



# Provincial Department of Education - Sabaragamuwa

General Certificate of Education (Adv. Level) Examination – November 2022

Grade 13 – Second Term Test – 2022 August

Chemistry 1

02

S

1


Two hours

01. In which of the following pairs of elements, have lone electron pairs exist ?

- (1) Cr, Co   (2) Fe, Co   (3) V, Co   (4) V, Cr   (5) Cr, Mn

02. The highest number of electron pairs in the principle quantum number  $n = 3$  of an atom is,

- (1) 3   (2) 4   (3) 5   (4) 8   (5) 9

03. The correct IUPAC name of the compound  is,

- (1) 5 – formyl – 4 – phenylpent – 3 – enamide  
(2) 5 – oxo – 4 – phenylpent – 3 – enamide  
(3) 4 – formyl – 4 – phenyl – 3 – butenamide  
(4) 4 – formyl – 4 – phenyl – 3 – pentenamide  
(5) 5 – amino – 5 – oxo – 4 – phenyl – 2 – pentenal

04. The correct increasing order of the strength of secondary interaction in the following systems is,

- (a)  $\text{NaCl}_{(\text{aq})}$    (b)  $\text{H}_2\text{O}$  and ethanol mixture  
(c)  $\text{CO}_2 (l)$    (d)  $\text{I}_2$  and acetone mixture

- (1)  $c < d < b < a$    (2)  $c < d < a < b$    (3)  $c < a < d < b$   
(4)  $d < c < b < a$    (5)  $d < c < a < b$

05. The shapes of  $\text{PCl}_4^+$ ,  $\text{PCl}_3$  and  $\text{PCl}_6^-$  respectively are,

- (1) Sea – Saw, trigonalbipyramidal and octahedral  
(2) Tetrahedral, trigonalbipyramidal and octahedral  
(3) Sea – Saw, trigonalplanar and square pyramidal  
(4) Tetrahedral, Pyramidal and octahedral  
(5) Tetrahedral, trigonal planar and octahedral

06. There is a spectral line in the atomic emission spectrum of strontium at 662 nm. The energy of a photon at this radiation and the region of electromagnetic spectrum are,

- (1)  $3 \times 10^{-19} \text{ J}$ , infrared   (2)  $3 \times 10^{-28}$ , visible   (3)  $3 \times 10^{-19} \text{ J}$ , Visible  
(4)  $3 \times 10^{-28}$ , ultraviolet   (5)  $3 \times 10^{-19} \text{ J}$ , ultraviolet



07. To neutralize 5 cm<sup>3</sup> of H<sub>2</sub>SO<sub>4</sub> solution with a density of 1.8 gcm<sup>-3</sup>, 84.6 cm<sup>3</sup> of 2 moldm<sup>-3</sup> NaOH was

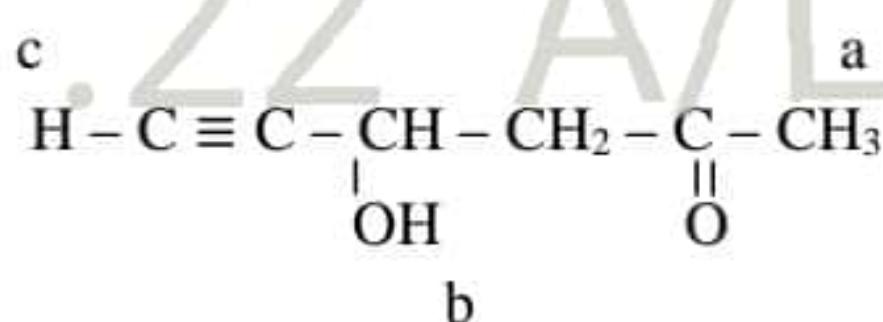
Required. The percentage purity of the acid is,

- (1) 66 %                      (2) 16.9%                      (3) 33%                      (4) 92 %                      (5) 80.4 %

08. Select the correct statement,

- (1) The electron pair geometry and the shape of NH<sub>4</sub><sup>+</sup> are different  
 (2) The descending order of first ionization energy of the atoms H, He, Li, Be and B are He > Be > H > Li > B  
 (3) The bond length of NO<sub>2</sub><sup>-</sup> is the longest among NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>+</sup> and NO<sub>2</sub><sup>-</sup>  
 (4) The bond angle of NH<sub>3</sub> is greater than that of NF<sub>3</sub> and the bond angle of PH<sub>3</sub> is smaller than that of PF<sub>3</sub>  
 (5) The electronegativity of C is the greatest in HCHO among HCHO, HCOOH, CCl<sub>4</sub> and CH<sub>3</sub>NH<sub>2</sub>

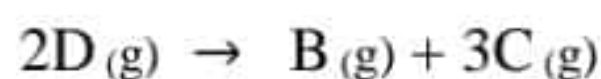
09.



The correct increasing order of acidic strength of H atom a, b, and c in above structure is,

- (1) a < b < c                      (2) b < c < a                      (3) c < b < a  
 (4) b < a < c                      (5) c < a < b

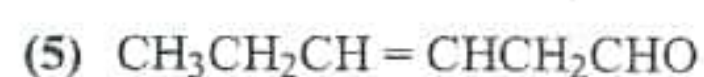
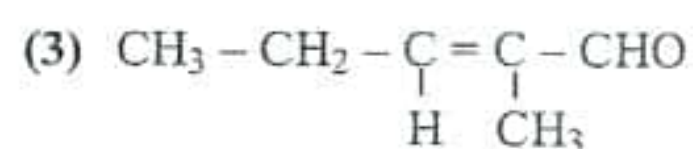
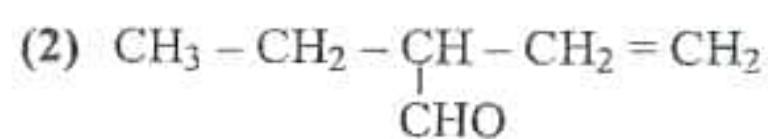
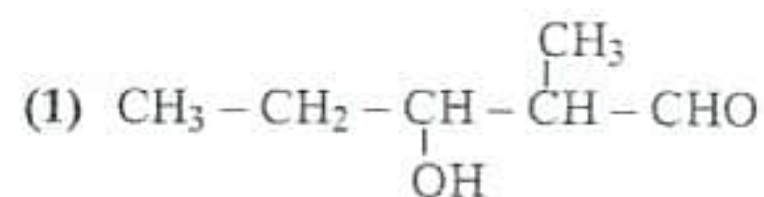
10. A mixture of A<sub>(g)</sub> and D<sub>(g)</sub> are included into a vacuumed flask, at T temperature. The initial pressure is P, The final Pressure was 2.5 p after the two gases completely decomposed according to following equation.



The initial rate of decomposition of A<sub>(g)</sub> is

- (1)  $K\left(\frac{P}{KP}\right)$                       (2)  $0.5K\left(\frac{P}{RT}\right)$                       (3)  $2.5K\left(\frac{P}{RT}\right)$                       (4)  $1.5K\left(\frac{P}{RT}\right)$                       (5)  $2.0K\left(\frac{P}{RT}\right)$

11. Propanol is being treated with solute NaOH and heated with I<sub>2</sub> which of the following will be the product?

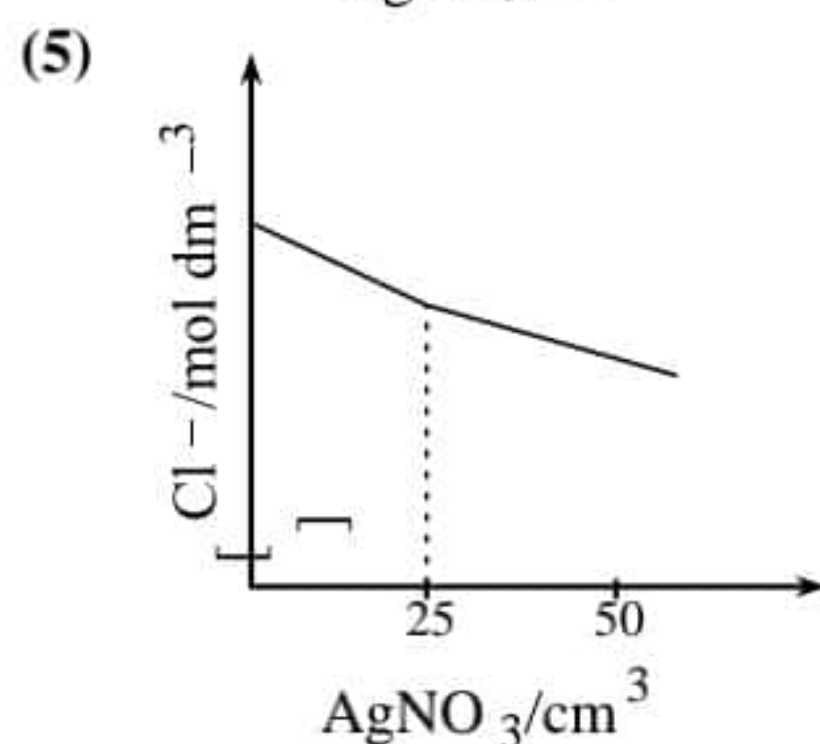
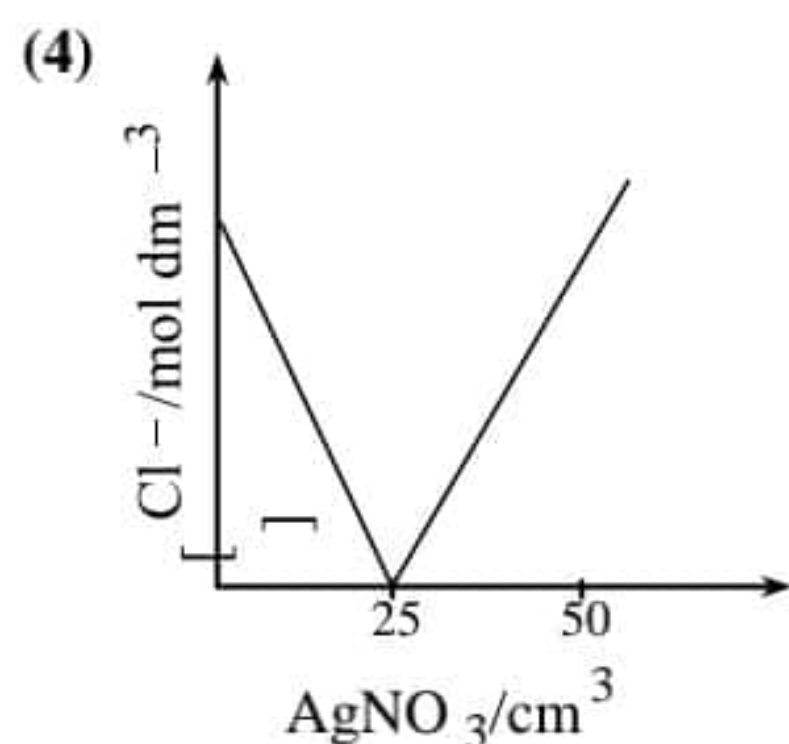
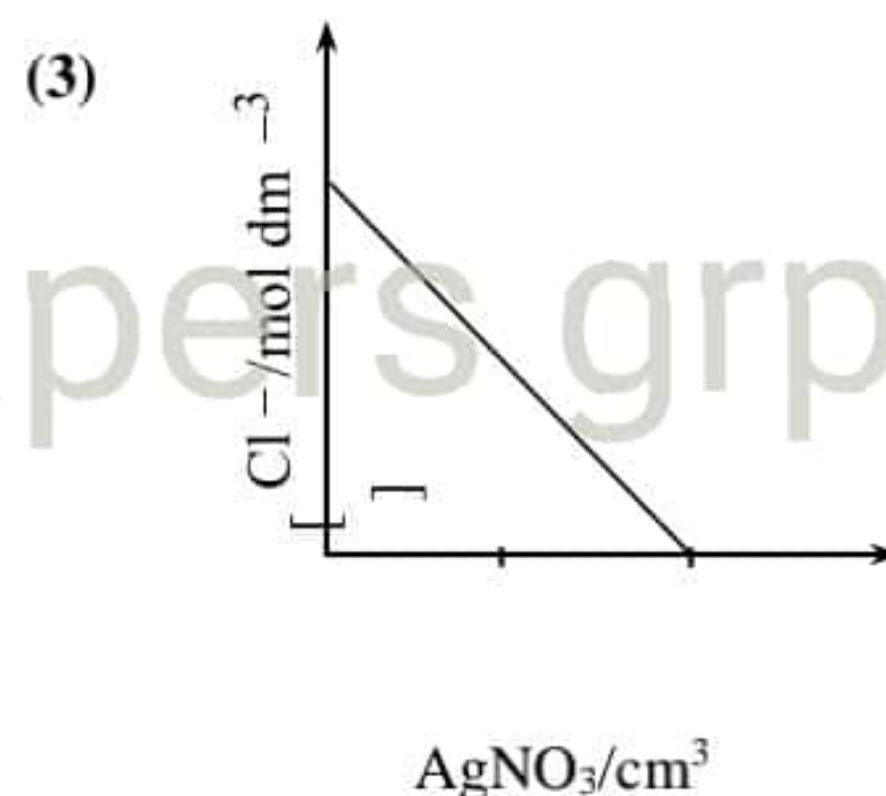
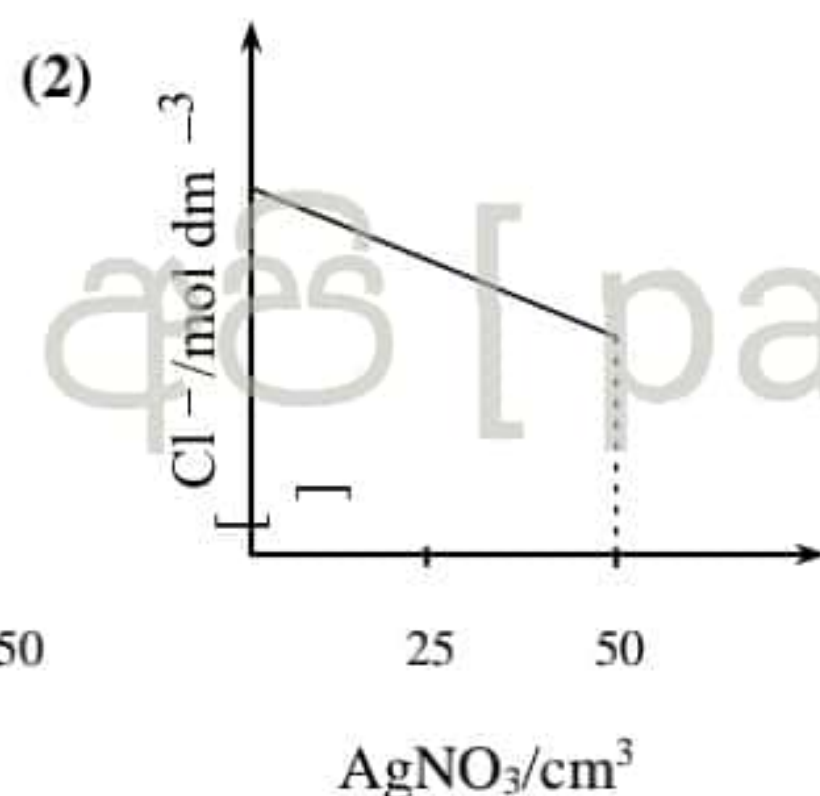
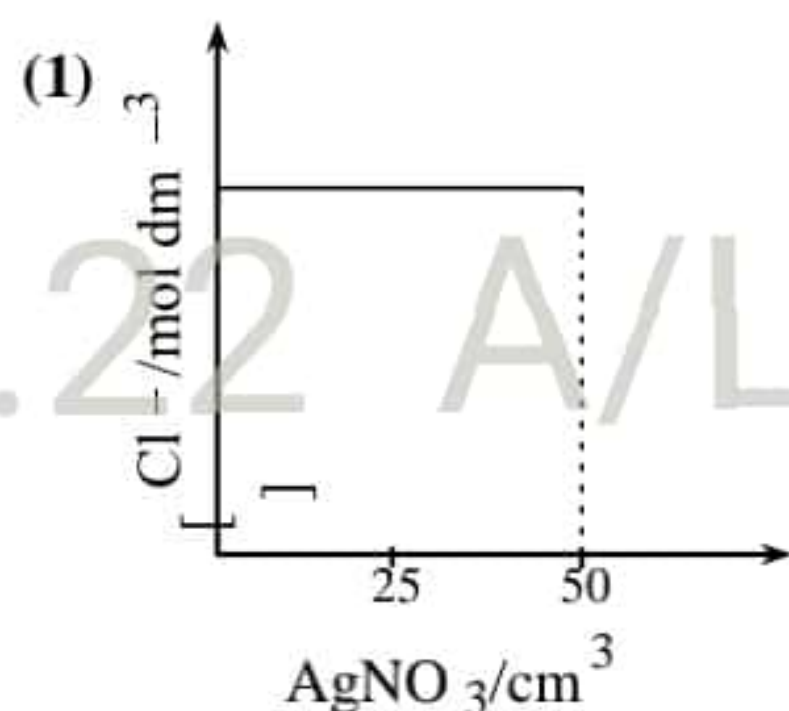


