Grade 12 3rd
2018 July
Royal (7)

A/L 2019/02/E-I

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Royal College Colombo 07

අධිසාමාන්‍ය පෙළ සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
General Certificate of Education (Adv. Level) Examination, August 2019

Grade 12 - 3rd Term Test
July, 2018

රසායන විද්‍යාව I
Chemistry I

02 E I

පැය දෙකයි
Two hours

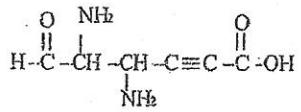
- This paper consists of 07 pages. (Periodic table and logarithm table are provided)
- Answer all the questions.
- Use of calculators is not allowed.
- Write your Index Number in the space provided in the answer sheet.
- Follow the instructions given on the back of the answer sheet carefully.
- In each of the questions 1 to 30, 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	$= 8.314\ J\ K^{-1}mol^{-1}$
Avogadro constant	N_A	$= 6.022 \times 10^{23} mol^{-1}$
Planck's constant	h	$= 6.626 \times 10^{-34}\ J\ s$
Velocity of light	c	$= 3 \times 10^{8}\ m\ s^{-1}$

1. The maximum sets of quantum numbers that can be written with $n = 3$ and $m_l = 2$ are
   01) 2 2) 4 3) 6 4) 8 5) 10

2. The increasing order of the size of B, N, O, F, Si and S is
   01) F < S < O < N < B < Si 02) B < N < O < F < Si < S 03) F < O < B < N < S < Si
   04) F < O < N < B < S < Si 05) Si < S < B < N < O < F

3. What is the IUPAC name of the following compound.



   01) 2,3-- diammonia–1–formyl–4–hexanoicacid 02) 2,3–diamino–6–formyl–4–hexynoic acid
   03) 4,5–diamino–6–oxo–2–hexynoic acid 04) 4,5–diamino–1-- formyl–2–hexynoic acid
   05) 4,5--diamine–1–oxo–2–hexynoic acid

4. X is an organic compound which burns in air giving $CO_2 : H_2O = 22 : 9$ by mass. It is needed 49.884 dm^3 of Oxygen at 27 ^0C under 1×10^5 Pa for the complete combustion of 0.5 mol of X. The molecular formula of X can be
   01) $C_3H_6O_2$ 02) C_3H_6O 03) C_3H_6 04) C_2H_4 05) C_2H_2

5. 7.48 g of a mixture containing $CaCO_3$ and CaC_2O_4 was heated to a high temperature until a constant mass is obtained. Mass of the residue was half of the initial mass. $CaCO_3$: CaC_2O_4 mole ratio in the initial mixture is,
01) 1 : 2 02) 1 : 3 03) 3 : 4 04) 4 : 3 05) 4 : 5

6. Which of the following statements regarding properties of atom is *correct*?
01) The radius of an atom depends only on the number of principal energy levels of the atom.
02) Ionization energy of an atom depends only on the electron configuration of the atom.
03) Electronegativity is constant for a given element.
04) Oxidation state of a bonded atom can be zero.
05) F(g) releases less energy than chlorine when an electron is gained as F is smaller in size.

7. The electron pair geometry and the molecular shape of $XeOF_2$ respectively, are
01) Trigonalbipyramidal and see-saw. 02) Trigonalbipyramidal and T-shape.
03) Trigonalbipyramidal and tetrahedral 04) Square planer and tetrahedral.
05) See-saw and trigonalbipyramidal.

8. An object of 10.0 mg is moving with the velocity of 100 m s^{-1}.The de-Broglie wavelength of this object would be,
01) 1.98×10^{-14} m 02) 1.98×10^{-25} m 03) 6.626×10^{-34} m
04) 6.626×10^{-31} m 05) 1.988×10^{-27} m

9. Choose the most suitable anion which shows the following observations
a) Give a yellow precipitate with H_2S.
b) Reacts with $KMnO_4$ / H^+ giving tetrahedral anion.
c) Does not evolve O_2 with acidified H_2O_2.
01) AsO_4^{3-} 02) PO_4^{3-} 03) AsO_3^{3-} 04) CrO_4^{2-} 05) PO_3^-

10. Purple colored Potassium Ferrate solution (K_2FeO_4) is stable only in basic medium. The following reaction is taking place when the medium is slightly acidified.
$K_2FeO_4 + H_2O \rightarrow Fe(OH)_3 + O_2 + KOH$ (Reaction is not balanced.)
Number of moles of O_2 can be obtained by 1 mol of K_2FeO_4 is,
01) 0.2 mol 02) 0.25 mol 03) 0.4 mol 04) 0.5 mol 05) 0.75 mol

11. Which of the following reactions is not likely to take place during the chlorination of CH_4 in the presence of sunlight
01) $Cl_2 \longrightarrow 2Cl^{\bullet}$ 02) $CH_4 + Cl^{\bullet} \longrightarrow \overset{\bullet}{C}H_3 + HCl$
03) $\overset{\bullet}{C}H_3 + \overset{\bullet}{C}H_3 \longrightarrow CH_3CH_3$ 04) $CH_3Cl + Cl^{\bullet} \longrightarrow \overset{\bullet}{C}H_2Cl + HCl$
05) $CH_4 + Cl_2 \longrightarrow CH_2Cl_2 + H_2$

12. What is the IUPAC name of $[Fe(CO)(NO_2)(OH_2)_4]SO_4$?
01) tetraaquacarconylnitrosyliron(III) sulfate 02) tetraaquacarconylnitrosylferrate(II) sulfate
03) tetraaquacarconylnitritoiron(III) sulfate 04) tetraaquanitritocarconyliron(III) sulfate
05) tetraaquacarconylnitritolferrate(II) sulfate

13. Consider the given statements regarding the following reaction.

$XO_{(g)} + XO_{2(g)} \longrightarrow X_2O_{3(g)}$

- Equimolar mixture of XO and XO_2 gases would completely react at 300K.
- X_2O_3 is not exist above 600 K.
- If all the gases do not involve in any other reaction other than the given reaction, which of the followings **false** regarding this reaction?

