

දකුණු පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව
தென் மாகாணக் கல்வித் திணைக்களம்
Southern Provincial Department of Education

අධ්‍යාපන පොදු සහතික පත්‍ර (උසස් පෙළ), 13 ශ්‍රේණිය, පළමු වාර පරීක්ෂණය, 2019 නොවැම්බර්
General Certificate of Education (Adv. Level), Grade 13, First Term Test, November 2019

රසායන විද්‍යාව I
Chemistry I

02 E I

පැය දෙකයි
Two hours

Instructions:

- A periodic table is provided.
- This paper consists of ten pages.
- Answer all questions.
- Write your name or **index number** in the space provided in the answer sheet.
- Follow the instructions given on the back of the answer sheet carefully.
- In each 1 to 50, pick one of the answer which is **correct or more appropriate** among the given answers (1), (2), (3), (4), (5) and mark on the answer sheet **with a cross (×)** in accordance with the instructions given on the back of the answer sheet.

Universal gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
Avagadro's constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
Velocity of light $c = 3 \times 10^8 \text{ m s}^{-1}$
Planck's constant $h = 6.626 \times 10^{-34} \text{ J s}$

01. Number of electrons, protons and neutrons in the molecule $^{35}_{17}\text{Cl}^{37}_{17}\text{Cl}$ respectively given in

- (1) 17, 17, 36 (2) 34, 34, 72 (3) 34, 34, 38
(4) 17, 17, 35.5 (5) 34, 34, 71

02. Which of the followings is the strongest reducing agent?

- (1) Na (2) Na^+ (3) K^+ (4) Zn (5) H

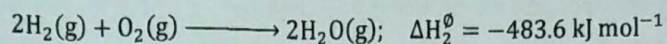
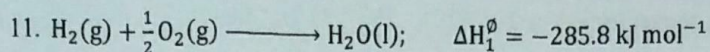
03. Which of the followings reacts with acidified potassium iodide solution?

- (1) HBr (2) FeCl_2 (3) H_2S (4) K_2O_2 (5) Cr_2O_3

04. The oxidation states of active C atom in the molecules CH_3CHO and CH_3COOH respectively given in,

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

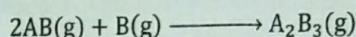
05. What is the IUPAC name of the compound $\text{CH}_3 - \text{C} \equiv \text{C} - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_2\text{OH}$?
- (1) 5-hydroxy-4-oxo-2-pentyne (2) 5-hydroxy-2-pentyn-4-one
 (3) 1-hydroxy-2-oxo-3-pentyne (4) 1-hydroxy-3-pentyn-2-one
 (5) 2-oxo-3-pentyn-1-ol
06. Calculate the Ba^{2+} ion concentration in mol dm^{-3} when 100 cm^3 of $0.25 \text{ mol dm}^{-3} \text{ Ba}(\text{NO}_3)_2$ and 100 cm^3 of $0.20 \text{ mol dm}^{-3} \text{ Na}_2\text{SO}_4$ solutions mixed together.
- (1) 0.025 (2) 0.125 (3) 0.05 (4) 0.25 (5) 0.0125
07. Which of the followings consist of two acidic oxides?
- (1) $\text{Mn}_2\text{O}_3, \text{CrO}_3$ (2) $\text{CrO}, \text{Mn}_2\text{O}_7$ (3) $\text{Cr}_2\text{O}_3, \text{MnO}_2$
 (4) $\text{MnO}_2, \text{CrO}_2$ (5) $\text{CrO}_3, \text{Mn}_2\text{O}_7$
08. A solid compound undergo thermal decomposition and a green colour precipitate obtained. The compound could be,
- (1) $\text{Cu}(\text{NO}_3)_2$ (2) $\text{Ni}(\text{NO}_3)_2$ (3) NiCO_3 (4) BaCrO_4 (5) $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$
09. An acetaldehyde was reacted with aqueous NaOH and the product was heated with a dilute acid. Then the product first reacted with CH_3MgBr and secondly underwent hydrolysis. The final product,
- (1) $\text{CH}_3\text{CH}=\text{CH}-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{OH}$ (2) $\text{CH}_3\text{CH}=\text{CH}-\overset{\text{CH}_3}{\text{C}}-\text{CHOH}$ (3) $\text{CH}_3\text{CH}=\text{CHCHO}$
 (4) $\text{CH}_2=\text{CHCH}_2-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{CHOH}$ (5) $\text{CH}_2=\text{CHCH}_2-\overset{\text{CH}_3}{\text{C}}-\text{OH}$
10. What is the most correct statement on Toluene ($\text{C}_6\text{H}_5\text{CH}_3$) ?
- (1) All carbon atoms are sp^2 hybridized
 (2) All carbon atoms on the same plane
 (3) All C - C bonds are equal in length
 (4) All C - C - C bond angles have a same value.
 (5) All C - H bond lengths are equal to each other.



