

Grade 12 3rd
2019 July
Royal 10

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පාසැලේ නම: රාජාලය - කොළඹ
Royal College - Colombo

Royal College - Colombo 07

පාසැලේ අංකය: 07
Colombo 07 Royal College

පසුගිය වසරේ පරීක්ෂණයේ ප්‍රතිඵලය:
Last Term Test only - 2018

වසර: 12

රසායන විද්‍යාව I
Chemistry I

02 E I

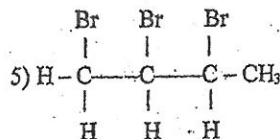
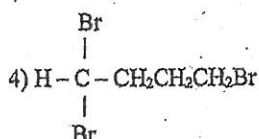
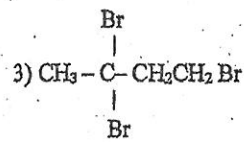
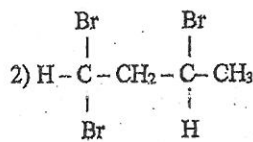
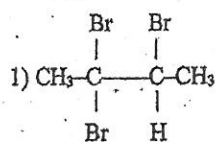
පරීක්ෂණ කාලය
Two hours

- ❖ This paper consists of 8 pages.
- ❖ 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 of the questions 1 to 50, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or most appropriate and mark your response on the answer sheet with a cross (X) in accordance with the instructions given on the back of the answer sheet.

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

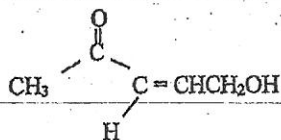
- 1) What is the number of orbitals containing electrons in a particular atom, that can exist in an atom with quantum numbers $n + l \leq 3$?
1) 4 2) 5 3) 6 4) 9 5) 14
- 2) Which of the following molecules is non polar?
1) C_2H_4 2) O_3 3) CHCl_3 4) N_2O 5) NF_3
- 3) Which of the following responses contain the species arranged in the order polar covalent, ionic and non polar covalent, according to the nature of bonds.
1) SiO_2 , CaO , I_2 2) CaO , SiO_2 , I_2
3) I_2 , CaO , SiO_2 4) CaO , I_2 , SiO_2
5) SiO_2 , I_2 , CaO
- 4) A mixture of PCl_5 and PCl_3 contains 17.91% phosphorous (P) by mass. The mass of PCl_5 in 10.0 g of this mixture is (P - 31, Cl - 35.5).
1) 6.03g 2) 12.0g 3) 10.2g 4) 5g 5) 8.25g
- 5) Which of the following compounds is most soluble in concentrated HCl ?
1) Ag_2S 2) PbCl_2 3) BaSO_4 4) CuS 5) AgI
- 6) A, B and C are three consecutive non transition elements in the periodic table. The standard first ionization enthalpies of A, B and C vary as $C < A < B$. Which of the following could be the valence shell configuration / common electron configuration of A?
1) $ns^2 np^1$ 2) $ns^2 np^2$ 3) $ns^2 np^3$ 4) $ns^2 np^4$ 5) $ns^2 np^5$
- 7) The IUPAC name of $\text{Na}_3[\text{Fe}(\text{CN})_6]$
1) Trisodium hexacyanidoferate(III) 2) Sodium hexacyanoiron(III)
3) Sodium hexacyanidoiron(III) 4) Sodium hexacyanidoferrate(III)
5) Sodium hexacyanidoironate(III)

- 8) Which of the following is the major product formed when $\text{H}-\text{C}\equiv\text{C}-\text{CH}=\text{CH}_2$ is treated with excess HBr ?



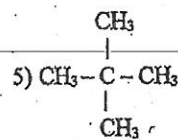
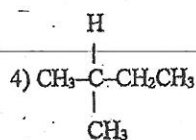
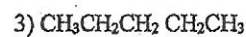
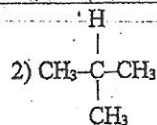
- 9) What is the number of linear isomers of molecular formula $\text{C}_4\text{H}_9\text{Cl}$?
- 1) 7 2) 8 3) 9 4) 10 5) 11

- 10) Which of the following correctly gives the IUPAC name of the compound.



- 1) 5-hydroxypent-3-en-2-one 2) 4-oxopent-2-en-1-ol
3) 5-hydroxy-1-methylpent-2-en-1-one 4) 5-hydroxy-2-oxopent-3-ene
5) 5-hydroxypentan-3-en-2-one

- 11) Which of the following compounds has the highest boiling point.



- 12) Which of the following statements is false regarding the ions N^{3-} , O^{2-} and F^- ?

- 1) Nuclear charge varies as $\text{N}^{3-} < \text{O}^{2-} < \text{F}^-$
2) They all have the same electron configuration.
3) The radii varies as $\text{N}^{3-} < \text{O}^{2-} < \text{F}^-$
4) The polarizability varies as $\text{F}^- < \text{O}^{2-} < \text{N}^{3-}$
5) Compounds containing these ions are formed when Li reacts separately with N_2 , O_2 and F_2 gases.

