නව නිර්දේශය / New Syllabus

කො/විශාඛා විද්‍යාලය කොළඹ - 05
Co / Visakha Vidyalaya , Colombo - 05

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021
General Certificate of Education (Adv. Level) Examination, 2021

රසායන විද්‍යාව I
Chemistry I

3 වන වාර පරීක්ෂණය, 2021
3rd Term Test , 2021

පැය දෙකයි.
Two hours

13– ශ්‍රේණිය Grade -13

02 E I

- This paper consists of 8pages. (Periodic table is provided.)
- Answer all the questions.
- Use of calculators is **not allowed**.
- Write your **index number** in the space provided in the answer sheet.
- Follow the instructions given on the back of the answer sheet carefully.
- In each questions 1 to 50, pick one of the answer sheet with a cross (x) in accordance with the instructions given on the back of the answer sheet.

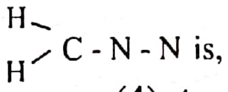
Universal gas constant,	R	$= 8.314\ \text{J mol}^{-1}\ \text{K}^{-1}$
Avogadro constant	N_A	$= 6.022 \times 10^{23}\ \text{mol}^{-1}$
Plank's constant	h	$= 6.626 \times 10^{-34}\ \text{Js}$
Velocity of light	C	$= 3 \times 10^{8}\ \text{ms}^{-1}$

(1) Consider the following discoveries with regards to structure of atom.

I. Conducting experiments for discovery of isotopes.
II. Deducing e/m ratio of electron.
III. Discovery of nucleus of atom..

Scientists involved in above discoveries (I, II, III) are respectively.

(1) Henry Becqueral, J.J. Thomson, Geiger
(2) J.J. Thomson, John Dalton, Ernest Rutherford.
(3) William Aston, J.J. Thomson, Henry Becqueral
(4) William Aston, J.J. Thomson, Ernest Rutherford
(5) Eugen Goldstein, J.J. Thomson, Geiger

(2) Number of resonance structures that can be drawn for  H_2C-N-N is,

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

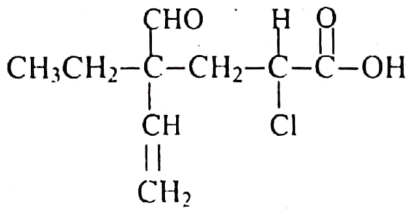
(3) Which of the following compound / ion has the least N -O bond length.

(1) NH_2OH (2) NO_2^+ (3) NO_2^- (4) FNO (5) NO_3^-

(4) Which of the following statement is **incorrect** regarding nuclide $^{52}_{24}Cr^{3+}$,

(1) Number of electron with quantum number $l = 0$ is 6 and $m_l = -1$ is 5.
(2) Number of electron with quantum number $l = 1$ is 4 and $m_l = -1$ is 5.
(3) Number of electron with quantum number $m_l = 0$ is greater than that of $l = 0$
(4) Number of electron with quantum number $m_l = +1$ and $m_l = -1$ are same in magnitude.
(5) Number of electron with quantum number $l = 0$ and $m_l = 0$ are same.

(5) IUPAC name of following compound is,



$$CH_3CH_2-\underset{\underset{\underset{CH_2}{||}}{CH}}{\overset{CHO}{C}}-CH_2-\underset{Cl}{\overset{H}{C}}-\overset{\overset{O}{||}}{C}-OH$$

(1) 2-chloro-4, 4-diethyl - 3 - formyl ypentanoic acid

(2) 2-chloro- 4- ethyl - 4 - oxopent- 5 - enoic acid

(3) 2-chloro- 4- ethyl - 4 - formyl- 5 - pentenoic acid

(4) 2-chloro-4-ethyl -4- formyl -5- hexenoic acid

(5) 2 - chloro - 4 - ethyl - 4- formylhexanoic acid

(6) Increasing order of radii of species P^{3-}, S^{2-}, Cl, K and K^+ is,

(1) $P^{3-} < S^{2-} < K < Cl < K^+$

(2) $S^{2-} < Cl < P^{3-} < K^+ < K$

(3) $Cl < K < P^{3-} < S^{2-} < Cl$

(4) $Cl < K < K^+ < S^{2-} < P^{3-}$

(5) $K^+ < Cl < K < S^{2-} < P^{3-}$

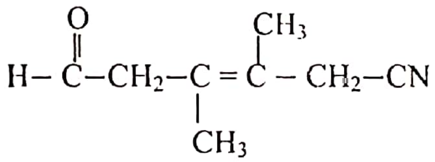
(7) Standard molar combustion enthalpy of graphite, dihydrogen and ethyne are respectively -394 kJmol^{-1},$-$ 286 kJ mol^{-1}and -1305 kJ mol^{-1}. Standard formation enthalpy of ethyne in kJ mol^{-1} is,

(1) -625 (2) -231 (3) $+231$ (4) $+625$ (5) -462

(8) 200 cm^3 of 0.4 mol dm^{-3} $BaCl_2$ solution and 300 cm^3 of 0.2 mol dm^{-3} NaCl solution are mixed. Cl^- ion concentration of this in mol dm^{-3} is,

(1) 0.12 (2) 0.18 (3) 0.44 (4) 0.65 (5) 0.87

(9) Which of the following statement is **incorrect** about given organic compound?



$$H-\overset{\overset{O}{||}}{C}-CH_2-\underset{CH_3}{C}=\overset{CH_3}{C}-CH_2-CN$$

(1) It shows diasteriomerism.

(2) Product given with dill. H_2SO_4 shows optical isomerism.

(3) IUPAC name is 3, 4 - dimethyl -6- oxohex-3-enenitrile.

(4) Product given with NaCN in acidic medium does not show optical isomerism.

(5) Product given with dill H_2SO_4, release CO_2 gas with Na_2CO_3

(10) Consider following reversible reaction.

$CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$ $\Delta H(-)$

1 mol from each gas is above reaction were added to rigid container at T K. At T K K_c of above system is 0.04. Which of the following statement is correct regarding this system.

(1) To attain equilibrium, reaction moves forward.

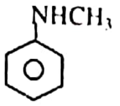
(2) At equilibrium $[CO_{(g)}] < [CO_{2(g)}]$

(3) With increasing of temperature Kc increases.

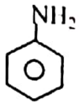
(4) At equilibrium $[H_2(g)] = [H_2O(g)]$

(5) At constant temperature, when volume of container is reduced to half, equilibrium shifts to forward.

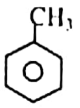
(11) The correct increasing order of bromination of following compounds with $Br_2/FeBr_3$ is,



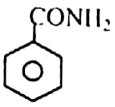
(a)



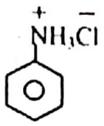
(b)



(c)



(d)



(e)

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

(12) The correct increasing order of bond angles in given species.

(1) $NCl_3 < ICl_4^- < COCl_2 < SiCl_4 < CN_2^{2-}$
(2) $NCl_3 < ICl_4 < SiCl_4 < COCl_2 < SiCl_4 < CN_2^{2-}$
(3) $ICl_4^- < NCl_3 < SiCl_4 < CN_2^{2-} < COCl_2$
(4) $ICl_4^- < SiCl_4 < NCl_3 < CN_2^{2-} < COCl_2$
(5) $ICl_4^- < NCl_3 < SiCl_4 < COCl_2 < CN_2^{2-}$

(13) Hydrogenation enthalpy of cyclohexene is () is −120 $kJmol^{-1}$. Resonance enthalpy of benzene is 150 $kJ\ mol^{-1}$. What is the hydrogenation enthalpy of benzene,

(1) -510 $kJ\ mol^{-1}$
(2) -269 $kJ\ mol^{-1}$
(3) -210 $kJ\ mol^{-1}$
(4) -30 $kJ\ mol^{-1}$
(5) +30 $kJ\ mol^{-1}$

(14) Purity of H_2SO_4 acid solution is 16%. If 60.0cm^3 of 0.1 $moldm^{-3}$ NaOH was used to neutralize 25.0 cm^3 from this acid solution, what is the density of acid, (H = 1, O = 16, S = 32)

(1) 0.024 gcm^{-3}
(2) 0.072 gcm^{-3}
(3) 0.960 gcm^{-3}
(4) 1.240 gcm^{-3}
(5) 1.460 gcm^{-3}.

