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LEVI BALIKA VIDYALAYA - COLOMBO

13 වන ශ්‍රේණි පළමු වාර පරීක්ෂණය - 2017 නොවැම්බර්  
Grade 13 First Term Test November 2017

මනසා සංවික්ෂා ධර්මය  
Manasa Samvitha Dharmaya

රසායන විද්‍යාව I  
Chemistry I

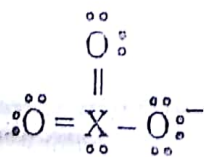
වැය දෙකයි  
Two hours

Important

- This paper consist of 9 pages
- Answer all the questions
- The use of calculators is not allowed
- Write your index number in the space provided in the answer sheet
- In each of the questions 1 to 50, pick one of the alternatives (1) (2) (3) (4) (5) which is correct as most appropriate and shade its number on the answer sheet provided

Universal gas constant	R	=	8.314 J K <sup>-1</sup> mol <sup>-1</sup>
Avergado's constant	N <sub>A</sub>	=	6.022 x 10 <sup>23</sup> mol <sup>-1</sup>
Speed of light	C	=	3.0 x 10 <sup>8</sup> ms <sup>-1</sup>
Planck's constant	h	=	6.626 x 10 <sup>-34</sup> Js

- Number of different values possible for magnetic quantum number (m<sub>l</sub>), if azimuthal quantum number is l for a given quantum number,
  - 2l
  - 2l - 1
  - 2(l + 1)
  - 2l + 1
  - 2(l - 1)
- Which of the following species shows the highest electronegativity for N,
  - NO<sub>2</sub>Cl
  - NH<sub>2</sub>OH
  - NO<sub>4</sub><sup>3-</sup>
  - NO<sub>2</sub><sup>-</sup>
  - NH<sub>3</sub>
- Increasing order of C - O bond length of species CH<sub>3</sub>CH<sub>2</sub>OH, CH<sub>3</sub>COO<sup>-</sup>, HCHO and CO<sub>3</sub><sup>2-</sup> is,
  - CH<sub>3</sub>CH<sub>2</sub>OH < CH<sub>3</sub>COO<sup>-</sup> < HCHO < CO<sub>3</sub><sup>2-</sup>
  - HCHO < CH<sub>3</sub>COO<sup>-</sup> < CO<sub>3</sub><sup>2-</sup> < CH<sub>3</sub>CH<sub>2</sub>OH
  - CO<sub>3</sub><sup>2-</sup> < CH<sub>3</sub>COO<sup>-</sup> < CH<sub>3</sub>CH<sub>2</sub>OH < HCHO
  - CH<sub>3</sub>CH<sub>2</sub>OH < CH<sub>3</sub>COO<sup>-</sup> < CO<sub>3</sub><sup>2-</sup> < HCHO
  - CH<sub>3</sub>CH<sub>2</sub>OH < CO<sub>3</sub><sup>2-</sup> < CH<sub>3</sub>COO<sup>-</sup> < HCHO
- Resonance structure of XO<sub>3</sub><sup>-</sup> is given below.



To which group of the periodic table does element X belong to?

- 14
- 15
- 16
- 17
- 18

5) Consider the two resonance forms



Which of the following is correct regarding structures A and B?

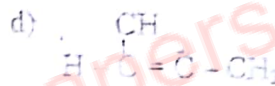
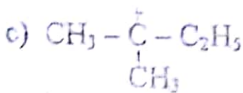
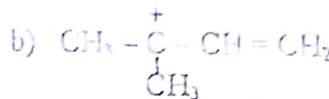
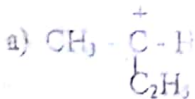
- 1) Structure A is more stable.
  - 2) Structure B is more stable.
  - 3) All atoms of structure A and B lie on one plane.
  - 4) Both C atoms in structure B are  $sp^3$  hybridized.
  - 5) Respective bond angles in structure A and B are equal.
- 6) Increasing order of oxidation no of C in HCHO, HCOOH,  $CCl_4$  and  $CH_3NH_2$  are

- 1)  $HCHO < CH_3NH_2 < CCl_4 < HCOOH$
- 2)  $CH_3NH_2 < HCHO < HCOOH < CCl_4$
- 3)  $CCl_4 < HCOOH < HCHO < CH_3NH_2$
- 4)  $CH_3NH_2 < HCOOH < HCHO < CCl_4$
- 5)  $HCHO < CH_3NH_2 < HCOOH < CCl_4$

7) Number of photons in a beam of visible light with 700 nm wave length emitting an energy of 4 J

- 1)  $1.41 \times 10^{19}$
- 2)  $1.41 \times 10^{28}$
- 3)  $1.43 \times 10^{-19}$
- 4)  $1.41 \times 10^{-28}$
- 5)  $6.022 \times 10^{23}$

8) Increasing order of stability of following carbocation is,



1)  $d < b < a < c$

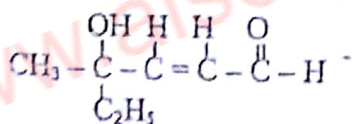
2)  $d < a < c < b$

3)  $a < c < d < b$

4)  $a < d < b < c$

5)  $a < d < c < b$

9) IUPAC name of the following organic compound is,



1) 4-methyl-4-hydroxy-3-pental

2) 4-methyl-4-ol-2-hexenal

3) 4-ethyl-4-hydroxy-2-pental

4) 4-hydroxy-4-methylhex-2-enal

5) 4-ethyl-4-hydroxy-3-pental

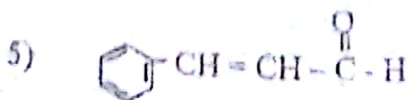
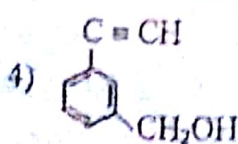
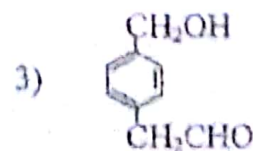
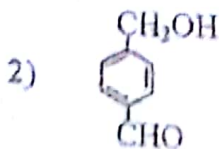
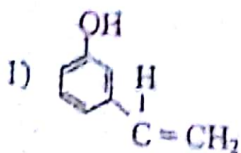
10) Observations given by compound A with some reagents are given below.

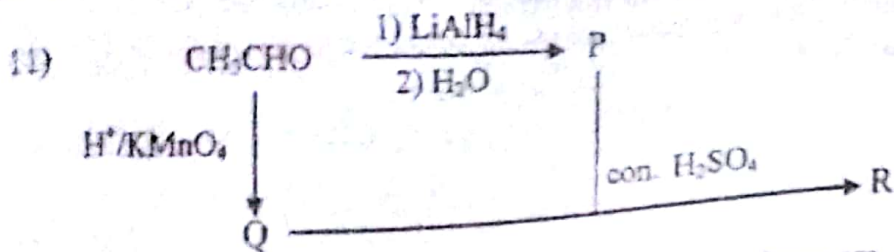
a) Decolorize acidic  $KMnO_4$

b) Forms a gas with Na metal.

c) Forms a white precipitate with tollen's reagent.

