

පැරණි නිර්දේශය/பழைய பாடத்திட்டம்/Old Syllabus

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
 இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம்
 Department of Examinations, Sri Lanka
 இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரīட்சைத் திணைக்களம்

OLD

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
 கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
 General Certificate of Education (Adv. Level) Examination, 2020

රසායන විද්‍යාව II
 இரசாயனவியல் II
 Chemistry II

02 E II

ප්‍රතිපත්ති පද්ධතිය සඳහා පමණි

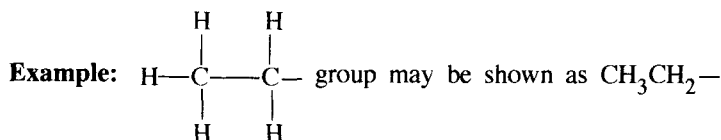
පැය තුනයි
 மூன்று மணித்தியாலம்
 Three hours

අමතර කියවීමේ කාලය - මිනිත්තු 10 යි
 மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்
 Additional Reading Time - 10 minutes

Use **additional reading time** to go through the question paper, select the questions and decide on the questions that you give priority in answering.

Index No. :

- * A Periodic Table is provided on page 15.
- * Use of calculators is not allowed.
- * Universal gas constant, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
- * Avogadro constant, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$
- * In answering this paper, you may represent alkyl groups in a condensed manner.



□ PART A — Structured Essay (pages 02 - 08)

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

□ PART B and PART C — Essay (pages 09 - 14)

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

For Examiner's Use Only

Part	Question No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	
Total		

Total

In Numbers	
In Letters	

Code Numbers

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

PART A — STRUCTURED ESSAY

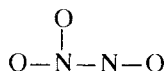
Answer **all four** questions on this paper itself. (Each question carries **10 marks**.)Do not
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1. (a) Write the answers to the questions given below on the dotted lines.

- (i) Of the three ions Na^+ , Mg^{2+} and F^- , which one has the **smallest** ionic radius?
- (ii) Of the three elements C, N and O, which one has the **highest** second ionization energy?
- (iii) Of the three compounds H_2O , HOCl and OF_2 , which one has the **most** electronegative oxygen atom?
- (iv) Of the three elements Be, C and N, which one will liberate energy when an electron is added to its atom [$\text{Y}(\text{g}) + \text{e} \rightarrow \text{Y}^-(\text{g})$; $\text{Y} = \text{Be}, \text{C}, \text{N}$] in the gaseous state?
- (v) Of the three ionic compounds NaF , KF and KBr , which one has the **highest** solubility in water?
- (vi) Of the three compounds HCHO , CH_3F and H_2O_2 , which one has the **strongest** intermolecular forces?

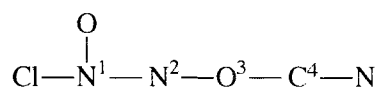
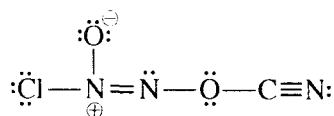
(2.4 marks)

- (b) (i) Draw the
- most**
- acceptable Lewis structure for the ion,
- $\text{N}_2\text{O}_3^{2-}$
- . Its skeleton is given below.



- (ii) Draw
- three**
- more Lewis structures (resonance structures) for this ion. Indicate the relative stabilities of the structures drawn by you, when compared with the most acceptable structure drawn in (i) above, by writing 'less stable' or 'unstable' under these structures.

- (iii) Complete the given table based on the Lewis structure and its labelled skeleton given below.



	N ¹	N ²	O ³	C ⁴
VSEPR pairs around the atom				
electron pair geometry around the atom				
shape around the atom				
hybridization of the atom				

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- Parts (iv) to (vii) are based on the Lewis structure given in part (iii) above. Labelling of atoms is as in part (iii).

(iv) Identify the atomic/hybrid orbitals involved in the formation of σ bonds between the two atoms given below.

- | | | |
|------------------------------|--------------------|--------------------|
| I. $\text{Cl}-\text{N}^1$ | Cl | N^1 |
| II. N^1-O | N^1 | O |
| III. N^1-N^2 | N^1 | N^2 |
| IV. N^2-O^3 | N^2 | O^3 |
| V. O^3-C^4 | O^3 | C^4 |
| VI. C^4-N | C^4 | N |

(v) Identify the atomic orbitals involved in the formation of π bonds between the two atoms given below.