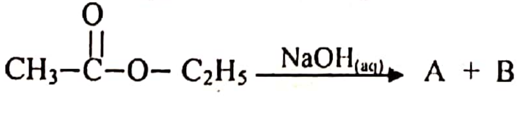
(15) A_2 and B_2 gases are mixed in volume 1:3 ratio at 700K and 200×10^5 Pa pressure. This was allowed to reach following equilibrium.

$A_2(g) + 3B_2(g) \rightleftharpoons 2AB_3(g)$

If $AB_{3(g)}$ volume percentage is 15% at equilibrium, what can be Kp. .

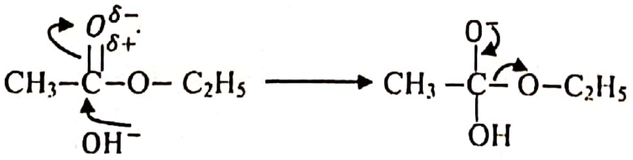
(1) $2.04 \times 10^{-7}\ Pa^{-2}$
(2) $4.06 \times 10^{-9}\ Pa^{-2}$
(3) $1.02 \times 10^{-15}\ Pa^{-2}$
(4) $2.04 \times 10^{-15}\ Pa^{-2}$
(5) $3.05 \times 10^{-15}\ Pa^{-2}$

(16) A student suggested following mechanism for reaction.

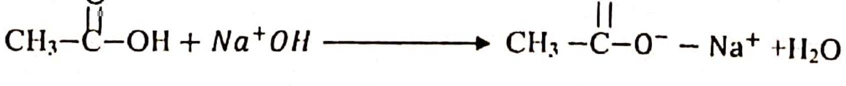


$$CH_3-\overset{O}{\overset{||}{C}}-O-C_2H_5 \xrightarrow{NaOH_{(aq)}} A + B$$

Step 1



Step 2



$$CH_3-\overset{O}{\overset{||}{C}}-OH + Na^+OH \longrightarrow CH_3-\overset{O}{\overset{||}{C}}-O^- - Na^+ + H_2O$$

Step 2 $\quad C_2H_5O^- + NaOH \longrightarrow C_2H_5\overset{-}{O}\overset{+}{Na} + OH^-$

Which of the following steps is /are correct.

(1) Step 1 only
(2) Step 2 only
(3) Step 3 only
(4) Only 1 and 3 steps
(5) All 1,2 and 3 steps

(17) At 450°C following equilibrium was achieved.

$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$

When forward reactions is considered what can be magnitude of ΔH and ΔS.

(1) $\Delta H = \Delta S = 0$
(2) $\Delta H > 0 , \Delta S > 0$
(3) $\Delta H < 0, \Delta S > 0$
(4) $\Delta H > 0, \Delta S < 0$
(5) $\Delta H < 0, \Delta S < 0$

(18) In mono atomic ion formed by a certain element has charge +3 and nucleon number is 62. In its nucleus neutron number is 1.21 times as number of protons. Its number of electron is,

(1) 25
(2) 26
(3) 27
(4) 28
(5) 34

(19) $Ag(s)$ / $AgCl_{(s)}$ electrode was immersed is 1 moldm^{-3} HCl aqueous solution and connected a hydrogen gas electrode without having liquid junction by 'a student, and formed an electro chemical cell. What is the correct notation of this cell.

$E^{\theta}\ H^+_{aq} / H_{2(g)} = 0.00V \quad E^{\theta}_{Agcl_{(s)}} / \ Ag_{(s)} = 0.22\ V$

(1) $Ag_{(s)} | AgCl_{(s)} \vdots H^+_{(aq,1moldm^{-3})} | H_{2(g)} | Pt_{(s)}$

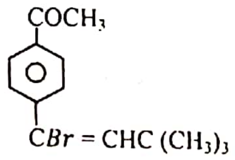
(2) $Pt_{(s)} | H_{2(g)} | H^+_{(aq,1moldm^{-3})} || Cl^-_{(aq,1moldm^{-3})} AgCl_{(s)} | Ag_{(s)}$

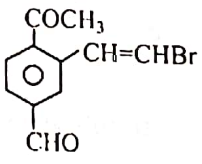
(3) $Pt_{(s)} | H_{2(g)} | H^+_{(aq,1moldm^{-3})} \vdots Cl^-_{(aq,1moldm^{-3})} AgCl_{(s)} | Ag_{(s)}$

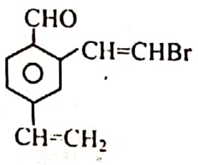
(4) $Pt_{(s)} | H_{2(g)} | HCl_{(aq,1moldm^{-3})} | AgCl_{(s)} | Ag_{(s)}$

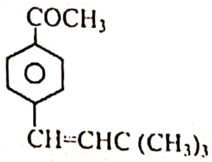
(5) $Ag_{(s)} | AgCl_{(s)} | HCl_{(aq,1moldm^{-3})} | H^+_{(aq,1moldm^{-3})} | H_{2(g)\ 1\ atm)}$

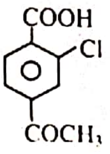
(20) Organic compound A decolorize Br_2 water and gives optically active compound with HBr. This product does not give a silver mirror with NH_3/ $AgNO_3$. A can be,

(1)


(2)


(3)


(4)


(5)


(28) Rate expression of reaction

$NO_{2(g)} + CO_{(g)} \longrightarrow NO_{(g)} + CO_{2\ (g)}$ is $R = K[NO_{2(g)}]^2$ which of the following is **incorrect** regarding this reaction.

(1) Unit of rate constant is $dm^3mol^{-1}s^{-1}$.
(2) Mechanism occurs via several steps.
(3) Graph of log value of rate Vs log value of concentration is a straight line with positive intercept and positive slope.
(4) When NO_2 concentration is increased by twice reaction rate get increased by twice.
(5) When $NO_{2(g)}$ concentration is halved reaction rate reduced by four times.

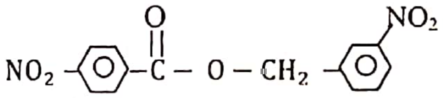
(29) Consider following reaction.

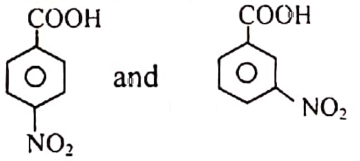
$2FeCl_{3(aq)} + Zn_{(s)} \longrightarrow 2\ FeCl_{2(aq)} + ZnCl_{2(aq)}$

It had been noticed that 25% of initial amount of Fe^{3+} ion converts to Fe^{2+}, when $Zn_{(s)}$ was added to 100 cm^3 of 0.18 $moldm^{-3}$ $FeCl_3$ solution after 3 minutes . In this reaction oxidation rate of Zn is,

(1) 0.0015 $moldm^{-3}\ s^{-1}$
(2) 0.0075 $moldm^{-3}\ s^{-1}$
(3) 0.25×10^{-3} $moldm^{-3}\ s^{-1}$
(4) 0.5×10^{-3} $moldm^{-3}\ s^{-1}$
(5) 1.25×10^{-4} $moldm^{-3}\ s^{-1}$

(30)

Reagents that necessary to synthesize,  from



(1) CH_3Cl, anhydrous $AlCl_3$ and $H^+/KMnO_4$
(2) $H^+ / KMnO_4$ and conc. H_2SO_4
(3) $LiAlH_4$, H_2O, and conc. H_2SO_4
(4) $H^+ / KMnO_4$ and $LiAlH_4$, H_2O,
(5) $LiAlH_4$, H_2O

- **Instructions for question no. 31 to 40.**

For each of the questions 31 to 40, four responses (a), (b), (c) and (d) are given. One or more of these is/are correct. Select the correct response / responses. In according to 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 (a) and (d) are correct
(5) If any other number or combination of response is correct

Summary of above Instruction.

