**Name**………………...…………………**Centre/Index No**………/……**Signature** ………

**P525/1**

**CHEMISTRY**



**Paper 1**

**July/August, 2024**

**hours.**

### KOLOLO SENIOR SECONDARY

#### **Uganda Advanced Certificate of Education**

##### INTERNAL MOCK EXAMINATIONS – JULY/AUGUST, 2024

**CHEMISTRY**

(Principal Subject)

Paper 1

2 hours 45 minutes.

**INSTRUCTIONS TO CANDIDATES:**

# Answer ALL questions in part A and Six questions from part B.

## All questions are to be answered in the spaces provided.

The Periodic Table with relative atomic masses is provided at the back

## ***For Examiner’s Use Only***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **Total** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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**SECTION A (46marks)**

1. The isotope decays by emission of beta – particle to a stable nuclide. The rate of emission of - particle is followed by as suitable method.
2. Draw a sketch showing the rate of emission of beta particles against time. (2marks)
3. 0.02g of were allowed to decay.
4. Write a nuclear equation for the decay process (1 mark)

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1. If the half – life of the potassium isotope is 12.5 hours. Calculate the mass of the stable nuclide formed after 25hours. (2marks)

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1. 5.2cm3 of a gaseous hydrocarbon Q were exploded with an excess of oxygen. After cooling to the original room temperature and pressure, a contraction in volume of 7.8cm3 was observed. A further contraction of 10.4cm3 was noted after treatment with concentrated potassium hydroxide solution.
2. Determine the molecular formula **Q** (3marks)

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1. Write a mechanism to show how **Q** can be converted into propyne. (2marks)

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1. (a) Define between a thermoplastic . (1marks)

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(b) Nylon, 6,6 is a thermoplastic with structure

n

1. Write the structure of the monomers (1 marks)

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(ii) Name the reaction for formation of nylon 6,6 (1 mark)

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(c) An aqueous solution containing 1.5% nylon 6,6 was found to exert osmotic pressure of 4.1 x 10-2 atm at 25oC. Calculate

(i) the molar mass of nylon 6,6 (1½marks)

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(ii) value of n (1 mark)

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1. (a) State Le’ Chatelier’s principle. (01mark)

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(b) A sample of calcium carbonate was introduced into a sealed container of volume

0.654dm-3 and heated to 1000K until equilibrium was reached. The equilibrium constant for the reaction.

is atm. Calculate the mass of calcium oxide present at equilibrium. (3½marks)

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1. Propene undergoes electrophilic addition reaction with bromine water while propanone undergoes nucleophilic addition reaction with sodium hydrogen sulphite.
2. Explain the difference in the reactivities of the two compounds (2½marks)

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1. Write an equation and outline a mechanism of the reaction between propanone and sodium hydrogen sulphite. (2½marks)

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1. (a) The decomposition temperature of hydrides of group IV element of the periodic table are given in the table below.

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| --- | --- | --- | --- | --- | --- |
| Formula of hydride | CH4 | SiH4 | GeH4 | SnH4 | PbH4 |
| Decomposition temperature(oc) | 800 | 450 | 290 | 150 | 0 |

(i) State the relationship between the decomposition temperatures and thermal stability of the hydrides. (½ mark)

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(ii) Explain your answer in (i) (1½marks)

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(b) Write equation for the hydrolysis of silicon tetrahydride. (1½marks)

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(c) Explain why methane does not undergo hydrolysis. (1½marks)

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1. (a) Distinguish between the term oxidation state and oxidation number (1mark)

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(b) Complex ions can sometimes exhibit isomerism. The compound is isomeric with the compound.

1. State the type of isomerism exhibited by the compounds (1 mark)

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1. List the ions produced by the two isomers in solution (1 mark)

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1. Draw the structure and name the shape adopted by the isomer

(1 mark)

|  |  |
| --- | --- |
| Structure | Shape |
|  |  |

(c) Barium nitrate solution was added . Write an equation for the reaction. (1½marks)

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1. (a) Explain what is meant by the term PKa of methanoic acid. (01mark)

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(b) 10 litres of an aqueous solution of methanoic acid was completely neutralized by of 10cm3 of 0.01M sodium hydroxide. Calculate the PH of the solution of methanoic acid.