- 13) In which of the following reactions a disproportionation occurs?
- A: Decomposition of H_2O_2 in presence of sunlight.
 B: Reaction NO_2 gas with NaOH .
 C: Thermal decomposition of PbS_2O_3 .
 D: Reaction of KIO_3 with KI in acid medium.
- 1) only in A and B.
 2) only in A, B and C
 3) in all A, B, C and D
 4) only in A, C and D
 5) only in A
- 14) The gases A and B contain in the mole ratio 2 : 3, in a container of 5 dm^3 at the temperature T. A certain amount of this gas mixture was sent into another 1 dm^3 evacuated container at T, until the pressure of this container is P. After that, the gas A was added to the initial container until the pressure is P at the same temperature T. What is the mole fraction of the gas A in the initial container?
- 1) $\frac{3P}{5}$ 2) $\frac{4P}{5}$ 3) $\frac{11P}{25}$ 4) $\frac{12P}{25}$ 5) $\frac{13P}{25}$
- 15) What is the temperature (in Celsius) at which the mean square speed of a certain ideal gas at 127°C gets increased by 40%?
- 1) 178 2) 287 3) 511 4) 560 5) 784
- 16) $2\text{A(g)} + \text{B(g)} \rightleftharpoons \text{C(s)} + 2\text{D(g)}$
 Which of the following correctly gives the relationship between K_p and K_c of the above equilibrium.
- 1) $K_p = K_c$ 2) $K_p = K_c(RT)$ 3) $K_c = K_p(RT)$
 4) $K_p = K_c(RT)^2$ 5) $K_c = K_p(RT)^2$
- 17) Which of the following is false regarding the following system at the dynamic equilibrium
- $$\text{Fe}_{(\text{aq})}^{3+} + 6\text{SCN}_{(\text{aq})}^- \rightleftharpoons [\text{Fe}(\text{SCN})_6]^{3-}_{(\text{aq})}$$
- 1) The red colour intensity increases when a small amount of FeCl_3 is added.
 2) The red colour intensity increases when a small amount of NH_4SCN is added.
 3) The rate of the reverse reaction increases when the concentration of $\text{Fe}^{3+}_{(\text{aq})}$ increases.
 4) The rate of the forward reaction increases when the temperature is increased.
 5) The rate of the reverse reaction increases when the temperature is increased.
- 18) A certain amount of the gas A was added to an evacuated rigid vessel and allowed to reach the equilibrium as given below. The total pressure of the equilibrium mixture at T was $1 \times 10^5 \text{ Pa}$ and 60% of initial A has been dissociated.
- $$3\text{A(g)} \rightleftharpoons \text{B(g)} + \text{C(g)}$$
- The K_p value of the above equilibrium at the temperature T is,
- 1) $9.0 \times 10^{-5} \text{ Pa}^{-1}$ 2) $5.0 \times 10^{-6} \text{ Pa}^{-1}$ 3) $2.25 \times 10^{-6} \text{ Pa}^{-1}$
 4) $1.25 \times 10^4 \text{ Pa}^{-1}$ 5) $2.25 \times 10^5 \text{ Pa}^{-1}$

- 19) 23.05 g of $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$ was dissolved in water completely and excess of AgNO_3 solution was added. The dry mass of the precipitate formed here is,
(Cr - 52, Ag - 108, Cl - 35, O - 16, H - 1)
- 1) 14.5g 2) 14.35g 3) 28.70g 4) 43.05g 5) 33.85 g
- 20) 0.4 g of pure Fe_2O_3 was dissolved completely in dil. H_2SO_4 and the resultant solution was treated with excess KI. The volume of $0.2 \text{ mol dm}^{-3} \text{ Na}_2\text{S}_2\text{O}_3$ required to react with the liberated I_2 completely is ?
(Fe - 56, O - 16)
- 1) 10.0 cm^3 2) 12.5 cm^3 3) 20.0 cm^3 4) 25.0 cm^3 5) 50.0 cm^3
- 21) A brown coloured gas evolved when a certain solid mixture is heated. It was heated until the evolution of gases is ceased and the residue formed was treated with a small amount of dil. HCl . Here, the same brown coloured gas evolved again.
Which of the following is true regarding the initial solid mixture?
- 1) a bromide is present.
2) a bromate is present.
3) a group I nitrate is present.
4) a group I nitrate and a group II nitrate is present.
5) a group II nitrate and a nitrate of d - block is present.
- 22) In which of the following reactions, sulfur is not formed as a product?
- 1) $\text{SO}_2 + \text{H}_2\text{S} \longrightarrow$
2) $\text{H}_2\text{S} + \text{FeCl}_3 \longrightarrow$
3) $\text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{SO}_4 \longrightarrow$
4) $\text{H}_2\text{S} + \text{Br}_2 \longrightarrow$
5) $\text{H}_2\text{S} + \text{CrCl}_3 \longrightarrow$
- 23) Which of the following correctly gives the products formed when NH_3 gas is burnt in air?
- 1) N_2 and H_2O 2) NO and H_2 3) NO and H_2O
4) N_2O and H_2O 5) N_2 , NO and H_2O
- 24) Which of the following correctly gives the increasing order of the ionic character of the compounds given?
- 1) $\text{SrCl}_2 < \text{BaF}_2 < \text{NaI} < \text{CsF}$
2) $\text{NaI} < \text{CaF} < \text{SrCl}_2 < \text{BaF}_2$
3) $\text{NaI} < \text{SrCl}_2 < \text{BaF}_2 < \text{CsF}$
4) $\text{CsF} < \text{NaI} < \text{SrCl}_2 < \text{BaF}_2$
5) $\text{BaF}_2 < \text{SrCl}_2 < \text{NaI} < \text{CsF}$
- 25) Which of the following gives the highest number of different alkenes when treated with alcoholic KOH
- 1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ 2) $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$ 3) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{Br} \\ | \\ \text{CH}_3 \end{array}$
- 4) $\begin{array}{c} \text{Br} \\ | \\ \text{CH}_3-\text{C}-\text{CH}_2\text{CH}_2\text{CH}_3 \\ | \\ \text{CH}_2\text{CH}_3 \end{array}$ 5) $\begin{array}{c} \text{Br} \quad \text{CH}_3 \\ | \quad | \\ \text{CH}_3-\text{C} \quad \text{C}-\text{CH}_3 \\ | \quad | \\ \text{CH}_2\text{CH}_3 \quad \text{H} \end{array}$