- | | | |
|----------------------------|--------------------|--------------------|
| I. N^1-N^2 | N^1 | N^2 |
| II. C^4-N | C^4 | N |
| | C^4 | N |

(vi) State the approximate bond angles around N^1 , N^2 , O^3 and C^4 atoms.

N^1 , N^2 , O^3 , C^4

(vii) Arrange the atoms N^1 , N^2 , O^3 and C^4 in the **increasing** order of electronegativity.

..... < < < (5.6 marks)

(c) Consider the following information.

- I. The atoms **A** and **B** combine to form a heterodiatomic molecule **AB** that has a σ bond. This is represented as **A-B**.
- II. The electronegativity of **A** is less than that of **B** ($X_A < X_B$).
 X = electronegativity of the atom
- III. The inter-nuclear distance between **A** and **B** atoms ($d_{\text{A-B}}$) of the **AB** molecule is given by the following equation.

$$d_{\text{A-B}} = r_A + r_B - c(X_B - X_A)$$

r = atomic radius, $c = 9 \text{ pm}$

Note: d and r are measured in picometres (pm). ($1 \text{ pm} = 10^{-12} \text{ m}$)

Based on the above information, answer the following questions.

(i) What is the name used to identify the type of σ bond between **A** and **B**?

.....

(ii) Show how fractional charges ($\delta+$ and $\delta-$) are located in the molecule **AB**.

.....

(iii) Write the equation to calculate the dipole moment (μ) of molecule **AB** and show its direction.

- (iv) Calculate the percentage of ionic character of the H-F bond in the HF molecule using the data given below.

Inter-nuclear distance of H_2 (d_{H-H}) = 74 pm

Electronegativity of F = 4.0

Inter-nuclear distance of F_2 (d_{F-F}) = 144 pm

Dipole moment of HF = 6.0×10^{-30} C m

Electronegativity of H = 2.1

Charge of an electron = 1.6×10^{-19} C

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(2.0 marks)

2. (a) A, B, C and D are chlorides of *p*-block elements. The elements A, B and C have atomic numbers less than 20 whereas in D it is greater than 20 ($20 < Z_D < 55$). A description of the products (P_1 – P_8) formed when A is reacted with a limited amount of water and B, C and D are reacted with excess water are given below.

Compound	Description of products	
A	P_1	a very weakly acidic solid
	P_2	a strong monobasic acid
B	P_3	a gas that turns red litmus blue
	P_4	a compound with bleaching properties
C	P_5	a tribasic acid
	P_6	a strong monobasic acid
D	P_7	a white precipitate
	P_8	a strong monobasic acid

- (i) Identify A, B, C and D (give the chemical formulae).

A: B: C: D:

- (ii) Give balanced chemical equations for the reactions of A, B, C and D with water to give products P_1 to P_8 .

.....

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(iii) Write balanced chemical equations for the following reactions.

I. P_1 with NaOH(aq)II. P_3 with MgIII. P_8 with Al

(5.0 marks)

- (b) A student is provided with bottles labelled **P, Q, R, S, T** and **U** containing aqueous solutions of $Al_2(SO_4)_3$, H_2SO_4 , $Na_2S_2O_3$, $BaCl_2$, $Pb(Ac)_2$ and KOH (**not in order**). Some useful observations for their identification on mixing two solutions at a time are given below.
(Ac - Acetate ion)

	Solutions mixed	Observations
I	T + R	a clear colourless solution
II	P + R	a white precipitate
III	T + S	a gelatinous white precipitate
IV	U + R	a white precipitate
V	P + Q	a white precipitate, turns black on heating
VI	P + U	a white precipitate, dissolves on heating

(i) Identify **P** to **U**.

P: **Q:** **R:**
S: **T:** **U:**

(ii) Give balanced chemical equations for each of the reactions **I** to **VI**.