Calculate the standard enthalpy change of the reaction $\text{H}_2\text{O}(\text{l}) \longrightarrow \text{H}_2\text{O}(\text{g})$ according to the above data in kJ mol^{-1} is,

- (1) -44.0 (2) +197.8 (3) -197.8 (4) -88.0 (5) +44.0

12. Following is an elementary reaction.



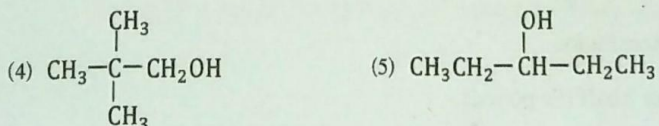
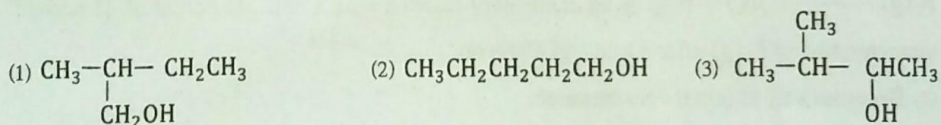
The enthalpy change of this reaction is $-a \text{ kJ mol}^{-1}$ and the activation energy of backward reaction is $b \text{ kJ mol}^{-1}$. The activation energy of the forward reaction is,

- (1) $a - b$ (2) $a + b$ (3) $b - a$ (4) $-b$ (5) a

13. When $\text{NH}_4\text{Cl}(\text{s})$ dissolves in water at 25°C , the temperature of the solution decreases. The correct symbols of ΔG , ΔH and ΔS values are given in,

	ΔG	ΔH	ΔS
(1)	-	+	+
(2)	+	-	-
(3)	-	-	-
(4)	-	+	-
(5)	+	+	+

14. The compound A having molecular formula $\text{C}_5\text{H}_{12}\text{O}$ does not show optical isomerism. A reacted with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and the product was reacted with NaBH_4 . Then compound A produced again. The structure of A is,



15. 6 g of a divalent metal chloride was completely converted to its sulphate. Then 7 g of the sulphate was produced. Calculate the relative atomic mass of the metal.

- (1) 24 (2) 40 (3) 56 (4) 79 (5) 88

16. Which of the followings is correct relevant to the SO_4^{2-} , SO_3^{2-} , $\text{S}_2\text{O}_3^{2-}$ ions?
- (1) The S atom with highest electronegativity value is in SO_3^{2-} ion.
 - (2) The highest S – O bond length available in SO_4^{2-} ion.
 - (3) All S atoms in above ions are sp^3 hybridized.
 - (4) SO_3^{2-} ion is pyramidal while the other two ions are tetrahedral in shape.
 - (5) The shapes of above ions respectively are tetrahedral, pyramidal and square planer.
17. Which of the following statements are true relevant to emission spectrum of hydrogen atoms?
- (1) The minimum wavelength in Lyman series is appropriate to the radiation occurs between $n = 2$ to $n = 1$ electron transition.
 - (2) Paschen series is positioned on ultraviolet region.
 - (3) The distance between adjacent spectral lines of a spectral series increases towards the frequency increasing direction.
 - (4) When an electron moves to a higher energy level from a lower energy level it absorbs energy.
 - (5) The energy relevant to each spectral line of the spectrum equals to the energy of a certain energy level of hydrogen.
18. $3\text{Br}_2(l) + 6\text{NaOH}(aq) \longrightarrow \text{NaBrO}_3(aq) + 5\text{NaBr}(aq) + 3\text{H}_2\text{O}(l)$
 The production rate of NaBr in the above reaction is $2.5 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$. Calculate the utilizing rate of NaOH in $\text{mol dm}^{-3} \text{ s}^{-1}$.
- (1) 2.5×10^{-2} (2) 3×10^{-2} (3) 0.5×10^{-2} (4) 5×10^{-2} (5) 2.08×10^{-2}
19. The ratio between square root velocities of O_2 and H_2 at 600 K is, ($\text{O} = 16, \text{H} = 1$)
- (1) 0.25 (2) 2.23 (3) 2.83 (4) 4 (5) 4.21
20. $\text{P}_2(g) \longrightarrow \text{Q}(g) + \text{R}(g)$ is an elementary reaction with a half life period of 45 seconds. The concentration of $\text{P}_2(g)$ after 3 min and 45 seconds is,
- (1) Becomes half of initial concentration.
 - (2) Becomes $\frac{1}{5}$ of initial concentration.
 - (3) Becomes $\frac{1}{32}$ of initial concentration.
 - (4) P_2 completely utilize after 2 half life periods.
 - (5) Cannot be determined as the order of the reaction is not given.

21. A rigid container with a volume of 41.57 dm^3 was filled with nitrogen gas in 33.6 dm^3 of atmospheric air at 27°C . Calculate the pressure of this container at 27°C which was filled with N_2 ?

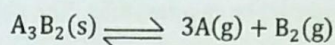
(Percentage of N_2 in atmospheric air is $80\% \left(\frac{V}{V}\right)$ and molar volume of N_2 gas is 22.4 dm^3)

- (1) $9 \times 10^4 \text{ Pa}$ (2) $7.2 \times 10^4 \text{ Pa}$ (3) $6 \times 10^4 \text{ Pa}$
 (4) $72 \times 10^4 \text{ Pa}$ (5) $9 \times 10^6 \text{ Pa}$

22. Consider $\text{XCl}_5 \rightarrow \text{XCl}_3 + \text{Cl}_2$. When concentration of XCl_5 increased in two times the rate of the reaction increases in 4 times. The true statement on the reaction is,

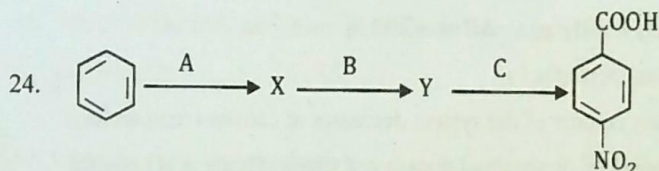
- (1) The order with respect to XCl_5 is 1. (2) The orders with respect to XCl_5 is 2
 (3) This is a single step reaction. (4) Above 1 and 2 are correct.
 (5) Above 2 and 3 are correct.