- 26) Which of the following is false regarding NH_4NO_2
- 1) NH_3 is evolved when boiled with NaOH
 - 2) When powdered Al is added after boiling with NaOH , NH_3 is evolved again.
 - 3) A brown coloured gas is evolved when dilute HCl is added to the solid.
 - 4) N_2 is evolved when the solid is heated.
 - 5) The net dipole moment of both ions is zero when considered separately.
- 27) The aqueous solution of S contains three cations as nitrates. When H_2S is passed into a small portion of S, a black precipitate is formed. The filtrate obtained here is basified, a black precipitate and a white precipitate are formed. In presence of excess of NaOH , only the white precipitate is dissolved. The three cations in solution S are,
- 1) $\text{Ag}^+/\text{Ni}^{2+}/\text{Al}^{3+}$
 - 2) $\text{Ag}^+/\text{Cu}^{2+}/\text{Zn}^{2+}$
 - 3) $\text{Cu}^{2+}/\text{Ni}^{2+}/\text{Mg}^{2+}$
 - 4) $\text{Fe}^{3+}/\text{Ni}^{2+}/\text{Al}^{3+}$
 - 5) $\text{Ag}^+/\text{Zn}^{2+}/\text{Al}^{3+}$
- 28) Consider the reactions,
- $$\text{Ba}(\text{NH}_2)_2(1) + (\text{NH}_4)_2\text{SO}_4(1) \longrightarrow 4\text{NH}_3(1) + \text{BaSO}_4(s) \quad \Delta H^\circ = -a \text{ kJmol}^{-1}$$
- $$\text{Ba}^{2+}(1) + \text{SO}_4^{2-}(1) \longrightarrow \text{BaSO}_4(s) \quad \Delta H^\circ = -b \text{ kJmol}^{-1}$$
- the ΔH° of the reaction $\text{NH}_3(1) + \text{NH}_4^+(1) \longrightarrow 2 \text{NH}_3(1)$ is
- 1) $\frac{a-b}{2}$
 - 2) $\frac{b-a}{2}$
 - 3) $\frac{a+b}{2}$
 - 4) $a-b$
 - 5) $b-a$
- 29) A rigid container of volume V contains an equimolar mixture of C_2H_4 and N_2H_4 . Another rigid container of volume V contains C_2H_4 and N_2H_4 and the mole fraction of C_2H_4 is $1/3$. Two containers are connected using a tube with a negligible volume and temperature is brought to 400°K . The total mass of combined system and the partial pressure of C_2H_4 respectively are 27 g and $3 \times 10^5 \text{ Pa}$. What is the total pressure of the system. (C - 12, O - 16, N - 14, H - 1)
- 1) $8.0 \times 10^5 \text{ Pa}$
 - 2) $5.0 \times 10^5 \text{ Pa}$
 - 3) $4.0 \times 10^5 \text{ Pa}$
 - 4) $3.6 \times 10^5 \text{ Pa}$
 - 5) $2.0 \times 10^5 \text{ Pa}$
- 30) For the reaction $2\text{A(g)} \longrightarrow \text{B(g)}$, the rate constant at temperature T is $K = 2.8 \times 10^{-2} \text{ s}^{-1}$. Which of the following is false?
- 1) reaction is first order.
 - 2) the rate of the reaction when the concentration of A is $2 \times 10^{-2} \text{ mol dm}^{-3}$ is $5.6 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$
 - 3) the reaction is an elementary reaction.
 - 4) It is not necessary that the molecularity of the reaction be zero.
 - 5) the value of k increases with the increase of the temperature.

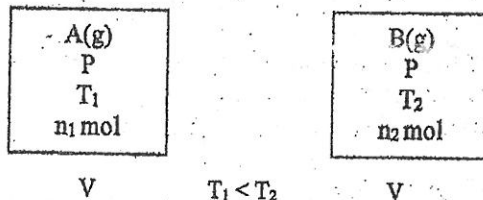
The instructions for the questions 31 to 40 are given below.

Summary of above instructions				
1	2	3	4	5
Only (a) and (b) correct	Only (b) and (c) correct	Only (c) and (d) correct	Only (d) and (a) correct	Any other response or combination of responses correct

- 31) The aqueous solution X containing cations, was acidified with dilute HCl and H_2S was passed through it. A clear solution was formed. Which of the following could not be present in X.

a) Co^{2+} b) Cu^{2+} c) Fe^{3+} d) Al^{3+}

- 32) Consider the following system.



The two rigid containers above contain the ideal gas A and the real gas B as given above. Which of the following is / are true.

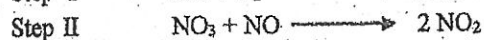
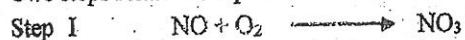
- a) The compressibility factor of the gas B, $Z < 1$.
 b) n_2 must be less than n_1 .
 c) The mean kinetic energy of a molecule of A is equal to that of a molecule of B.
 d) The Z of B must increase when the volume is decreased at constant temperature.
- 33) $\text{A} + \text{B} \longrightarrow \text{C} + \text{D}$
- Consider the above reaction. This reaction occurs at constant pressure and constant temperature of 250 K. But this reaction does not occur at 350 K and constant pressure. The mechanism of this reaction does not change within the temperature range from 250 K – 350 K. Which of the following is/are true regarding this reaction.
- a) $\Delta S > 0$
 b) $\Delta H > 0$
 c) at 350K, $\Delta G > 0$
 d) the rate of the reaction gradually decreases when the temperature is gradually increased from 250 K.

- 34) Certain amount of acidified KMnO_4 is added into a solution containing aqueous KI and CCl_4 . Which of the following is/are true regarding the colour combination of the solution associated with the reactions occurs.

	aqueous solution	CCl_4 layer
a)	colourless	purple
b)	brown	purple
c)	brown	colourless
d)	purple	purple

- 35) Which of the following is always true about the molecularity of a reaction.
- a) molecularity is equal to overall order of the reaction.
 b) The sum of the stoichiometric coefficient of the balanced equation is equal to the molecularity.
 c) The molecularity of an elementary reaction is equal to its overall order.
 d) In general, the molecularity can not be a large number.