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

(21) When temperature of a gas is reduced by keeping volume at constant value, pressure of gas decreases. What can be the reason for that,

(1) Increasing inter molecular attraction of molecules.
(2) Decreasing number of collisions per unit time between gas particles.
(3) Decreasing velocity of gas molecules
(4) Increasing distance between gas particles.
(5) At low temperature collisions are not perfect elastic.

(22) Inorganic compound X does not dissolve completely in dill. H_2SO_4 and gives dark colour gas. Also it gives green colour in flame test. X can be,

(1) $CuBr_2$
(2) $Ba(NO_2)_2$
(3) $Ba(NO_3)_2$
(4) $Pb(NO_2)_2$
(5) AgBr

(23) 20 cm^3 of 0.2 mol dm^{-3} $NaOH_{(aq)}$ solution was mixed with 50 cm^3 of 0.2 mol dm^{-3} $CH_3COOH_{(aq)}$ solution. What can be the pH value of resultant solution.
25°C K_a of CH_3COOH $= 1.8 \times 10^{-5}$ $moldm^{-3}$.

(1) 2.35
(2) 3.28
(3) 4.25
(4) 4.28
(5) 4.57

(24) Sample of 27.4 g of $NaHCO_3$ and Na_2CO_3 mixture was reacted with excess dill. HCl. Volume of released gas at standard temperature and pressure is 6.72 dm^3. Mass of Na_2CO_3 in mixture is,
(Na =23 , C = 12 , O = 16, H = 1)

(1) 3.2 g
(2) 8.4 g
(3) 10.6 g
(4) 16.8 g
(5) 17. 1 g

(25) pH of aqueous solution consist mono basic weak acid HA and its salt NaA is 6 when NaA salt concentration is 0.01 $moldm^{-3}$.
Ka of HA = 1×10^{-5} $moldm^{-3}$
What is the pH of aqueous solution made up of only above same HA.

(1) 3.0
(2) 4.0
(3) 4.5
(4) 5.0
(5) 6.0

(26) 5 A current was passed through aqueous solutions of $AgNO_3$, $CuSO_4$ and $Cr_2(SO_4)_3$ for 1 hour. The atomic ratio of elements Cu, Ag and Cr is (Cu = 64, Ag = 108 , Cr = 52)

(1) 2:1:3
(2) 1:2:3
(3) 2:3:6
(4) 2:6:3
(5) 3:6:2

(27) $AgCl_{(s)}$ gets dissolved in excess $NH_{3(aq)}$ and forms coordinate complex as in below reaction.

$$Ag^+_{(aq)} + 2NH_{3(aq)} \rightleftharpoons [Ag(NH_3)_2]^+_{(aq)}$$

$Kc = 1.7 \times 10^7$ ksp of AgCl $= 1.8 \times 10^{-10}$

What is the molar solubility of AgCl in 3.0 $moldm^{-3}$ $NH_{3(aq)}$ solution at 25°C.

(1) 1.34×10^{-4} mol dm^{-3}
(2) 2.68×10^{-4} mol dm^{-3}
(3) 0. 15 mol dm^{-3}
(4) 0.1 mol dm^{-3}
(5) 1.14×10^{12} mol dm^{-3}

(31) Select the correct statement/s regarding polymers.

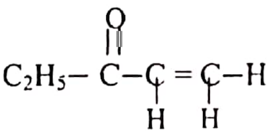
(a) During rulcanization of rubber, cross links are formed between polyisoprene chains by sulfur and elasticity increases.

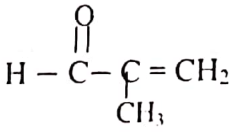
(b) Repeating unit of Teflon is $-(CF_2-CF_2)-$

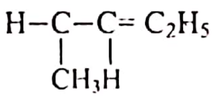
(c) Phenol formaldehyde and PVC are linear polymers.

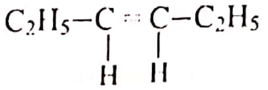
(d) Terylene is a thermosetting condensation polymer.

(32) A mixture of C_2H_5CHO and HCHO was reacted with aqueous NaOH and dehydrated. Which of the following can be condensation addition products present in the mixture.

(a) 
$C_2H_5-\overset{\overset{O}{\|}}{C}-\underset{H}{\underset{|}{C}}=\underset{H}{\underset{|}{C}}-H$

(b) 
$H-\overset{\overset{O}{\|}}{C}-\underset{CH_3}{\underset{|}{C}}=CH_2$

(c) 
$H-\underset{CH_3}{\underset{|}{C}}-\underset{H}{\underset{|}{C}}=C_2H_5$

(d) 
$C_2H_5-\underset{H}{\underset{|}{C}}=\underset{H}{\underset{|}{C}}-C_2H_5$

(33) Which of the following statement/ s is /are true regarding system which is at equilibrium?

(a) In the same temperature, same equilibrium can be achieved by initiating from any direction.

(b) At constant temperature, when inert gas is added, equilibrium point shifts to direction which has less molecules.

(c) In exothermic forward reaction, when temperature is increased, equilibrium point shifts to forward.

(d) When a catalyst is added, equilibrium point does not change.

(34) Which of the following reaction/s give/s a acyclic carbocation as intermediate.

(a) $C_6H_5CH_2Cl$ + dill. NaOH

(b) C_6H_5Cl + dill. NaOH

(c) $C_6H_5CH = CH_2 + HBr + R_2O_2$

(d) $C_6H_5\,C(CH_3)_2\,Cl + CH_3\,C \equiv \bar{C}\,\overset{+}{Na}$

(35) Which of the following statements is /are correct regarding electrolysis of NaCl aqueous solution using inert electrodes.

$2H^{+}_{(aq)} + 2e \longrightarrow H_{2(g)}$ $E^{\theta} = 0.00$ V

$2H_2O + 2e \longrightarrow H_{2(g)} + 2OH^{-}_{(g)}$ $E^{\theta} = -0.83$V

$Na^{+}_{(aq)} + e \longrightarrow Na_{(s)}$ $E^{\theta} = -2.71$ V

$Cl_{2(g)} + 2e \longrightarrow 2Cl^{-}_{(aq)}$ $E^{\theta} = +1.36$ V

$O_{2(g)} + 4H^{+}_{(aq)} + 4e \longrightarrow 2H_2O_{(l)}$ $E^{\theta} = +1.23$ V

a) since H^{+} ion concentration is smaller in aqueous solution, H_2 gas does not evolve from cathode.

b) initially O_2 evolves from anode

c) initially Cl_2 evolves from anode

d) when small amount of phenolphthalein is added, around cathode pink colour can be seen.

(36) Which of the following statement /s is /are **incorrect** regarding manufacture of H_2SO_4 from contact process.

(a) H_2S, SO_2 and SO_3 gases involve in contact process.

(b) To make SO_3 in large scale, according to $2SO_2 + O_2 \rightleftharpoons 2SO_3$ reaction, high pressure is used.

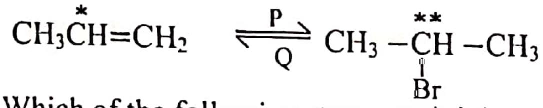
(c) Optimum temperature of 723 K is used to prevent lowering of production rate.