23. Solid A_3B_2 decomposes as follows,



Calculate the partial pressure of $\text{A}(\text{g})$ if the equilibrium constant for this reaction is K_P at this temperature,

- (1) $\left(\frac{K_P}{9}\right)^{\frac{1}{3}}$ (2) $\left(\frac{K_P}{27}\right)^{\frac{1}{4}}$ (3) $(3K_P)^{\frac{1}{4}}$
 (4) $\left(\frac{K_P}{3}\right)^{\frac{1}{2}}$ (5) The data given is not sufficient to calculate partial pressure.



The reagents A, B and C respectively in the above reaction sequence are,

- (1) conc HNO_3 / conc H_2SO_4 , CH_3Cl / An. AlCl_3 , H^+/KMnO_4
 (2) CH_3Cl / An. AlCl_3 , H^+/KMnO_4 , conc HNO_3 / conc H_2SO_4
 (3) CH_3Cl / An. AlCl_3 , conc HNO_3 / conc H_2SO_4 , H^+/KMnO_4
 (4) CH_3COCl / An. AlCl_3 , conc HNO_3 / conc H_2SO_4 , H^+/KMnO_4
 (5) conc HNO_3 / conc H_2SO_4 , CH_3COCl / An. AlCl_3 , H^+/KMnO_4

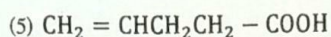
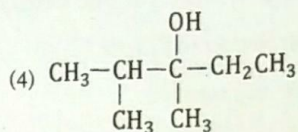
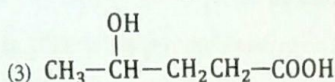
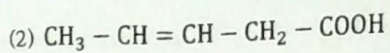
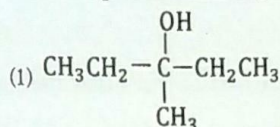
25. The true statement among the followings

- (1) Aldehydes are reduced by Tolleng's reagent.
 (2) Ketones cannot be oxidized to carboxylic acids by H^+/KMnO_4
 (3) The product $\text{R} - \overset{\text{O}}{\parallel} \text{C} - \text{O}^- \text{Cu}^+$ is bricks red in colour which is given by the reaction of aldehydes with Fehling's solution.
 (4) Aldehydes and ketones undergo self condensation reactions with dil. NaOH
 (5) Aldehydes and ketones can be separated and identified by 2,4-DNP.

26. A certain organic compound indicates the following properties.

- i. It reacts with PCl_5 .
- ii. It turns acidic KMnO_4 solution to colourless
- iii. It's optically active

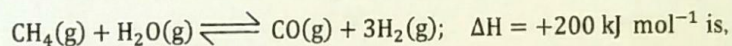
This compound could be,



27. A student bubbled chlorine gas in to a solution in a test tube. The chlorine changes its oxidation state up to +5 inside the solution. The solution could be.

- (1) dil. HNO_3
- (2) dil. NaOH
- (3) dil. NH_4OH
- (4) conc. NH_3
- (5) conc. KOH

28. True statement relevant to the equilibrium reaction



- (1) Forward trend of the reaction increases.
- (2) Forward trend increase when volume of the system decreases at constant temperature.
- (3) Forward trend can be increased by increasing temperature when volume is at constant
- (4) Backward trend increases when volume of the system increased at constant temperature.
- (5) Backward trend can be increased by applying a certain amount of $\text{CH}_4(\text{g})$ in to the system.

29. Which of the followings is false relevant to isomers?

- (1) Although the isomers of a compound show different physical properties their chemical properties are similar.
- (2) Position isomers are occurred y changing the position of atom group of atoms or functional group.
- (3) Geometrical isomerism is a type of stereo isomerism.
- (4) The isomers of same mirror images are introduced as enantiomers.
- (5) Stereo isomerism is introduced when different structural compounds occurred by arrangement of bonds in the space.

30. The enthalpy change which does not use to calculate the lattice enthalpy of NaCl is,

- (1) $\text{Na(s)} + \frac{1}{2}\text{Cl}_2(\text{g}) \longrightarrow \text{NaCl(s)}$ (2) $\text{Na(s)} \longrightarrow \text{Na(g)}$
 (3) $\text{Na(g)} \longrightarrow \text{Na}^+(\text{g})$ (4) $\frac{1}{2}\text{Cl}_2(\text{g}) \longrightarrow \text{Cl(g)}$
 (5) $\text{Cl(g)} \longrightarrow \text{Cl}^+(\text{g})$

- **For Question number 31 to 40**, one or more response/s among the given four responses (a), (b), (c) and (d) is/are correct. Select the correct response/responses according to the given instructions below and mark on

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

Summary of the above instructions

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

31. Which of the following two elements contain/s an unpaired electrons in their outermost shell?

- (a) Na, Cr (b) Cl, Cu (c) O, H (d) K, B

32. Consider the quantum group $n = 4$, $l = 0$, $m_l = 0$. Which of the following statement/s is/are true?

- (a) Relevant element belongs to s block
 (b) There are 2 elements which belong to same quantum group.
 (c) The relevant element gives a purple colour in flame test
 (d) This quantum group belongs to elements Cu and Cr