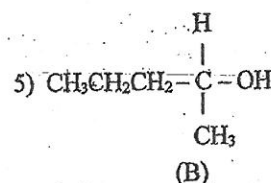
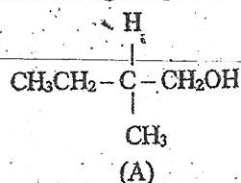
- 36) Two steps related to a particular chemical reaction is given below.



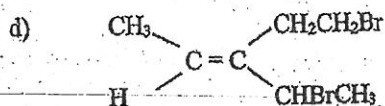
Which of the following is true?

- If the step I is relatively slow, the order with respect to NO is,
 - If the activation energy of step I is relatively high, it is the rate determining step.
 - If the step II is relatively slow, the order with respect to O_2 is zero.
 - The overall order of the reaction is 2, regardless of the rate determining step, as both steps contain an equal number of reactant molecules involved in them.
- 37) Which of the following is/are true regarding catalysts?
- they increase the amount of products formed.
 - they change the mechanism of the reaction
 - they increase the frequency of effective collision.
 - they always increase the fraction of effective collisions.

- 38) Consider the following compounds.



- Both A and B show stereoisomerism.
 - A and B are structural isomers of each other.
 - Both of the compounds formed by dehydration of A and B show geometric isomerism.
 - Both A and B are alcohols.
- 39) Which of the following species can reduce copper from +2 oxidation state to +1 oxidation state?
- H_2S
 - SO_2
 - KI
 - Mg
- 40) Which of the following compound / compounds show(s) stereoisomerism ?
- $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
 - $(\text{CH}_3)_2\text{C}=\text{CHCH}_3$
 - $\text{CH}_3\text{CH}_2\text{CHBrCH}_2\text{CH}_2$



Instruction for question No. 41 to 50

Response	first statement	second statement
(1)	True	true and correctly explain the 1 st statement
(2)	True	true, but does not explain the 1 st statement correctly
(3)	True	False
(4)	False	True
(5)	False	False

	first statement	second statement
41)	When two reaction occurring under the same conditions are considered, the reaction with the higher negative ΔG° value always occurs with a higher rate.	The activation energy of reactions with higher negative ΔG° values is small treated with.
42)	The rate of a multi – step reaction is always less than that of an elementary reaction.	The molecularity of a multi – step reaction is always greater than that of an elementary reaction.
43)	The dipole moment of NH_3 is greater than that of H_2O .	The number of polar bonds in NH_3 is greater than that is H_2O .
44)	When an aqueous solution of $\text{Ca}(\text{OH})_2$ is treated with excess of CO_2 gas, a solution of $\text{Ca}(\text{HCO}_3)_2$ is formed at the end.	$\text{Ca}(\text{HCO}_3)_2$ is formed by the reaction between CaCO_3 and $\text{H}_2\text{CO}_3(\text{aq})$.
45)	NaIO_3 is formed by the reaction between I_2 and NaOH .	NaOH can act as an oxidizing agent.
46)	The pressure of a gas is an extensive property.	The pressure of a gas depends on the amount of the substance of the gas.
47)	The boiling point of HI is greater than that of H_2O .	The London forces in HI are stronger than the London forces in H_2O .
48)	The ΔH associated with the dissolution of any compound in water is negative.	The entropy increases when any compound is dissolved in water.
49)	The ionic radius decreases when moving across a period of non transition elements from left to right.	The effective nuclear charge increases when moving from left to right of a period of non transition elements.
50)	C_2H_4 as well as C_2H_2 decolorizes bromine water.	C_2H_4 as well as C_2H_2 is unsaturated.

AL/2020/02/E (Grade 12, 3rd term Test)



Royal College - Colombo 07
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 රාජකරුණකොටුව 07
 රාජකරුණකොටුව 07
 රාජකරුණකොටුව 07

Final Term Test July 2019

Grade 12

රසායන විද්‍යාව II
 Chemistry II

02 E II

පැය තුනයි
 Three hours

Name : Index No. Grade :

- * A periodic table is provided
- * Use of calculators is not allowed.
 - o Universal gas constant $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$
 - o Avogadro constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
 - o Planck's constant $= 6.626 \times 10^{-34} \text{ Js}$
 - o Velocity of light $= 3 \times 10^8 \text{ ms}^{-1}$

Part A – Structured Essay (pages 2 – 10)

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

Part B Essay (pages 11 – 14)

- * At the end of the time allotted for this paper, tie the answers to the three Parts A, B, C together so that Part A is on top and hand them over to the Supervisor.
- * You are permitted to remove only Parts B and C of the question paper from the Examination Hall.

For Examiner's Use Only

Paper - I	
Paper II	
Total	
Percentage	

Final Marks	
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Part	Question NO	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	
Total		
Percentage		

Part A – Structured Essay

Answer all the questions on this paper itself.

1) a) Arrange the following in the increasing order of the property indicated in parentheses,

i) Be, Si, S (First ionization enthalpy)

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ii) O₂, F₂, Cl₂, Br₂ (Bond dissociation enthalpy)

..... < < <

iii) Na₂O, MgO, SiO₂, B₂O₃ (Acidity)

..... < < <

iv) Li₂CO₃, BeCO₃, Na₂CO₃, Cs₂CO₃ (Thermal stability)

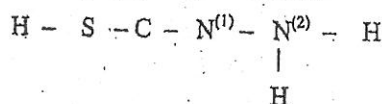
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v) [CoCl₄]²⁻, [Ni(H₂O)₆]²⁺, [Cu(H₂O)₆]²⁺, [CuCl₄]²⁻

(Wave length of the electromagnetic radiation related to their colour)

..... < < <

b) The skeleton of H₃CSN₂⁺ is given bellow.



i) Draw the most acceptable Lewis structure for H₃CSN₂⁺.