(d) In adsorption chamber, SO_3 and conc. H_2SO_4 are mixed in counter current principal method

(37) In aqueous solution of salt, precipitate is formed when $NH_{3(aq)}$ is added gets dissolved in excess $NH_{3(aq)}$. But for aqueous solution of that salt, gives a precipitate with $NaOH_{(aq)}$ which is insoluble in excess $NaOH_{(aq)}$. Cation/s of that salt can be,

(a) Ni^{2+} (b) Zn^{2+} (c) Al^{3+} (d) Co^{2+}

(38) Consider following reaction



$$CH_3\overset{*}{C}H{=}CH_2 \underset{Q}{\overset{P}{\rightleftharpoons}} CH_3-\underset{\substack{|\\ Br}}{\overset{**}{C}H}-CH_3$$

Which of the following statement/s is/are correct regarding P and Q reactions?

	P	Q
(a)	Electrophilic substitution	Elimination
(b)	Nuleophilic addition	Electrophilic substitution
(c)	Electrophilic addition	Elimination
(d)	Electro negativity of C^* decreases	Electronegativity of C^{**} increases

(39) Which of the following statement/s is /are true regarding root mean square speed (x) of a gas.

(a) When thermodynamic temperature of gas is doubled x^2 gets doubled

(b) When pressure of gas is doubled , x gets doubled.

(c) When volume of gas doubled, x becomes half.

(d) x^2 does not depends as gas type at same temperature.

(40) Which of the following gives a black precipitates upon mixing.

(a) $AgNO_{3(aq)}$, $NaCl_{(aq)}$ and $NH_{3(aq)}$

(b) $HCl_{(aq)}$, $Pb(NO_3)_{2(aq)}$ and $H_2S_{(g)}$

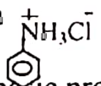
(c) $HCl_{(aq)}$, $CuSO_{4(aq)}$ and $Na_2S_{(aq)}$

(d) $FeCl_{3(aq)}$, $AgNO_{3(aq)}$ and $NH_{3(aq)}$

- **Instructions for question no. 41 to 50.**

In question no. **41** to **50**, 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) and (5) that best fits the two statements and mark appropriatly 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.	Fe^{3+}, was mixed with acidic KI and when excess $Na_2S_2O_3$ is added to that , system under goes decolourization.	Fe^{3+} reacts with KI to release I_2 and solution turns brown.
42.	25°C for any aqueous solution $pk_w = 14$	At 25°C , for pure water always pH = pOH = 7
43.	A mixture of acetone and $CHCl_3$ forms a non ideal solution with negative deviation.	When acetone and $CHCl_3$ are mixed, H bonds are formed.
44.	Ideal gas can not be liquefied at high pressure by lowering temperature.	When a real gas is above its critical temperature, can be liquefied by compressing.
45.	When HBr is added to but-1-ene with R_2O_2 , product shows enantiomerism.	Product formed when but-1-ene,is reacted with HBr is polar medium , shows enantiomensm.
46.	Nernst distribution law can't be applied to system formed by dissolving HCl in $CHCl_3$ and H_2O.	In two immiscible solvents when solute concentration is very law Nernst distribution law can't be applied.
47.	Cork is the main reducing agent in blast furnace.	In blast furnace cork acts as a fuel.
48.	When  $\overset{+}{N}H_3\overset{-}{Cl}$ reacts with aqueous NaOH , a gas with basic property is given out.	Ammonium salts give ammonia gas with aqueous NaOH
49.	In an elementary reaction always rate constant does not equal to rate.	In an elementary reaction, even though reaction rate depends on initial reactant concentration, rate constant, is independents from that.
50.	In photo chemical smog, atomic O react with O_2 to give O_3.	In photo chemical smog high energy UV dissociates O_2 gas into atomic O.

නව නිර්දේශය / *New Syllabus*

විශාඛා විද්‍යාලය කොළඹ 05
Visakha Vidyalaya, Colombo 05

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021
General Certificate of Education (Adv. Level) Examination, 2021

රසායන විද්‍යාව II
Chemistry II

13 ශ්‍රේණිය , තුන්වන වාර පරීක්ෂණය 2021 දෙසැම්බර්
Grade 13 , 3rd Term Test December 2021

පැය තුනයි.
Three hours

02 S II

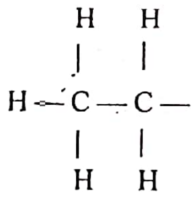
අමතර කියවීම් කාලය විනාඩි 10 කි.

Name:..**Grade:**

Part A – Structured Essay (Pages 02 – 10)

- * Use of calculators is not allowed.
- * Answer all the questions.
- * Write your answer in the space provided below each question.
- * Please note that the space provided is sufficient for the answer and that extensive answers are not expected.

In answering questions 4 and 8, you may represent alkyl groups in a condensed manner.

eg 

$$H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-$$

may be shown as CH_3CH_2-

Part B and Part C – Essay (Pages 11 - 19)

- * Answer four questions selecting not more than two questions from each part.
- * At the end of the time allocated for this paper, the answers to 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 Part B and C of the question paper from the Examination Hall.

Universal gas constant R = 8.314 J mol^{-1} K^{-1}
Avogadro constant N_A = 6.022 x 10^{23} mol^{-1}
Plank's constant h = 6.626 x 10^{-34} Js
Velocity of light C = 3 x 10^8 m s^{-1}
Faraday constant F = 96500 Cmol^{-1}

Part	Q. NO.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	

Final Marks

In numbers	
In Letters	

Part A - Structured Essay

✻Answer all four questions. Each carries 10 marks.

1. (a) Consider following elements, answer the questions given below.

Li, N, O, F, Mg, Al, Si, S, Cl, Xe

(i) The element which has highest second ionization energy..

(ii) Element which form a linear oxide by sp^2 hybridization ....

(iii) Element which forms a dimer chloride in gaseous phase. ....

(iv) Pair of elements which form a molecule that has octahedral geometry ....

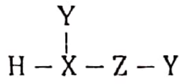
(v) When product/s formed by burning the element/s in air are dissolved in water, they/it give/s a gaseous product. Identify element/s. ....

(vi) Pair of elements that form a compound having highest enthalpy of lattice.

....

(3.0 marks)

(b) The skeleton of the molecule $HXZY_2$ formed by combining elements X, Y, Z is given below.



$$H-\overset{\overset{\displaystyle Y}{|}}{X}-Z-Y$$

A compound formed by combining X and Y of this molecule shows bleaching effect and chloride of Z hydrolyses giving a weak acid and a weak base. Identify elements X, Y, Z.

(i) X- .... Y - ....

Z - ....

(ii) Using **true symbols** of identified elements, draw stable Lewis dot- dash structure for the above molecule in given box.

(iii) Except drawn stable Lewis dot-dash structure, draw two more resonance structures; A and B for this molecule. Draw the least stable structure in given box B.

A

B

(iv) Draw stable Lewis structure of above molecule mentioning geometrical distribution around X and Z atoms.

(v) Complete the following table considering X and Z atoms of above molecule.

	X	Z
VSEPR pair		
Electron pair geometry		
Shape		
Hybridization		

(4.0 marks)

(c) Arrange following in **ascending order** of the property indicated in parentheses.

(ii) N_2, N_3^-, N_2H_4. N_2H_2 (N–N bond length)

................<................<................<................

(iii) CO_2, HCOOH, HCOH , HCN (C electronegativity of C)

................<................<................<................

(iv) SiO_2, NO, Cl_2O_7, P_2O_5 (melting point)

................<................<................<................

(v) NH_3, PH_3, PF_3, NF_3 (bond angle)

................<................<................<................