01) $\Delta H<0$.
02) $\Delta S< 0$.
03) $\Delta G < 0$ at 25^0C.
04) this reaction is favored by high temperatures.
05) Reaction may be at equilibrium between 300 K – 600 K.

14. Consider the following reactions with relevant thermodynamic data

$Si_{(S)} + 2\ H_{2\,(g)} \rightarrow SiH_{4\,(g)}\ \Delta H_f^\circ = 34.3$ kJ $Si_{(S)} + O_{2\,(g)} \rightarrow SiO_{2\,(S)}\ \Delta H_f^\circ = -910.9$ kJ

$H_{2\,(g)} + O_{2\,(g)} \rightarrow H_2O_{2\,(l)}\ \Delta H_f^\circ = -187.9$ kJ $H_{2\,(g)} + H_2O_{2\,(l)} \rightarrow 2\ H_2O_{(l)}\ \Delta H_f^\circ = -383.8$ kJ

The enthalpy change of $SiH_{4\,(g)} + 2\ O_{2\,(g)} \rightarrow SiO_{2\,(S)} + 2\ H_2O_{(l)}$ [ΔH_{rxn}°] in kJ is ,

(1) -1133.0 (2) -1708.7 (3) -1324.9 (4) -1516.9 (5) -153.6

15. What is the molecule which has four carbon atoms bonded linearly?

01) $CH_3 - CH_2 - CH_2 - CH_3$ 02) $CH_3CH = CHCH_3$ 03) $CH_2 = CHCH_2CH_3$
04) $CH_3C \equiv CCH_3$ 05) $CH_2 = CHC \equiv CH$

16. The reaction $NO_{2\,(g)} + CO_{(g)} \rightarrow NO_{(g)} + CO_{2\,(g)}$ take place in two steps as

$NO_{2\,(g)} + NO_{2\,(g)} \xrightarrow{Slow\ Reaction} NO_{(g)} + NO_{3\,(g)}$ $NO_{3\,(g)} + CO_{(g)} \xrightarrow{Fast\ Reaction} NO_{(g)} + CO_{2\,(g)}$

The rate of the reaction depends on.

(1) $[NO_2]\ [CO]$ (2) $[NO_2]^2\ [CO]$ (3) $[NO_2]^2\ [NO_3]\ [CO]$
(4) $[NO_2]^2$ (5) $[NO_3]\ [CO]$

17. Which of the following trend is correct regarding Alkali metals?

01) All of them can produce peroxide and superoxides.
02) Electrolysis is the only method of extraction of these metals.
03) Reactivity increase with the atomic number.
04) LiN_3 liberate NH_3 with water.
05) Oxidation state of K in KO_2 is +2.

18. O_2a nd He gases are in a rigid containerat room temperature under 384 Hg mm pressure. A Mg strip which is in the container was burnt completely so that all the O_2 present in the container used up. Then the system was allowed tocool to the room temperature. The pressure in the container was measured to be 128 Hg mm. The mass ratio O_2 : He in the initial mixture is .

01) 2 : 1 02) 3 : 1 03) 4 : 1 04) 8 : 1 05) 16 : 1

19. Which of the following statements regarding sulfur/Nitrogen is ***false***?
    01) Nitrogen shows the highest valance in second period.
    02) The maximum number of electrons which can be present in the valence shell of nitrogen is 8 in a compound.
    03) The maximum oxidation number that can be achieved by oxidizing sulphur with hot con. HNO_3 is +4.
    04) An aqueous solution of SCl_4 shows bleaching property.
    05) Both rhombic sulphur and monoclinic sulphur consists of S_8 molecules.

20. Select the most acidic oxide
    01) I_2O_5 02) Cl_2O_7 03) Mn_2O_7 04) V_2O_5 05) CrO_6

21. Concentration of KOH in a solution which contains 30% of KOH by mass is 6.9 $moldm^{-3}$. The density of the solution is, (H = 1, O = 16, K = 39)
    01) 0.956 gcm^{-3} 02) 1.288 gcm^{-3} 03) 0.325 gcm^{-3} 04) 2.315 gcm^{-3} 05) 1.326 gcm^{-3}

22. Which of the following reactions occurs without an observable color change.
    01) Sn^{2+} and $KMnO_4/H^+$ 02) SO_2 and H_2O_2 03) SO_2, Br_2 and H_2O
    04) Fe^{2+} and $KMnO_4/H^+$ 05) Fe^{3+}, H^+ and KI

23. 1.12 dm^3 of O_2 was collected under standard temperature and pressure by incomplete decomposition of 12.75g of $NaNO_3$. Then the residue was dissolved in water and diluted up to 100 cm^3. 25 cm^3 of the solution was acidified with H_2SO_4 and titrated with 0.2 $moldm^{-3}$ $KMnO_4$ solution. The volume of $KMnO_4$ required to complete the reaction is (Na = 23, O = 16, N = 14)
    01) 100 cm^3 02) 75 cm^3 03) 50 cm^3 04)37.5 cm^3 05) 25 cm^3

24. Which of the following pairs of cations shows the same color in aqueous medium.
    01) Mn^{2+} / Cr^{3+} 02) Cr^{3+} / Fe^{2+} 03) Cu^{2+} / Zn^{2+} 04) Co^{2+} / Ni^{2+} 05) Fe^{3+}/ Ti^{3+}

25. The rate of the reaction A + B → C was determined by changing the concentrations of A and B as in the following table.