12. 6.56g of the organic compound is combusted in a suitable manner. 14.08g of CO<sub>2</sub>, 4.32g of H<sub>2</sub>O and N<sub>2</sub> were formed as products. The molar mass of X is 164 g mol<sup>-1</sup>. What is the amount of O<sub>2(g)</sub> required for the combustion of 1.0 mol of X in the above conditions ? (N = 14, O = 16, C = 12)

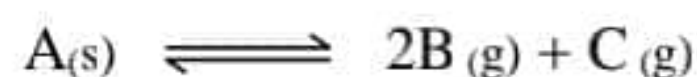
- (1) 4.0 mol                      (2) 6.0 mol                      (3) 7.0 mol                      (4) 9.0 mol                      (5) 11.0 mol



13.  $50 \text{ cm}^3$  of  $0.1 \text{ mol dm}^{-3} \text{ AgNO}_3$  solution was added dropwise to  $50 \text{ cm}^3$  of  $0.1 \text{ mol dm}^{-3} \text{ BaCl}_2$  solution. The correct variation at volume of  $\text{AgNO}_3$  added and the  $[\text{Cl}^-]$  is given by



14. Above  $350 \text{ K}$  temperature A decomposes as follows :



If a certain amount of  $\text{A}_{(\text{s})}$  moles to the above equilibrium at  $400 \text{ K}$  inside a closed vessel, the partial pressure at B will be,

$$K_p = 3.2 \times 10^{13} \text{ pa}^3$$

- (1)  $1.6 \times 10^4 \text{ pa}$       (2)  $1.6 \times 10^3 \text{ pa}$       (3)  $4.0 \times 10^4 \text{ pa}$   
(4)  $2.0 \times 10^4 \text{ pa}$       (5)  $8 \times 10^4 \text{ pa}$

15. Inside a closed vessel a certain amount of  $\text{A}_{(\text{g})}$  is placed at temperature T. Then A decomposes as follows,



Which of the following is false regarding this elementary reaction?

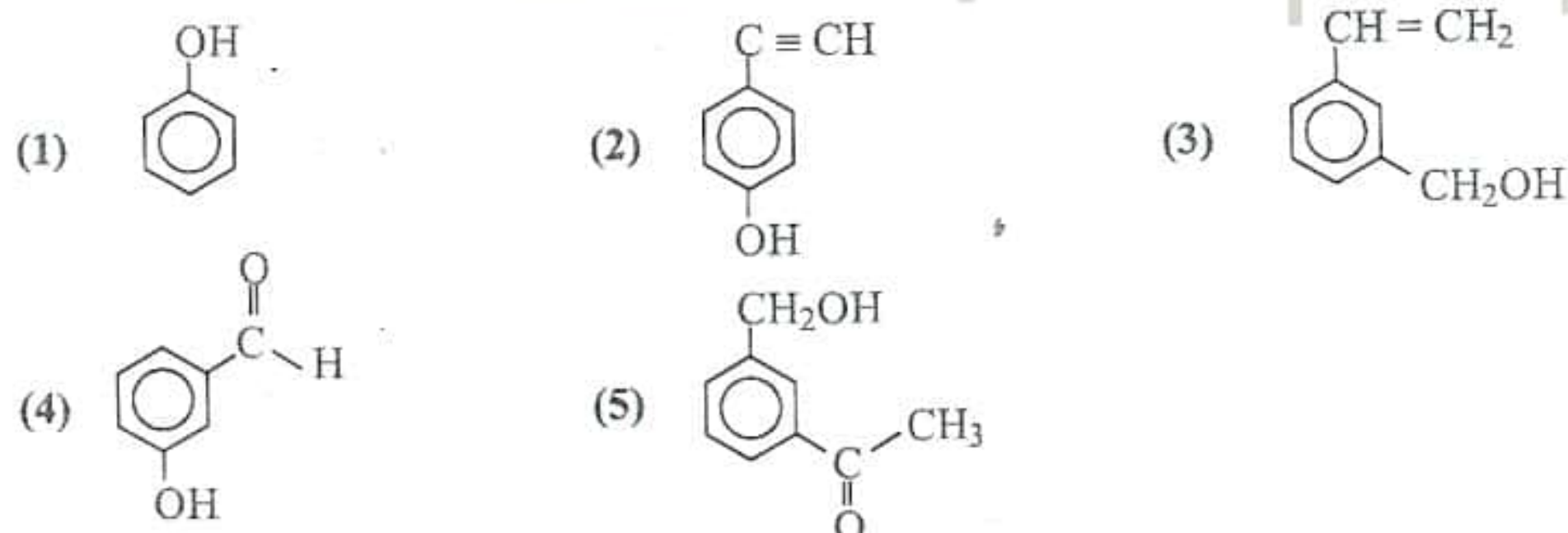
- (1) The rate of formation of B equals to the rate of decompose of A.  
(2) The half Life of the reaction depends on the initial concentration of A.  
(3) The rate constant of the reaction depends on concentration of A.  
(4) The rate of the reaction decrease with the time.  
(5) The fraction of productive collisions does not change with time.



16. The aromatic compound A shows all the following observations.

1. Decolorizes bromine water
2.  $H_2$  gas with sodium metal.
3. Gives a white precipitate with ammonium silver nitrate

The compound could be,



17. At the given temperature the density of A gas is as double the density of B gas Molar mass of B gas is as four times that of  $A(g)$ . If  $P_A$  and  $A_B$  are the partial pressure of A and B, the ratio of them is,

- (1)  $\frac{P_A}{P_B} = \frac{1}{8}$  (2)  $\frac{P_A}{P_B} = \frac{1}{4}$  (3)  $\frac{P_A}{P_B} = 1$
- (4)  $\frac{P_A}{P_B} = 4$  (5)  $\frac{P_A}{P_B} = 8$

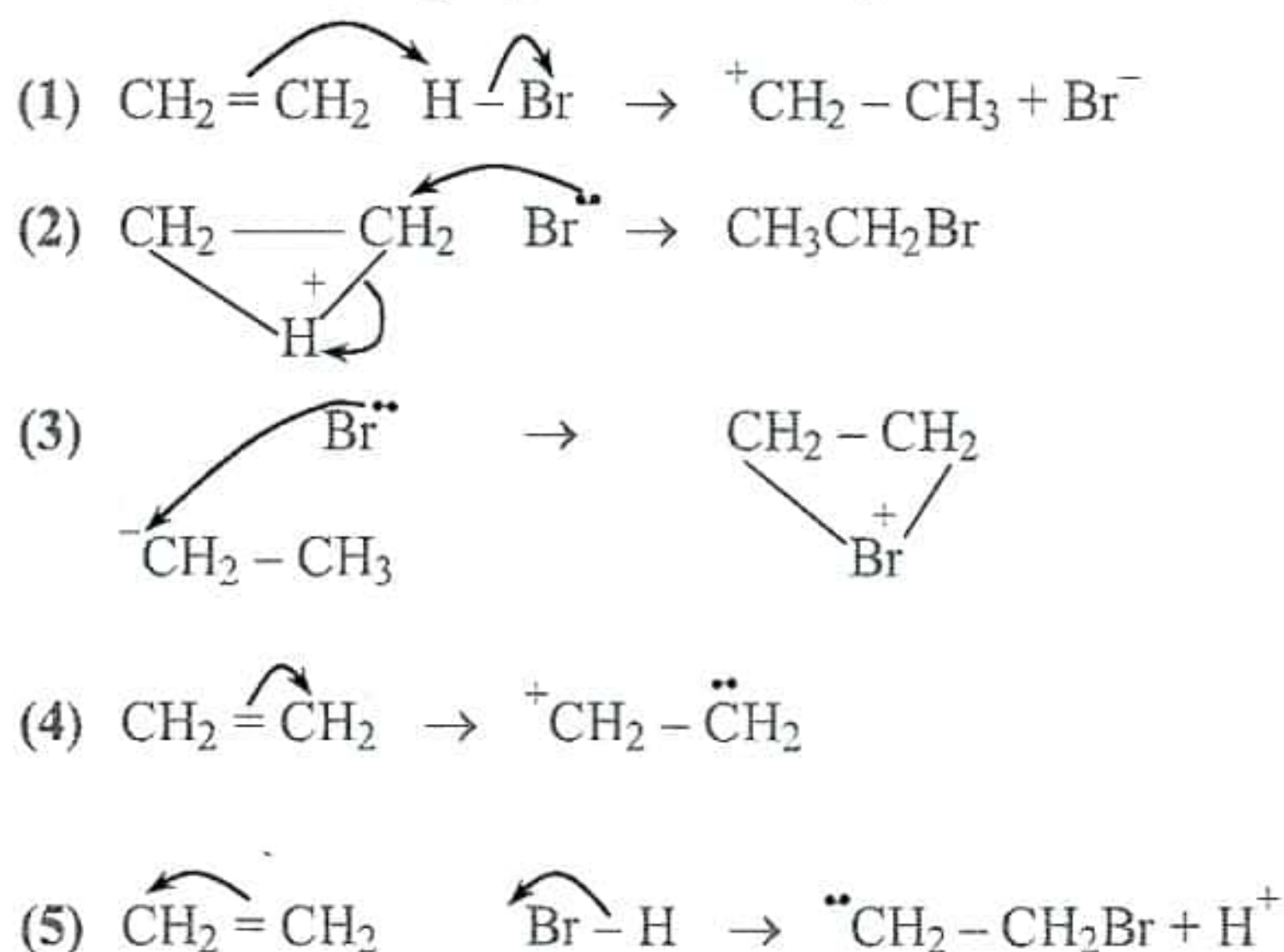
18.  $25 \text{ cm}^3$  of  $0.25 \text{ mol dm}^{-3}$   $(NH_4)_3 PO_4$  is diluted up to  $500 \text{ cm}^3$ . The composition of  $NH_4^+$  ions in the solution in ppm is  
( P = 31 , O = 16 , N = 14 , H = 1 )