(vi) Pb, Cu, I, Ag (ratio between neutrons protons in nucleous)

................<................<................<................

100

(3.0 marks)

2. (a) The element A belongs to s-block in periodic table. When A is reacted with hot water, it evolves colourless and odourless gas B and form a white colour compound, C. When A is burnt in air, it forms compounds D and E. When E is reacted with water, compound C is produced and gas F is evolved. The gas F converts red litmus to blue. The element A is used to prevent the corrosion of iron. Its sulphate is water soluble.

(i) Identify metal A

....

(ii) Identify substances B, C, D, E and F.

B - .... C- ....

D - .... E- ....

F - ....

(iii) When metal A is reacted with conc HNO_3 it gives N_2H_4, nitrate of metal and H_2O. Write the balanced chemical equation.

....

(iv) Mention any other use of metal A other than one mentioned above.

....

....

(v) Giving chemical formulae of hydrides of the elements in period that A belongs to, indicate the acidity and basicity of these hydrides.

....

....

(5.0 marks)

(b) Five test tubes labeled as A to E contain $LiNO_3$, NH_4Cl, $NaNO_3$, NH_4NO_3, and $(NH_4)_2Cr_2O_7$ (not in order). The heat decomposition experiments and observations to identify these are given below.

Compound	**Observation**
A	An acidic, but not a diatomic molecular gas evolved
B	Two gases are evolved. When these two gases are passed to $AgNO_3$ solutions separately, one gas gives a white precipitate and other dissolves the precipitate further.
C	Forms a green residue
D	Colourless and odourless gas evolves and when Mg strip is burnt in it, gives a white residue.
E	Neutral but not a bimolecular gas evolves

(i) Identify A, B, C, D and E.

A - .... D- ....

B - .... E- ....

C- ....

(ii) Write down balanced chemical equations for heat decomposition reactions for each of the compound.

....

....

....

....

....

(iii) Write down balanced chemical equations for the reaction of compound C with dil. NaOH.

....

....

(5.0 marks)

(b) $X_{2(g)} + Y_{2(g)} \rightleftharpoons 2XY_{(g)}$

At 25°C, according to above reaction. rate constant of forward reaction is K_f, $1.7 \times 10^{-19}\ mol^{-1}\ dm^3 s^{-1}$ and rate constant of decomposition of XY is K_r, $2.4 \times 10^{-21}\ mol^{-1}\ dm^3 s^{-1}$.

(i) Find the equilibrium constant of above equilibrium system.

....

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(ii) When 0.5 mol of XY is added to a rigid vessel at 25°C the system reaches to new equilibrium at 100°C. Then, it is observed that 0.05mol of Y exists.

(I) Find K_c of the system at 100°C.

....

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(II) Explain whether the reaction is an exothermic reaction or endothermic reaction, according to the answers in (i) and (ii) above.

....

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....

100

(4.0 marks)

4. (a) A, B, C are structured isomers having chemical formula C_4H_9N. A shows diastereomerism. B shows enantiomersim. All three compounds; A, B, C decolourize bromine water.
When all these compounds A, B, C get reacted with $NaNO_2$, and dil HCl, products D, E, F can be obtained. Only F does not show stereoisomerism. D, E, F does not give orange precipitates with 2,4 - DNP.
When D, E, F are treated with PCC, they form G,H, I respectively. When G, H, I are reacted with 2,4-DNP they give orange precipitates. Only H does not give a silver mirror with tollen's reagent.
When the products obtained by catalytic hydrogenation of G, H, I are reduced by $NaBH_4$; G and I give same product J. H gives K. K shows enantiomerism.

3. (a) The reaction that forms $HI_{(g)}$ by adding $H_{2(g)}$ and $I_{2(g)}$ is an exothermic reaction and it happens in two steps as follows.

Step 1 $I_{2(g)} \underset{R_r}{\overset{\text{fast } R_f}{\rightleftharpoons}} 2I_{(g)}$

Step 2 $H_{2(g)} + 2I_{(g)} \xrightarrow{\text{slow}} 2HI_{(g)}$

Activation energy of forward reaction - E_{a_f}
Activation energy of backward reaction- E_{a_r}
Forward reaction -Rate constant - K_1
Second reaction -Rate constant - K_2
Activation energy of second reaction - E_{a_2}
Equilibrium constant - K_C

(i) What is the overall reaction that forms HI?

....

(ii) According to the rate determing step, what is the rate expression?

....

(iii) If the rate constant for overall reaction is K, deduce $K_C = \frac{K}{K_2}$.

....

....

....

....

....

....

(iv) The relevant reaction for (i) is a bimolecular reaction / trimolecular reaction. **(Underline the correct answer.)**

(v) Draw energy profile relevant to the reaction. Mention initial reactants, final products, intermediates, activation energies E_{a_f}, E_{a_r} and E_{a_2} transition states TS_1 and TS_2 on that energy profile.

(vi) Drawing the structures at TS_1 and TS_2 states, mark the bonds that breaking and forming appropriately.

(6.0 marks)

(i) Draw the structures of A, B, C in the boxes below.

A B C

(ii) Draw the structures of D, E, F in the boxes below.

D E F

(iii) Draw the structures of G, H, I in the boxes below.

G H I

(iv) Draw the structures of J, K in the boxes below.

J K

(v) Mention the type of constitutional isomerism in between J and K.

....

....

....

....

(vi) Draw the structures of the products P and Q which can be obtained by H in following reactions.

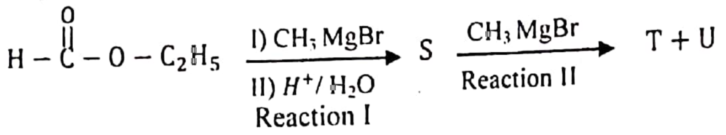
$$\boxed{} \xleftarrow{C_2H_5NH_2} \mathbf{H} \xrightarrow[II)\ H^+/H_2O]{I)\ C_2H_5MgBr} \boxed{}$$

P Q

(4·2 marks)

(b) i) Complete following three reaction sequences, drawing structures of compounds S, T, U, V, W, X and giving reagents / catalysts M, N in given boxes.

Sequence I



$$H-\overset{\overset{O}{\|}}{C}-O-C_2H_5 \xrightarrow[\text{II) } H^+/H_2O]{\text{I) } CH_3MgBr} S \xrightarrow[\text{Reaction II}]{CH_3MgBr} T + U$$

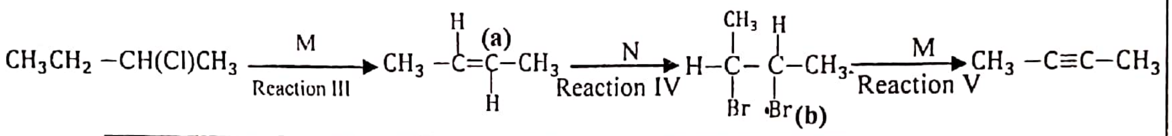
Reaction I

S

T

U

Sequence II

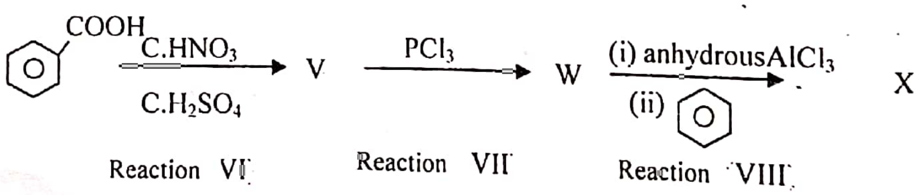


$$CH_3CH_2-CH(Cl)CH_3 \xrightarrow[\text{Reaction III}]{M} CH_3-\underset{H}{\overset{H}{C}}=C-CH_3 \text{ (a)} \xrightarrow[\text{Reaction IV}]{N} H-\underset{Br}{\overset{CH_3}{C}}-\underset{Br}{\overset{H}{C}}-CH_3 \text{ (b)} \xrightarrow[\text{Reaction V}]{M} CH_3-C\equiv C-CH_3$$

M

N

Sequence III



V

W

X

(ii) Selecting one of the reactions among I-VIII, give one example for each of the following type of reactions.