( Pka of methanoic at 25℃ is 3.745). (2marks)

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(c) The molar conductivity of a 0.103M methanoic acid solution at 25oC is 16.2 Scm2mol-1.

Calculate the;

1. degree of dissociation of methanoic acid. (1½marks)

(molar conductivity of methanoic acid at infinite dilution is 405 Scm2mol-1)

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1. pH of a solution (1½marks)

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1. (a)(i) Hydrogen fluoride can be prepared by heating calcium (II) fluoride with concentrated sulphuric acid. Write equation for the reaction. (1½ marks)

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(ii) Give a reason why hydrogen bromide cannot be prepared by a similar method to that in (i) (1½ marks)

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(b) Write equation for the reaction of hydrogen fluoride and silicon (IV) oxide.

(1½marks)

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**SECTION B (54marks)**

1. (a) (i) Explain what is meant by the term positive deviation (1 mark)

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(ii) State two conditions under which Raoult’s law is valid (1 marks)

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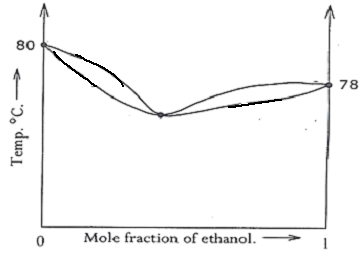
(b) Explain why some solutions deviate from Raoult’s law? (4marks)

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(c) The graph below shows the boiling point – composition diagram for benzene – ethanol

system



Explain the shape of the graph (3marks)

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1. The first electron affinities of the elements in period 3 are given below

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Elements | Na | Mg | Al | Si | P | S | Cl | Ar |
| First electron affinity (KJ/mol) | -20 | +67 | -30 | -135 | -60 | -200 | -364 | 0 |

1. State and explain the general trend in the first electron affinities of the elements (5marks)

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1. Explain why the first electron affinity of magnesium is more positive than the normal observed trend (2marks)

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1. Why is the first electron affinity of argon zero? (3marks)

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1. Write equations to show how the following compounds can be synthesized.

OCH3

Br

(a) from benzene (3marks)

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**C-CH2CH2-C**

O

Cl

Cl

O

(b)

from ethanol (3 marks)

…………………………………………………………………………………………………………………………………………………………………………………………………….

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(c) from ethene (3 marks)

SO3H

CH3

C

O

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1. (a) What is meant by the term rate determining step in a chemical reaction (1mark)

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(b) The decomposition of gaseous dinitrogen pentoxide is represented by

2N2O5(g) 4NO2(g)+O2(g)

and is first order with respect to dinitrogen pentoxide

1. Write down the rate equation with respect to dinitrogen pentoxide (1mark)

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1. A proposed mechanism for the reaction is made up of the following steps

N2O5  N2O3+ O2  I

N2O3  NO + NO2  II

NO + 2N2O5  3NO2 + N2O5 III

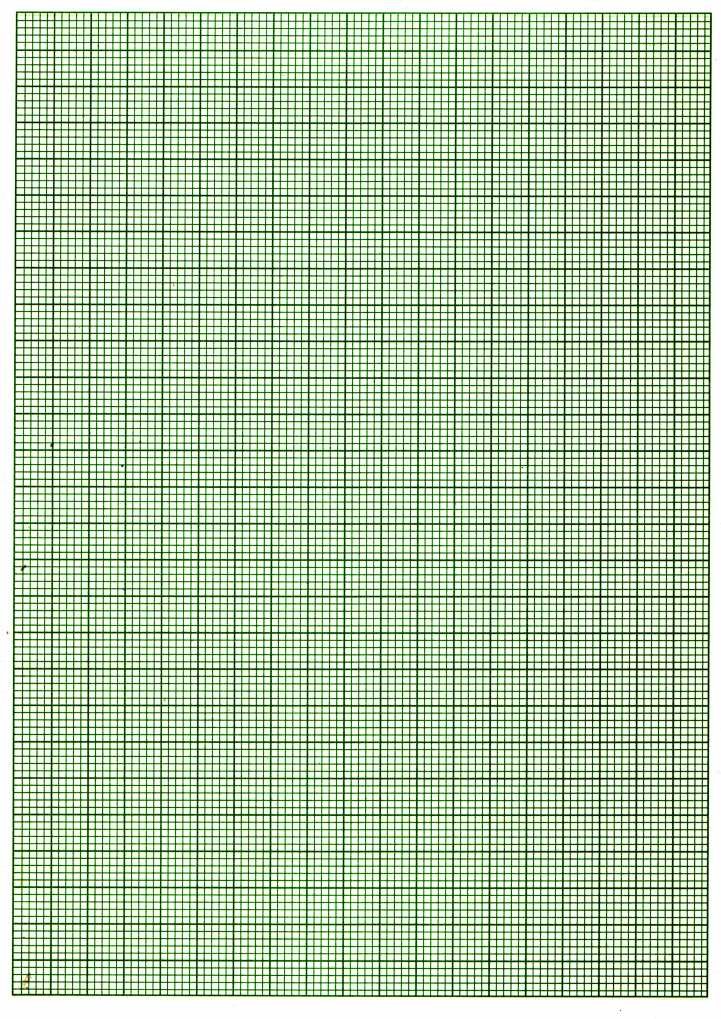
From your rate equation in (b)(i), write down which of the steps would be expected to be the rate determining step. Give a reason for your answer (2mark)