I:
II:
III:
IV:
V: formation of white precipitate:
 turning black on heating:
VI:

(Note: indicate precipitates as ↓)

(5.0 marks)

100

3. (a) A saturated aqueous solution of a sparingly soluble salt $AB_2(s)$ was prepared by stirring an excess amount of $AB_2(s)$ in 1.0 dm^3 of distilled water at 25°C . The amount of $A^{2+}(aq)$ ions present in this saturated aqueous solution was found to be $2.0 \times 10^{-3} \text{ mol}$.

(i) Write the equilibrium related to the dissolution of $AB_2(s)$ in the above system at 25°C .

.....

(ii) Write the expression for the equilibrium constant for the equilibrium written in (i) above at 25°C .

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(iii) Calculate the value of the equilibrium constant stated in (ii) above at 25 °C.

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(iv) Another saturated aqueous solution of AB_2 was prepared by stirring an excess amount of $AB_2(s)$ in 2.0 dm^3 of distilled water at 25 °C. Giving reasons, predict the value of the equilibrium constant for this system.

.....

.....

(v) A small amount of the strong electrolyte $NaB(s)$ is added to a saturated aqueous solution of AB_2 at 25 °C. Giving reasons, predict whether the concentration of $A^{2+}(aq)$ is increased or decreased.

.....

.....

.....

(6.0 marks)

(b) At 298 K, $0.01 \text{ mol dm}^{-3} \text{ CH}_3\text{COONa}(aq)$ solution was mixed with an equal volume of $0.01 \text{ mol dm}^{-3} \text{ HCl}(aq)$ solution. Calculate the pH of the resultant solution.

(at 298 K, $K_b(\text{CH}_3\text{COO}^-(aq)) = 5.0 \times 10^{-11}$ and $K_w = 1.0 \times 10^{-14}$)

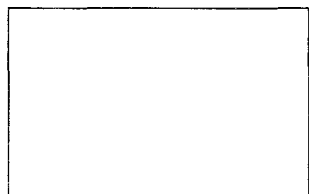
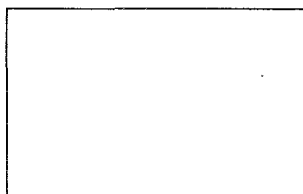
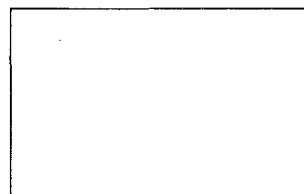
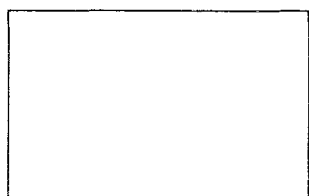
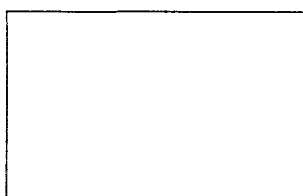
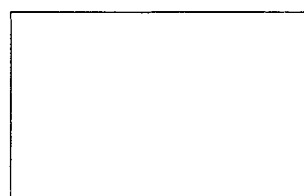
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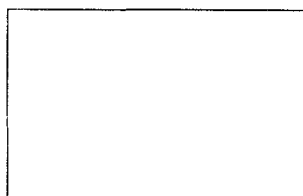
4. (a) **A, B, C** and **D** are structural isomers having the molecular formula C_6H_{10} . None of them show optical isomerism. All four isomers, **A, B, C** and **D** when treated with $HgSO_4/dil. H_2SO_4$ give products which react with 2,4-dinitrophenylhydrazine (2,4-DNP) to give coloured precipitates. Only **A** gives a precipitate with ammonical $AgNO_3$. **A** has only one position isomer, which is **B**. **B** is a chain isomer of **C**. **C** reacts with $HgSO_4/dil. H_2SO_4$ to give two products **E** and **F**. **D** reacts with $HgSO_4/dil. H_2SO_4$ to give only one product, which is **E**.

(i) Draw the structures of **A, B, C, D, E** and **F** in the boxes given below.