I. acid -base reaction. ....

II. elimination reaction ....

(5.0 marks)

(iii) Write down the mechanism to obtain (b) using (a) mentioned in sequence II.

....

....

....

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....

....

(0.8marks) 100

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Co/ Visakha Vidyalaya, Colombo - 05

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General Certificate of Education (Adv. Level) Examination, 2021

රසායන විද්‍යාව II
Chemistry II

13 ශ්‍රේණිය , Grade 13

3 වාර පරීක්ෂණය 2021 දෙසැම්බර්
3^{rd} Term Test 2021 December

02 E II

※ Universal gas constant R = $8.314\ \text{J mol}^{-1}\text{K}^{-1}$

※ Avogadro's constant N_A = $6.022 \times 10^{23}\ \text{mol}^{-1}$

Part B - Essay

- **Answer only two questions. (Each carries 15 marks)**

5. (a) At 300K ammonium Hydrogen sulphide attains following equilibrium.

$$NH_4HS_{(s)} \rightleftharpoons NH_{3(g)} + H_2S_{(g)} \quad \text{—— (1)}$$

Pure $NH_4HS_{(s)}$ was introduced to rigid container which has O_2 gas at 300K at 1×10^5 Pa pressure. after reaching equilibrium at 300K, total pressure of system (1) became 3×10^5 Pa.

(i) Calculate Kp for above reaction at 300 K.

(ii) When system was heated to 600 K , other than above (1) reaction, following reaction also occurs.

$$4NH_{3(g)} + 3O_{2(g)} \rightleftharpoons 2N_{2(g)} + 6H_2O_{(g)} \quad \text{—— (2)}$$

When the system reaches equilibrium total pressure became 7×10^5 Pa . When anhydrous $CoCl_2$ was added pressure decreased to 6.8×10^5 Pa.

(I) Calculate Kp for equilibrium (1) at 600 K.

(II) Predict the enthalpy of equilibrium(1) as exothermic or endothermic.

(III) Calculate Kp for equilibrium (2) at 600 K.

(9.0 marks)

(b) $100\ cm^3$ of $CHCl_3$, $100\ cm^3$ of $0.1\ mol dm^{-3}$ HCl and $100\ cm^3$ of $NH_{3(aq)}$ solution were mixed and allowed to separate layers. After separation of layers, $10\ cm^3$ of $CHCl_3$ layer was titrated with $0.01\ mol dm^{-3}$ HCl solution. Burette reading at end point is $20.0\ cm^3$ · pH of aqueous layer at 25°C is 8 and distribution coefficient of NH_3 in water and $CHCl_3$ is 20.

(i) What is the concentration of NH_3 in $CHCl_3$ layer.

(ii) What is the concentration of NH_3 in aqueous layer.

(iii) Calculate K_b of $NH_{3(aq)}$ at $25^\circ C$

(iv) Find out concentration of NH_3 in original solution. **(6.0 marks)**

6. (a) (i) Standard electrode potentials of elements X and Y at different oxidation states are given below.

$X^{4+}_{(aq)} + 2e \longrightarrow X^{2+}_{(aq)} \quad E^{\theta} = +0.60 \text{ V}$

$X^{2+}_{(aq)} + 2e \longrightarrow X_{(s)} \quad E^{\theta} = -1.00 \text{ V}$

$Y^{2+}_{(aq)} + e \longrightarrow Y^{+}_{(aq)} \quad E^{\theta} = +0.13 \text{ V}$

$Y^{2+}_{(aq)} + e \longrightarrow Y_{(s)} \quad E^{\theta} = +1.2 \text{ V}$

Find out

(i) Net reaction

(ii) Standard notation

(iii) Standard electro motive force of electro chemical cells formed according to following I and II instances.

(I) Electro chemical cell made up of standard $y^{2+}_{(aq)} / y^{+}_{(aq)}$ half cell and standard $x^{4+}_{(aq)} / x^{2+}_{(aq)}$ half cell using Pt electrodes.

(II) Electro chemical cell made up of standard $x^{2+}_{(aq)} / x_{(s)}$ half cell and standard $y^{+}_{(aq)} / y_{(s)}$ half cell.

(ii) Draw a diagram of electro chemical cells. According to A and B cell reactions Label.

(I) anode

(II) cathode

(III) movement of electron in the diagram.

$$\left.\begin{array}{ll} (A)\ Cr_{(s)} + Sn^{4+}_{(aq)} \longrightarrow Cr^{3+}_{(aq)} + Sn^{4+}_{(aq)} \\ (B)\ H_{2(g)} + Br_{2(aq)} \longrightarrow H^{+}_{(aq)} + Br^{-}_{(aq)} \end{array}\right\} \text{not balanced}$$

(8.0 marks)

(b) (i) Aqueous solution of 1dm^3 consist 2×10^{-3} of $Mn^{2+}_{(aq)}$ and 1×10^{-2} mol $Cu^{2+}_{(aq)}$. This was acidified with 0.02 mol dm^3 HCl solution and saturated with H_2S gas. Water solubility of H_2S is 0.34 gdm^{-3} and its concentration is independent from other species in medium. Using a suitable calculation, show which ions will precipitate.

k_{a_1} H_2S $= 1 \times 10^{-7}$ mol dm^{-3}

$k_{sp,Mns}$ $= 5 \times 10^{-10}$ mol^{2}dm^{-6}

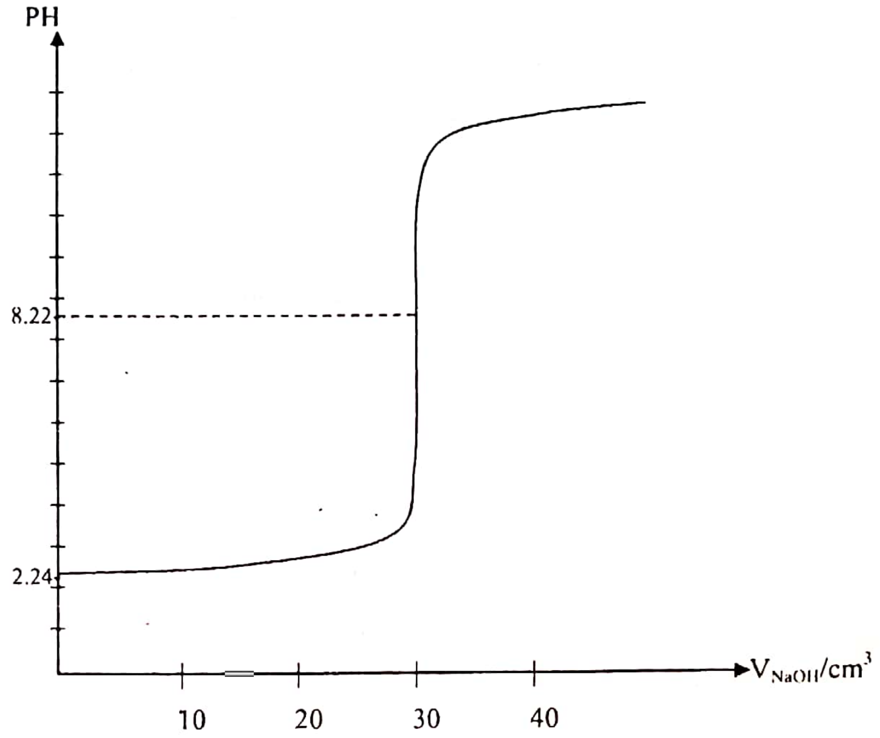
k_{a_1} H_2S $= 1 \times 10^{-14}$ mol dm^{-3}

$k_{sp,Cus}$ $= 8.5 \times 10^{-36}$ mol^{2}dm^{-6}

(ii) If there is cation which does not precipitate, calculate the [H$^+$] ion required to precipitate that.