Experiment No:	[A] / $moldm^{-3}$	[B] / $moldm^{-3}$	Rate / $moldm^{-3}s^{-1}$
1	0.2	0.2	0.02
2	0.2	0.4	0.04
3	0.6	0.4	0.36
4	0.6	0.8	R

    What would be the rate (value of R) of the experiment 4 ?
    01) 0.36 mol dm^{-3} s^{-1} 02) 0.48mol dm^{-3} s^{-1} 03) 0.64mol dm^{-3} s^{-1}
    04) 0.72mol dm^{-3} s^{-1} 05) 0.96mol dm^{-3} s^{-1}

26. 1 m^3 sample of air, polluted with ozone (O_3) slowly bubbled through 1 dm^3 of KI solution (excess of KI) 50 cm^3 of resultant solution was titrated with $Na_2S_2O_3$. 40 cm^3 of 0.01 $moldm^{-3}$ $Na_2S_2O_3$ solution was needed to complete the titration. What is the O_3 concentration in air in ppm?
    (Density of air under these condition is 1.5 kg m^{-3})
    01) 192 02) 128 03) 96 04) 64 05) 48

27. S(s) (Rhombic) + O_2 (g) → SO_2(g) ; ΔH^0 = -296 kJmol^{-1}
S(s) (monoclinic) + O_2 (g) → SO_2(g) ; ΔH^0 = -296.4 kJmol^{-1}
According to the above enthalpy changes, the standard formation enthalpy of SO_2 (g) and S(s) (monoclinic) are respectively in kJ mol^{-1} units.

01) -296.4, -0.4 02) -296, -0.4 03) +296.4, +0.4
04) -296.4, -592.4 05) -296, +0.4

28. Solution P contains two cations. Some tests and observations related to identificationof cations are given bellow.

* A portion of P was acidified with dil. HCl and H_2S was bubbled, a brown precipitate was obtained.
* Another portion of P was treated with $KMnO_4$ and acidified with dil. HCl and then H_2S was bubbled - a yellow precipitate was formed,
* Filtered the yellow precipitate and boiled off excess H_2S. Then NH_4Cl / NH_4OH was added into it and H_2S was bubbled, A white precipitate was obtained

cations in the solution P could be,

01) Sn^{2+}, Zn^{2+} 02) Sn^{2+}, Al^{3+} 03) Fe^{2+}, Al^{3+} 04) Fe^{2+}, Zn^{2+} 05) Cd^{2+}, Zn^{2+}

29. Which of the following statements is ***fals***?

(1) Both Ammonia and water can act as an oxidizing agent, a reducing agent, an acid and a base.
(2) When SO_2 decolorize something, the colored compound always turns in to its hydride.
(3) When Cl_2 decolorizes something, the colored compound always turns in to its oxide.
(4) $SO_{3(g)} + H_2O \rightarrow H_2SO_{4(aq)}$ is an endothermic reaction, thus it fumes in moist air.
(5) The lattice enthalpy is always negative for a stable ionic compound.

30. Which of the following nuclear reaction is ***incorrect***?

01) ${}^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{236}_{92}U$ 02) ${}^{236}_{92}U \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + {}^{3}_{0}n$

03) ${}^{238}_{92}U + {}^{1}_{0}n \longrightarrow {}^{239}_{92}U + {}^{0}_{0}\gamma$ 04) ${}^{239}_{93}U \longrightarrow {}^{239}_{94}U + {}^{0}_{-1}\beta$

05) ${}^{235}_{92}U + {}^{0}_{+1}\beta \longrightarrow {}^{236}_{93}U$

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

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

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

Summary of above instructions				
01)	02)	03)	04)	05)
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. Species which has/have an electron pair geometry which is different from the electron pair geometry of SF_4.
    a) XeO_2F_2 b) $XeOF_4$ c) XeO_4 d) XeF_2

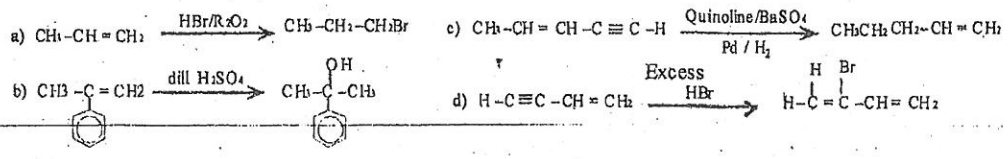
32. Which of the following statement/s is/are incorrect regarding chemistry of alkaline earth metals.
    a) These have two electrons in (n-1)s sub energy level.
    b) There are colored compound in these even though these are not transition elements.
    c) These form only ionic compounds as these are good metals.
    d) Among elements in same period, these elements have the lowest third ionization energy.