33. Consider a standardization titration of $\text{Na}_2\text{S}_2\text{O}_3$ solution using KIO_3 and KI. Which of the following/s is/are true? (Relative molecular mass of $\text{KIO}_3 = 214$)

- (a) 0.01 mol of KI is sufficient to react completely with 0.428 g of KIO_3 .
 (b) 0.428 g of KIO_3 reacts with 0.012 mol of $\text{Na}_2\text{S}_2\text{O}_3$.
 (c) Maximum amount of 0.06 mol of I_2 can be produced by 0.428 g of KIO_3
 (d) Starch is used as the indicator and endpoint colour change is colourless \longrightarrow blue.

34. Which of the following/s bleach/es coloured wet flower petals?

- (a) H_2O_2 (b) H_2O (c) KClO_4 (d) NaOCl

35. Which of the following pairs consist/s of complex ions which have similar colours?
- (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$ (c) $[\text{Cu}(\text{NH}_3)_4]^{2+}$ and $[\text{Ni}(\text{NH}_3)_6]^{2+}$
 (b) $[\text{MnCl}_4]^{2-}$ and $[\text{CoCl}_4]^{2-}$ (d) $[\text{FeCl}_4]^-$ and $[\text{NiCl}_4]^{2-}$
36. A 0.001 mol of a hydrocarbon gives 0.66 g of CO_2 , 0.27 g of H_2O by complete combustion. True statement/s on this hydrocarbon is/are,
- (a) It is an aromatic compound having molecular formula $\text{C}_{15}\text{H}_{15}$,
 (b) It's molecular formula is $\text{C}_{15}\text{H}_{30}$.
 (c) It is an aliphatic compound having the empirical formula CH_2 .
 (d) The empirical formula of it is CH .
37. Which of the following statement/s is/are correct relevant to alcohols?
- (a) Tertiary alcohols can be obtained by the reaction of Grignard reagent with esters.
 (b) As 2 lone pair electrons available on O atom alcohols are more alkaline than amine.
 (c) Primary alcohols give aldehydes with the reaction of H^+/KMnO_4
 (d) Secondary alcohols give ketones with the reaction of H^+/KMnO_4
38. Which of the following statement/s is/are true?
- (a) 2-chloro-2-methylpropane and 1-chloro-2-methylpropane respectively undergo nucleophilic substitution reactions by single and double step mechanism.
 (b) 2-chlorobutane shows enantiomer isomerism
 (c) The product given by the reaction with 2-chlorobutane and alcoholic KOH shows stereoisomerism.
 (d) 1-butene gives a white precipitate with ammonical silver nitrate.
39. Which of the following/s is/are not a/an assumption of molecular kinetic theory?
- (a) Gas molecules randomly move in different velocities.
 (b) The volume of gas molecules are negligible compared to the volume of the gas container.
 (c) Pressure of the gas occurs by the collisions of gas molecules on each other.
 (d) The mean kinetic energy of gas molecules depend only on temperature.
40. When considering the following system if volume is doubled at constant temperature.
- $$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$$
- (a) Reaction shifts to forward
 (b) Reaction shifts to backward
 (c) Partial pressure of all constituents increases
 (d) K_p does not change.

- For question number 41 to 50, two statements are given.

Select the most appropriate response to the two statements among the given responses (1), (2), (3), (4) and (5) and mark as appropriate according to the given instructions in the following table.

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. Alkyl halides are water insoluble	Alkyl halides are non-polar molecules.
42. Diazonium salts with phenol/ NaOH undergo electrophilic substitution reactions.	In electrophilic substitution reactions diazonium salts act as electrophiles.
43. Amines are alkaline then ammonia	Amines have alkyl groups which link with N atom.
44. Conc. H_4SO_4 turns blue coloured $CuSO_4$ crystal to white.	Conc. H_4SO_4 is a dehydrator.
45. AgI dissolves in conc. NH_3	Ag^+ ion forms $[Ag(NH_3)_2]^+$ complex with conc. NH_3 .
46. Following reaction is endothermic $A + B \rightarrow C + \text{energy}$.	The energy at final state is low than it's initial state of an endothermic reaction.
47. A brown colouration can be observed in a closed container which filled with $N_2O_4(g)$ with time.	An equilibrium reaction contains both reactants and products at constant temperature.
48. ${}^9_4Be + {}^4_2\alpha \rightarrow {}^{12}_6C + {}^1_0n$ Above indicates a balanced chemical reaction.	In the discovery of neutron by Rutherford α particles were bombarded on a sheet of Be.
49. The bond length in between any two carbons of benzene is with the same value	The all six carbon atoms in benzene are sp hybridized.
50. Boiling point variations of the following is, $CH_4 < NH_3 < H_2O < HF$	When electronegativity of an element is higher the strength of hydrogen bond of its hydrides also increases.