Compound A can be,

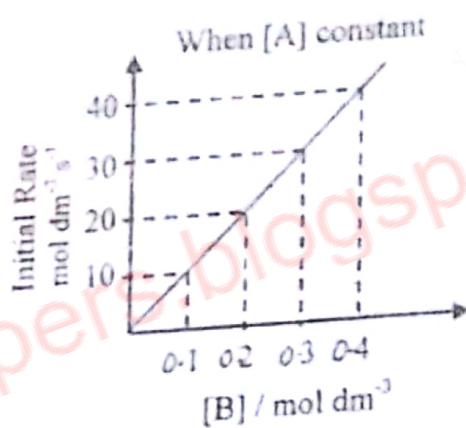
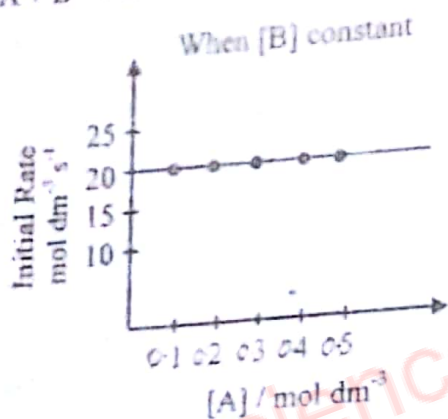




Structures P, Q and R in the above reaction scheme are,

- |   |  |  |
|---|--|--|
| 1) $\text{CH}_3 - \text{CH}_2 - \text{OH}$                            | $\text{CH}_3\text{CH}_2 - \text{O}^-$                              | $\text{CH}_3\text{CH}_2\text{O} - \text{CH}_2\text{CH}_3$                                |
| 2) $\text{CH}_3\text{CH}_2\text{OH}$                                  | $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$ | $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{O} - \text{C}_2\text{H}_5$ |
| 3) $\text{CH}_3\text{CH}_2\text{OH}$                                  | $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$ | $\text{C}_2\text{H}_5 - \overset{\text{O}}{\parallel} \text{C} - \text{O} - \text{CH}_3$ |
| 4) $\text{CH}_2 = \text{CH}_2$  | $\text{CH}_3 - \text{CH}_2\text{O}^-$                              | $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{C}_2\text{H}_5$                            |
| 5) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$ | $\text{CH}_3\text{CH}_2\text{OH}$                                  | $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{O} - \text{C}_2\text{H}_5$ |

12) The following graphs show the results of an experiment done to find the order of the reaction  $\text{A} + \text{B} \rightarrow \text{C} + \text{D}$



Orders with respect to A and B respectively are,

- 1) 1, 0      2) 1, 2      3) 0, 1      4) 0, 2      5) 2, 1

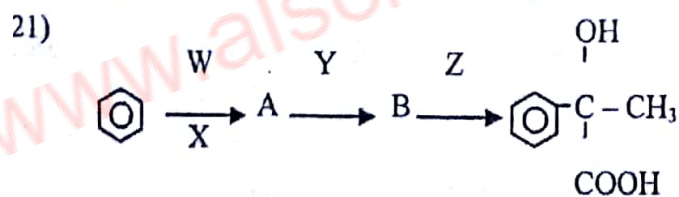
13) Enthalpy of bond dissociation of bonds  $\text{S} = \text{O}(\text{g})$  and  $\text{S} - \text{O}(\text{g})$  are  $x \text{ kJ mol}^{-1}$  and  $y \text{ kJ mol}^{-1}$  respectively.  $\text{S} - \text{O}(\text{g})$  mean bond dissociation enthalpy of  $\text{S} - \text{O}$  in  $\text{SO}_3^{2-}$  anion is,

- 1)  $\frac{x+y}{3}$       2)  $\frac{x}{2}$       3)  $\frac{2y+x}{3}$       4)  $y$       5)  $\frac{3y+x}{3}$

14) Which of the following statement is correct?

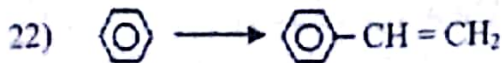
- Density of a gas at a given temperature is always directly proportional to its molar mass.
- Density of each of the gases of a mixture of gases under constant temperature and pressure, is directly proportional to its mean square speed.
- Density ratio of different gases with similar masses in a closed container is equal to the ratio of relative molecular masses.
- Mass of a gas inversely proportional to universal gas constant.
- Rate of diffusion of a gas is directly proportional to its molar mass.

- 15) Molar ratio of  $\text{CaCO}_3$ ,  $\text{MgCO}_3$  in a mixture containing only  $\text{CaCO}_3$ ,  $\text{MgCO}_3$  and  $\text{SiO}_2$  is 1 : 1. 2.00 g of this mixture is heated until a constant mass is obtained mass of the residue is 1.12 g. Mass percentage of  $\text{CaCO}_3$  in the mixture is, (Ca = 40, Mg = 24, C = 12, O = 16)
- 1) 25%                      2) 50%                      3) 40%                      4) 35%                      5) 30%
- 16) Volume of  $0.6 \text{ mol dm}^{-3} \text{ Na}_2\text{S}_2\text{O}_8$  required to react with  $25.00 \text{ cm}^3$  of  $0.8 \text{ mol dm}^{-3} \text{ Cr}^{3+}$  (aq) solution in neutral medium is (in  $\text{cm}^3$ ), ( $\text{Cr}^{3+}$  is oxidized to  $\text{Cr}_2\text{O}_7^{2-}$  and  $\text{S}_2\text{O}_8$  is reduced to  $\text{SO}_4^{2-}$ ).
- 1) 10                      2) 50                      3) 20                      4) 25                      5) 30
- 17)  $2\text{KNO}_3(\text{s}) \longrightarrow 2\text{KNO}_2(\text{s}) + \text{O}_2(\text{g})$   
The above reaction is non spontaneous  $25^\circ\text{C}$  but spontaneous above  $25^\circ\text{C}$ .  
Correct statement about the above reaction at  $25^\circ\text{C}$  is,
- 1)  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  are equal.                      2)  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  are positive.  
3)  $\Delta G$  and  $\Delta H$  are negative and  $\Delta S$  is positive.                      4)  $\Delta G$  and  $\Delta S$  are negative and  $\Delta H$  is positive.  
5)  $\Delta G$  and  $\Delta H$  are positive and  $\Delta S$  is negative.
- 18) IUPAC name of  $[\text{CoCl}(\text{NH}_3)_5]\text{Br}_2$  is,
- 1) pentaamminechloridocobalt(III) bromide.                      2) pentamminechlorocobalt (III) bromite.  
3) chloropentaamminecobalt (III) bromide.                      4) pentaaminochloridocobalt (II) bromide.  
5) pentaminechloridocobaltate (III) bromide.
- 19) Salt A reacts with dil. HCl forming a gas which decolourizes the colour of  $\text{KMnO}_4$ . When NaOH is added to the above solution a precipitate is formed first and then it dissolves. A can be,
- 1)  $\text{Zn}(\text{NO}_3)_2$                       2)  $\text{Cr}_2(\text{SO}_3)_3$                       3) MnS                      4)  $\text{NiSO}_3$                       5)  $\text{Cr}(\text{NO}_3)_3$
- 20)  $\text{MI}$  and  $\text{MF}_2$  are two sparingly soluble salts, derived from the transition element M having two different oxidation numbers. The solubility of  $\text{MI}$  and  $\text{MF}_2$  are  $S_1$  and  $S_2$  respectively and solubility products are  $K_{sp1}$  and  $K_{sp2}$  respectively. When each salt is in equilibrium with its saturated solution if  $\frac{K_{sp1}}{[\text{M}^+(\text{aq})]} = \frac{K_{sp2}}{[\text{M}^{2+}(\text{aq})]}$ . Which of the following is correct.
- 1)  $S_1 = S_2$                       2)  $S_1 = S_2^2$                       3)  $S_1^2 = S_2$                       4)  $S_1^2 = 4S_2^2$                       5)  $S_1^2 = 2S_2^2$