33. Cation/s which give/s precipitate with aqueous ammonia and get dissolves in excess ammonia is/are
    a) Cr^{3+} b) Mn^{2+} c) Ni^{2+} d) Zn^{2+}

34. 200.0 cm^3 of 0.01moldm^{-3} Na_2SO_4 solution was mixed with 200.0 cm^3 of 0.01 moldm^{-3} Na_3PO_4 solution. If there is no volume change during mixing, which of the following statement/s is/are correct regarding this mixture, (density of the solution is = 1 g cm^{-3}, Na = 23, S = 32, O = 16, P = 31)
    a) Na^+ composition is 345 ppm b) Na^+ concentration is 0.05 moldm^{-3}
    c) SO_4^{2-} composition is 480 ppm d) PO_4^{3-} composition is 475 ppm

35. Which of the following statement/s is/are correct regarding redox nitration between $Na_2C_2O_4$ and $KMnO_4$?
    a) $KMnO_4$ is a primary standard substance.
    b) HCl can be used to acidify the medium.
    c) During reaction MnO_4^- gets reduced to Mn^{2+} ion.
    d) The activation energy of reaction between MnO_4^- and $C_2O_4^{2-}$ is high therefore mixture should be heated to 60 ^{0}C before titrating.

36. Which of the following reaction is/are correct?



37. Which of the following compound/s is/are insoluble in water but soluble in conc. HCl?
    a) $PbCl_2$ b) SbOCl c) $COCl_2$ d) $AlCl_3$

38. Which of the following statement/s is/are correct regarding spontaneity of a reaction?
    a) All exothermic reactions are spontaneous.
    b) All processes with increasing entropy are spontaneous.
    c) In an isolated system, spontaneity is decided only by entropy change.
    d) All endothermic reactions with decreasing entropy are nonspontaneous.

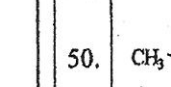
39. Which of the following pair of compounds forms a precipitate when an excess of the first salt (finely powdered) is mixed with the second salt and dissolve in water?

	First Salt	Second Salt
a)	$Ba(OH)_2$	$Al(NO_3)_3$
b)	NH_4CO_3	$Na_2C_2O_4$
c)	$Sb(NO_3)_3$	$CaCl_2$
d)	$AgNO_3$	NH_4NO_2

40. Which of the following statement/s is/are correct regarding hydrocarbons.
    a) Alkanesreact with oxygen.
    b) Characteristic reaction type of alkenes with dill.H_2SO_4 is nucleophilic addition.
    c) Reactivity of alkynes with Cl_2 is less compared to that of alkenes.
    d) Both alkenes and alkynes are decolorized by acidified $KMnO_4$.

Instruction for question No. 41 to 50

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

	First Statement	Second Statement
41.	Melting point of CH_3F is less than that of CCl_4	There are instances where strength of dispersion forces exceeds dipole - dipole interactions.
42.	Bond angle of H_2O is greater than the bond angleof OF_2.	Electronegativity of fluorine is greater than that of oxygen.
43.	The pressure of a real gas cannot be greater than that of a ideal gas under identical condition.	Overall attraction is alwaysexerted among the particles of a real gas.
44.	Mean kinetic energy of Argon (Ar) is greater than that of Helium (He) at 27 ^{0}C.	Ar atom is heavier than He atom.
45.	Aqueous solutions of Cu^{2+} and Ni^{2+}cannot be distinguished by passing H_2S gas through respective solutions.	Both NiS and CuSprecipitates are black in color.
46.	The overall order of a multi-step reaction is always equal to the molecularity of the rate determin step.	The rate of a multi step reaction always depend only on the rate determining step.
47.	$SO_2(g)$ can decolorize acidified $KMnO_4(aq)$ solution.	In aqueous medium $SO_2(g)$ act as a bleaching agent.
48.	A white precipitate is formed when a small amount of NH_3 is added to an aqueous solution of $ZnCl_2$ saturated with H_2S.	$Zn(OH)_2$ is a white precipitate.
49.	The decomposition temperature of $BeCO_3$ is less than that of $CaCO_3$.	The ΔG value of the decomposition of $CaCO_3$ is more positive than that of $BeCO_3$.
50.	 ($CH_3CH = CHCH_3$) Shows the diasteriomerism.	Hybridization of the C^A atom changes from SP^2 to SP^3 on addition of HBr to $CH_3CH = C^AHCH_3$.

*** 24.07.2018 ***

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Royal College Colombo 07

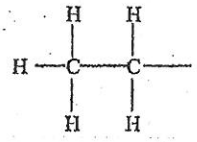
අධිසාමාන්‍ය පෙළ සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
General Certificate of Education (Adv. Level) Examination, August 2019

Grade 12 - 3rd Term Test
July, 2018

රසායන විද්‍යාව II Chemistry II	02 E II	පැය දෙකයි මිනිත්තු හතරයි *Two and half Hours*

Name ..... Class: ..... Ind No:.....

* **A Periodic table and logarithm table are provided on page**
* Use of calculators is not allowed.
* Universal gas constant, $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Avogadro constant, $N_A = 6.022 \times 10^{23}\ mol^{-1}$
* Plank's constant $h = 6.626 \times 10^{-34}\ J\ s$ Speed of light $C = 3 \times 10^{8}\ m\ s^{-1}$
* In answering this paper, you may represent alkyl groups in a condensed manner.