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ii) Draw four (4) resonance structures for the above molecule excluding the structure drawn in (i) above and comment on the stabilities of each separately compared to the structure drawn in (i).

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iii) Complete the following table based on the structure drawn in part (i) above.

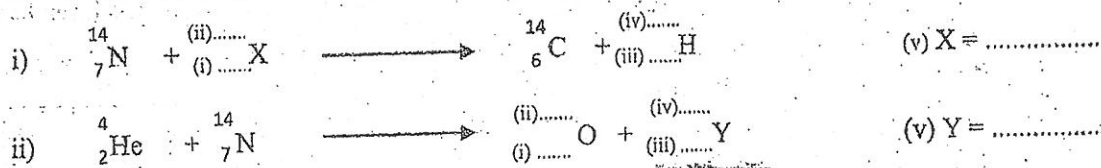
Atom	Shape around the atom	Electron pair geometry	Oxidation number
S			
C			
N ⁽¹⁾			
N ⁽²⁾			

iv) Identify the atomic/hybrid orbitals involved in the formation of the following sigma (σ) bonds in the Lewis structure drawn in part (i) above. (Numbering of the atoms is as in the given skeleton)

- I) S - C and
- II) N⁽¹⁾ - N⁽²⁾ and
- III) S - H and

v) Sketch the shape of the Lewis structure drawn in part (i) above indicating approximate values of the bond angles.

c) Balance the following nuclear reactions using appropriate values for the blank.



d) Explain the following observations.

- i) CO_2 is more acidic than that of CO.

- ii) The boiling point of ICl ($M_r = 162.5$) is greater than that of Br_2 ($M_r = 160$).

- 2) a) The scientist Niels Bohr was able to come up with a structure for the atom which is the smallest fundamental unit of matter based on the line spectrum of Hydrogen. The Bohr model of an atom is based on several hypotheses.

When move away from the nucleus, energy of the energy elevels gradually increase while energy gap between successive energy levels change.

The energy levels are numbered as $n = 1, 2, 3 \dots$ and so on beginning from the nucleus,

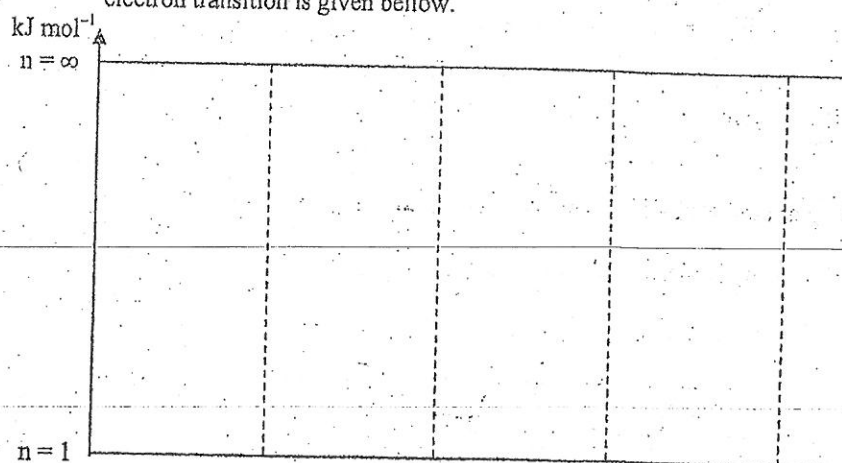
If the energy of the highest energy level is considered as 0 kJ mol^{-1} , the energy differences of the energy levels $n = 3, 2$ and 1 relative to highest energy level are $146, 328$ and 1312 kJ mol^{-1} respectively.

Answer the following questions based on the line spectrum of hydrogen and the above description.

- i) State the postulates in which the Bohr model was based on.

- ii) State how the energy differences of the successive energy levels change when move away from the nucleus.

- The first and the highest energy levels of hydrogen atom, which can be used to indicate the electron transition is given bellow.



- iii) Using the given data and your knowledge, draw another four (4) energy levels clesest to first energylevel on the given diagram.
- iv) Indicate the energies of energy levels drawn relative to highest energy level. (0 kJ mol^{-1}) (Zero)
- v) Draw the arrows to indicate all possible electron transitions (Series wise).
- vi) State the region of the electro magnetic spectrum to which the each series belong. (State bellow the relevant series)

- vii) Calculate the wave length of the radiation emitted due to the electron transition from 3rd energy level to the 2nd energy level, in nanometers (nm)
 ($h = 6.626 \times 10^{-34} \text{ Js}$, $c = 3.0 \times 10^8 \text{ m s}^{-1}$, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$)

- b) X is an element of p -block of the periodic table. X shows the following reactions under certain condition.

- P) By reacting with oxygen, forms two oxides A and B having +2 and +4 oxidation numbers.
 Q) Compound C is formed with hydrogen. Electron pair geometry around the central atom in C is tetrahedral.
 R) B reacts with water in the presence of excess oxygen forming an oxo acid D.
 S) Aqueous solutions B and D are reacted to form compound E, which is used as a fertilizer.
 T) The formal charge of the central atom of the uninegative oxoanion (F) of X is +1.
 U) C is given as one of the products when F reacts with KOH in the presence of Devarda's Alloy.

- i) Identify the element X.

- ii) Identify the chemical species from A to F.

A	B	C
D	E	F

- iii) Write the balanced chemical equation for the reaction taking place in U. (F with KOH in the presence of Aluminium (Al)).

- iv) What is the most abundant form of X?