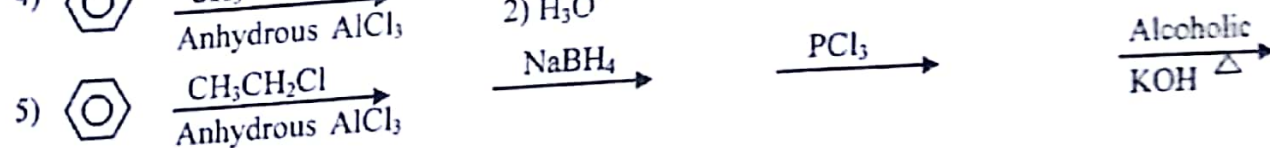
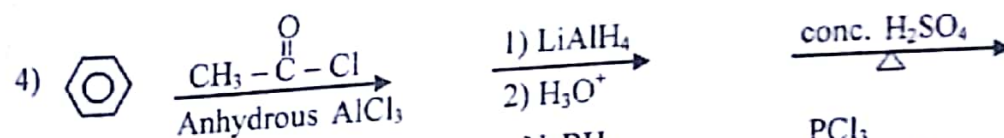
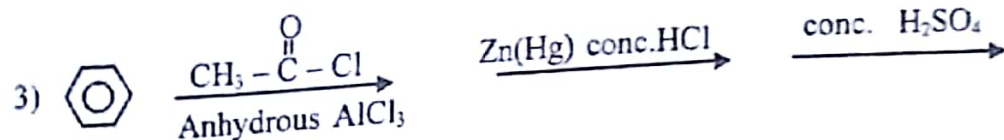
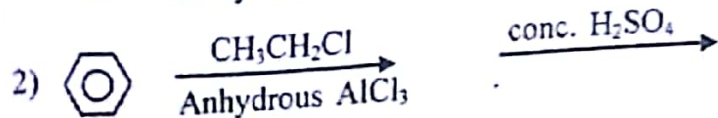
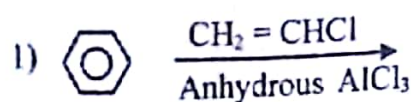


W, X, Y and Z reagents respectively are,

- | W  | X                      | Y                        | Z                        |
|--|------------------------|--------------------------|--------------------------|
| 1) $\text{CH}_3\text{CH}_2\text{COCl}$                             | Anh. $\text{AlCl}_3$   | $\text{CH}_3\text{MgBr}$ | $\text{H}_3\text{O}^+$   |
| 2) $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl}$ | Anh. $\text{AlCl}_3$   | HCN                      | $\text{H}_3\text{O}^+$   |
| 3) $\text{CH}_3\text{CH}_2\text{Cl}$                               | Anh. $\text{AlCl}_3$   | HCN                      | $\text{H}_3\text{O}^+$   |
| 4) HCN   | $\text{H}_3\text{O}^+$ | Anh. $\text{AlCl}_3$     | $\text{CH}_3\text{COCl}$ |
| 5) $\text{CH}_3\text{MgBr}$  | $\text{H}_3\text{O}^+$ | HCN                      | $\text{H}_3\text{O}^+$   |



Most suitable reaction scheme for the above conversion is,



23) When excess HCl is added to an aqueous solution a brown gas was formed while the solution turned dark blue. When excess  $\text{NH}_3$  (aq) was to another portion of the initial solution a yellow - brown solution was formed which turned darker after some time. When dilute HCl was added to the initial solution it turned brown. The initial solution contains,

- 1)  $\text{Cu}(\text{NO}_2)_2$       2)  $\text{Cu}(\text{NO}_3)_2$       3)  $\text{Fe}(\text{NO}_2)_3$       4)  $\text{Co}(\text{NO}_2)_2$       5)  $\text{Co}(\text{NO}_2)_3$

24)  $25.0 \text{ cm}^3$  of  $0.1 \text{ mol dm}^{-3}$   $\text{HCl}(\text{aq})$  is added to  $0.1 \text{ g}$  of a sample containing  $\text{NaOH}$ . When the above solution is diluted to  $100.0 \text{ cm}^3$  using distilled water, pH of the resultant solution was 2. Mass percentage of  $\text{NaOH}$  in the sample is, (Na - 23, H - 1, O - 16)

- 1) 25%      2) 40%      3) 56%      4) 60%      5) 80%

25) The system which does not form a buffer solution when mixing is,

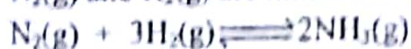
- 1)  $0.2 \text{ mol dm}^{-3} \text{HCOONa } 50.0 \text{ cm}^3 + 0.1 \text{ mol dm}^{-3} \text{HCl } 50.0 \text{ cm}^3$   
 2)  $0.5 \text{ mol dm}^{-3} \text{CH}_3\text{COOH } 50 \text{ cm}^3 + 0.2 \text{ mol dm}^{-3} \text{NaOH } 50.0 \text{ cm}^3$   
 3)  $0.2 \text{ mol dm}^{-3} \text{HCOOH } 50.0 \text{ cm}^3 + 0.5 \text{ mol dm}^{-3} \text{NaOH } 50.0 \text{ cm}^3$   
 4)  $0.2 \text{ mol dm}^{-3} \text{NH}_4\text{OH } 50.0 \text{ cm}^3 + 0.2 \text{ mol dm}^{-3} \text{CH}_3\text{COOH } 50.0 \text{ cm}^3$   
 5)  $0.2 \text{ mol dm}^{-3} \text{Na}_2\text{CO}_3 \text{ } 50.0 \text{ cm}^3 + 0.2 \text{ mol dm}^{-3} \text{HCl } 50.0 \text{ cm}^3$

26) A saturated solution of  $\text{Ca}(\text{OH})_2$  is prepared by dissolving  $\text{Ca}(\text{OH})_2$  powder in  $100.0 \text{ cm}^3$  of water at  $25^\circ\text{C}$ . This was filtered and  $25.0 \text{ cm}^3$  of the filtrate was titrated against  $0.01 \text{ mol dm}^{-3}$   $\text{HCl}$  solution. Volume of  $\text{HCl}$  required for the end points is  $12.5 \text{ cm}^3$ . The solubility product ( $K_{sp}$ ) of  $\text{Ca}(\text{OH})_2$  at  $25^\circ\text{C}$  in  $\text{mol}^3 \text{ dm}^{-9}$ .

- 1)  $1.25 \times 10^{-18}$       2)  $6.25 \times 10^{-8}$       3)  $2.5 \times 10^{-5}$       4)  $8 \times 10^{-4}$       5)  $4 \times 10^{-4}$

- 27) Which of the following statement is correct regarding a strong acid strong base titration,
- 1) Any indicator can be used for these titrations under any condition.
  - 2) Equivalence point pH does not depend on the concentration of acid or base.
  - 3) Equivalent point pH is 7 for any acid or base.
  - 4) Solution in the flask at half equivalence point shows properties of a buffer.
  - 5) The vertical portion of the pH curve decreases as the concentration of the acid and base increases.

- 28)  $N_2(g)$  and  $H_2(g)$  are mixed in a mole ratio of 1 : 3 and allowed to reach the following equilibrium.



Mole percentage of  $N_2$  remaining in the system at equilibrium is 50%

If equilibrium pressure is P, partial pressure of  $H_2$  gas is,

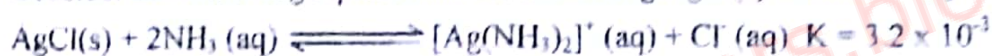
- 1)  $\frac{P}{2}$                       2)  $\frac{P}{3}$                       3)  $\frac{2P}{3}$                       4)  $\frac{3P}{5}$                       5)  $\frac{2P}{5}$

- 29) The following equilibrium is established when ethanoic acid and ethanol are heated with conc.  $H_2SO_4$
- $$CH_3COOH(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l); \Delta H < 0$$

Number of moles of  $CH_3COOC_2H_5$  in the mixture of equilibrium can be increased by,

- 1) Adding water to the mixture at equilibrium.
- 2) Increasing the temperature of the system.
- 3) Adding excess conc.  $H_2SO_4$  to the mixture
- 4) Adding dilute NaOH to the mixture.
- 5) Number of moles of  $CH_3COOC_2H_5$  cannot be increased by any of the above.

- 30) Consider the following equilibrium for dissolving  $AgCl(s)$  in dilute  $NH_3$



The equilibrium for the formation of  $[Ag(NH_3)_2]^+$  is as follows,



Calculate  $K_{sp}$  of  $AgCl(s)$  in the above temperature. ( $\text{mol}^2 \text{ dm}^{-6}$ )

- 1)  $5.12 \times 10^{-4}$     2)  $2 \times 10^{-10}$     3)  $5 \times 10^9$     4)  $4 \times 10^3$     5)  $8 \times 10^{-7}$

\* Instructions for question No 31 to 40

For each of the questions 31 to 40, one or more responses (a), (b), (c) and (d) given is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

- (1) if only (a) and (b) are correct
- (2) if only (b) and (c) are correct
- (3) if only (c) and (d) are correct
- (4) if only (d) and (a) are correct
- (5) if any other number or combination of responses is correct.