May be shown as CH_3CH_2-

- **Part A – Structured Essay (pages 2 – 9)**

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

- **Part B Essay (pages 10 – 14)**

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

For Examiner's Use Only

Part	Question No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9	
Total		
Percentage		

Final Mark

In Numbers	
In Letters	

Marking Examiner 1	
Marking Examiner 2	
Checked by :	
Supervised by:	

PART A – STRUCTURED ESSAY

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

01) a) Consider the following chemical species.

$S_2O_3^{2-}$, NO_3^-, NO_2^-, MnO_4^{2-}, AlO_2^-, IO_3^-, CrO_4^{2-}, AsO_4^{3-}, BrO_2^-

Which one of the above species,

i) forms a white precipitate with aqueous Ag^+ ions which quickly turns into black?

.....

ii) evolves a basic gas with powdered Al and NaOH?

.....

iii) shows different colors in acidic and basic media without changing the oxidation number of the central atom?

.....

iv) disproportionates in acidic or neutral medium?

.....

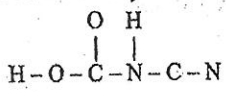
v) is pyramidal in shape?

.....

vi) does not show any change upon addition of an acid, but forms a yellow precipitate with H_2S in an acidic medium.

.....

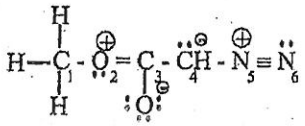
b) The skeleton of a carboxylic acid which has the molecular formula $C_2H_2O_2N_2$ is given below.



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

ii) Draw four resonance structures for this molecules (excluding the structure drawn in part (i) above)

c) A resonance structure of "methyl diazoacetate" is given below and atoms have been labeled from 1-6.



Complete the following table based on the above structure.

Atom	C_1	O_2	C_3	C_4	N_5
Number of VSEPR pairs					
Electron pair Geometry					
Shape around the atom					
Hybridization of the atom					

ii) State the approximate values of the bond angles given bellow.

$C_1\hat{O}_2C_3$ - ..... $O_2\hat{C}_3C_4$ - ..... $C_4\hat{N}_5N_6$ - .....

d) Suggest an element which can be used in place of X in each of the following chemical species.

	Molecule / ion	Shape of the molecule	Principal quantum number of the valance shell of the central atom.	X
1	XO_2	bent	3	
2	XCl_3	Pyramidal	2	
3	XF_3	T-shape	2	
4	XO_2^+	Linear	2	

02) a) Atomic number of the metal M is 29. Answer the questions based on M.

i) Write down the complete electron configuration of the cation (Stable electron configuration of isolated gaseous ion) in MCl_2.

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ii) State the color of the compound MCl_2 and the chemical species responsible for the color.

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iii) Color of MCl_2 turns into yellow (X) when treated with conc.HCl the resultant solution turns into colorless forming $[MCl_2]^-$ when SO_2 is passed through the solution.

I) Identify the chemical species responsible for the yellow color.

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II) What is the role of SO_2 in above reaction?

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III) Briefly explain why $[MCl_2]^-$ is colorless.

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iv) Yellow color of the species X [X *in part (ii) above*] turns into blue color on dilution. Write down the relevant ionic equation for this conversion.

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b) A is a white solid. It reacts with dil.H_2SO_4 liberating the colorless gas B and giving a clear solution C. when gas B is passed through a solution of acidified $K_2Cr_2O_7$, the solution turned green with the formation of yellow/white colloidal precipitate D. The gas E obtained by burning D in air reacts with gas B giving D and colorless liquid F. Anhydrous $CuSO_4$ turns into blue when F is added. The white precipitate which is formed by reacting C with NaOH is soluble in excess of NaOH and NH_4OH.

i) Identify chemical species from A to F.

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

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

ii) Write down the balanced chemical equations for all the reactions described above.

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iii) Give a method to identify each of the gases B and E, from a mixture.

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c) Propose a method to identify each chemical species in the following sets of chemicals using the given method/reagents.

i) $(NH_4)_2CO_3(aq)$, $(NH_4)_2SO_4(aq)$, $Ba(OH)_2(aq)$ } by mixing pairwise and using dil.HNO_3

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ii) $KOH_{(aq)}$, $NaCl_{(aq)}$, $CH_3COOH_{(aq)}$ } using red litmus

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iii) $(NH_4)_2Cr_2O_7(s)$, $ZnCO_3(s)$, $MgCO_3(s)$ } Heating to a high temperature.

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03) a) The following description refers to the experiment carried out to study kinetics of the reaction.

$2I^-_{(aq)} + H_2O_{2(aq)} + 2H^+_{(aq)} \rightarrow I_{2(aq)} + 2H_2O_{(l)}$

In this experiment concentrations of the acid and H_2O_2 were much greater than the concentration of KI and they were kept constant during all the experiments. Rate is measured by measuring the time taken to produce a constant amount of I_2. (Use your knowledge on the experiment of the reaction between Fe^{3+} and I^- ions performed by you in the laboratory, to answer to this question)

Experiment	[KI] / mol dm^{-3}	Time (s)	1/t s^{-1}
1	0.004	74	0.0135
2	0.006	49.4	0.0202
3	0.008	37	0.0270
4	0.010	30	0.0333
5	0.012	25	0.0400

i) In all of the above experiments aqueous H_2O_2 was always added at last. State why this was necessary?

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ii) Explain why the volume of the system was kept constant for all experiments.