- v) Briefly explain answer given in part(iv).

- vi) Write the balanced chemical equations for the reactions shown by the compound C with the following chemical species.

I. With excess Cl_2

II. With Mg

vii) State three reasons for the element X to be different from the other elements in that group.

- 1)
- 2)
- 3)

c) The mass of the residue obtained by complete decomposition 5.28 g of a mixture of $(\text{NH}_4)_2\text{CO}_3$ and MgCO_3 was 1.6 g.

i) Write the balanced chemical equations for the thermal decomposition of the above mixture.

.....

ii) Calculate the mass percentage of $(\text{NH}_4)_2\text{CO}_3$ in the given mixture.

.....

3) a) Solutions were mixed according to the following table in an experiment performed to study the chemical kinetics of the reaction between $\text{Na}_2\text{S}_2\text{O}_3$ and HCl by a group of advanced level students.

Reaction mixture	0.1mol dm^{-3} $\text{Na}_2\text{S}_2\text{O}_3 / \text{cm}^3$	0.1mol dm^{-3} HCl / cm^3	Y / cm^3
1	10.0	5.0	10.0
2	15.0	5.0
3	20.0	5.0
4	20.0	4.0
5	20.0	3.0

i) Write the balanced chemical equation for the reaction between $\text{Na}_2\text{S}_2\text{O}_3$ and HCl .

.....

ii) In the above table,

i) What is Y?

ii) Fill the blanks in the above table indicating the appropriate volumes of Y.

iii) Explain the importance of adding "Y" in this experiment.

.....

- The observed results of the above reaction were recorded in a table as indicated below.

reaction mixture.	time (t) taken to disappear the cross (X)/ s
1	20.1
2	13.3
3	10.1
4	10.2
5	10.0

- iv) What is meant by the "time" taken to disappear "X" in the table above?

- v) State four (4) special things which you must pay your attention in this experiment when obtain the readings for the time taken to disappear the cross (X).

- vi) Write the rate expression for the above reaction.

- vii) Giving reason determine the order with respect to HCl.

- viii) Starting from the rate equation, obtain the relationship $V^x S_2O_3^{2-} t = k$

(In this, expression x is the order with respect to $S_2O_3^{2-}$ concentration and $V_{S_2O_3^{2-}}$ is the volume of $S_2O_3^{2-}$ solution)

- ix) Calculate the order with respect to $S_2O_3^{2-}$ concentration in the above reaction using the equation in part (viii).

- x) Calculate the concentration of $Na_2S_2O_3$ in the reaction 'mixture 2' after 13.3 s, if the concentration of the observed product in the above reaction was $0.015 \text{ mol dm}^{-3}$.

b) Consider the following bimolecular elementary reaction.



i) What are the basic requirements which should be fulfilled by the reactant molecules for the above reaction to occur?

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ii) Write the rate expression for the above reaction.

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iii) Draw the structure of the transition state (intermediate complex) which is expected in the transition between the reactant and product. Indicate the bonds which are broken and the bonds which are formed.

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4) (a) i) Draw all the possible acyclic structural formulae for the organic compound with the molecular formula $\text{C}_4\text{H}_7\text{Br}$.

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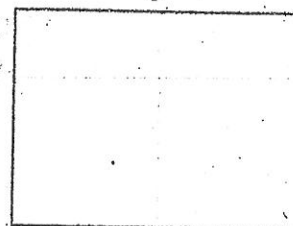
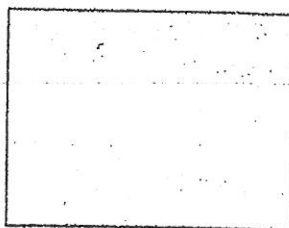
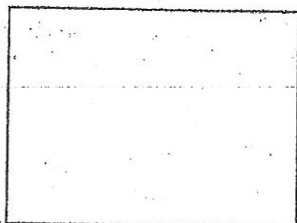
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ii) One of the above structures (A) shows optical isomerism and two of them (B and C) show geometric isomerism. Draw the structures of A, B and C.

A

B

C



iii) Giving reasons state whether the product obtained by treating A with Ni / H_2 onto A, shows optical isomerism?

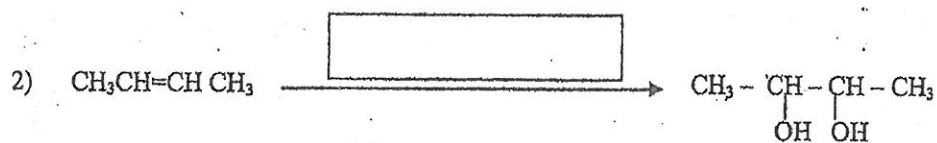
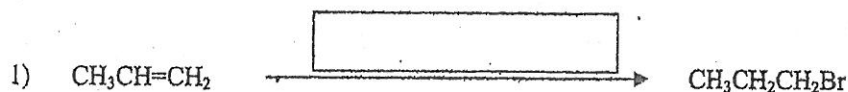
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- iv) One of the structures of C_4H_7Br does not show geometric isomerism and optical isomerism. Write the reaction mechanism for the reaction between that compound and HBr molecule.

b) Fill in the blanks with the suitable reagents along with appropriate reaction conditions, (if any)



c) Explain the following.

- i) Which one out of alkynes and alkenes is more reactive towards electrophilic addition reactions. Briefly explain your answer.

- ii) When bromine water is added with $NaNO_3$ into a sample of $CH_3CH_2CH_2CH=CH_2$ the compound $CH_3CH_2CH_2-\underset{\substack{| \\ NO_3}}{CH}-\underset{\substack{| \\ Br}}{CH_2}$ will be formed.