- (1) 1350 (2) 5137 (3) 4500 (4) 675 (5) 600

19. The standard lattice energy of  $CaCl_{2(s)}$  is  $2337 \text{ KJ mol}^{-1}$ . The hydration enthalpy of  $Ca^{2+}_{(g)}$  and  $Cl^{-}_{(g)}$  are  $-1650$  and  $-364 \text{ KJ mol}^{-1}$  respectively. The dissolution energy of  $CaCl_{2(s)}$  is,

- (1)  $-41 \text{ KJ mol}^{-1}$  (2)  $-323 \text{ KJ mol}^{-1}$  (3)  $-284 \text{ KJ mol}^{-1}$
- (4)  $+323 \text{ KJ mol}^{-1}$  (5)  $+41 \text{ KJ mol}^{-1}$

20. Which of the following depicts a correct step of the reaction between HBr and ethane?





21. Which one of the following statements are correct according to the molecular kinetic theory of gases?

1. The average kinetic energy of a gas molecule is proportional to the absolute temperature.
2. Root mean square velocity depends on the type of gas.
3. At constant temperature, the total kinetic energy of a gas molecule is independent of the pressure
4. At constant temperature, the total kinetic energy changed due to collisions among molecules
5. The volume of a gas molecule is not negligible when compared to the volume of the vessel

22. When  $\text{SO}_3^{2-}$  is oxidized by  $\text{IO}_3^-$  ions  $\text{I}_2$  is formed. What is the mass of  $\text{KIO}_3$  required to reduce  $25 \text{ cm}^3$  of  $0.1 \text{ mol dm}^{-3}$   $\text{Na}_2\text{SO}_3$ ? (K = 39, O = 16, I = 127)

- (1) 2.14 g                      (2) 21.4 g                      (3) 0.0214 g                      (4)  $2.1 \times 10^{-4}$  g                      (5) 0.214 g

23. Inside a vessel of  $20 \text{ dm}^3$  2.0 mol of an ideal gas is found at  $8.2 \times 10^5 \text{ Pa}$  pressure. The root mean square velocity of this gas is  $820 \text{ ms}^{-1}$ . What is the molar mass of this gas ?

- (1)  $44 \text{ g mol}^{-1}$                       (2)  $37 \text{ g mol}^{-1}$                       (3)  $16 \text{ g mol}^{-1}$                       (4)  $4 \text{ g mol}^{-1}$                       (5)  $2 \text{ g mol}^{-1}$

24.  $50 \text{ cm}^3$  of  $0.2 \text{ mol dm}^{-3}$   $\text{RNH}_2$  is mixed with  $50 \text{ cm}^3$  of  $0.2 \text{ mol dm}^{-3}$   $\text{HCl}$ . Which of the following gives the pH value of the solution?

- (1)  $\text{p}K_2 = \frac{\text{p}K_1 + 1}{2}$                       (2)  $\frac{\text{p}K_2 + 1}{\text{p}K_1}$                       (3)  $\frac{\text{p}K_2 - \text{p}K_1 + 1}{2}$
- (4)  $\frac{\text{p}K_1 + \text{p}K_2 + 1}{2}$                       (5)  $\frac{\text{p}K_1}{\text{p}K_2}$

25. Which of the following statements regarding N and P are false ?

1.  $\text{H}_3\text{PO}_2$  as well as  $\text{HNO}_2$  are mono basic acids
2. Both  $\text{NH}_3$  and  $\text{PH}_3$  are gases
3. Oxides of both the elements formed by their highest oxidation states are acidic.
4. Oxidation states of N and P in  $\text{NCl}_3$  and  $\text{PCl}_3$  are the same
5. At room temperature, nitrogen and phosphorous do not react with atmospheric oxygen

26. Which of the following statements regarding Mg and its compounds are false?

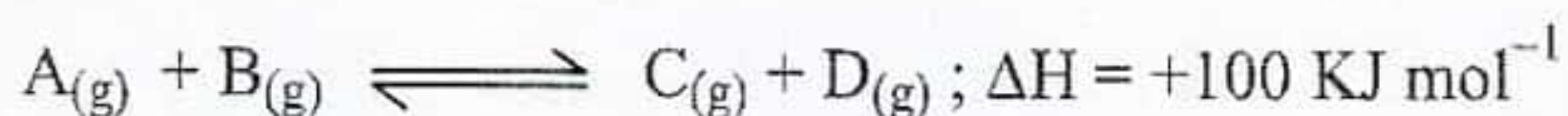
1. Its oxide is basic
2. Mg forms two products when heated in air
3. Mg does not react with cold water at room temperature
4. Heat decomposition of  $\text{Mg}(\text{NO}_3)_2(\text{s})$  gives only one product
5. Aqueous solution of  $\text{MgCl}_2$  is acidic.



27. In basic medium  $\text{MnO}_4^-$  oxidizes  $\text{M}^{2+}$  into  $\text{MO}^{n+}$  25 cm<sup>3</sup> of 1.2 mol dm<sup>-3</sup>  $\text{M}^{2+}$ , required 40 cm<sup>3</sup> of 1.25 mol dm<sup>-3</sup>  $\text{KMnO}_4$  solution. What is the value of n ?

- (1) 1                      (2) 2                      (3) 3                      (4) 4                      (5) 5

28. Consider the following reaction.



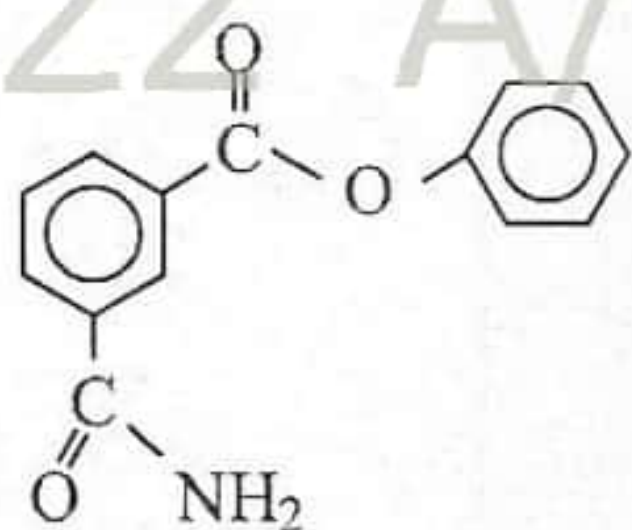
Which of the following will increase the yield of D

1. By increasing the total pressure of the system
2. By reducing the total pressure of the system
3. By reducing the temperature of the system
4. By removing B from the system
5. None of the above will increase the yield of D

29. Select the incorrect statement regarding 3d elements and their compounds.

1. Their chemical reactivity is lesser than that of s block elements
2. All the elements can show +2 oxidation state.
3. Most of their compounds act as catalysis
4. They have larger electronegativity values than s block elements
5. Complex compounds formed by them are not colorful

30.



This compound is heated with aqueous KOH solution. What are the products expected from this reaction?

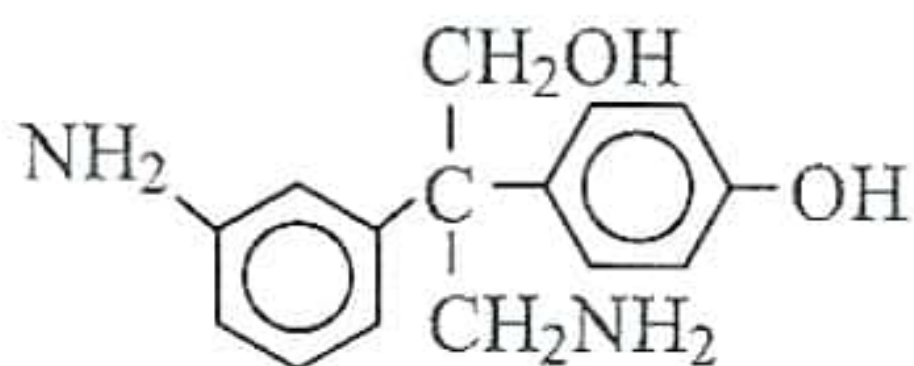
- (1) , ,  $\text{NH}_3$
- (2) , ,  $\text{NH}_3$
- (3) , ,  $\text{NH}_3$
- (4) , ,  $\text{NH}_3$
- (5) , ,  $\text{NH}_3$



- Instruction for questions 31 – 40

| (1)                             | (2)                             | (3)                             | (4)                             | (5)                                                                  |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------------------------------------------|
| Only (a) and (b)<br>Are correct | Only (b) and (c)<br>Are correct | Only (c) and (d)<br>Are correct | Only (d) and (a)<br>Are correct | Only one response or<br>any other number of<br>responses are correct |

31. Consider the optically active compound given below.



Which of the following step is correct

- The product formed by  $\text{NaNO}_2/\text{HCl}$  reaction is
- Product formed by adding PCC is
- A cannot decolorized NaOH
- Does not react with NaOH

32. Which of the following statement are false ?

- The first nuclear model was presented by Thompson
- The  $e/m$  ratio does not depend on the type of gas in the cathode ray tube
- For the gold foil experiment particles similar to He atoms were used
- Electrons behave both as waves and particles

33. Which of the following is not a disproportionation reaction ?

- $\text{Cl}_{2(\text{aq})} + 2\text{Br}^-_{(\text{aq})} \rightarrow 2\text{Cl}^-_{(\text{aq})} + \text{Br}_{2(\text{aq})}$
- $\text{S}_2\text{O}_3^{2-} + 2\text{H}^+_{(\text{aq})} \rightarrow \text{SO}_{2(\text{g})} + \text{S}_{(\text{s})} + \text{H}_2\text{O}_{(\text{l})}$
- $2\text{H}_2\text{O}_{2(\text{aq})} \rightarrow 2\text{H}_2\text{O}_{(\text{l})} + \text{O}_{2(\text{g})}$
- $2\text{Cu}^+_{(\text{aq})} \rightarrow \text{Cu}_{(\text{s})} + \text{Cu}^{2+}_{(\text{aq})}$

34. Which of the following aqueous solution is not acidic?

- $\text{C}_2\text{H}_5\text{ONa}$
- $\text{AlCl}_3$
- $\text{NH}_4\text{Cl}$
- $\text{CH}_3\text{COONH}_4$



35. Which of the following statements/statement concerning phenol are/is true?

- a. Produces  $\text{CO}_2$  gas on reaction with  $\text{Na}_2\text{CO}_3$
- b. Produces phenyl Ester on reaction with  $\text{CH}_3\text{COOH}$  acid
- c. Gives a white colour precipitate with bromine water
- d. Gives a coloured compound with diazonium salt under alkaline conditions.