Summary of above information				
(1)	(2)	(3)	(4)	(5)
Only (a) and (b) correct	Only (b) and (c) correct	Only (c) and (d) correct	Only (d) and (a) correct	If any other number or combination of responses correct

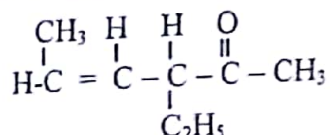
31) Correct statement/s regarding  $\text{NH}_3$  is.

- a)  $\text{NH}_3$  can be formed by heating any ammonium salt with a strong base
- b)  $\text{NH}_3$  reacts with excess  $\text{Cl}_2$  forming  $\text{NCl}_3$
- c)  $\text{NH}_3$  is liberated when  $\text{NaNO}_3$  is heated with Fe powder.
- d)  $\text{NH}_3$  reacts with Na forming metal nitride and  $\text{H}_2$  gas.

32) Yellow coloured complexes are,

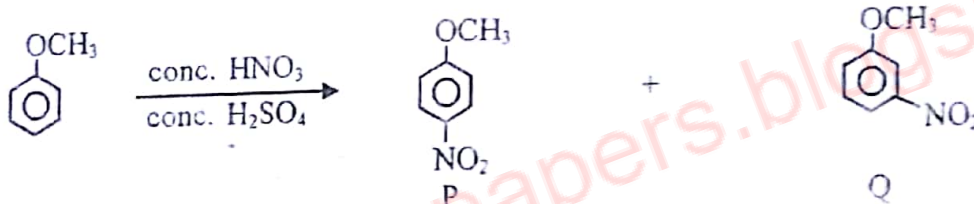
- a)  $[\text{Ni}(\text{NH}_3)_6]^{2+}$  and  $[\text{MnCl}_4]^{2-}$
- b)  $[\text{NiCl}_4]^{2-}$  and  $[\text{FeCl}_4]^-$
- c)  $[\text{CuCl}_4]^{2-}$  and  $[\text{FeCl}_4]^-$
- d)  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  and  $[\text{Cu}(\text{OH}_2)\text{Cl}_2]$

33) Which of the following statement/s is/are correct regarding the molecule given below.



- a) It shows stereoisomerism but does not show geometrical isomerism
- b) It is optically active
- c) The product formed by Zn / (Hg) with conc HCl shows optical isomerism.
- d) The product formed by the above compound with HBr has two optically active isomers.

34) Which of the following statement/s is/are correct regarding the reaction given below.



- a) Major product is P.
- b) Major product is Q.
- c) It is an electrophilic addition reaction.
- d) A carbocation is formed during the first step of the reaction.

35) Which of the following statement/s is/are correct

- a) Unit of rate constant of a reaction does not depend on order of the reaction.
- b) Order with respect to a given reactant in a chemical reaction is not changed, even if the concentration of one reactant is comparatively greater than the other.
- c) A catalyst does not affect the activation energy of the reaction.
- d) When concentration of reactants are increased under constant temperature, Rate of reaction increases due to the increase of the fraction of molecules greater than the activation energy

36)  $\text{P}(\text{s}) \rightarrow 2\text{X}(\text{g}) + \text{Y}(\text{s})$  for the above reaction  $\Delta H^\ominus = +180 \text{ kJ mol}^{-1}$   $\Delta S^\ominus = +160 \text{ J K}^{-1} \text{ mol}^{-1}$  Which of the following is/are correct regarding the above reaction.

- a) Reaction is spontaneous at  $25^\circ\text{C}$
- b)  $\Delta G^\ominus$  of the reaction at  $25^\circ\text{C}$  is  $-132.32 \text{ kJ mol}^{-1}$
- c)  $\Delta S^\ominus$  is positive above  $1000 \text{ K}$
- d) At temperature above  $1125 \text{ K}$  of this reaction becomes negative and decomposition occurs spontaneously.

- 37) Which of the following is true regarding chemical kinetics?
- Order and molecularity of an elementary reaction is equal.
  - When a reaction proceeds under constant temperature rate of reaction decreases due to the reduction of the fraction of molecules that have exceeded the activation energy.
  - Molecularity of the rate determining step of a multi step reaction is equal to the number of steps.
  - Catalyst increases the rates of both forward and reverse reactions.

- 38) Which of the following cation/s,
- Form a precipitate which is insoluble in excess  $\text{NH}_4\text{OH}$
  - Form a precipitate which is insoluble in excess  $\text{NaOH}$

- $\text{Fe}^{3+}$
- $\text{Mg}^{2+}$
- $\text{Al}^{3+}$
- $\text{Cu}^{2+}$

- 39) Which of the following is/are correct regarding  $\text{H}_2\text{O}_2$ ,

- It undergoes disproportionation when heated
- It is a bleaching agent and reduces coloured surfaces
- It is a non polar molecule.
- It is reduced to water by  $\text{SO}_2$

- 40)  $n$  moles of  $\text{O}_3$  was allowed to reach equilibrium in a rigid container at  $T$  K and  $1 \times 10^5$  Pa. The molar dissociation was 0.4.



Which of the following statement is/are true regarding the above equilibrium system,

- The number of moles of  $\text{O}_3$  and  $\text{O}_2$  are equal.
- The density of the system changes as it reaches equilibrium
- equilibrium pressure is  $1.5 \times 10^5$  Pa
- The density of the equilibrium mixture is given by  $\frac{48 \times 10^5}{RT}$

\* Instructions for question No. 41 to 50

In question no. 21 to 25, two statements are given in respect of each question.

From the table given below, select the response out of the responses (1), (2), (3), (4), (5) that best fits the two statements given for each of the questions and mark appropriately on your answer sheet.

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 statement	Second statement
41)	If all carbon atoms lie on one plane, they have same hybridization.	All C atoms of the compound $(\text{CH}_3)_2\text{CCH}_2\text{O}\overset{\text{O}}{\parallel}{\text{C}}\text{CH}_2\text{Cl}$ which lie on same plane have $\text{sp}^2$ hybridization.
42)	Reactions having a positive entropy change occur always spontaneously under high temperature.	A chemical reaction to be spontaneous, enthalpy change should be always negative.
43)	pH of pure water is always 7.	Always $[\text{H}_3\text{O}^+] = [\text{OH}^-]$ in pure water.
44)	$\text{CH}_3\text{COONH}_4(\text{aq})$ solution is neutral at $25^\circ\text{C}$ .	Cation or anion formed by the weak base or weak acid do not undergo hydrolysis.
45)	The concentration of chlorides can be determined by titrating against acidic $\text{K}_2\text{Cr}_2\text{O}_7$	$\text{K}_2\text{Cr}_2\text{O}_7$ is a primary standard and also a strong oxidizing agent.
46)	Zn has the lowest melting point among the transitional elements.	Contribution to the mobile electron reservoir is less by the elements which contain a stable electronic configuration.
47)	Solubility of hydroxides of group 2 increase down the group.	Hydration enthalpy of cations of group 2 increases down the group.
48)	$\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$ , reacts with dilute NaOH and forms $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ by a single step nucleophilic substitution mechanism.	$\text{C}_6\text{H}_5\text{CH}_2^+$ is a primary carbocation.
49)	An aqueous solution of $\text{AlCl}_3$ is acidic.	$\text{AlCl}_3$ can act as a lewis acid.
50)	Compressibility factor of $\text{CO}_2$ under low pressures is less than 1. ( $Z < 1$ )	$\text{CO}_2$ molecules have dipole interactions.



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DEVI BALIKA VIDYALAYA - COLOMBO 8

13 වන ශ්‍රේණිය පළමු වාර පරීක්ෂණය - 2017 නොවැම්බර්  
Grade 13 First Term Test November 2017

රසායන විද්‍යාව II  
Chemistry II

02 E II

පැය තුනයි  
Three hours

Name: ..... Grade : .....