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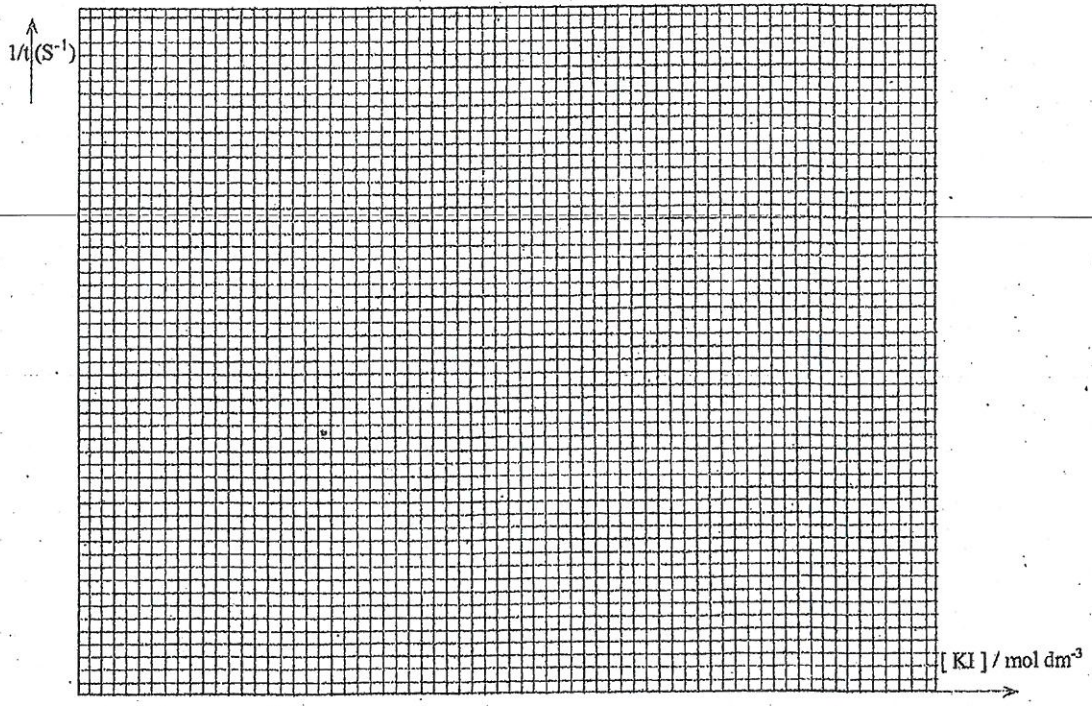
iii) Plot a graph of the initial rate ($R \propto 1/t$) on the vertical axis against concentration of KI used on the horizontal axis, on the scale given below.



iv) Use your graph to determine the order (n) with respect to I^- ions.

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vi) Further studies show that the rate equation for this reaction is $R = k [I^-_{(aq)}]^n [H_2O_{2(l)}]$ { n – the value determined in the (iv) above}

I) From this rate equation, state what can be deduced about the role of $H^+_{(aq)}$? -

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II) State the units of the rate constant.

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b) i) Define the term **"catalyst"**.

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ii) State the difference between homogeneous and heterogeneous catalysts.

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iii) Some transition metals ions are good homogeneous catalysts in aqueous solutions. Explain this statement briefly.

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iv) Some compounds of transition metals and metals themselves act as heterogeneous catalysts for gas phase reactions. Explain how this is achieved?

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04) a) A, B and C are three structural isomers of a hydrocarbon with the formula C_7H_{12}. A, B and C all exhibit optical isomerism. The compound D obtained by partial hydrogenation (Using Lindlar's catalyst) of A exhibits geometrical and optical isomerisms. B and C are reacted with $AgNO_3/NH_4OH$ forming white precipitates. On hydrogenation with H_2 / Ni, A, B and C all yield the same compound E. D reacts with HBr yielding F.

i) Identify the compounds from A to F.

A B C

D E F

ii) Draw the structures of geometrical isomers of D and give their specific names.

b) Write the reagents / catalyst / conditions P, Q, R, S, T, U, V and W (with suitable conditions, if any) of the following reactions in the boxes given bellow.

i) $CH_4 \xrightarrow{P} CCl_4$

ii) $CH_2 = CH_2 \xrightarrow{Q} \overset{Br\ Br}{\underset{|\quad|}{CH_2CH_2}}$

iii) $CH_3CH = CH_2 \xrightarrow{R} CH_3CH_2CH_2\text{-}Br$

iv) $CH_3CH = CH_2 \xrightarrow{S} \overset{OH}{\underset{|}{CH_3CHCH_3}}$

v) $CH_3CH = CH_2 \xrightarrow{T} \overset{OH\ \ OH}{\underset{|\quad\ |}{CH_3CH - CH_2}}$

vi) $CH_3C \equiv CH \xrightarrow{U}$ Brown-red precipitate (Chocolate brown)

vii) $CH_3C \equiv CH \xrightarrow{V} CH_3\overset{O}{\overset{\|}{C}}-CH_3$

viii) $CH_2=CH-CH_3 \xrightarrow{W} CH_3\overset{Br}{\underset{|}{C}}HCH_3$

P	Q	R	S
T	U	V	W

c) Write the mechanism for the reaction in b) (viii) above.

24.07.2018

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Royal College Colombo 07

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
General Certificate of Education (Adv. Level) Examination, August 2019

Grade 12 - 3rd Term Test
July, 2018

රසායන විද්‍යාව II
Chemistry II

02 E II

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

PART B – ESSAY

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

05) a) A and B are two rigid bulbs made by transparent glass. These bulbs are connected through a capillary tube with a tap. The tap is initially closed. Bulb A contains only gaseous XO and B contains only gaseous Oxygen $(O_{2(g)})$. Each gas exists under the conditions indicated in the table given below.