36. Which of the following statements/ statement are/is true?

- a. The order of a basic reaction is an integer.
- b. The order respect to the relevant reactant of a reaction, can be determined by the stoichiometry of the balanced Equation
- c. The rate of a zero order reaction is always constant.
- d. The order of a reaction must be determined experimentally.

37. Which of the following Statements/statement are/is correct regarding the group is in the periodic table?

- a. The metallic character increases down a group
- b.  $\text{SbCl}_2$  dissolves in excess water to form a clear acidic solution
- c. The boiling points of the hydrides from  $\text{NH}_3$  to  $\text{SbH}_3$  gradually increase
- d.  $\text{NCl}_3$  aqueous solution has bleaching properties

38. Which of the following statements/statement are/is true regarding the gas?

- a. The total mass of ideal gas is negligible
- b. The volume of an ideal gas at constant pressure doubles when the temperature is raised from 300k to 400k
- c. Compressibility coefficient is used to measure the deviation of a real gas from ideal behavior
- d. Condition where ideal behavior can be expected from a real gas are very low pressure and high temperatures.

39. Which of the following Statements/statement are / is true?

- (a)  $\Delta H < 0$  and  $\Delta S > 0$  reactions are always spontaneous.
- (b)  $\Delta H > 0$  and  $\Delta S > 0$  reactions are always spontaneous.
- (c)  $\Delta H > 0$  and  $\Delta S > 0$  reactions are not spontaneous in all temperatures.
- (d)  $\Delta H < 0$  and  $\Delta S > 0$  reactions are spontaneous in low temperatures

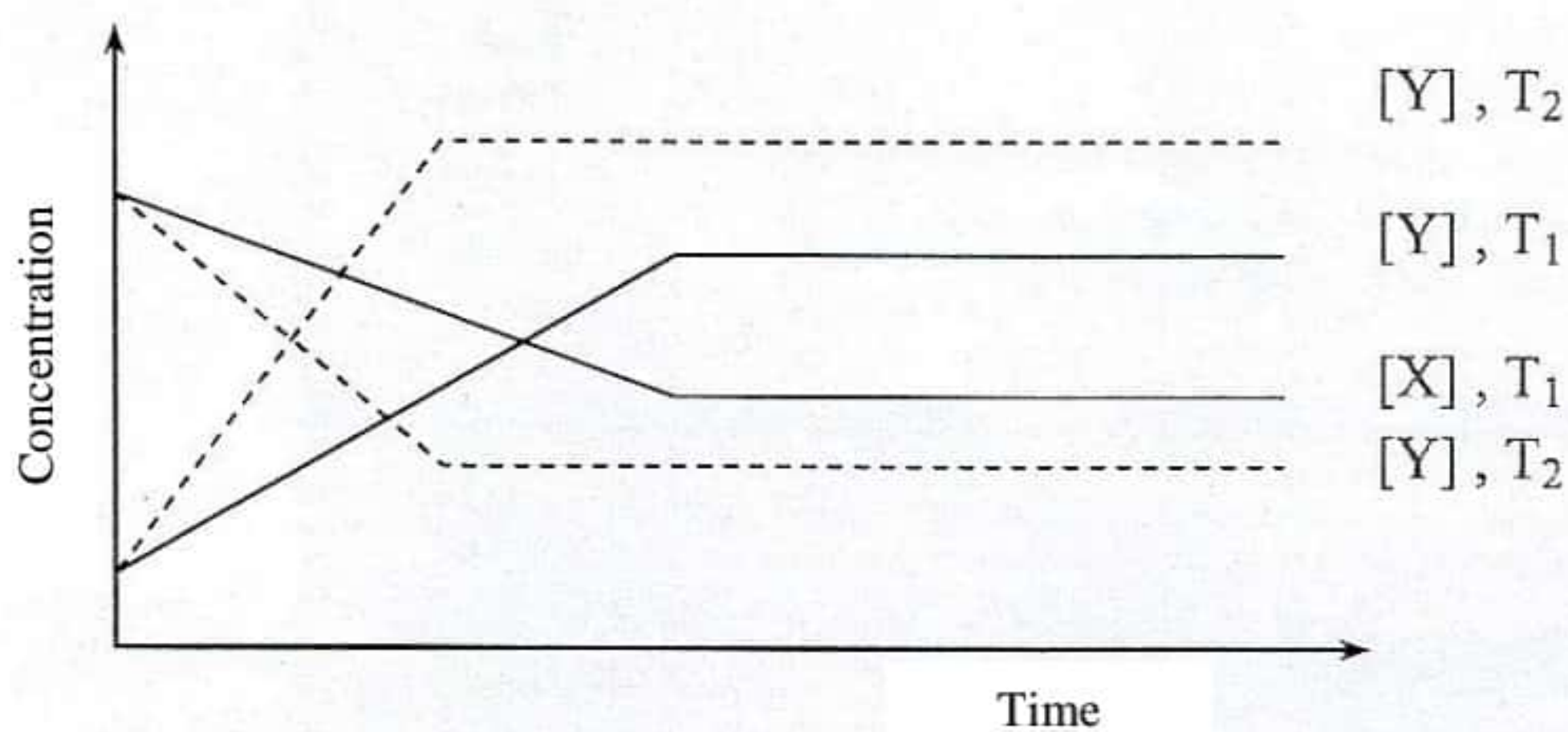


40. The initial concentration of  $X_{(g)}$  in two rigid containers at temperatures  $T_1$  and  $T_2$  are equal  $X_{(g)}$  give the following Equilibrium.



The graph below shows how the concentrations of X and Y related to these two temperatures with time

At  $T_1$  temperature, the concentration variations of X and Y are represented by straight lines (—), at  $T_2$  temperature the concentration variations of X and Y are represented by dashed lines. (----)



Which of the following statements/statement are/is true?

- (a)  $T_2 < T_1$  (b)  $T_2 > T_1$   
 (c) The forward reaction is endothermic (d) The backward reaction is exothermic

.22 A/L අයි [ papers grp ]



## ❖ Instructions for question number 41 to 50

| Response | First Statement | Second Statement                                         |
|----------|-----------------|----------------------------------------------------------|
| (1)      | True            | True, and correctly explains the first statement         |
| (2)      | True            | True, but does not explain the first statement correctly |
| (3)      | True            | False                                                    |
| (4)      | False           | True                                                     |
| (5)      | False           | False                                                    |

|      | First Statements                                                                                                                                                              | Second Statements                                                                                         |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 41.  | $\text{AgNO}_3$ and $\text{Zn(NO}_3)_2$ solution cannot be distinguished from an aqueous ammonia solution                                                                     | Both $\text{Ag}^+$ and $\text{Zn}^{2+}$ ions can form soluble ammine complex with water                   |
| 42.  | As the $(-)$ value of $\Delta G$ increases for a given reaction, the reaction becomes more efficient                                                                          | As the resulting the $(-)$ value of $\Delta G$ is increased, the reaction rate is also increased.         |
| 43.  | Reaction with $\text{Cl}_{2(g)}$ and $\text{KOH}_{(aq)}$ gives a mixture of compound with the positive and negative oxidation number on chlorine                              | Depending on the reaction conditions, the products obtained from $\text{Cl}_2$ and $\text{KOH}$ will vary |
| 44.  | A catalyst lowers the activation energies of forward and backward reaction by the same amount.                                                                                | A catalyst increase the efficiency of a reaction.                                                         |
| 45.  | The boiling point of 2, 3- dimethyl butane is higher than that of hexane.                                                                                                     | As the side chain of an alkane increases the surface area of the molecule increases.                      |
| 46.  | The C-X bond in aryl halides is not polarized as the C-X bond in alkyl halides.                                                                                               | $\text{sp}^2$ hybridized C atoms are more electronegative than $\text{sp}^3$ hybridized C atoms.          |
| 47.  | $\text{H}_{2(g)} + \text{Cl}_{2(g)} \rightleftharpoons 2\text{HCl}_{(g)}$ When the volume of the equilibrium is halved for the above reaction, the equilibrium point changes. | When the volume is halved, both forward and backward reaction rate increase                               |
| 48.  | Aniline is more alkaline than acetamide                                                                                                                                       | Aniline has more resonance structures compared to acetamide.                                              |
| 49.  | $\text{NH}_2^-$ and $\text{NH}_3$ are conjugate acid-base pairs                                                                                                               | A pair of acid-base that differ from each other by only one proton is a conjugate acid-base pair.         |
| 50.. | Whenever the equilibrium point changes, the equilibrium constant also changes.                                                                                                | Whenever the equilibrium constant changes, the equilibrium point also changes.                            |



|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |

|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |    |     |    |     |    |     |    |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|----|-----|----|-----|----|-----|----|
| 57 | La | 58 | Ce | 59 | Pr | 60 | Nd | 61 | Pm | 62 | Sm | 63 | Eu | 64 | Gd | 65 | Tb | 66 | Dy | 67 | Ho | 68  | Er | 69  | Tm | 70  | Yb | 71  | Lu |
| 89 | Ac | 90 | Th | 91 | Pa | 92 | U  | 93 | Np | 94 | Pu | 95 | Am | 96 | Cm | 97 | Bk | 98 | Cf | 99 | Es | 100 | Fm | 101 | Md | 102 | No | 103 | Lr |





සබරගමුව පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව

Provincial Department of Education - Sabaragamuwa

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය - 2022 නොවැම්බර්  
General Certificate of Education (Adv. Level) Examination - November 2022

13 ශ්‍රේණිය - දෙවන වාර පරීක්ෂණය - 2022 අගෝස්තු

රසායන විද්‍යාව II  
Chemistry II

02 S II

Part A Structured Essay

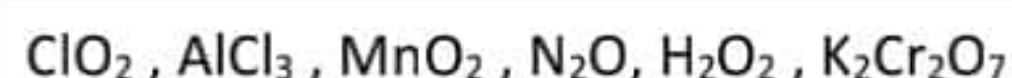
Three hours

Answer four questions on this paper itself.

Each question carries 10 marks

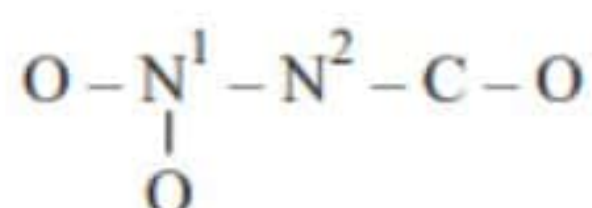
1.

a) Answer the questions from (i) to (vi) using the compounds given below



- I. A molecule with an unpaired electron .....
- II. An Oxidizing agent, that can be used as a primary standard .....
- III. Behave as a lewis acid .....
- IV. An amphoteric oxide, that behave as a catalyst .....
- V. A gaseous product, given by thermal decomposition of ammonium nitrate .....
- VI. The aqueous solution undergoes disproportionation .....

b) The skeleton of  $\text{CN}_2\text{O}_3$  molecule is given below

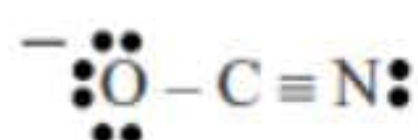


I. Draw the most suitable Lewis structure for this molecular

II. Give oxidation states of nitrogen atoms of above (i)

$\text{N}^1$  .....  $\text{N}^2$  .....