- \* A periodic table is provided
- \* Use of calculators is not allowed.

Part A - Structured Essay (pages 2 - 9)

- \* Answer all the questions on the question paper itself.
- \* Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that extensive answers are not expected.

Part B and Part C Essay (pages 10 - 15)

- \* Answer four questions selecting two questions from each part. Use the papers supplied for this purpose.
- \* At the end of the time allotted for this paper, tie the answers to the three Parts A, B and C together so that Part A is on top and hand them over to the Supervisor.
- \* You are permitted to remove only Parts B and C of the question paper from the Examination Hall

- \* Universal gas constant  $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$
- \* Avogadro constant  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

For Examiner's Use Only

Answer all questions. (Each question carry 10 marks)

1) a) Arrange the following in decreasing order of the property given in parenthesis.

i) CaO, MgO, SrO, BaO (Solubility in water)

.....

ii) CO, CH<sub>4</sub>, HCHO, C<sub>2</sub>O<sub>4</sub><sup>2-</sup> (Electronegativity of C)

.....

iii) NO, NO<sub>2</sub><sup>-</sup>, NH<sub>2</sub>OH, NO<sub>3</sub><sup>-</sup> (Bond length of N - O)

.....

iv) COS, CH<sub>3</sub><sup>+</sup>, CH<sub>3</sub><sup>-</sup>, CH<sub>4</sub> (Bond angle)

.....

v) NO<sub>2</sub><sup>+</sup>, ICl<sub>4</sub><sup>-</sup>, I<sub>3</sub><sup>-</sup>, IO<sub>3</sub><sup>-</sup> (Total number of lone pairs in the ion)

.....

(20 marks)

b) The ester Methyl carbamate can be prepared by the reaction of methanol with urea. This carcinogenic as well as used to synthesize certain medicines and pesticides. The molecular formula of methyl carbamate is C<sub>2</sub>H<sub>5</sub>NO<sub>2</sub>. Its skeletal structure is given below. No H atoms are attached to O atoms.



i) Draw the most acceptable lewis structure for the above molecule.

.....

.....

.....

ii) Find the formal charges and oxidation numbers of the atoms N<sup>1</sup>, C<sup>2</sup>, O<sup>3</sup> and C<sup>4</sup>, and write them in the table provided.

Atom	N <sup>1</sup>	C <sup>2</sup>	O <sup>3</sup>	C <sup>4</sup>
Formal Charge				
Oxidation number				

iii) Draw resonance structures for the above molecule except lewis structure drawn in part (i) above.



ii) State the type of lattice structure, primary interaction and secondary interaction for each of the species given in the following table.

	Lattice structure	Primary interaction	secondary interaction
SiC (s)			
Na (s)			
Ice			
Dry ice			

(2.0 marks)

2) a) The following question is based on the non consecutive elements X, Y and Z in the 3<sup>rd</sup> period of the periodic table. X does not show a colour in the flame test but burns with a bright flame in air. X does not show a considerable reaction with cold water. Y burns with a blue flame in air and forms a gas with a pungent smell. Z exists as a diatomic molecule at room temperature and shows bleaching properties.

i) Identify X, Y and Z.

X ..... Y ..... Z .....

ii) Write balanced chemical equations for the reactions of X with warm water and with air

.....  
.....  
.....

iii) Y shows variable oxidation states. Write all stable oxidation states formed by Y and give one example for each.

.....  
.....  
.....  
.....

iv) An oxide of Y shows both oxidizing and reducing properties. Write half reactions to show oxidizing & reducing properties of it in acidic medium.

Oxidation .....

Reduction .....

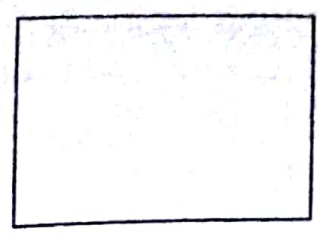
v) Write a test in brief, to identify the oxide in (iv) above.

.....  
.....

vi) Write the balanced chemical equation for the reaction of Z with water.

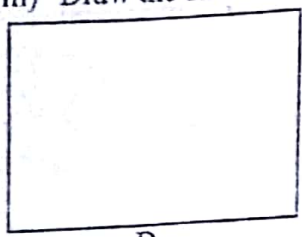
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ii) Draw possible structures for B and C.

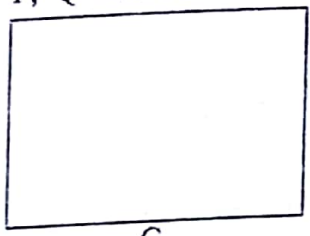


When heated with concentrated  $H_2SO_4$ , P, Q and R gave V, W and X respectively. W shows diastereoisomerism.

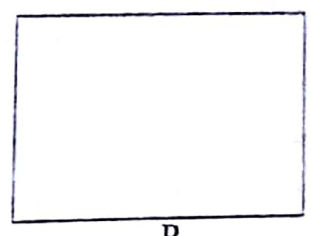
iii) Draw the structures of B, C, P, Q and R.



B



C



P

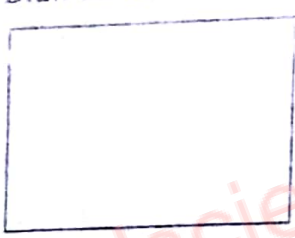


Q



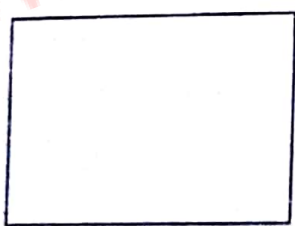
R

iii) Draw the structures of the diastereomers of W

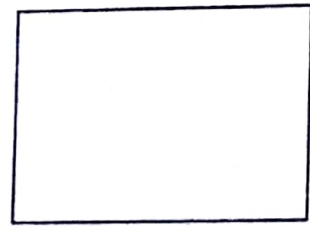


iii) On heating with conc.  $H_2SO_4$ , S gave Y. When reacted with HBr, V and Y form the same product.

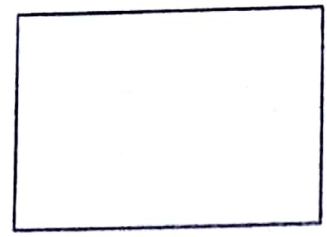
Draw the structures of D, E, S and T.



D



E

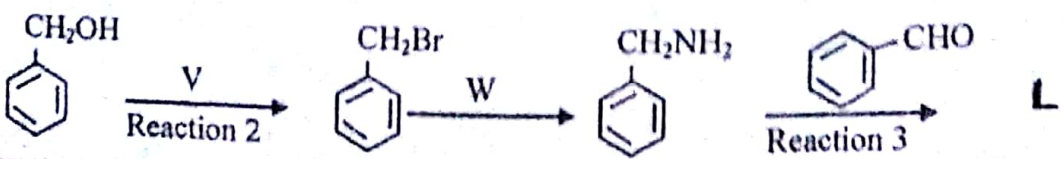
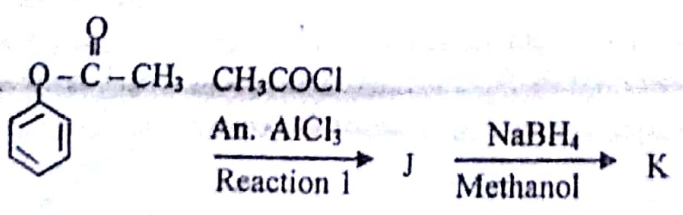


S



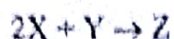
T

b) Consider the following two reaction schemes.



iii) If the temperature of the system was increased to 400 K, how would it affect the rate constant

(c) Consider the following reaction.



The following data were collected in order to determine the overall order of the above reaction.