(c) At 25 °C, 20 cm^3 of mono basic weak acid was taken into titration flask and titrated with 0.1 moldm^{-3} NaOH with solution. pH curve for this titration is given below.

(25 °C $K_w = 1 \times 10^{-14}$ mol^{2}dm^{-6})



(i) Considering pH of equivalence point of this titration, predict the strength of acid as weak or strong used in this titration. (No need to do a calculation)

(ii) Calculate concentration of mono basic acid.

(iii) Calculate dissociation constant of acid using pH at equivalence point.

(iv) Calculate pH of solution when 15.0cm^3 of NaOH is added.

(v) When 1.0cm^3 of 0.1 mol dm^{-3} HCl is added to system at (iv) , state does pH gets increased, decreased or remain unchanged. Explain your answer.

(vi) Find out new pH of solution formed when 10.0cm^3 of 0.1 mol dm^{-3} HCl was added to solution at equivalence point.

(7.0 marks)

7. (a) Consider following reaction at 25 °C

$PbCl_{2(s)} \longrightarrow Pb^{2+}_{(aq)} + 2Cl^{-}_{(aq)}$

Following data for ΔH_f^θ and ΔS^θ at 25 °C

	ΔH_f^θ / kJmol^{-1}	ΔS^θ / Jmol^{-1}K^{-1}
PBCl$_{(s)}$	−359	136
$Pb^{2+}_{(aq)}$	−1.7	10.5
$Cl^{-}_{(aq)}$	167	57

(i) Does this reaction is spontaneous at 25 °C. Explain by a suitable calculation.

(ii) At T°C this is spontaneous calculate minimum possible value for T.

(iii) State assumptions used in part (ii) calculation. **(4.0 Marks)**

(b) (i) At temperature T °C, A and B form a binary ideal solution. When its at equilibrium with its vapour, molar fractions of A and B in vapour phases is Y_A and Y_B and that in liquid phase is X_A and X_B. At this temperature saturated vapour pressure of A and B are respectively P_A^0 and P_B^0. Show that

$$Y_A = \frac{P_A^0 X_A}{P_A^0 XA + P_B^0 X_B}$$

(ii) At 60°C benzene and toluene form a binary ideal solution. When its at equilibrium with its vapour, molar ratio of benzene and toluene is 2 : 3 in liquid phase. At 60 °C saturated vapour pressure of benzene and toluene are 5×10^4 Pa and 2×10^4 Pa.

(I) Calculate molar fraction of benzene and toluene at vapour phase.

(II) Calculate total pressure of vapour phase when its at equilibrium.

(III) Considering above calculations and given information,
Draw composition vapour diagram of this mixture at 60°C and mark

(A) saturated vapour pressure of benzene

(B) saturated vapour pressure of toluene

(C) Total pressure in part (II) **(5.0 marks)**

(c) Solution X has 4 metal cations. Following tests were carried out to identify these cations.

	Test	Observations
(1)	Excess NaOH was added to part of solution X.	Precipitate is formed (P_1)
(2)	Filtrate of (1) was treated with drop wise addition of dill. HCl	Precipitate is formed (P_2)
(3)	P_2 precipitate was separated and excess NH_3 was added.	Precipitate gets dissolved
(4)	P_2 precipitate was mixed with excess NH_3.	Coloured solution (S_1) and a precipitate (P_3) are formed
(5)	$P_3$was dissolved in dill. HCl and NH_4SCN was added to that .	Blood red solution is formed
(6)	Above coloured solution S_1in (4) was reacted with excess HNO_3 and H_2S gas was bubbled.	Black precipitate (P_4) is formed.
(7)	To filtrate in (6), conc HCl was added.	Blue colour solution (S_2) is formed.

(i) Identify four cations in solution X.

(ii) Write chemical formula of precipitates P_1, P_2, P_3 and P_4

(iii) Identify compound in step 5 that gives observation.

(iv) Write chemical formula of coordinate complexes in coloured solution S_1 and S_2 and write their IUPAC names.

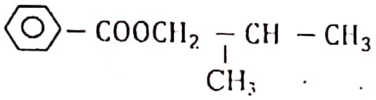
(v) Coordinate complex in solution S_2 forms ion with octahedral geometry with oxalate ion. Draw the structure of this ion.

(6.0 marks)

Part C - Essay

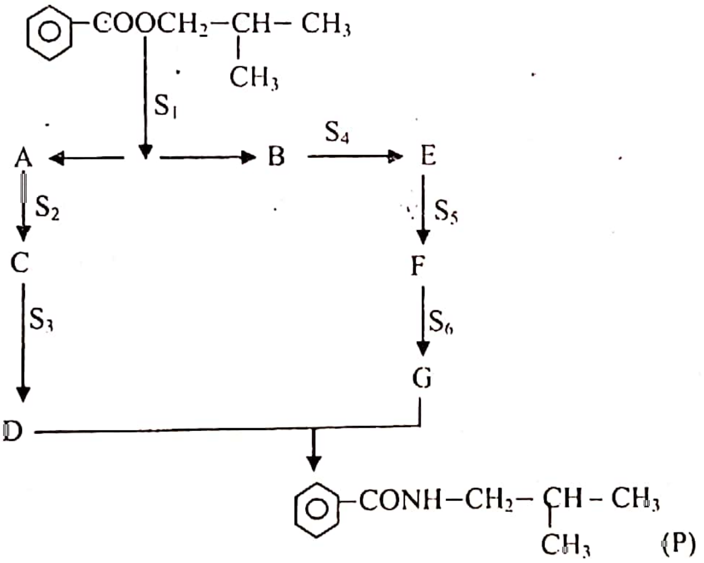
- **Answer only two questions. (Each carries 15 marks)**

8. (a) Using



as the only organic compound following reaction sequence is used to synthesize compound (P)

Complete this reaction sequence by drawing structures of compound A, B, C, D, E, F and G and writing selected reagents S_1 to S_7 from the given list.

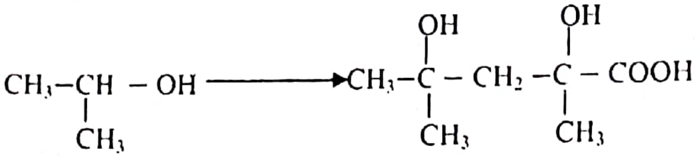


Chemical List

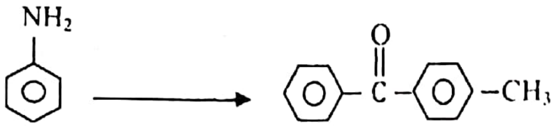
$NaOH_{(aq)}$, H_2SO_4, PCl_5, $H^+/KMnO_4$, $LiAlH_4$, Dry ether, NH_3

(7.5 marks)

(b) How to carry out following conversions with out using more than 4 steps.

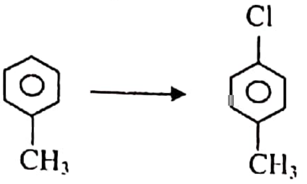
(i) 

$$CH_3-CH(CH_3)-OH \longrightarrow CH_3-C(OH)(CH_3)-CH_2-C(OH)(CH_3)-COOH$$

(ii) 

(3.0 marks)

(c) Consider following reaction.