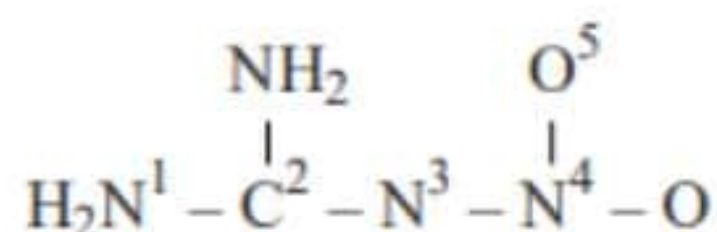
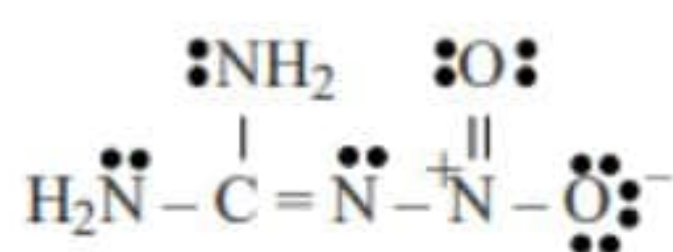
III. The most stable Lewis dot dash diagram for the ion  $\text{OCN}^-$  is shown below. draw another two Lewis dot dash structures (resonance structures) for this ions



.22 A/L අපි [ papers grp ]



IV. Based on the Lewis structure given below . complete the given table



|                                             | N <sup>1</sup> | C <sup>2</sup> | N <sup>3</sup> | N <sup>4</sup> |
|---------------------------------------------|----------------|----------------|----------------|----------------|
| I. VSEPR pairs around the atom              |                |                |                |                |
| II. Electron pairs geometry around the atom |                |                |                |                |
| III. Shapes around the atom                 |                |                |                |                |
| IV. Oxidation number of the atom            |                |                |                |                |

V. Identify the atomic/ hybrid orbitals involved in the formation of the following 6 bond in the Lewis dot and dash diagram in part (iv) above.(numbering of atoms is as in part (iv) )



VI. Identify the atomic orbitals involve in the formation of the following π bonds in the Lewis dot dash diagram in part (iv) .(numbering of atoms is as in part (iv) )

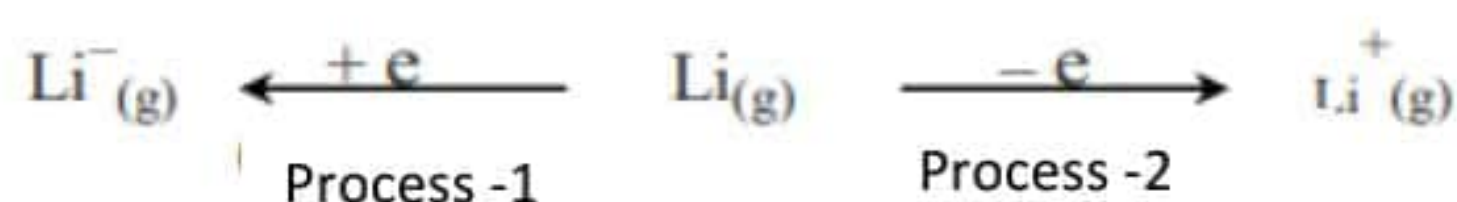


VII. Arrange N<sup>1</sup>, C<sup>2</sup>, N<sup>3</sup>, N<sup>4</sup>, in increasing order of their electronegativity

22 A/L  $\text{A/L}$  [ papers grp ] (50 marks)

c)

I. Two processes that can be happened on gaseous Lithium atom are given below



- Energetically which process has more feasibility to happen ? .....
- Explain your answer

.....

.....



- II.
- The nuclide  ${}^{238}_{92}\text{U}$  converts in to  ${}^{206}_{82}\text{Pb}$  by evolving  $\alpha$  and  $\beta$  particles. This process is happening via several steps. Calculate number of  $\alpha$  particles and  $\beta$  particles evolve by  ${}^{238}_{92}\text{U}$  nuclide separately
  - Give balanced nuclear reaction for above process

.22 A/L අයි [ papers grp ]

(32 marks)

2.  
a.

- X is a p – Block element in the periodic table. Atomic number of X is less than 20
- First five successive ionization energy values of X, respectively are 1086, 2353, 4620, 6223 and 37831  $\text{KJmol}^{-1}$
- X exists as two allotropic forms. Boiling points of both allotropic forms are extremely high
- When X is completely burnt in air, form a colorless, odorless gas  $X_1$
- X reacts with concentrated  $\text{H}_2\text{SO}_4$  acid to give a mixture of gases
- When this gas mixture is passed through a solution of aqueous  $\text{Ba}(\text{OH})_2$ , formed a white precipitate mixture Y
- This precipitate mixture is separated in to two portions. Diluted HCl is added into one portion. Then the precipitation is completely dissolved and formed  $X_1$  and  $X_2$  gases
- To the other portion of the Y,  $\text{H}_2\text{O}_2$  is added. then diluted HCl is added A portion of the precipitate is dissolved and Z white precipitate is remaining
- When  $X_1$  is reduced with X, formed the gas  $X_3$
- $X_3$  is an industrially useful gas, but poisonous for living beings

- Identify X .....
- Write down the ground state electronic configuration of X .....
- What are the major oxidation states of X .....
- Write the chemical formulae of following species  
 $X_1$  .....  $X_2$  .....  $X_3$ .....  
 $Y$  .....  $Z$  .....
- Draw the most acceptable Lewis dot dash diagrams of  $X_1$  and  $X_3$   
 $X_1$  .....  $X_3$  .....



- vi. Give balanced chemical / ionic equation to indicate given reactions  
I . reaction between X and conc .H<sub>2</sub>SO<sub>4</sub>

.....

- II. Reaction between the Y precipitate and H<sub>2</sub>O<sub>2</sub> in acidic medium

.....

- vii. Give one industrial application of X and X<sub>3</sub>

X .....

X<sub>3</sub> .....

(50 marks)

b ) The aqueous solution of the following compounds are provided in the test tubes labelled from A and E . (not in order)

Mg(NO<sub>3</sub>)<sub>2</sub> , K<sub>2</sub>CO<sub>3</sub> , NaCl , Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, AgNO<sub>3</sub>

To distinguish the above compounds , BaCl<sub>2(aq)</sub> and diluted NH<sub>3</sub> (dropwise) are added separately in to portions of solutions observations are given in the following table

| solution | BaCl <sub>2</sub> solution                        | diluted NH <sub>3</sub> solution                                 |
|----------|---------------------------------------------------|------------------------------------------------------------------|
| A        | White precipitate . It is insoluble in hot water  | Brown precipitate . which is insoluble in excess NH <sub>3</sub> |
| B        | White precipitate . which is soluble in dil HCl   | Clear solution                                                   |
| C        | White precipitate . which is insoluble in dil HCl | White precipitate . which is insoluble in excess NH <sub>3</sub> |
| D        | Clear solution                                    | White precipitate                                                |
| E        | Clear solution                                    | Clear solution                                                   |

- i. Identify the solutions A to E

A ..... B..... E.....

C..... D.....

- ii. Write the balanced equation for the reactions, which form precipitates (Indicate precipitates using an arrow (↓))

(50 marks )



03.

a) In the ozone layer  $O_3$  dissociates via two steps

i. Write down two dissociation steps of ozone. Indicate sign of enthalpy change of two steps

ii. What is the intermediate of this dissociation process?

.....

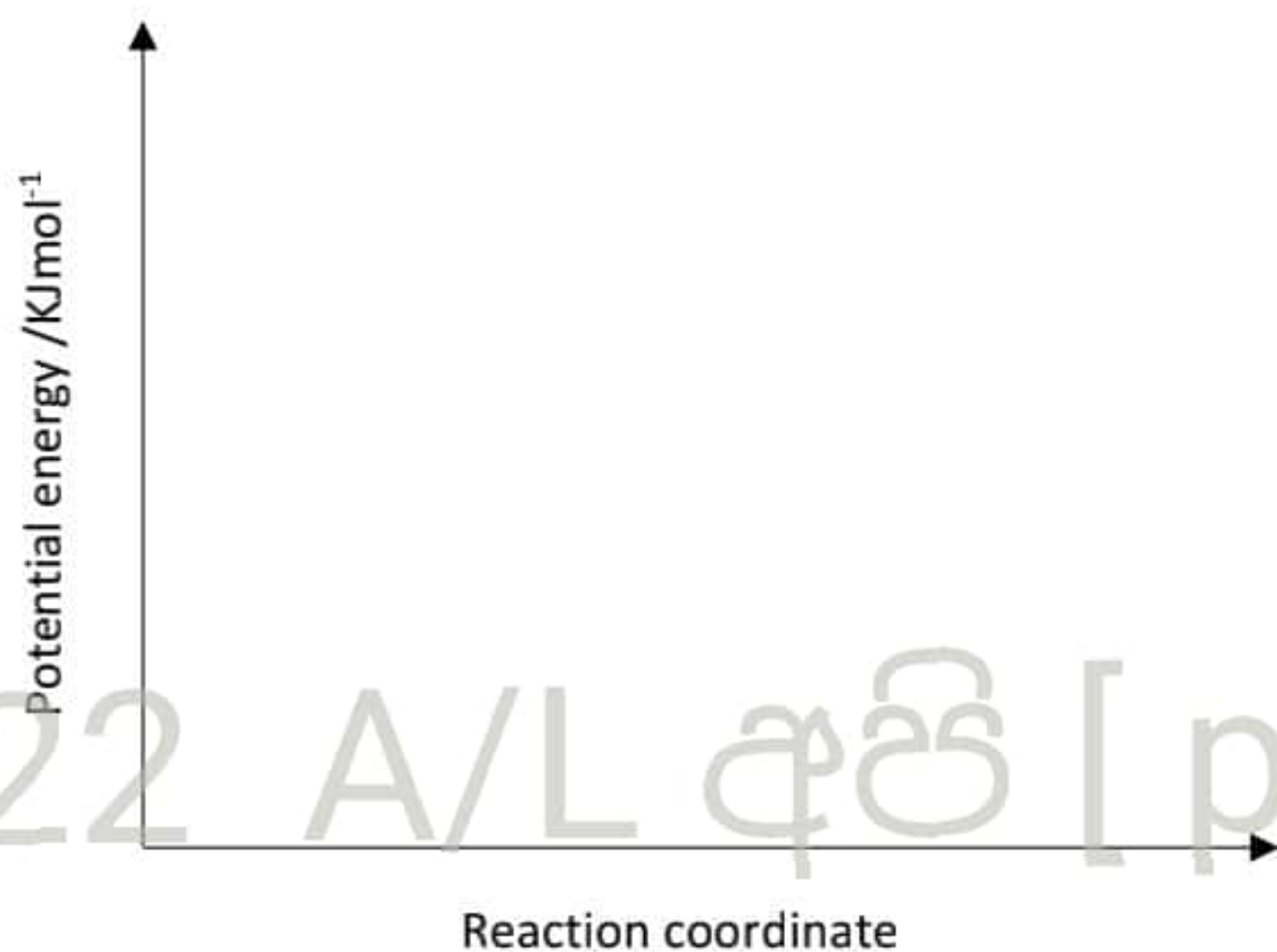
iii. Mention molecularity of each step

step 1.....

step 2 .....

iv. Among the steps given in part i

- Activation energy of forward reaction and the backward reaction of second step respectively are,  $19 \text{ KJmol}^{-1}$  and  $411 \text{ KJmol}^{-1}$
- Draw the energy profile for this process
- Clearly indicate reactants, products, enthalpy change and transition stage in the energy profile



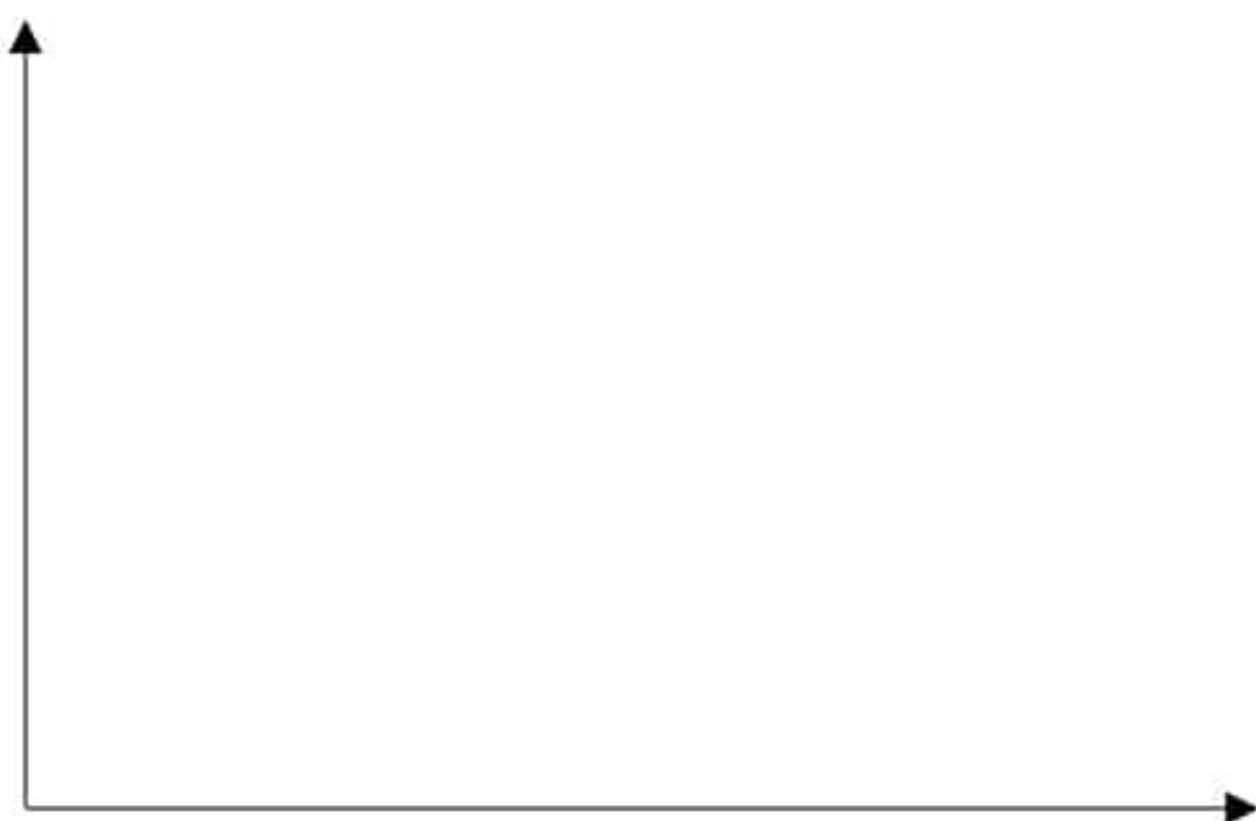
(50 marks )

b)  $X \rightarrow Y + Z$  ; This is a first order reaction

- i. Initial concentration of X is  $3.00 \text{ mol dm}^{-3}$  and half life is 200 s . find out rate of the reaction



ii. Draw the graph to indicate variation of concentration of x over the time



iii write the rate equation of this reaction

iv. calculate rate constant

.22 A/L අයි [ papers grp ] (50 marks )

4. a ) The compound A with the molecular formula  $C_4H_9Br$  reacts with alcoholic KOH to produce B. B doesn't exhibit stereo isomerism

B reacts with HBr and produce C . C is not optically active, but it is an isomer of A

The compound A , convert into its Grignard reagent D

D reacts with the compound E, which is known as acetone.