Experiment	Initial concentrations / mol dm <sup>-3</sup>		Initial rate / mol dm <sup>-3</sup> s <sup>-1</sup>
	X	Y	
1	1 x 10 <sup>-2</sup>	1 x 10 <sup>-2</sup>	2 x 10 <sup>-6</sup>
2	2 x 10 <sup>-2</sup>	1 x 10 <sup>-2</sup>	8 x 10 <sup>-6</sup>
3	2 x 10 <sup>-2</sup>	2 x 10 <sup>-2</sup>	8 x 10 <sup>-6</sup>
4	3 x 10 <sup>-2</sup>	3 x 10 <sup>-2</sup>	18 x 10 <sup>-6</sup>

i) Calculate the order with respect to X.

.....  
.....  
.....

ii) Calculate the order with respect to Y.

.....  
.....  
.....

iii) What is the overall order of the reaction.

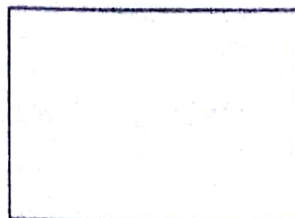
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iv) Calculate the initial rate of the reaction, if the initial concentration of X is 0.5 mol dm<sup>-3</sup> and initial concentration of Y is 5 mol dm<sup>-3</sup>.

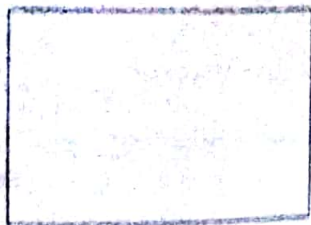
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4) a) The carbonyl compounds A, B, C, D and E are structural isomers of each other, having the molecular formula C<sub>5</sub>H<sub>10</sub>O. Only A shows optical isomerism. A, B and C react with LiAlH<sub>4</sub> followed by water, and form optically active P, Q and R respectively, whereas D and E when reacted with the same reagent form optically inactive S and T. The molecular formula of P, Q, R, S and T is C<sub>5</sub>H<sub>12</sub>O.

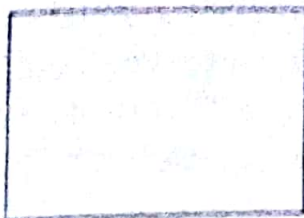
i) What is the structure of A.



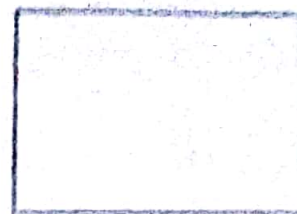
i) Draw the structures of J, K and L in the boxes provided below.



J



K



L

ii) Write the reagents V and W in the boxes provided below.



V



W

iii) Writing  $A_E$ ,  $A_N$ ,  $S_E$ ,  $S_N$  or E in the appropriate box, classify each of the reactions 1, 2 and 3 as electrophilic addition ( $A_E$ ), nucleophilic addition ( $A_N$ ), electrophilic substitution ( $S_E$ ), nucleophilic substitution ( $S_N$ ) or elimination (E) reaction.

Reaction 1

Reaction 2

Reaction 3

c) i) What is the structure of the major product of the reaction between  $CH_2 = CH_2CH_2Cl$  and  $NaOH(aq)$

.....

ii) Write the mechanism of the above reaction.

.....  
.....  
.....





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DEVI BALIKA VIDYALAYA - COLOMBO

13 වන ශ්‍රේණිය පළමු වාර පරීක්ෂණය - 2017 නොවැම්බර්  
Grade 13 First Term Test November 2017

රසායන විද්‍යාව II  
Chemistry II

02 S II

Part B - Essay

Answer two questions only. (Each question carries 15 marks.)

- 5) a) i) Define Avogadro's law.  
ii) Derive the Avogadro's law using the ideal gas equation  $PV = nRT$
- b) A sample of gas  $X_2$  was placed in a rigid container (A) with a volume of  $12 \text{ dm}^3$  at  $127^\circ\text{C}$  temperature and  $8.314 \times 10^5 \text{ Pa}$  pressure.  
A sample of gas  $Y_2$  was placed in a rigid container (B) with a volume of  $6 \text{ dm}^3$  at  $27^\circ\text{C}$  temperature and  $16.628 \times 10^5 \text{ Pa}$  pressure.  
The two containers were connected by a tube of negligible volume, and the temperatures were kept unchanged, find,

- i) Partial pressure of  $X_2$  in container A.  
ii) Partial pressure of  $Y_2$  in container B.  
iii) Find the total pressure of the system.

The temperature of the above combined system was raised up to  $267^\circ\text{C}$ , and when a small amount of a catalyst (negligible volume) was added in to the system, gas  $X_2$  and  $Y_2$  reacted to form  $XY_2$ .  $Y_2$  reacted completely and the final pressure of the system was  $12.471 \times 10^5 \text{ Pa}$ .

- iv) Write the balanced chemical equation using n.  
v) Calculate the total number of moles of in the combined container.  
vi) Find the value of n.

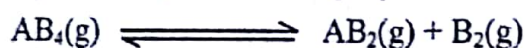
- c) i) At  $127^\circ\text{C}$   $A_3B_4(g)$  reaches the following equilibrium.



At equilibrium, 20% of  $A_3B_4(g)$  by volume was left, and the partial pressure of  $A_2(g)$  was  $8.314 \times 10^5 \text{ Nm}^{-2}$ .

- i) Find the equilibrium concentration of each species in  $\text{mol dm}^{-3}$ .  
ii) Find the equilibrium constant  $K_c$  of the above equilibrium reaction at  $127^\circ\text{C}$ .  
iii) Using the  $K_c$  value calculated in (ii) above, find  $K_p$  of the equilibrium reaction at  $127^\circ\text{C}$ .  
(No marks would be awarded for the calculation of  $K_c$  using  $K_p$ )

- ii) The temperature of the above system is then raised to  $227^\circ\text{C}$ . In addition to the above equilibrium, the following equilibrium was also established by the decomposition of  $AB_4(g)$



A sample of  $A_3B_4(g)$  was placed in a rigid container of volume  $7.2 \text{ dm}^3$  and allowed to reach equilibrium at  $227^\circ\text{C}$ . 40% of the initial moles of  $A_3B_4(g)$  was left at equilibrium and the number of moles of  $AB_2$  was 20% of the initial moles of  $A_3B_4(g)$ . The total pressure at equilibrium was found to be  $4.157 \times 10^6 \text{ Pa}$ .

- i) Find the initial number of moles of  $A_3B_4(g)$ .  
ii) Find the partial pressure of all the species at equilibrium.  
iii) Find the equilibrium constants at  $25^\circ\text{C}$  of the two systems at equilibrium using partial pressure

- 6) a) i) I) Derive the Ostwald dilution law for an aqueous solution of  $\text{NH}_3$ . Define the terms in it.  
 II) State the variations of the molar dissociation and the concentrations of  $\text{OH}^-$  (aq) and  $\text{H}^+$  (aq) when an aqueous solution of a weak base is diluted.
- ii) I)  $10.0 \text{ cm}^3$  of a  $0.1 \text{ mol dm}^{-3}$   $\text{NaOH}$  solution was added to  $10.0 \text{ cm}^3$  of  $0.2 \text{ mol dm}^{-3}$  mono protic weak acid solution  $\text{HA}$ . If the pH of the resultant solution was 4.5, find the dissociation constant ( $K_a$ ) of the weak acid at this temperature.

II) Calculate the pH of  $0.2 \text{ mol dm}^{-3}$   $\text{HA}$  solution.

III)  $10.0 \text{ cm}^3$  of the above weak acid  $\text{HA}$  was taken into a titration flask and titrated against  $0.1 \text{ mol dm}^{-3}$   $\text{NaOH}$  solution at  $25^\circ\text{C}$ . Calculate the equivalence point pH of the titration.

IV) A, B and C are three acid base indicators and their  $\text{pK}_{\text{In}}$  values are given below.

Indicator	$\text{pK}_{\text{In}}$
A	3.4
B	6.1
C	8.2

State which one of the above three indicators is most suitable for the titration in (iii) above.