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Final Term Test July 2019

Grade 12

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Chemistry II

02 E II

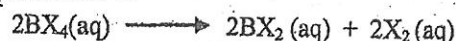
Part B – Essay

Answer two questions only. (Each question carries 150 marks)

5) Answer part 'a' and either part 'b' or part c in question number 5 [(a + b) or (a + c)]

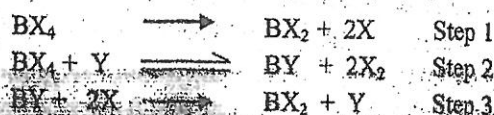
- a) i) State the rate expression for the hypothetical reaction $aA \longrightarrow bP$ by considering the rate of the reaction as R , rate constant as k and the order of the reaction as n .
- ii) Considering the log values of the rate expression, obtain a relationship in the form of $y = mx + C$.
- iii) Indicate the variations of the log values of the above variables for first order, second order and third order reactions comparatively on the same plot of a graph.
X axis $\log [A]$
Y axis $\log [R]$
- iv) State how the order of the reaction is obtained by using the above graph.
- v) State the units of the rate constants separately for each of the order of the reactions.

- b) A solution containing a compound with a concentration of 0.8 mol dm^{-3} decomposes as indicated below at a temperature of T .



Rate constant of this reaction at the temperature T was $1.386 \times 10^{-4} \text{ s}^{-1}$.

- i) Write the rate expression for the given reaction stating the reasons for it to be in the first order.
- ii) Calculate the half-life ($t_{1/2}$) of the above reaction at the temperature given.
[For a first order reaction, $t_{1/2} = \frac{0.693}{K}$ K is the rate constant.]
- iii) Calculate the concentration of BX_4 at 4h and 10 mins after the reaction has started.
- iv) Calculate the amount of heat energy released to the environment by a volume of 5 dm^3 of the above solution with the given concentration when allowed to decompose for 25 minutes.
(The values of enthalpy of formation for $\text{BX}_4(\text{aq})$, $\text{BX}_2(\text{aq})$ and $\text{X}_2(\text{aq})$ at the temperature considered are -170 kJ mol^{-1} , -300 kJ mol^{-1} and 0 kJ mol^{-1} respectively)
- v) The reaction mechanism for the above reaction is given below.



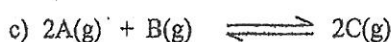
- I) Identify the species given as X , BY and Y in the above reaction mechanism.
- II) Identify the rate determining step from the above, giving reasons for your answer.

- vi) Consider the following reaction.



The order of the reaction stated above with respect to A is one. The reaction was started by maintaining the concentration of A constant at 0.5 mol dm^{-3} and by taking the initial concentration of B as 0.2 mol dm^{-3} . Concentration of B was 0.1 mol dm^{-3} after 20 s and it was 0.05 mol dm^{-3} after 30 s.

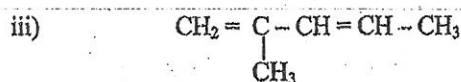
- I) Deduce the order of the reaction with respect to B.
- II) Calculate the overall order of the reaction.
- II) Calculate the rate constant if the initial rate of the reaction was $1.55 \times 10^{-4} \text{ mol dm}^{-3} \text{ s}^{-1}$.
- II) Find out the time taken to complete the reaction.



- i) Consider the above system which is at the state of dynamic equilibrium, derive the relationship between K_p and K_c .
- ii) 2 mol of gas A and 1 mol of gas B are in a rigid closed container with a volume of V at a temperature of 400 K and $6 \times 10^5 \text{ Pa}$ pressure.
When the temperature of the mixture was decreased to 300 K, the system achieves the above dynamic equilibrium. The total pressure of the system at equilibrium was $3.75 \times 10^5 \text{ Pa}$.
 - I) Calculate the no of moles of each of the constituents in the system separately at equilibrium.
 - II) Calculate the partial pressure of each constituent in the system separately at equilibrium.
 - III) Calculate the values of K_p and K_c for the equilibrium at 300 K temperature.
- iii) Three (3) gases A, B and C were inserted in an evacuated vessel at 300 K temperature, in such a way that their partial pressures were $1 \times 10^5 \text{ Pa}$ for each gas.
Calculate the reaction quotient (Q_p) for this instance.
- iv) Determine the direction of the overall reaction giving reasons.
- v) Graphically represent (plot the graphs for) the variation between the rate of forward reaction and the rate of backward reaction with time, starting from the point where these gases were mixed (at $t = 0$).
Indicate how the concentrations of each of the constituents vary with time in a separate graph.

- 6) a) i) Define the standard enthalpy of combustion.

ii) When a volume of 10 dm^3 of a gas mixture containing methane (CH_4) and ethane (C_2H_6) under standard conditions was subjected to complete combustion, it released 509.1 kJ of heat energy. Calculate the percentage composition of each gas by volume. Under the relevant conditions the molar volume of a gas was $24 \text{ dm}^3 \text{ mol}^{-1}$. The values of the standard enthalpy of combustion for CH_4 and C_2H_6 are -891 kJ mol^{-1} and $-1423 \text{ kJ mol}^{-1}$ respectively.



The compound which is indicated in the above structure exists as a gas at a temperature T. Some thermochemical data which are relevant to this temperature are stated below.

Bond dissociation enthalpy of C – C bond	= +348 kJ mol^{-1}
Bond dissociation enthalpy of C – H bond	= +413.4 kJ mol^{-1}
Bond dissociation enthalpy of C = C bond	= +615.1 kJ mol^{-1}
Sublimation enthalpy of C (s, gr) bond	= +718.4 kJ mol^{-1}
atomization enthalpy of H	= +218 kJ mol^{-1}

Calculate the standard enthalpy of formation in the above compound at the temperature T using the data given.

- b) Thermochemical data related to a certain set of elements and compounds at a temperature of 1500 K are stated below.