* * *

Periodic Table

1 H																2 He	
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uum	111 Uuu	112 Uub	113 Uut	...				

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

දකුණු පළාත් අධ්‍යාපන දෙපාර්තමේන්තුව
 தென் மாகாணக் கல்வித் திணைக்களம்
 Southern Provincial Department of Education

අධ්‍යාපන පොදු සහතික පත්‍ර (උසස් පෙළ), 13 ශ්‍රේණිය, පළමු වාර පරීක්ෂණය, 2019 නොවැම්බර්
 General Certificate of Education (Adv. Level), Grade 13, First Term Test, November 2019

රසායන විද්‍යාව II
 Chemistry II

02 E II

පැය 03 ටී
 Three hours

Index number:

- * Use of calculators is not allowed.
- * Avagadro's constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
- * Planck's constant $h = 6.626 \times 10^{-34} \text{ J s}$
- * Velocity of light $c = 3 \times 10^8 \text{ m s}^{-1}$
- * Universal gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

Part A - Structured Essay (2 -8 pages)

- * Answer all the questions on this 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 excepted.

Part B and C Essay (9 -13 pages)

- * Select two questions from each part and answer four questions from both parts.
- * At the end of the time allocated for this paper, tie the answers to the two parts A and B together so that part A is on the top and hand them over to the supervisor.
- * You are permitted to remove part B and C of the question paper from the examination hall.

For Examiners' use only

Part	Question Number	Marks obtained
A	01	
	02	
	03	
	04	
B	05	
	06	
	07	
C	08	
	09	
	10	
Total		
Percentage		

Final Mark

In numbers	
In letters	

Signature

Examiner	
Supervised by	

Part A – Structured Essay

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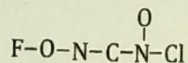
- Answer all four questions on this paper itself. (Each question carries 10 marks)

01. (a) Consider the first and second period elements of the periodic table. Fill the blanks (i) to (x) using the symbol of respective element only.

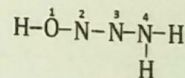
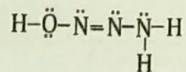
- (i) The element with highest first ionization energy
- (ii) The element which forms most stable diatomic molecule.
- (iii) Two elements which form electron deficient compounds
- (iv) The most electronegative element
- (v) An element which is in use for motor traffic signal
- (vi) The elements which directly use as a fuel
- (vii) The element with highest atomic radii
- (viii) The element with highest boiling point
- (ix) The element which shows highest oxidation state/ number
- (x) The nonmetallic element which forms the hydride with highest boiling point

(3.0 marks)

- (b) (i) The sketch of the $\text{FO}_2\text{N}_2\text{CCl}$ is as follows. Draw most acceptable Lewis dot dash structures and 2 other resonance structures. Write the word stable below the most stable structure.



- (ii) Consider the following Lewis dot dash structure. Atoms are numbered as given below.

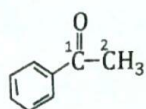


Complete the following table using the numbered atoms.

	O ¹	N ²	N ³	N ⁴
VSEPR pairs				
Electron pair geometry				
Shape				
Hybridization				

(see page three)

(iii)



Consider the C and O atoms numbered as 1 or 2 in the given molecule.

What are the atomic/ hybridized orbitals which participate for the following bonds.

${}^1\text{C}-\text{O}$ σ bonds

${}^1\text{C}-\text{O}$ π bonds

${}^1\text{C}-{}^2\text{C}$ σ bonds

(4.0 marks)

(c) Arrange the following according to the ascending order of given properties.

(i) COCl_2 , CO_2 , CO_3^{2-} (C - O bond length)

..... < <

(ii) $\text{Mg}(\text{NO}_3)_2$, $\text{Be}(\text{NO}_3)_2$, $\text{Ca}(\text{NO}_3)_2$ (Thermal decomposition temperature)

..... < <

(iii) PCl_4^+ , ICl_4^- , NCl_3 (Bond angle)

..... < <

(iv) Fe^{2+} , Mn^{2+} , V^{2+} (Number of unpaired electrons)

..... < <

(v) Mg, Na, Al (Second ionization energy)

..... < <

(vi) MgSO_4 , CaSO_4 , SrSO_4 (Solubility in water)

..... < <

(3.0 marks)

02. (a) P, Q and R are three consecutive nonmetallic elements which positioned on second period of the periodic table. P shows allotropy. One allotrope of P conducts electricity.

(i) Identify the elements P, Q and R.

P - Q - R -

(ii) Mention 2 crystalline allotropes of P

..... ,

(iii) Mention five stable oxidation states of element Q and write example (compound) for each.

Oxidation state**Example**

.....

.....

.....

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(see page four)

(iv) Mention the formula of oxoacid which derives from its highest oxidation state of element Q.

.....

(v) When this Oxo acid mentioned in (iv) in its concentrated state reacts with P. Write the balanced chemical equation for it.

.....

(vi) Write one use of Q and R each.

Q -

R -

(vii) I. Write formulae of two compounds formed by element R with hydrogen.

.....

II. Draw the structure of the compound which has a higher relative molecular mass among the given two above.

III. Write the balanced chemical equation for the reaction of the compound drawn in II with KI in acidic medium.

.....

(5.0 marks)

(b) A is a salt which formed by a s block element.

I. When salt A undergo thermal decomposition it evolved brown coloured gas (C) and a white residue (B)

II. A Yellow precipitate (D) was formed when K_2CrO_4 solution is added to aqueous solution of A.

III. Hydroxide of A is water soluble.

(i) Write chemical formulae of A, B, C and D

A - C -

B - D -

(ii) Write balanced chemical equations for the instances given as I and II.

I.

II.