(i) Identify reagents and reaction conditions to get done this reaction.

(ii) Write mechanism for above step. **(3.0 marks)**

(d) State which one is more basic out of ethyl amine and ethanamide giving reasons. **(1.5 marks)**

9\. (a) A solid sample of mineral X has , FeS, Cu_2S and inert material. To determine mass percentage of each substance following procedure was used.

4.0 g of sample X was reacted completely using 44.00 cm^3 of 1.0 $moldm^{-3}$ $KMnO_4$ in acidic medium. During this SO_2, Mn^{2+} , Fe^{3+} and Cu^{2+} are formed. Under this condition formed SO_2 does not react with $KMnO_4$. Then SO_2 was boiled off.

Resultant solution is above after expel of SO_2, was treated with excess solid KI. Liberated Iodine was titrated with 1.0 $moldm^{-3}$ $Na_2S_2O_3$ solution. Required volume, for complete reaction was 40.00 cm^3. (Cu = 64 , S =32 , Fe = 56)

(i) Write balanced chemical equations for reaction both titrations.

(ii) Find out mass percentages of FeS and Cu_2S in the mineral X.

(iii) State indicators used in each titration.

(8.0 marks)

(b) Compound A is a salt of d block element. It gets dissolved in water to give coordinate complex B which is coloured.

When $AgNO_3(aq)$ is added to B solution, white precipitate of C is formed. Its insoluble in dill. HNO_3. When $BaCl_{2(aq)}$ is added to solution B, gave a precipitate. Solution B does not response to chlorine water test.

When $NH_{3(aq)}$ is added to solution B coloured precipitate D is formed. But it is insoluble in excess $NH_{3(aq)}$. When H_2S gas is passed to solution B, coloured precipitate E is formed which is not black. But solution B does not give precipitate with H_2S is acidic medium.

(i) Identify salt A.

(ii) Write electronic configuration of d block metal cation in A.

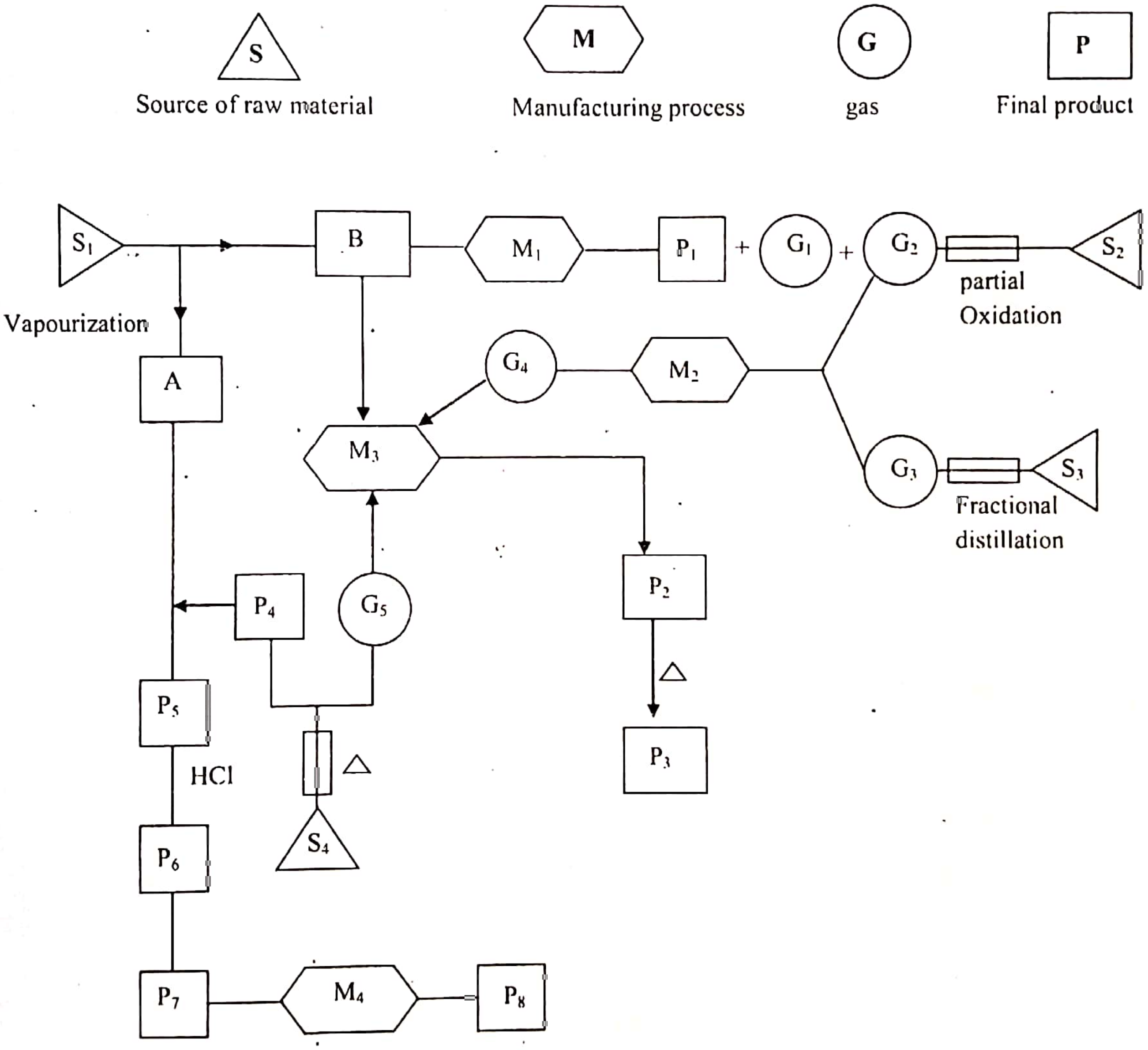
(iii) Write chemical formula of B, C, D and E.

(iv) When D is exposed to air, give the formula and colour of product that formed.

(v) Write balanced chemical equation for reaction in part (iv) above.

(vi) Above reaction in part (iv) is used in quantitative analysis method of determining certain water quality parameter. Give the name of analytical method and water quality parameter. **(7.0 marks)**

10. (a) Following diagram is a flow chart of manufacture of compounds of sodium and nitrogen.



(i) What are the sources of raw material/s given as S1, S2, S3 and S4.

(ii) State what are A and B that can be obtained from source S_1

(iii) State remanufacturing process M_1, M_2, M_3 and M_4

(iv) What are the gases G_1, G_2, G_3, G_4 and G_5

(v) Identify products P_1, P_2, P_3, P_4, P_5, P_6, P_7 and P_8

(vi) Give reaction conditions relevant to M_2 manufacturing process.

(7.0 marks)

(b) Liquid petroleum is popular as a house hold fuel as its easy to use.

(i) What are the main constituent of liquid petroleum gas contained in house hold gas cylinder.

(ii) Which chemical substance is used to identify if there is a leakage in liquid petroleum gas while in use.

(iii) During emission of gases given in parts (i) and (ii) above, composition of air changes. State two environmental problems cause by this.

(iv) Write two long term detrimental circumstances cause by environmental problem that occur due to gas given in (ii) above.

(4.0 marks)

(c) Environmentalist state that concentration of heavy metals increases in water due to excessive usage of agro chemicals for Agricultural works in upcountry area.

(i) Write 3 heavy metals that can release to water due to agricultural works.

(ii) Stat two most practicable units that can be used to express heavy metal content in a water sample.

(iii) "A student says that conductivity is the most suitable method as a water quality parameter when expressing heavy metal composition in water" Do you agree with this statement. Explain.

(iv) State the definition chemically given for heavy metals.

(v) State two effects cause by presence of heavy metals to drinking water for children.

(4.0 marks)

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Visakha Vidyalaya , Colombo –05