Bulb	A	B
Gas	XO	O_2
Initial pressure	6×10^5 Pa	20×10^5 Pa
Volume	4.157 dm^3	8.314 dm^3
Temperature	27 ^{0}C	227 ^{0}C

i) Calculate the initial amounts (moles) of gas in each bulb.

ii) The tap is opened and gases were allowed to mix freely and completely. At the same time the temperature of the entire system was brought to 127 ^{0}C. The following reaction occurs during the mixing. Temperature of the each bulb kept unchanged at 127 ^{0}C.

$$2XO_{(g)} + O_{2(g)} \rightarrow 2XO_{2(g)}$$

i) Identify the limiting reagent of the above reaction.

ii) Calculate the number of moles of each gas after the completion of the reaction.

iii) Calculate the final pressure of the gas mixture.

iv) Calculate the partial pressure of each gas in the final gas mixture.

v) Following reaction occurs in the final system when the system expose to ultraviolet radiation (UV).

$$2\ XO_{2\,(g)} \longrightarrow X_2O_{4\,(g)}$$

After few seconds, at time t (after t seconds), stop the irradiation. At time t it has been found that

$$\frac{\text{moles of } XO_2}{\text{moles of } X_2O_4} = 2$$

Calculate the followings at time t s

I) number of moles of XO_2 and X_2O_4 in the final gas mixture.

II) total pressure of the system.

III) partial pressure of X_2O_4 gas in the final gaseous mixture in bulb A.

b) The balanced chemical equation for the reaction of gaseous NO_2 with $F_{2(g)}$ is

$2NO_{2(g)} + F_{2(g)} \rightarrow 2NO_2F_{(g)}; \Delta H(+)$

The suggested mechanism for this reaction is

$NO_{2(g)} + F_{2(g)} \xrightarrow{\text{slow}} NO_2F_{(g)} + F_{(g)}$

$NO_{2(g)} + F_{(g)} \xrightarrow{\text{fast}} NO_2F_{(g)}$

i) Write the rate law of the reaction according the mechanism suggested above.

ii) Give one reason as to why the above mechanism is considered to be acceptable.

iii) What is the rate determining the step of the reaction according to the mechanism suggested above.

iv) Draw the energy profile of the reaction, based on the mechanism given above and label it completely.

v) Draw the structures of the transition states of above reaction.

vi) Considering the above mechanism plot the $[NO_{2(g)}]$ against time graph and comment on the half life of NO_2.

vii) Based on the above mechanism, write two main requirements to be fulfilled to occur the above reaction. (Your answer must be specific to this reaction)

06) a) Define the term **"first ionization energy"** of hydrogen.

b) The amount of energy of an electron in a particular energy level (n) of hydrogen atom is given by Balmer - Rydberg equation as,

$E_n = \frac{-k}{n^2}$ where $k = 2.18 \times 10^{-18} J$

i) What is meant by the minus sign (-) in the above equation?

ii) Calculate the first ionization energy of hydrogen in kJ mol^{-1}.

iii) Calculate the energy difference between first and second energy levels in kJ mol^{-1}.

iv) Calculate the wavelength corresponds to the photon emitted when the electron of an exited hydrogen atom drops from the second energy level to the first energy level.

c) An inorganic compound contains only Na, N, O and H. The mass percentage of Na, N and H are 18.85%, 11.48% and 4.10% respectively.

i) Calculate the empirical formula of the above compound.

ii) Calculate the molecular formula of the above compound if the relative molecular mass of the above compound is about 250.

iii) This compound consists of two sodium salts, and H is present as H_2O only. Deduce the number of moles of H_2O in one mole of compound and identify the two salts.

iv) State two experiments which can be used to confirm two anions in the salt. (experimental details are not required)

07) a) A and B are two coordinate complex compounds formed by Chromium metal. Both complexes are octahedral in geometry. The oxidation states of chromium in both complexes are the same. One of the ligands in both compound is ammonia (NH_3). Only H_2O and Br^- can be present as ligands other than NH_3. The only ionic anion bonded to the coordination sphere is Br^-. There are four NH_3 molecules in each coordination sphere. 1 mol of A gives 3 moles of AgBr when A is treated with excess of $AgNO_3$ while, 1 mol of B gives 2 moles of AgBr when B is treated with excess of $AgNO_3$.

i) Identify the oxidation state of Cr in complexes.

iii) Give formulae of coordinate complex compounds A and B giving reasons.

iv) Draw the structure of coordination sphere of A.

b) i) When 72.0 g of graphite was burnt in limited Oxygen CO(g) and CO_2(g) are formed and 1798 kJ of heat energy is released.

If the standard formation enthalpy of CO(g) and CO_2(g) are -111 $kJmol^{-1}$ and -394 $kJmol^{-1}$ respectively,

i) Find out molar ratio of CO(g) and CO_2(g) in the product mixture. (C - 12).

ii) Find out volume of minimum amount of air that should be used in above i) process to get some product mixture at STP. (Assume that mole fraction of $O_{2(g)}$ in air is 0.2)

iii) $CO_{(g)}$ can be used to reduce $Fe_2O_{3(s)}$ into $Fe_{(s)}$ according to the reaction

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$

Standard formation enthalpy of $Fe_2O_{3(s)}$ is -824 $kJmol^{-1}$.