Compound	$H_m^\theta / \text{kJmol}^{-1}$	$S_m^\theta / \text{kJmol}^{-1}$
$\text{Fe}_2\text{O}_3(\text{s})$	-604.1	87.4
$\text{Fe}(\text{s})$	0.0	27.3
$\text{O}_2(\text{g})$	0.0	205.0

- i) Determine the spontaneity of the following reaction at 1500 K temperature, with a suitable calculation using the data given.



- ii) At a temperature of 1500 K it is found out that $\text{Fe}_2\text{O}_3(\text{s})$ can be reduced to $\text{Fe}(\text{s})$ by $\text{CO}(\text{g})$. ($\text{CO}_2(\text{g})$ is also formed during the reaction)



If the ΔG^θ value for the above reaction is -514 kJmol^{-1} determine the validity of the above statement with the aid of a suitable calculation. 1500 K.

- c) i) Write the kinetic equation for gases and define each of the terms of it.
 ii) Derive an expression for the density of an ideal gas starting from the kinetic equation.
 iii) State an expression for the root mean square speed $\sqrt{C^2}$ of an ideal gas in relation to its molar mass (M) and the absolute temperature (T).
 iv) By using those two (2) expressions obtained for the parts (ii) and (iii), state the relationship between the root mean square speed, pressure of a gas and the density of an ideal gas.
 v) Calculate the root mean square speed for a gas X_2 with the relative molecular mass of 28 at a temperature of 831.4 K.
 vi) Calculate the density of the gas if its pressure is $2 \times 10^5 \text{ Pa}$.

Part C - Essay

Answer two questions only. (Each question carries 150 marks)

- 7) a) An organic compound A is consisted of 47.52% of C, 6.93% of H, 13.86% of N and O only by mass. (C = 12, H = 1, N = 14, O = 16)
- Find out the empirical formula of A.
 - If the relative molecular mass of A is 100, what is the molecular formula of A?
 - A contains only one substituted NO_2 group and the C atom which is bonded to the N atom shows sp^2 hybridization.
 Compound A shows geometric isomerism and when HBr is added to A, the resulting molecule shows optical isomerism.
 State the structural formula of A.
- b) Do the following translations.
- $\text{CH}_3 - \text{C} \equiv \text{CH} \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
 - $\text{CaC}_2 \longrightarrow \text{Cu}_2\text{C}_2$
- c) i) When alkenes react with $\text{NaOH} / \text{KMnO}_4$, some times give green solutions. Explain.
 ii) Write the mechanism for the reaction between $\text{CH}_3\text{CH}=\text{CH}_2$ and Br_2 .

- 08) a) A, B, C, D and E are five stable cations in aqueous solutions formed by d – block elements in the fourth (04) period.

Certain reactions and the corresponding observations for each of those cations are given below.

- i) A $\xrightarrow[\text{NH}_3(l)]{\text{conc. HCl}}$ P (blue colour solution)
- ii) B $\xrightarrow{\text{K}_3[\text{Fe}(\text{CN})_6]_{(aq)}}$ Q (yellow solution)
- iii) C $\xrightarrow{\text{DMG/OH}^-}$ R (dark blue compound)
- iv) D $\xrightarrow[\text{(dimethylglyoxime)}]{\text{NH}_4\text{SCN}}$ S (red precipitate)
- v) E $\xrightarrow{\text{NH}_4\text{SCN}}$ T (dark red colour solution)

Write the chemical formulae for the species from A to E and from P to T.

- b) In a solid mixture X, three (03) metal cations are found as their respective nitrates and another metal cation is existing as a different compound. Atleast one of those cations belong to the 3rd period in the periodic table.

Certain experiments which were carried out to analyze qualitatively and the relevant observation are given below.

Experiment	observation
1. A sample of X is dissolved in water.	A coloured solution and a white precipitate.
2. The residue obtained after filtering in experiment (1) was treated with dil. HNO_3 .	The precipitate dissolved forming a gas with a pungent smell.
3. For a sample from the coloured filtrate resulted from (1), aqueous NH_3 was added in excess.	Dark blue solution and a coloured precipitate was obtained.
4. conc. HCl was added to the precipitate obtained from (3).	A yellowish solution was obtained.
5. For the solution resulted in (4), H_2O was added followed by the addition of NH_4SCN solution.	A dark red solution.
6. A separate sample obtained from (1) was acidified with dil. HCl and H_2S was bubbled.	A black precipitate.
7. For another sample resulted from (1), aqueous NaOH was added in excess.	A precipitate and a colourless solution.
8. For the colourless solution from (7), dil. HCl was added in a drop-wise manner.	First forms a white precipitate which gets dissolved later.
9. Another portion of X was added to water and H_2O_2 was also added.	A white precipitate which is insoluble in dil. HNO_3 acid is formed.

- i) Identify the four (04) cations and the other anion (which is not the NO_3^-) present in the given mixture X.
- ii) Briefly explain the observations obtained for each of the experiments stated above.
- C) A solution with a volume of 250 cm^3 was prepared by dissolving a mixture containing FeSO_4 and Na_2SO_3 . To a 25 cm^3 sample of that solution, a $\text{BaCl}_2(\text{aq})$ solution acidified with dil. HNO_3 was added into that in excess. The dry mass of the precipitate formed is 0.466 g . Another 25 cm^3 sample from the initial solution was taken and was titrated with an acidified 0.1 mol dm^{-3} KMnO_4 solution. 8 cm^3 of KMnO_4 solution was used up to reach the end – point.
- i) Write the balanced chemical equations for all the chemical reactions during this process.
- ii) Calculate the molar ratio of $\text{FeSO}_4 : \text{Na}_2\text{SO}_3$ which was present in the solid mixture.
(Ar: Fe = 56 Ba = 137 O = 16 S = 32 Na = 23)