The product of this reaction is hydrolyzed using diluted acid to obtain the product F

i. Draw the structures of A,B,C,D,E and F in the boxes given below



A



B



C



D



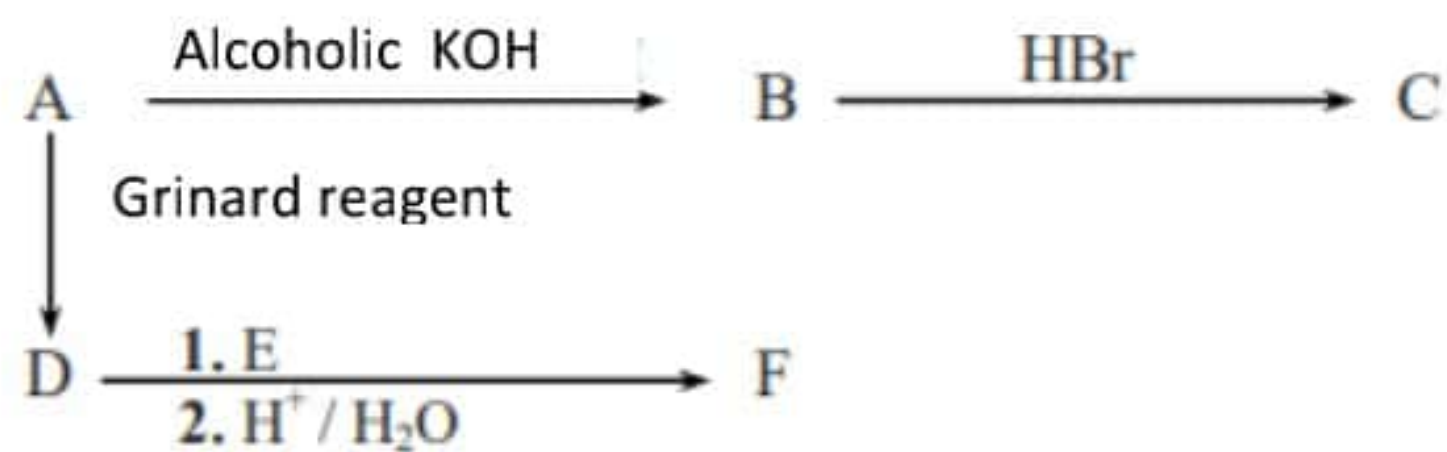
E



F



ii.



Selecting from the list given below. Write the type of reaction taking place in above reaction sequence of ( a)

Elimination reactions, electrophilic addition reaction, electrophilic substitution nucleophilic addition, nucleophilic substitution , other

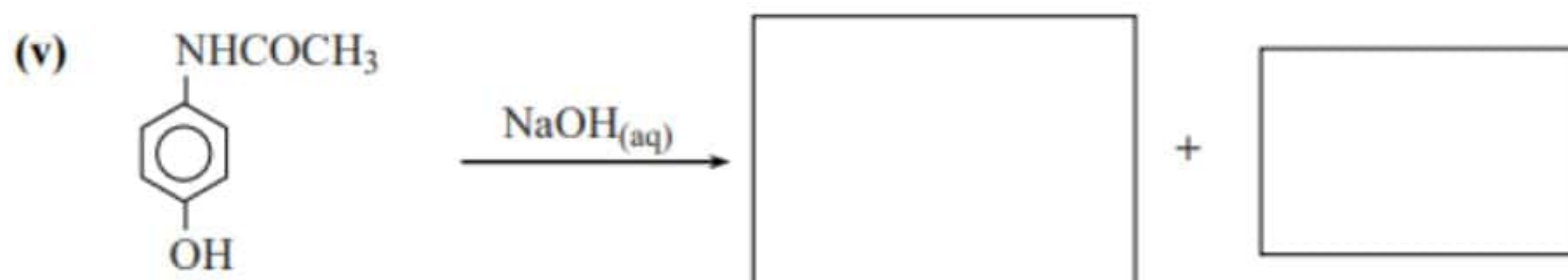
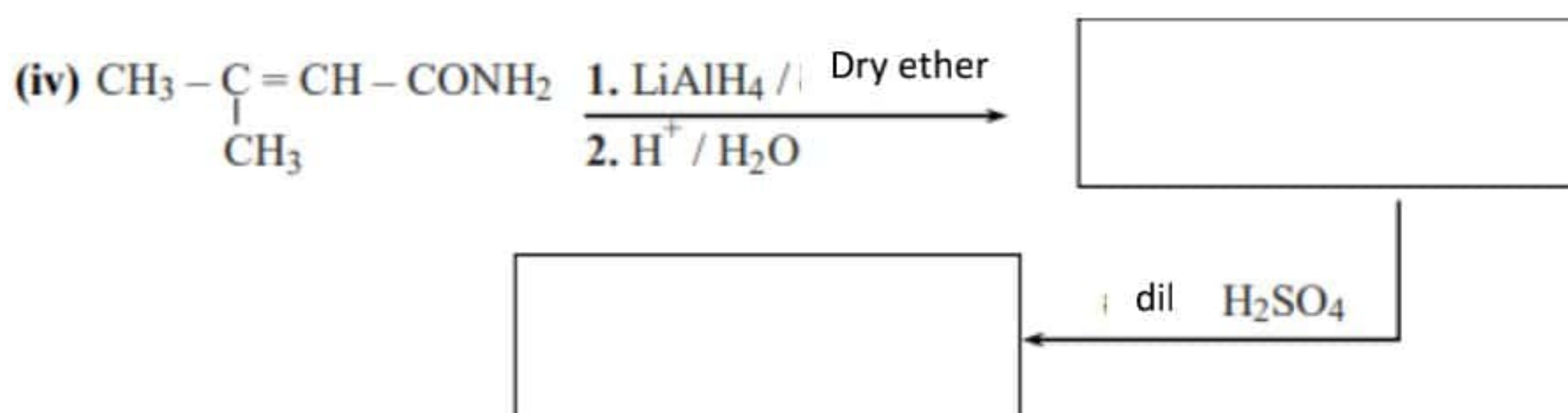
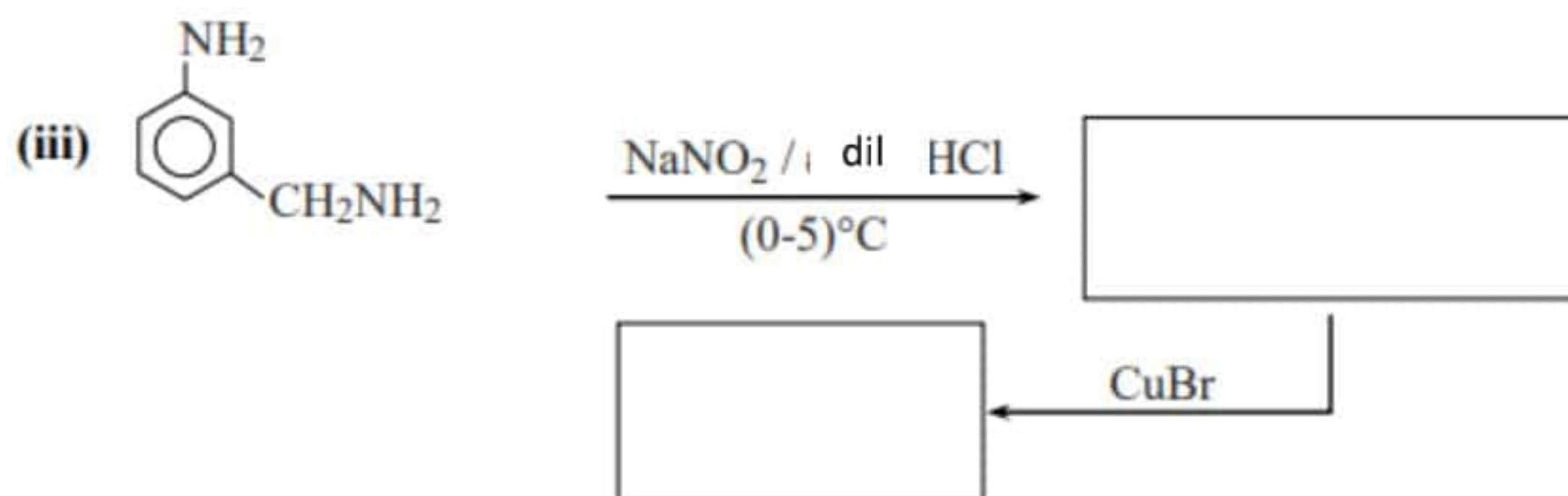
i. A → B .....

ii. B → C .....

iii. D → F .....

(50 marks)

b Draw the structures in the boxes and complete the reaction sequence







සබරගමුව පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව  
Provincial Department of Education - Sabaragamuwa

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය - 2022 නොවැම්බර්  
General Certificate of Education (Adv. Level) Examination - November 2022

13 ශ්‍රේණිය - දෙවන වාර පරීක්ෂණය - 2022 අගෝස්තු

රසායන විද්‍යාව II  
Chemistry II

02 S II

Part B - Essay

Answer for two questions only

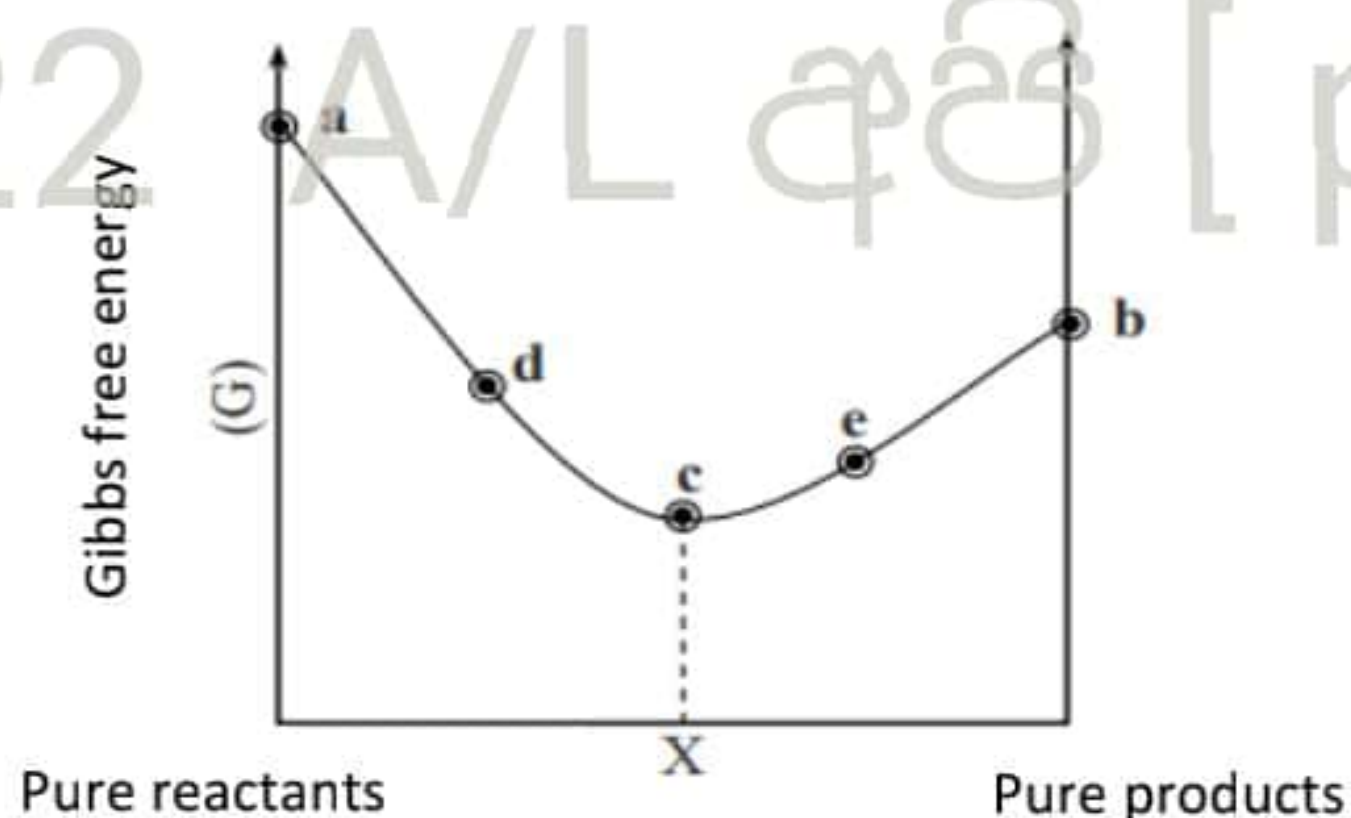
05. (a) The following data are given for the equilibrium reaction  $2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$