(iii) Write balanced chemical equation for the reaction occurred in an aqueous solution of salt A with Al powder and NaOH solution.

.....

(iv) Mention a chemical test which can be used to identify the gas evolved in (iii)

.....

(v) Suggest a suitable experiment (which does not indicate here) to identify the anion in salt A.

.....

(5.0 marks)

100

03. Following indicates an experiment which was done by a student to determine the rate of reaction between $\text{Na}_2\text{S}_2\text{O}_3$ and HNO_3 acid.

Solutions were mixed according to the given table below in a beaker which was placed on a white sheet of paper which marked with a black coloured cross.

Further time taken for disappearance of black cross was measured for each instance. Readings are given in the following table.

Experiment No.	Volume of $0.15 \text{ mol dm}^{-3} \text{ Na}_2\text{S}_2\text{O}_3 \text{ (cm}^3\text{)}$	Volume of $3 \text{ mol dm}^{-3} \text{ HNO}_3 \text{ (cm}^3\text{)}$	Volume of $\text{H}_2\text{O (cm}^3\text{)}$	Time required to precipitate a constant amount of S/S
1	25.00	5.0	—	9.2
2	20.00	5.0	5.0	11.4
3	15.00	5.0	10.0	15.4
4	10.00	5.0	15.0	t

(i) Write balanced chemical equation for the reaction occurs.

.....

(see page six)

Do not write
any thing in
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(ii) Write a statement for the rate of the reaction using
the order with respect to concentration of $\text{Na}_2\text{S}_2\text{O}_3$ is m ,
the order with respect to concentration of HNO_3 is n ,
the rate constant for the reaction is k and
the rate of the reaction is (R)

.....

(iii) Calculate m the order with respect to the concentration of $\text{Na}_2\text{S}_2\text{O}_3$ using the data given in
the table.

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(iv) Deduce the n the order with respect to concentration of HNO_3 if the rate constant of the
reaction at $30\text{ }^\circ\text{C}$ is $3 \times 10^2\text{ s}^{-1}$.

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(v) Calculate the required time (t) to precipitate constant amount of S in experiment No. 4.

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- (vi) What is the reason to use a constant volume of HNO_3 acid with a high concentration for the above experiment?

.....

- (vii) What is the purpose of using water in experiment no 2 and 4?

.....

- (viii) Does the reaction between $\text{Na}_2\text{S}_2\text{O}_3$ and HNO_3 is a single step reaction? Explain briefly with reasons.

.....

(10 marks)

100

04. (a) A, B, C and D are organic compounds with molecular formula C_5H_{10} . They do not show stereo or enantiomer isomerism. The above compounds separately reacted with conc. H_2SO_4 and the products were hydrolysed. The same product E was given by B and D here. The products given by A and C were heated with anhydrous Al_2O_3 . Then A gave F. It shows stereo isomerism. And the product G was given by C.

- (i) Draw structures of A, B, C, D, E, F and G.

A	B	C
D	E	F
G		

(see page eight)

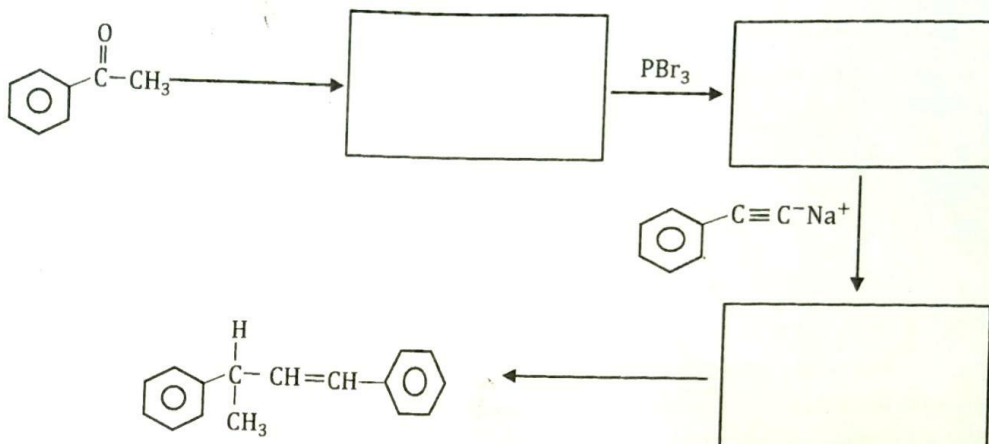
- (ii) Write a suitable experiment and its observation to separate and identify E from other compounds.

Experiment :

Observation:

(4.0 marks)

- (b) Indicate suitable reagents and conditions on the given arrows and the structures in given cages for the following reaction sequence.



(3.0 marks)

- (c) (i) Write the reaction between the alcohol $\text{CH}_3\text{CH}_2\text{OH}$ and HBr .

.....

- (ii) Select and write the reaction type as nucleophilic addition or nucleophilic substitution or electrophilic addition or electrophilic substitution.

.....

- (iii) Indicate the mechanism of the above reaction.

(3.0 marks)

100

Part B - Essay

Answer 4 questions only (Each question carries 15 marks)

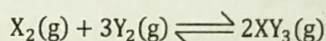
5. (a) (i) Deduce the relationship for an ideal gas using its pressure (P) temperature (T) density (d), Molar mass (M) and universal gas constant (R).
- (ii) An ideal gas exists at 27 °C and 1.02×10^5 Pa pressure in a 0.5 dm^3 volume. Relative molecular mass of gas is 44.