V) Sketch a titration curve for the above titration in (iii) above and mark the initial pH, half equivalence point pH and equivalence point pH.

- b) i) i) Derive an expression for the solubility product ( $K_{\text{sp}}$ ) of  $\text{Ca}(\text{OH})_2$   
 II) If the molar solubility of  $\text{Ca}(\text{OH})_2$  of  $25^\circ\text{C}$  is  $2 \times 10^{-3} \text{ mol dm}^{-3}$ , find the  $K_{\text{sp}}$  of  $\text{Ca}(\text{OH})_2$   
 III) A  $0.2 \text{ mol dm}^{-3}$   $\text{CaCl}_2$  solution was saturated with  $\text{Ca}(\text{OH})_2$  of  $25^\circ\text{C}$ . Calculate the pH of the solution. State clearly any assumptions made.
- ii)  $25.0 \text{ cm}^3$  of a  $0.05 \text{ mol dm}^{-3}$   $\text{MgCl}_2$  solution was mixed with  $25.0 \text{ cm}^3$  of  $0.002 \text{ mol dm}^{-3}$   $\text{AgNO}_3$  solution. Using a proper calculation show whether a precipitate is formed or not when the above solutions are mixed.

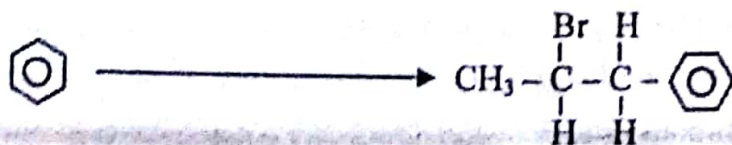
$$K_{\text{sp}}(\text{AgCl}) = 1 \times 10^{-8} \text{ mol}^2 \text{ dm}^{-6}$$

7) a) i) Compare the acidity of alcohols and phenols.

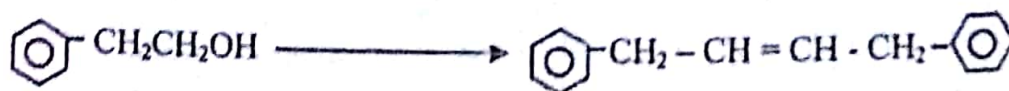
ii) I) Write the balanced equation for the reaction of  $\text{CH}_3\text{CH}_2\text{OH}$  with  $\text{Na}$ .

II) The organic product formed in (I) above, reacts with  $\text{CH}_3\text{CH}_2\text{Br}$  in two different ways and form two different products. Write the mechanisms for the formation of the two different products and state the type of mechanism for each path.

b) i) Using  $\text{CH}_3\text{CH}_2\text{OH}$  and benzene as the only organic compounds show how you would carry out the following conversions. s



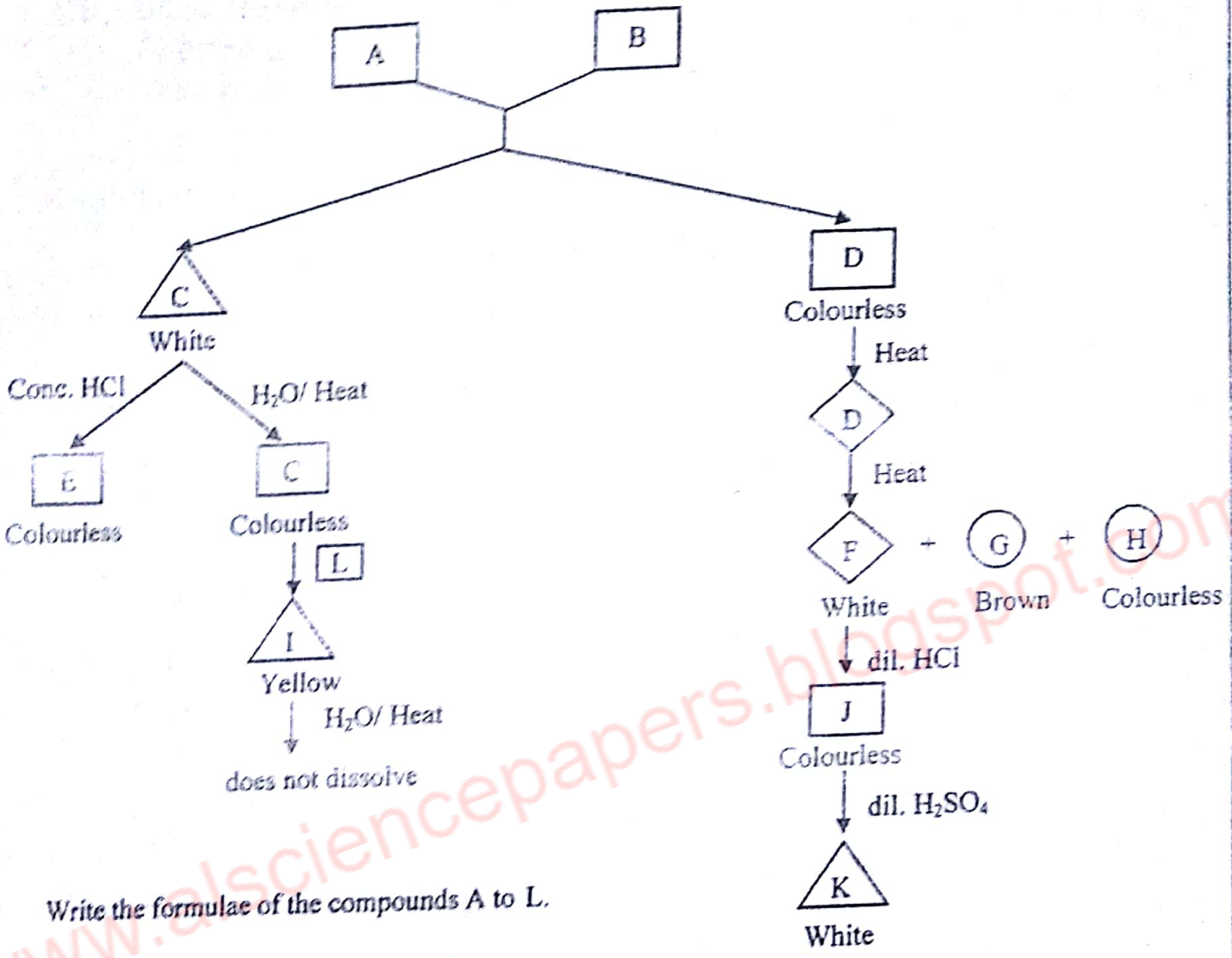
ii)



c) Using  $\text{CH}_3\text{CH}_2\text{OH}$  as the only organic compound how would you synthesize  $\text{CH}_3\text{CH} = \text{CH} - \underset{\text{H}}{\overset{\text{C}_2\text{H}_5}{\text{C}}} - \text{Br}$

Answer two questions only. (Each question carries 15 marks.)

(8) a) The following reaction scheme is provided to you regarding the mixing of two aqueous solutions of salts A and B. The following symbols are used to show solid liquid and gas.



Write the formulae of the compounds A to L.

b) Metal "M" forms two salts X and Y.

The following experiments and observations are made to identify aqueous solutions of salts X and Y.