Substance	ΔS_f^0 / $J K^{-1} mol^{-1}$
$Fe_2O_{3(S)}$	87
$CO_{(g)}$	198
$CO_{2(g)}$	214
$Fe_{(S)}$	181

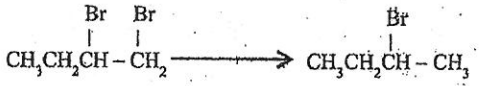
I) What is the enthalpy change of reduction of iron according to equation given above.

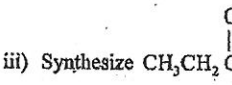
II) In blast furnace method, of ion extraction is done at 2000 K temperature. Deduce whether this reaction is feasible at this temperature, using a suitable calculation.

III) State any assumptions that you made in this calculation (if any).

08) a) Show, how you would carry out the following conversions.

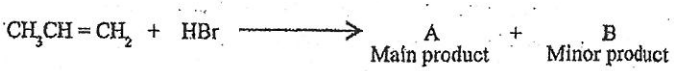
i) $CH_3CH_2CH_2CH_2\text{-}Br \rightarrow CH_3CH_2C \equiv C\,Na$

ii) 

iii) Synthesize  using only the following reagents and solutions.

$CH_3CH_2CH_2CH_2OH$, CH_3CH_2OH, Conc. H_2SO_4, Dil. H_2SO_4, $HgSO_4$, Br_2, CCl_4, KOH, HBr.

b) Consider the following reaction.



i) Identify A and B.

ii) Explain why A is the major product with the help of the mechanism.

c) Show that how you would separate each gas from a mixture of C_2H_2 and C_2H_4.

09)

(a) X is a mixture of salts containing only one cation and four anions. The following tests were carried to identify these ions.

		Observations
(1)	Dilute H_2SO_4 was added to X	Two colorless gases and a brown gas were liberated forming a turbid solution.
(2)	X was dissolved in water	Clear solution obtained.
(3)	Add $Pb(CH_3COO)_2$ was added to the solution obtained from test (2).	White precipitate/s was/were formed.
(4)	Warm the above precipitate in (3)	Black precipitate was given.
(5)	The filtrate from (4) above was allowed to cool.	white needle like crystals were formed.
(6)	$CaCl_{2(aq)}$ was added to the filtrate from (3).	There was no observable change.
(7)	The resultant solution from test (6) was heated .	White precipitate was formed.
(8)	After the liberation of the gas, the solution in (1) was treated with KOH.	A gas which turns red litmus blue was evolved.

(i) Identify the four cation and anions present in the mixture X.

(ii) Explain how the solution in test (1) became turbid.

(iii) Identify the precipitates obtained in tests (3), (4), (5) and (7).

(iv) Identify the gases obtained in tests (1) and (8).

b) Identify the compounds P, Q and R in the following descriptions and explain the observations with the help of balanced ionic / chemical equations.

i) P is an orange colored solid. When P is treated with NaOH, a gas which turns a filter paper moistened with Nesssler reagent into brown was evolved and the solution turned yellow.

ii) An aqueous solution of Q is formed a white precipitate with $BaCl_2$ and it is soluble in dil.HNO_3. Q was treated with H_2O_2 and then it was mixed with $BaCl_2$ solution, the precipitate, formed was insoluble in dil.HNO_3. A green precipitate was formed when Q is mixed with KOH solution and it was not dissolved in excess of KOH. The green precipitate did not show any change when expose to air.

iii) Solid R does not form a precipitate or does not evolve a gas when treated with dilute HCl. But it liberates a gas which forms white fumes with gaseous HCl, when treated with Devarda's alloy (mixture of Cu, Al and Zn) in the presence of NaOH. R forms a precipitate with ammonia which dissolves on addition of excess of aqueous NH_3.

c) A student performed the following sequence of reactions to determine the mass of pure Fe in a corroded iron nail.
The corroded iron nail (with the initial mass 7.24g) was dissolved in concentrated H_2SO_4 and left for a period of time until it is completely dissolved.
After that it was analyzed in the following manner. (assume that rust is completely composed of Fe_2O_3)

Procedure I

The above solution formed by dissolving the iron nail in concentrated H_2SO_4 was transferred into a 100.00 cm^3 volumetric flask and diluted up to the mark with distilled water 25.0 cm^3 portion of the above solution is taken into a titration flask and 5.0 cm^3 of H_3PO_4 was added.
$KMnO_4$ solution (solution S) which is prepared separately was taken and diluted two times. Then the above solution was titrated with this $KMnO_4$ solution. The average value of three burette readings was 10.0 cm^3. (Fe = 56.0)

Procedure II

13.4 g of pure $Na_2C_2O_4$ was weighed accurately and dissolved in distilled water and the solution was diluted to 100.0 cm^3. 25.0 cm^3 of this solution was titrated with the above $KMnO_4$ solution in procedure (I) before it is diluted two times (solution S). The volume at the end point was 25.0 cm^3.

i) Write the balanced equations for the reactions occurred in the experiment.

ii) What are the color changes in the above titrations?

iii) What is the concentration of the $KMnO_4$ solution before the dilution?

iv) Briefly explain the function of H_3PO_4 in procedure I.

v) Calculate the mass of pure Fe in the iron nail.

vi) State whether the mass of the iron nail before the corrosion can be calculated from this method? If it can't be calculated, what further information is required?