Calculate the mass of the gas which occupies this volume.

(4.0 Marks)

- (b) 4 mol of gas X_2 exists in a closed rigid container at 600 K. The pressure inside the container is 4×10^6 Pa. Gas Y_2 was inserted to the same container keeping the temperature as a constant until total pressure becomes 6×10^6 Pa. (RT at 600 K = $5 \times 10^3 \text{ J mol}^{-1}$)

- (i) Calculate the number of moles of Y_2 added to the container.
- (ii) Following equilibrium was reached at 842 K by the above system.



- I. Write the statements for the K_p and K_c for the above equilibrium reaction.
- II. It was found that equilibrium amount of XY_3 is 1 mol.
Calculate the number of moles of X_2 and Y_2 available in the mixture.
- III. Calculate K_p for the above equilibrium reaction.
- IV. Calculate K_c using the relationship between K_p and K_c
(RT at 842 K = $7 \times 10^3 \text{ J mol}^{-1}$)

(11.0 Marks)

6. (a) (i) Define standard enthalpy of neutralization of an acid.
- (ii) Followings are the enthalpy changes of some species at 25 °C.

Substance	HX(aq)	OH ⁻ (aq)	X ⁻ (aq)	H ₂ O(l)
$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	-320	-230	-320	-286

- I. Use the above data to calculate standard neutralization enthalpy of a weak acid HX(aq).
- II. Standard enthalpy change for the following reaction is -57 kJ mol^{-1} .
 $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$ Calculate the standard dissociation enthalpy of the weak acid HX

(4.0 Marks)

(see page ten)

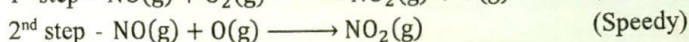
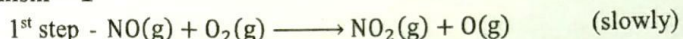
- (b) Consider the reaction $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{NO}_2(\text{g})$. Following table indicates an experiment carried out at 25°C to determine chemical kinetics of the above reaction.

Experiment	$[\text{O}_2]$ / mol dm^{-3}	$[\text{NO}]$ / mol dm^{-3}	Initial rate / $\text{mol dm}^{-3} \text{ s}^{-1}$
1	0.50	0.20	3.0×10^{-3}
2	0.50	0.40	6.0×10^{-3}
3	1.00	0.40	2.4×10^{-2}

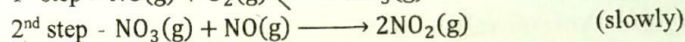
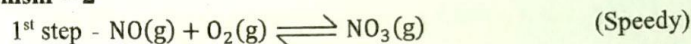
- (i) The order with respect to $\text{NO}(\text{g})$ and $\text{O}_2(\text{g})$ respectively are m and n . Calculate m & n .
 (ii) Use the values obtained in m and n above and write a statement for rate of the reaction.
 (iii) Calculate the rate constant K .
 (iv) Followings are the two reaction mechanisms presented by two students for the above reaction.

Do you agree with this reaction mechanism according to the rate statement of the reaction? Explain with reasons.

Mechanism - 1



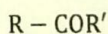
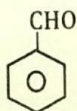
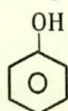
Mechanism - 2



- (v) If the reaction was carried out at 127°C suggest the rate of the reaction.
 (Increases/ Decreases) Explain your answer.

(10.0 Marks)

7. (a) (i) You are provided 4 bottles of unlabeled samples of the following compounds.



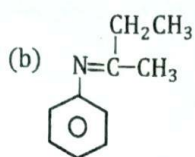
Separate and identify the above 4 using an ammonical AgNO_3 solution, Br_2 liquid and Brady's reagent only.

- (ii) Consider the evolved gas when water was added drop wise to an inorganic compound which led to an exothermic reaction in the school laboratory.

It is a hydrocarbon and it turns Br_2 liquid to colourless.

- I. Identify the evolved gas.
- II. Write balanced chemical equations for all proceeding reactions.
- III. Write relevant reaction which converts this gas to an aldehyde by a single step.
- IV. Produce $\text{CH}_3\text{COOC}_2\text{H}_5$ using the above aldehyde as the only available organic compound by 3 steps.
- V. Write the reaction mechanism relevant to the reaction of CH_3COCl with dilute NaOH .

(9.0 Marks)



The is an Imine. Synthesis this Imine using Anilene and ethanol as the only available organic compounds not exceeding 7 steps.

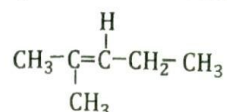
(6.0 Marks)

8. (a) X is an organic compound having molecular formula C_3H_6O

(i) X, reacts with (i) $LiAlH_4$ and (ii) H_2O to give a secondary alcohol Y.

Identify X and Y.

(ii) Synthesis the following compound using X as the initial compound in 3 steps.



(4.0 Marks)

(b) A is an organic compound having molecular formula $C_4H_{10}O_2$. When A undergo the following experiments the observations obtained are given below.

1. When Na is added to A, a gas evolved
2. Compound A did not react with NaOH
3. A has 2 carbon atoms which can show enantiomer isomerism.

(i) Draw the structure of A.

(ii) Use Butanal only as the available organic compound and synthesis compound A in 5 steps. Use the following reagents only for the synthesis.