Test	Observation
I. X was dissolved in dilute HCl	No gas was formed and a clear solution was formed.
II. Concentrated H <sub>2</sub> SO <sub>4</sub> was added to X.	A coloured gas evolved.
III. Excess dilute NH <sub>3</sub> was added to the solution obtained in (I)	A white precipitate was first formed and then a clear solution was obtained.
IV. Dilute HCl was added to Y.	No gas was formed.
V. NaOH (aq) was added to Y and heated with metal M.	A gas with a pungent smell was evolved

- i) Explaining the observations identify metal M.
- ii) Giving reasons identify anions which can be present in salt X.
- iii) Write another experiment to confirm the anion present in X.
- iv) Giving reasons identify Y.

e) The following experiments are carried out to determine the concentrations of  $\text{Cr}^{3+}$  and  $\text{CrO}_4^{2-}$  in a solution

A volume of  $25.0 \text{ cm}^3$  of a solution containing  $\text{Cr}^{3+}$  and  $\text{CrO}_4^{2-}$  was diluted to  $250.0 \text{ cm}^3$  using distilled water. (Solution A)

### Experiment 1

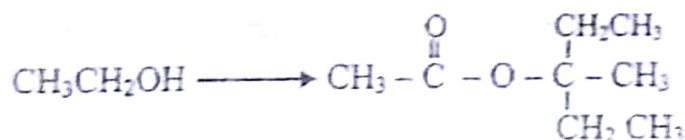
Excess  $\text{BaCl}_2$  (aq) was added to  $100 \text{ cm}^3$  of the solution A. The dry mass of the precipitate formed was  $1.012 \text{ g}$ .

### Experiment 2

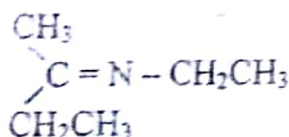
$\text{NaOH}$  and excess  $\text{H}_2\text{O}_2$  was added to  $25.0 \text{ cm}^3$  of solution A. This was acidified and titrated against  $0.5 \text{ mol dm}^{-3} \text{ Fe}^{2+}$  solution. The volume of  $\text{Fe}^{2+}$  (aq) required for the titration was  $18.0 \text{ cm}^3$

- I) Write balanced chemical equations for all the reactions taking place above.
- II) Calculate the concentrations of  $\text{Cr}^{3+}$  and  $\text{CrO}_4^{2-}$  in the <sup>initial</sup> solution.

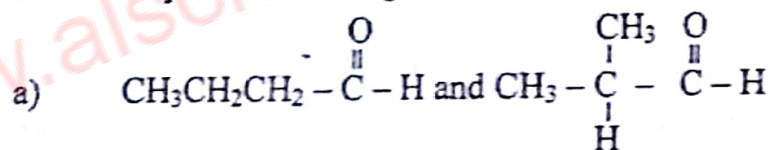
9) a) i) Using  $\text{CH}_3\text{CH}_2\text{OH}$  as the only organic compound, show how you would do the following conversion in minimum number of steps.



ii) Using  $\text{CH}_3\text{CH}_2\text{Br}$  as the only organic compound show how you would synthesize the following compound.



i) Show how you would distinguish the following compounds without using the Lucas reagent.



b)  $\text{CH}_2 = \text{CH}_2$  and  $\text{CH}_3\text{CH} = \text{CH}_2$

b) When sample of  $\text{FeCl}_3$  and  $\text{FeCl}_2$  was dissolved separately in water, two hydrated species A and B are formed (Not in order)

A and B are coordination compounds of Iron with a octahedral geometry containing  $\text{H}_2\text{O}$  and  $\text{Cl}^-$  as ligands.

A and B were separated and their atomic compositions were determined. The compounds were further analysed using the procedures given below.

### Analysis of A

When excess  $\text{AgNO}_3$  (aq) was added to  $100.00 \text{ cm}^3$  of a  $0.015 \text{ mol dm}^{-3}$  solution of A, a white precipitate, soluble in dilute ammonia, was obtained. The dry mass of this precipitate was  $4.305 \text{ g}$ .

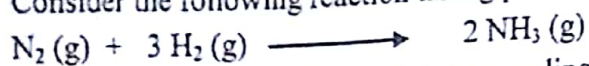
### Analysis of B

When excess  $\text{AgNO}_3(\text{aq})$  was added to  $100.00 \text{ cm}^3$  of a  $0.1 \text{ mol dm}^{-3}$  solution of A, a white precipitate that was soluble in dilute ammonia was obtained. The dry mass of the precipitate was  $4.305 \text{ g}$ .

(H - 1, O - 16, Cl - 35.5, Fe - 56, Ag - 108)

- Deduce the structure of hydrated complexes possible for A.
- Deduce the structure of hydrated complex for B.
- Out of the structures named in (i) above, find the correct structure of A.
- Write the electronic configurations of metal cations in compounds A and B above.

10) a) i) Consider the following reaction taking place at  $25^\circ \text{C}$ .



The following thermo chemical data regarding the above reaction are provided to you.

	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	$S^\ominus / \text{Jk}^{-1} \text{mol}^{-1}$
$\text{NH}_3(\text{g})$	-46	193
$\text{N}_2(\text{g})$	0	191.5
$\text{H}_2(\text{g})$	0	130.6

- Show whether the above reaction is spontaneous or not at this temperature.
- Calculate the temperature at which the above reaction reaches equilibrium.
- State any assumptions made in the above calculation.

i) I) Define "Enthalpy of solution"

II) Below are the data gathered for the experiment to find the enthalpy of solution of KCl at room temperature. (K = 39, Cl = 35.5)

Mass of KCl =  $3.725 \text{ g}$   
Volume of the solution =  $300 \text{ cm}^3$   
Temperature change =  $1.05^\circ \text{C}$   
Specific heat capacity of the solution =  $4200 \text{ J kg}^{-1} \text{ K}^{-1}$

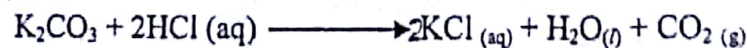
- Find the standard enthalpy of solution of KCl.
- State any assumptions made in the above calculation.

b) In order to determine the enthalpy change for the reaction,

$2\text{KHCO}_3(\text{s}) \longrightarrow \text{K}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$  the following experiment consisting of two steps was carried out at room temperature.

#### Step I

$1.98 \text{ g}$  of solid  $\text{K}_2\text{CO}_3$  was added to  $30.00 \text{ cm}^3$  of  $2.0 \text{ mol dm}^{-3}$  HCl acid solution. The temperature rise was  $5.2^\circ \text{C}$ .



#### Step II

$1.50 \text{ g}$  of solid  $\text{KHCO}_3$  was added to  $30.00 \text{ cm}^3$  of  $2.0 \text{ mol dm}^{-3}$  HCl acid solution. The temperature fall was found to be  $3.7^\circ \text{C}$ .



Specific heat capacity and density of HCl at constant pressure is  $4.18 \text{ J kg}^{-1} \text{ K}^{-1}$  and  $1 \text{ g cm}^{-3}$  respectively.

- Calculate the enthalpy changes (in  $\text{kJ mol}^{-1}$ ) of the reactions in steps I and II.
- Using thermochemical cycle and the values obtained in (i) above calculate the enthalpy change of the reaction.



- State assumptions and experimental errors that may occur during the experiment.
- State if there is a difference between the heat change and the enthalpy change of a given reaction at a given temperature. Explain your answer.

c) A fungicide shampoo contains Se. The experimental procedure of an experiment conducted to find the composition of Se, is given below.

$45.0 \text{ cm}^3$  (excess) of  $0.02 \text{ mol dm}^{-3}$  ammoniacal  $\text{AgNO}_3$  was added to  $5.0 \text{ cm}^3$  of the fungicide. Under the above conditions Se forms two precipitates as follows.



When excess  $\text{HNO}_3$  is added to the above mixture containing the two precipitates,  $\text{Ag}_2\text{Se}$  does not dissolve whereas  $\text{Ag}_2\text{SeO}_3$  does.

The above resultant solution was then titrated with  $0.04 \text{ mol dm}^{-3}$   $\text{KSCN}$  solution in order to find the remaining  $\text{Ag}^+$  concentration. Then  $\text{Ag}^+$  is precipitated as,  $\text{Ag}^+ (\text{aq}) + \text{SCN}^- (\text{aq}) \rightarrow \text{AgSCN} (\text{s})$

The volume of  $\text{KSCN}$  required for this was  $16.0 \text{ cm}^3$ .

- Write balanced chemical equation for the reaction taking place between  $\text{Ag}^+$  and Se in ammonium hydroxide medium.
- Calculate the composition of Se in the fungicide in  $\text{mol dm}^{-3}$ .

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