Which is one of a step in the contact process of manufacturing  $\text{H}_2\text{SO}_4$  acid at 298K .

| Compound           | $G^\theta_f / \text{KJmol}^{-1}$ | $\Delta H^\theta_f / \text{KJmol}^{-1}$ | $S^\theta / \text{JK}^{-1} \text{mol}^{-1}$ |
|--------------------|----------------------------------|-----------------------------------------|---------------------------------------------|
| $\text{SO}_{2(g)}$ | -300                             | -297                                    | 248                                         |
| $\text{O}_{2(g)}$  | 0                                | 0                                       | 205                                         |
| $\text{SO}_{3(g)}$ | -371                             | -396                                    | 257                                         |

- Calculate  $\Delta H^\theta$  at 298K for the above reaction
- Calculate  $\Delta S^\theta$  at same temperature.
- Calculate  $\Delta G^\theta$  with the help of  $\Delta H^\theta$  and  $\Delta S^\theta$  values that you have calculated in part i and ii above
- Comment on the spontaneity of the above reaction if the temperature increases up to 1000K (50 marks)

b) The following plot shows the variation of gibbs free energy Vs reaction coordinate



- Give gibbs energy values for the points a and b
- Consider the gradient of the points d and e as Q and K . comment on the spontaneity by at these points by considering these values.
- Consider  $\Delta G = 0$  at the point c. give a relationship between Q and K at the point c. Briefly comment on the characteristics of this system at these two points (40 marks)



C) consider the reactions and data given in the table below. When changing the relevant factor as mentioned below, if the equilibrium point shifts to forward direction put F. If the equilibrium point shifts to backward put R. If there is no effect put E

F - Forward

R - Reverse

E - Equilibrium

V - volume

T - absolute temperature P - Pressure

(60 marks)

|     | Reaction                                                                           | $\Delta H^\circ$<br>kJ mol <sup>-1</sup> | Adding a reactant by keeping V and T constant<br><b>1</b> | Increase Temperature<br><b>2</b> | Introduce an inert gas by keeping V and T constant<br><b>3</b> | Increase pressure while keeping T constant<br><b>4</b> | Insert an inert gas while keeping P and T constant<br><b>5</b> | Introduce a catalyst<br><b>6</b> |
|-----|------------------------------------------------------------------------------------|------------------------------------------|-----------------------------------------------------------|----------------------------------|----------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------|----------------------------------|
| i   | $\text{CO}_{(g)} + 2\text{H}_{2(g)} \rightleftharpoons \text{CH}_3\text{OH}_{(g)}$ | -90                                      |                                                           |                                  |                                                                |                                                        |                                                                |                                  |
| ii  | $\text{C}_{(s)} + \text{CO}_{2(g)} \rightleftharpoons 2\text{CO}_{(g)}$            | +173                                     |                                                           |                                  |                                                                |                                                        |                                                                |                                  |
| iii | $2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$         | -197                                     |                                                           |                                  |                                                                |                                                        |                                                                |                                  |
| iv  | $\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2\text{NO}_{2(g)}$                   | +57                                      |                                                           |                                  |                                                                |                                                        |                                                                |                                  |
| v   | $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightleftharpoons 2\text{NH}_{3(g)}$          | -96                                      |                                                           |                                  |                                                                |                                                        |                                                                |                                  |

❖ Copy a simple table as given below to provide your answer

|     | 1 | 2 | 3 | 4 | 5 | 6 |
|-----|---|---|---|---|---|---|
| i   |   |   |   |   |   |   |
| ii  |   |   |   |   |   |   |
| iii |   |   |   |   |   |   |
| iv  |   |   |   |   |   |   |



06) a)

- I. When the reaction  $2\text{HBr}_{(g)} \rightarrow \text{H}_{2(g)} + \text{Br}_{2(g)}$  is occur , the concentration of  $\text{HBr}_{(g)}$  had been reduced from  $0.5\text{mol dm}^{-3}$  to  $0.455\text{mol dm}^{-3}$  with in the first 15 seconds
- Write the rate of the reaction with respect to reactants and products
  - Calculate the rate of depletion of HBr in the above reaction
  - Calculate the rate of formation of  $\text{H}_2$
  - Calculate the rate of formation of  $\text{Br}_2$
  - The volume of the container of which the above reaction takes place is  $0.5\text{dm}^3$  . calculate the number of moles of  $\text{Br}_2$  that formed during the first 15 seconds
- II. The reactant A and B react with each other to give the product C



The following table gives the data for two initial rates which were carried out at two deferent temperature by changing the initial concentrations of A and B

| Experiment no | Initial concentration $\text{mol dm}^{-3}$ |                      | Initial rates $\text{mol dm}^{-3}\text{s}^{-1}$ |                      |
|---------------|--------------------------------------------|----------------------|-------------------------------------------------|----------------------|
|               | A(g)                                       | B(g)                 | 300K                                            | 320K                 |
| 1             | $2.5 \times 10^{-4}$                       | $3.0 \times 10^{-5}$ | $5.0 \times 10^{-4}$                            | $2.0 \times 10^{-3}$ |
| 2             | $5.0 \times 10^{-4}$                       | $6.0 \times 10^{-5}$ | $4.0 \times 10^{-3}$                            | -                    |
| 3             | $1.0 \times 10^{-3}$                       | $6.0 \times 10^{-5}$ | $1.6 \times 10^{-2}$                            | -                    |

- Write the rate expression for the above reaction
  - Calculate orders with respect to A and B at 300K
  - Calculate the rate constant at 300K
  - Comment on the change in reaction rate at 320K
- (75 marks)

b) consider the equilibrate system given below



when the system reached dynamic equilibrium at  $25^\circ\text{C}$  , the equilibriate mixture contain 0.01 mol of  $\text{CO}_2$ , 0.01 mol of  $\text{H}_2$ , 0.08mol of CO and 0.02mol of  $\text{H}_2\text{O}$  vapour.

- Write the  $K_c$  expression for the above equilibrium
- If the volume of the system is  $V\text{dm}^3$  calculate  $K_c$  at  $25^\circ\text{C}$
- If 0.06mol of  $\text{H}_2\text{O}_{(g)}$  was newly introduced after 10 s from moment of reaching equilibrium. Calculate the new  $Q_c$  for the system
- State to which direction the system had been shifted with the new introduction.
- The system again reached equilibrium after at 20<sup>th</sup> second. Calculate the number of moles of each substance at The new equilibrium
- Roughly sketch how the concentration of  $\text{CO}_{2(g)}$  and  $\text{CO}_{(g)}$  get change with the time from the initial moment

(75 marks)

.22 A/L අයි [ papers grp ]



07) a) i. In any aqueous solution water self dissociate by forming the equilibrium  $\text{H}_2\text{O}_{(l)} \rightleftharpoons \text{H}^+_{(aq)} + \text{OH}^-_{(aq)}$

Write an expression for  $K_w$  of water

ii. Show that  $\text{pH} + \text{pOH} = \text{p}K_w$  for any aqueous solution

iii. Derive  $\text{pOH} = \frac{1}{2}\text{p}K_b - \frac{1}{2}\log_{10} C$  for a monoprotic weak base solution of which the "C" is the concentration of the weak base and  $K_b$  is the dissociation constant of it

iv. calculation pH value of a solution of weak base B. at  $25^\circ\text{C}$  concentration of B is  $0.1\text{mol dm}^{-3}$ .

$$K_b = 1.0 \times 10^{-5} \text{ mol dm}^{-3}, K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$$

v. calculate the pH of a solution prepared by mixing  $60\text{cm}^3$  of  $0.05\text{mol dm}^{-3} \text{NH}_3$  and  $40\text{cm}^3$  of  $0.05\text{mol dm}^{-3} \text{HCl}$   $K_b(\text{NH}_3) = 1.0 \times 10^{-5} \text{ mol dm}^{-3}$

(75 marks)

b) A, B, and C are three oxoanions formed by three elements belong to 3d block. Answer the questions given below by considering the following table

|   | experiment                                        | observations                |                                             |                                  |
|---|---------------------------------------------------|-----------------------------|---------------------------------------------|----------------------------------|
|   |                                                   | A                           | B                                           | C                                |
| 1 | Acidified $\text{Fe}^{2+}_{(aq)}$ was added       | No colour change            | Colour get changed                          | No considerable observation      |
| 2 | Dil $\text{H}_2\text{SO}_4$ was added in dropwise | No considerable observation | The colour changed by forming a precipitate | A white precipitate was obtained |
| 3 | Dil $\text{NaOH}$ was added in dropwise           | No colour change            | No considerable change                      | No considerable change           |
| 4 | Basic $\text{H}_2\text{O}_2$ Was added            | No considerable change      | Colored precipitate was obtained            | No considerable change           |

- Identify the oxoanions A, B, and C together with the respective colours
- Write the balanced ionic equation for the chemical processes that specified by "\*" mark in the above experiment 1, 2, 3, 4
- After the experiment 1 above the d block element in the complex A forms a coordination complexes with  $\text{Cl}^-$  and  $\text{NH}_3$  ligands with coordination number 6. these complexes have a charge zero, +1, +2 and they were labeled as P, Q, and R respectively. Give the structures of P, Q, and R
- Write the IUPAC name of P

(75 marks)