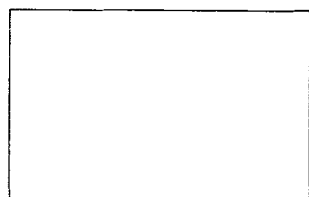
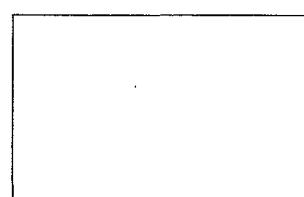
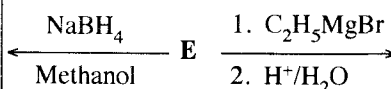
**A****B****C****D****E****F**

- (ii) Which of the compounds **A, B, C** and **D** gives a product that does not show diastereoisomerism when reacted separately with $H_2 / Pd-BaSO_4 /$ quinoline?

- (iii) Draw, in the box given below, the structure of the product **G** obtained when **A** is reacted with excess HBr .

**G**

- (iv) Draw the structures of products **X** and **Y** obtained in the following reactions of **E**, in the appropriate boxes.

**X****Y**

Name a test to distinguish between **X** and **Y**.

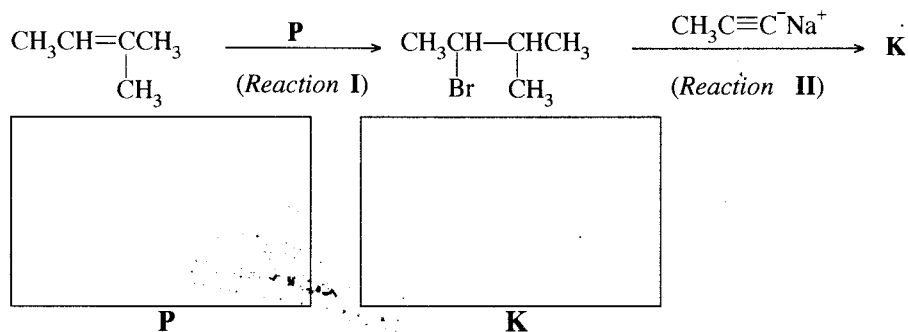
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(6.0 marks)

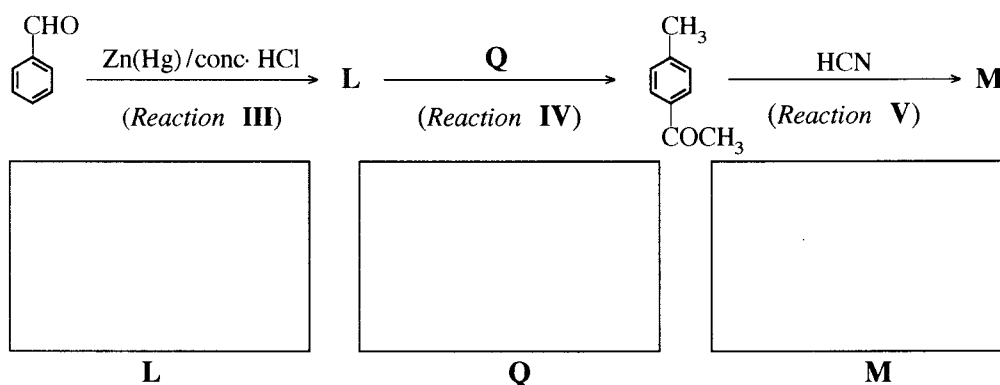
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- (b) (i) Complete the following three reaction sequences by drawing structures of compounds **K**, **L** and **M** and giving the reagents/catalysts **P**, **Q** and **R** in the boxes given below.

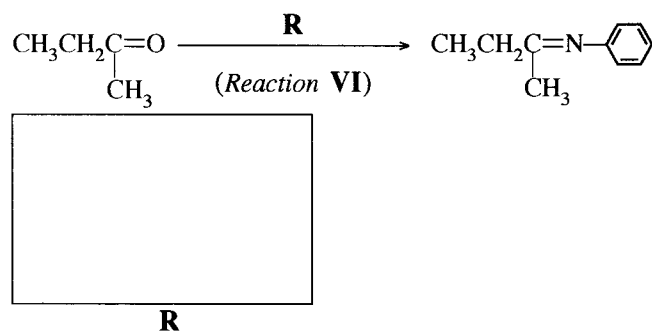
Sequence 1:



Sequence 2:



Sequence 3:



(3.0 marks)

- (ii) Selecting from the reactions **I – VI**, give **one (01)** example for each of the following types of reactions.

Nucleophilic addition

Nucleophilic substitution

(1.0 marks)

* *

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