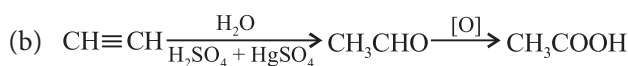
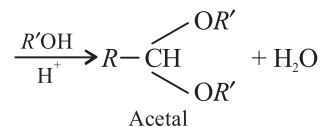
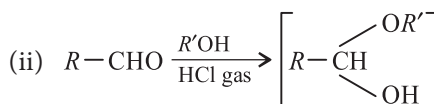
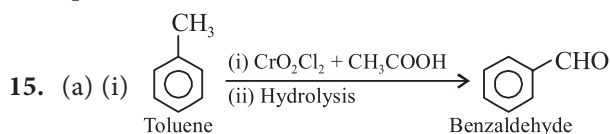
OR

(i) After acetylation of aniline, acetanilide is formed in

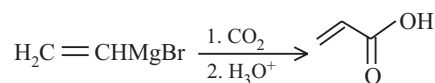
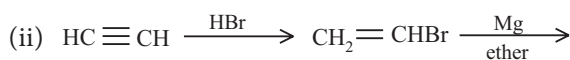
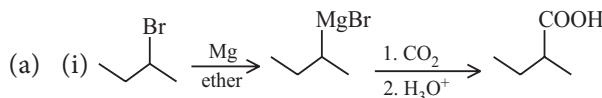
which due to the presence of  $-\overset{\text{O}}{\parallel}\text{C}-\text{CH}_3$  group having -I effect, electron density on N-atom decreases and hence, activation effect of aniline gets reduced.

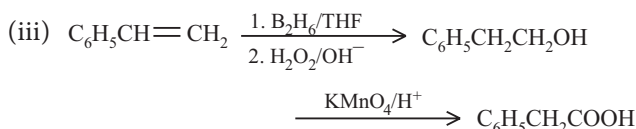
(ii) CH<sub>3</sub>NH<sub>2</sub> is more basic than C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub> because in aniline the lone pair of electrons on nitrogen are involved in resonance.

(iii) Nitration is carried out with conc. HNO<sub>3</sub> in the presence of conc. H<sub>2</sub>SO<sub>4</sub>. In the presence of these acids, the -NH<sub>2</sub> group of aniline gets protonated and is converted into -N<sup>+</sup>H<sub>3</sub> group. This positively charged group acts as a strong electron withdrawing and meta-directing group. Hence, the incoming electrophile goes to m-position.



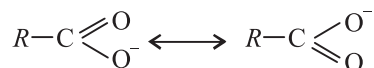
OR





(b) Nitrobenzoic acid is more acidic than chlorobenzoic acid due to greater -I effect of nitro group than chloro group.

(c) Due to resonance structure of carboxylate ion the C - O bond acquires some double bond character, due to which its length is less than that in alcohol.



16. (a) The given reaction is



$$\text{At } t = 0 \quad 0.4 \text{ atm} \quad \quad 0 \quad \quad 0$$

$$\text{At time } t \quad (0.4 - x) \text{ atm} \quad \quad x \text{ atm} \quad \quad x \text{ atm}$$

Total pressure at time  $t$  will be

$$P_T = (0.4 - x) + x + x = 0.4 + x$$

$$x = (P_T - 0.4)$$

Pressure of  $\text{SO}_2\text{Cl}_2$  at time  $t$  will be

$$p_{\text{SO}_2\text{Cl}_2} = 0.4 - x = 0.4 - (P_T - 0.4) = 0.8 - P_T$$

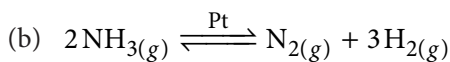
$$\text{At time } t = 100 \text{ s, } P_T = 0.7 \text{ atm}$$

$$\therefore p_{\text{SO}_2\text{Cl}_2} = 0.8 - 0.7 = 0.1 \text{ atm}$$

According to first order kinetic equation

$$k = \frac{2.303}{t} \log \frac{P_{\text{SO}_2\text{Cl}_2}(\text{initial})}{P_{\text{SO}_2\text{Cl}_2}(\text{after reaction})}$$

$$= \frac{2.303}{100} \log \left( \frac{0.4}{0.1} \right) = 1.3 \times 10^{-2} \text{ s}^{-1}$$



$$k = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

The order of reaction is zero *i.e.*,

$$\text{Rate} = k [\text{Reactant}]^0$$

$$\text{Rate} = 2.5 \times 10^{-4} \times 1 = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$\therefore \text{Rate of reaction} = \frac{d[\text{N}_2]}{dt} = \frac{1}{3} \frac{d[\text{H}_2]}{dt}$$

$$\text{The rate of formation of } \text{N}_2 = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$\text{Again, } 2.5 \times 10^{-4} = \frac{1}{3} \frac{d[\text{H}_2]}{dt}$$

$$\therefore \frac{d[\text{H}_2]}{dt} = 7.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

Therefore, rate of formation of  $\text{H}_2$

$$= 7.5 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$$

OR

(a) (i) First order

$$\text{(ii) } \ln[R] = -kt + \ln[R]_0$$

Comparing this equation with  $y = mx + c$ , if we plot  $\ln[R]$  vs  $t$ , we get a straight line with slope =  $-k$  and intercept =  $\ln[R]_0$

(iii) For first order reaction, unit of  $k = \text{s}^{-1}$

(b) Given :  $[R]_0 = 1$ ,  $[R] = 0.80$ ,  $t = 160 \text{ min}$

$t_{1/2} = ?$

$$\text{For first order reaction } k = \frac{2.303}{t} \log_{10} \frac{[R]_0}{[R]}$$

$$\text{or, } k = \frac{2.303}{160 \text{ min}} \log_{10} \frac{1}{0.8}$$

$$\text{or, } k = \frac{2.303}{160 \text{ min}} \times \log 1.25$$

$$\text{or, } k = \frac{2.303 \times 0.0969}{160 \text{ min}} = 1.39 \times 10^{-3} \text{ min}^{-1}$$

$$\text{Again } t_{1/2} = \frac{0.693}{k} = \frac{0.693}{1.39 \times 10^{-3}} \text{ min} = 497 \text{ min}$$