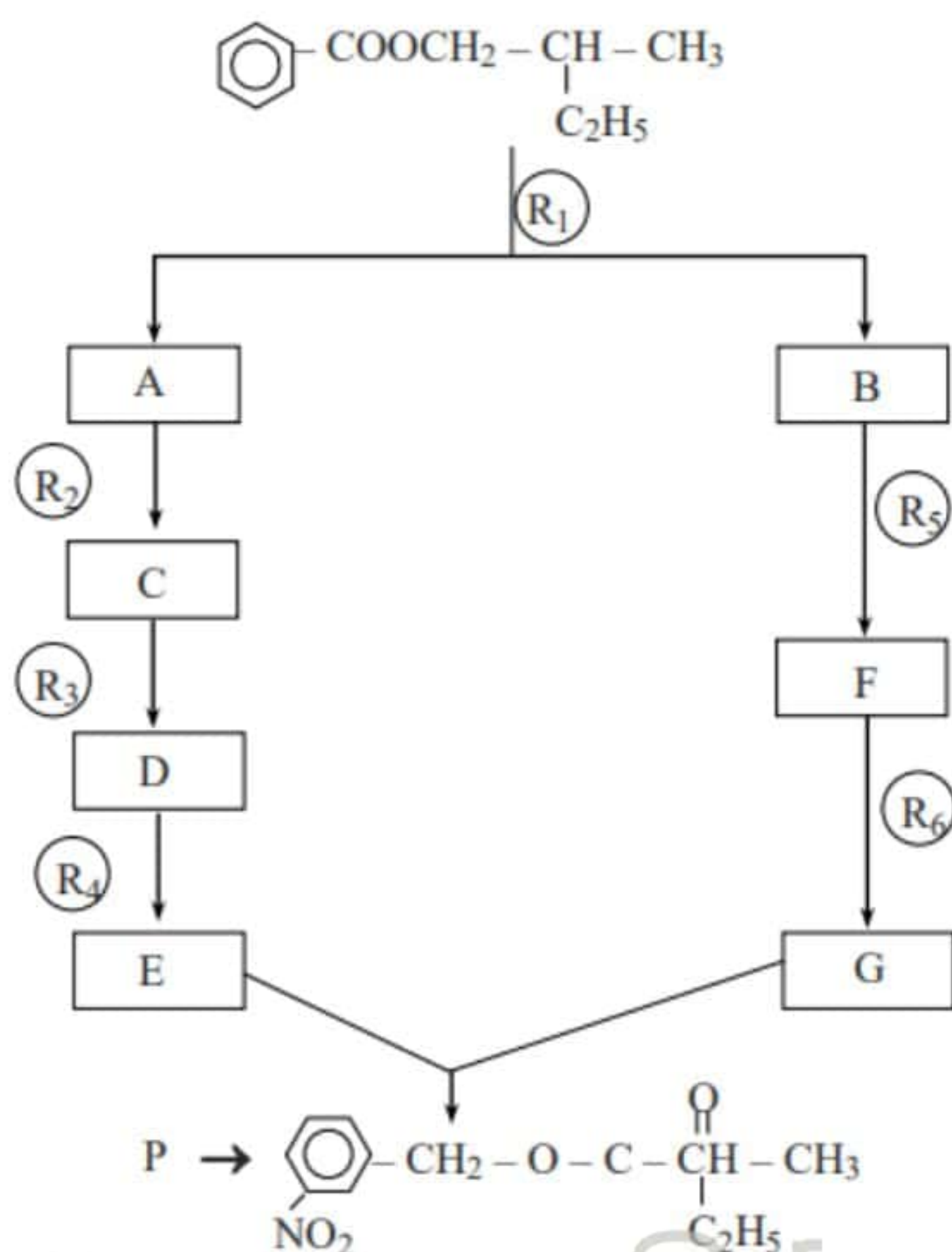


## Part C - Essay

Answer only two questions

08) a) The organic compound  $\text{C}_6\text{H}_5\text{COOCH}_2\text{CH}(\text{C}_2\text{H}_5)\text{CH}_3$  is used as the only organic compound in the synthesis process of compound P

using only the chemicals given in the list below complete the following reaction scheme, by writing the structures of compounds A,B,C,D,E,F and G in the boxes and the reagents R1, to R6 in the circles



### List of chemicals and reagents

NaOH<sub>(aq)</sub>, conc H<sub>2</sub>SO<sub>4</sub>,  
PCl<sub>3</sub>, H<sup>+</sup>/KMnO<sub>4</sub>, LiAlH<sub>4</sub>,  
conc HNO<sub>3</sub>, dil H<sub>2</sub>SO<sub>4</sub>

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i. Using only the same set of reagents show how you would carryout the following conversions not exceeding 3 steps

(I) benzene  $\rightarrow$  m-bromobenzoic acid

(II) benzene  $\rightarrow$  p-bromobenzoic acid

(40 marks)

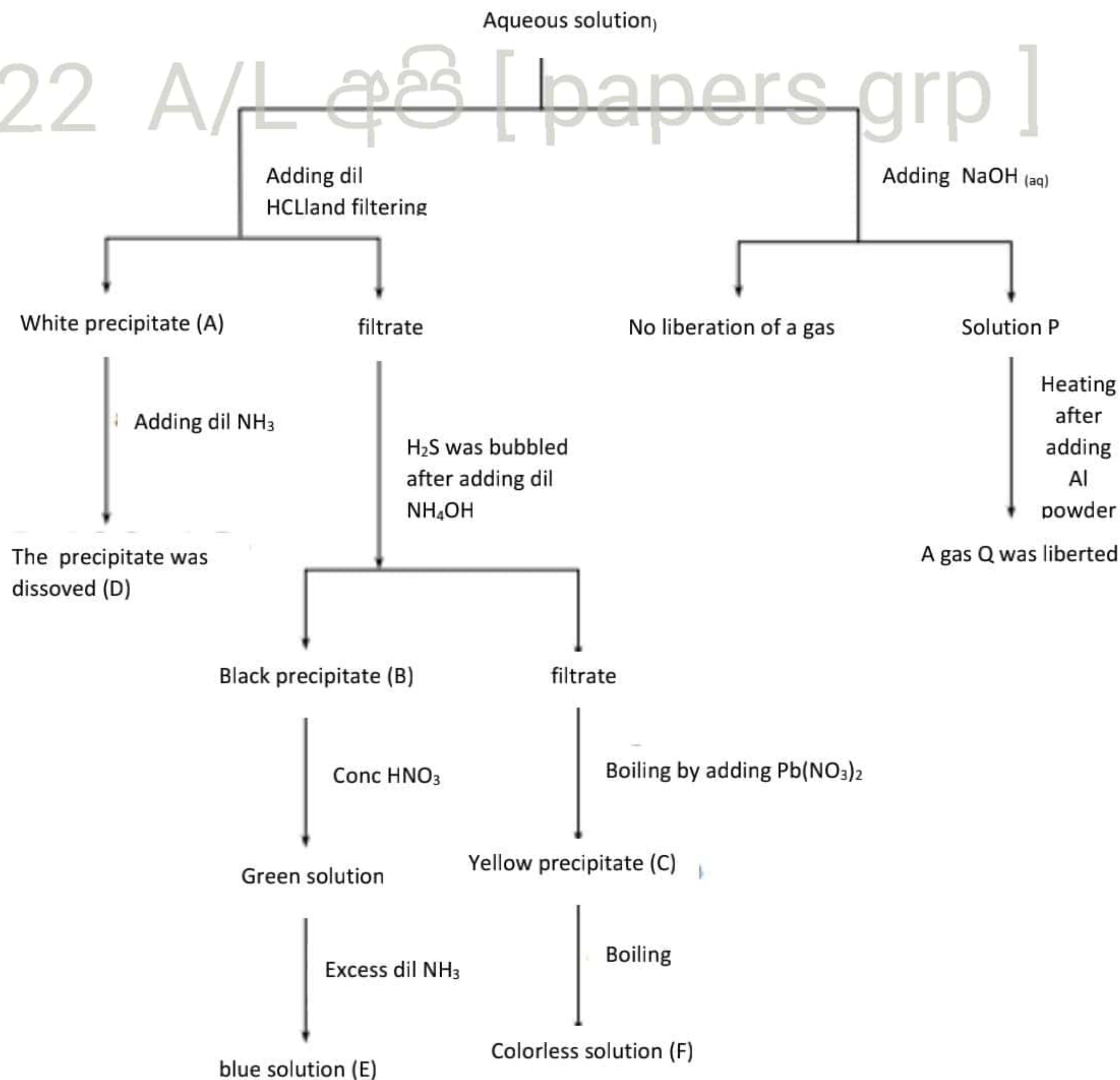
C consider the reaction  $\text{CH}_3\text{CH}=\text{CH}_2$  is reacting with HBr

- Write the structure of the main product and minor product
- Briefly explain the reason of getting two products
- Give the mechanism for the formation of the main product

(50 marks)



09 ) An aqueous solution contains two metal cations and two anions . the following experiments were carried out to identify these ions



- Identify the two cations and two anions in the mixture
- Identify the precipitates A,B,C
- Write the IUPAC names of the complexes D and E
- What is the observation when colorless F solution is cooling down?
- Write the balanced ionic/chemical equation for liberating Q gas from the solution P

(75 marks)



b) the following procedure was carried out to calculate mass percentages of  $\text{FeC}_2\text{O}_4$  and  $\text{FeCl}_3$  in a mixture which contains  $\text{FeC}_2\text{O}_4$ ,  $\text{FeCl}_3$  and an inert material

- Solution B was prepared by taking 8g from the solid mixture and dissolving it in dil  $\text{H}_2\text{SO}_4$ . This was transferred to  $250\text{cm}^3$  volumetric flask and diluted up to the mark by adding distilled water

#### Procedure I

A  $25\text{cm}^3$  portion of solution B was treated with  $20\text{cm}^3$  of dil  $\text{H}_2\text{SO}_4$  and the solution was heated to  $60^\circ\text{C}$ . obtained solution was titrated with a  $\text{KMnO}_4$  solution. The volume required to get the end point is  $30\text{cm}^3$

#### Procedure II

The  $\text{KMnO}_4$  solution that used in ( I ) above was kept in the buretts and titrated with a  $25\text{cm}^3$  portion of acidifies  $0.1\text{mol dm}^{-3}$   $\text{FeSO}_4$  solution. The volume of  $\text{KMnO}_4$  required to get the end point was  $20\text{cm}^3$

#### Procedure III

To a  $25.0\text{cm}^3$  sample of solution B excess KI was added. The  $\text{I}_2$  liberated was then titrated with  $0.05\text{mol dm}^{-3}$   $\text{Na}_2\text{S}_2\text{O}_3$  solution using starch as the indicator. The volume required was  $28.0\text{cm}^3$

NOTE

- Either  $\text{FeC}_2\text{O}_4$  or the inert material will not react with KI
- Effect of  $\text{Cl}^-$  to the titration is negligible

- Write balanced ionic/chemical equations for all the chemical reactions take place in these procedure
- Calculate the mass percentages of  $\text{FeC}_2\text{O}_4$  and  $\text{FeCl}_3$  in the initial solid sample
- State the colour changes that occur during the titrations I and 2 above  
(  $\text{Fe} = 56$ ,  $\text{Cl} = 35.5$ ,  $\text{O} = 16$ ,  $\text{C} = 12$  )

75 marks

10) a) This question is based on molecular kinetic equation of gases

- Write molecular kinetic equation of gases. Define all the terms in the equation
- Derive that pressure of a gas at a certain temperature is proportional to the number of molecules of that gas present inside a unit volume
- By combining with a suitable equation show that square mean velocity of a gas at a certain temperature is inversely proportional to its molar mass
- At a pressure  $1.0 \times 10^5$  Pa density of a gas is  $7.5 \text{ g dm}^{-3}$ . calculate the root mean square velocity of the gas  
"under any condition of temperature and pressure for any amount of any type of gas  $\frac{PV}{nT} = ZR$   
. under any condition if  $Z = 1$ , the particular gas is considered as ideal "
- At 300K and 3.0bar pressure the density of a helium and oxygen gaseous mixture is  $1.0 \text{ g dm}^{-3}$ . Under these condition the product (compressibility factor X gas constant) is  $0.0842 \text{ dm}^3 \text{ bar K}^{-1} \text{ mol}^{-1}$ . calculate the mass percentage of helium in this mixture. ( $\text{O} = 16$ ,  $\text{H} = 4$ )

(70 marks)



b) following procedure describe a method to determine O<sub>3</sub> content in atmosphere. A volume of  $2.0 \times 10^4 \text{ dm}^3$  of air at s.t.p was bubbled through NaI aqueous solution  $\text{O}_3 + 2\text{I}^- + \text{H}_2\text{O} \rightarrow \text{O}_2 + \text{I}_2 + 2\text{OH}^-$

to completely react with the liberating I<sub>2</sub> 4.2cm<sup>3</sup>. volume of 0.01mol dm<sup>-3</sup> S<sub>2</sub>O<sub>3</sub><sup>2-</sup> was required

- i. What is the amount of I<sub>2</sub> that react with S<sub>2</sub>O<sub>3</sub><sup>2-</sup>
  - ii. Calculate amount of O<sub>3</sub> present in  $2.0 \times 10^4 \text{ dm}^3$  of air at s.t.p
  - iii. Calculate O<sub>3</sub> content in atmosphere in ppm
- (30 marks)
- c) i. Consider the reduction reaction showed by a gaseous dihalogen inside an aqueous medium. show that this reduction reaction is depending upon the following three factors.
- Dissociation energy of the gaseous dihalogen
  - Electron affinity of a gaseous atom of the halogen
  - Hydration energy of the gaseous halide ion

NOTE : "Energy " here abbreviated for change in gibbs free energy associated with each process

- ii . i. write the ground state electronic configuration  $\text{C}^+_{(\text{g})}$ ,  $\text{N}^+_{(\text{g})}$ ,  $\text{O}^+_{(\text{g})}$  and  $\text{F}^+_{(\text{g})}$
- ii. Give the ascending order of the first ionization energy of these ions
  - iii. Briefly explain the reason for the variation in part ii above

(50 marks)

.22 A/L අයි [ papers grp ]