$LiAlH_4$, dilute alkaline $KMnO_4$, HBr, H_2O , alcoholic KOH, conc. H_2SO_4

(5.5 Marks)

(c) (i) I. Formation of C_2H_6 can be formed as one of the final products of the reaction of CH_4 and Cl_2 in the presence of light energy.

Write the reaction mechanism of the above formation of C_2H_6 .

Show relevant electron transitions using half curved arrows.

II. Write the name/ type of the reaction mechanism occurred in the reaction between CH_4 and Cl_2 in the presence of sunlight.

III. Indicate the type of fission occurred in the above mechanism in the bonds of

(a) $Cl - Cl$ and

(b) $C - H$ in CH_4

(Indicate whether it is a homolytic or heterolytic fission)

(ii) Explain with reasons the variation of alkalinity nature of amines and alcohol.

(5.5 Marks)

9. (a) X is a solution which prepared by dissolving solid compounds in water. This solution contains two cations and two anions. This solution is green in colour.

Following experiments were carried out to identify ions in solution X and the relevant observations given are indicated below too.

Experiment	Observation
I. The solid compound X undergoes the flame test.	A purple flame obtained.
II. Few drops of Dil. H_2SO_4 was added to a certain portion of solution X and H_2O_2 was added too.	Solution Y in yellowish brown colour was obtained.
III. Aqueous NH_3 was added in excess to solution Y.	A reddish brown precipitate was obtained.
IV. Dil. HNO_3 and aq. AgNO_3 was added to a portion of solution X	A white precipitate dissolved in dil NH_3 was obtained.
V. Dil HCl was added to the solid compound mixture.	A reddish brown gas was evolved.

- (i) Identify the two cations and two anions in the solution X.
 (ii) Write balanced chemical equations for the experiments done and observations obtained in above II, III and IV

(5.0 Marks)

- (b) Following procedure was carried out to determine percentage of Iron in an alloy.

- I. 0.85 g of the sample of alloy was taken into a beaker. 5 cm^3 of conc H_2SO_4 was added to it and diluted with water up to volume of 50 cm^3 with care. Then beaker was closed and kept for a day. (**Alloy completely reacted with acid and then Iron converted to its minimum stable positive oxidation state here**)
- II. Then the solution was transferred to a 250 cm^3 volumetric flask and water was added up to the water mark level.
- III. 25.00 cm^3 of the above solution in II was taken to a titration flask and 5 cm^3 of H_3PO_4 acid was added to it. And it was titrated with 0.01 mol dm^{-3} KMnO_4 solution and the burette reading at the end point was 28.00 cm^3 ($\text{Fe} = 56$)
- (i) Write balanced chemical equations for all possible reactions in the above process.
 (ii) Mention the colour change of this titration.
 (iii) What is the indicator used in this titration. Mention the specific feature of it.
 (iv) Calculate the percentage of iron (w/w) in this alloy.
 (v) What is the task of H_3PO_4 in above III.

(7.0 Marks)

(c) Consider the oxo acids which formed by +1, +3, +5 and +7 oxidation states of chlorine.

- (i) Write the chemical formulae of above oxo acids.
- (ii) Draw Lewis structures of them.
- (iii) Write IUPAC names of the strongest and weakest acids among them.

(3.0 Marks)

10. (a) Write balanced chemical equations for all possible reactions in the following processes.

- (i) Heating K, Li and Al elements in a mixture of O_2 and N_2 gases.
- (ii) Reactions of NCl_3 , $SbCl_3$, NaH , CaC_2 and Mg_3N_2 with water.
- (iii) Thermal decomposition of compounds NH_4NO_2 , $(NH_4)_2CO_3$, $NaNO_3$ and $Mg(NO_3)_2$.

(5.0 Marks)

(b) Consider the following 3 processes.

- I. When conc KOH is added to a coloured aqueous solution of P a green coloured solution of Q was given.
- II. In the presence of H_2O_2 solution Q gave a brown precipitate R.
- III. R dissolved in conc. HCl and gave a colourless solution of S.

- (i) Identify compounds P, Q, R and S.
- (ii) Write balanced chemical equations relevant to above I, II and III.
- (iii) Write electronic configuration of the cation in the solution S.
- (iv) What can be observed if solution S is alkalined with dilute NH_3 ?
- (v) A portion of solution P was acidified with dil H_2SO_4 acid and gas H_2S was passed through it. Write the balanced chemical equation for the reaction occurs here.

(5.5 Marks)

(c) X is a d block element which belongs to the fourth period of the periodic table. X shows +2 \ stable oxidation state in combined state only. An aqueous solution of X^{2+} forms a precipitate with dilute NaOH which is dissolved in excess NaOH as well as conc. NH_3

- (i) Identify X.
- (ii) Mention the colour of X^{2+} aqueous solution.
- (iii) Write the colour and the formula of the precipitate formed when dil NaOH is added to X^{2+} aqueous solution.
- (iv) Write the formula and colour of the compound forms if excess NaOH is added to the above precipitate in (iii)
- (v) Conc. HCl is excessly added to X^{2+} aqueous solution. Write the formula and IUPAC name of the forming compound.

Mention the formula of the compound of which X^{2+} formed with conc NH_3 . (4.5 Marks)

Periodic Table

1 H																2 He	
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uum	111 Uuu	112 Uub	113 Uut	...				

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