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(c) Data for the decomposition of dinitrogen pentoxide at 333K are shown below

|  |  |
| --- | --- |
| Pressure of dinitrogen pentoxide (Pa) | Rate of reaction (per second) |
| 1200 | 1.04 |
| 1000 | 0.88 |
| 800 | 0.69 |
| 400 | 0.34 |

1. Plot a graph rate of a reaction against pressure of dinitrogen pentoxide (3marks)



1. Use the graph in (d)(i) to determine the rate constant for the reaction at 333K

(2marks)

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1. (a) Define each of the following terms
2. atomization energy (1mark)

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1. lattice energy (1mark)

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(b) Draw a fully labelled energy diagram for the formation of potassium bromide.

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(c) Using the information in the table below, calculate the lattice energy of potassium bromide. (3marks)

|  |
| --- |
|  |
| ⅟2 Br2(l) - 392 |
|  |
| K+(g) |
| Br2(l) 2Br(g) |
|  |
| K+ (g) + |

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(d) The values of lattice energies of other potassium halides are

|  |
| --- |
| Compound |
| Lattice energy - 813 -710 -643 |

1. State and explain the trend in the lattice energies of the compounds (2marks)

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1. Explain how the lattice energies of , and correlate with the stability of these compounds. (2marks)

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1. (a) Define the term freezing point depression (1mark)

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(b) The values of molal elevation constant and molal depression constant for water are 0.52 and 1.86°C kg mol–1 respectively. If the elevation in boiling point by dissolving a solute is –0.2°C, what will be the depression in freezing point of this solution? (3marks)

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(c) Why benzoic acid dissolved in benzene shows a lesser value of osmotic pressure than expected one, but 0.1 molar hydrochloric acid shows greater depression in freezing point than 0.1 molar acetic acid. (4marks)

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(d) State two advantages of using mass spectrometer in determining relative molecular mass compared to freezing point depression method (1mark)

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1. (a) A compound **X**, vapour density 2.589, contains Carbon 62.07%, Hydrogen 10.34% the rest being oxygen. **X** dose not burn with a sooty flame.
2. Calculate the empirical formula of **X**. (**C=12, H = 1,O =16**). (1½marks)

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1. Determine the molecular formula of **X**. (1marks)

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(b) Hydrolysis of **X** yielded compounds, **Y**, **C4H10O** and **Z, C2H4O2**. Both **Y** and **Z** react with metallic sodium. **Z** reacted with sodium carbonate but **Y** did not:

1. Identify **Z**  (½mark)

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1. Write the names and the structural formula of all the possible Isomers of **Y**.

(2marks)

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1. Name a reagent that can be used to distinguish between the isomers in (b) (ii) and state what would be observed if the reagent is reacted separately with each of the isomers. (2marks)

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(c) When **Y** was warmed with acidified potassium dichromate solution there was no observable change:

(i) Identify **Y**. (½marks)

……………………………………………………………………………………………….

(ii) Write equation and outline a mechanism for the reaction between **Y** and concentrated orthophosphoric acid. (1½marks)

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1. (a) State what is observed and write equation for the reaction when;

(i) A mixture of methanoic acid and ammoniacal silver nitrate in a boiling tube is heated in a water bath. (2 marks)

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(ii) Concentrated nitric acid and solid lead (IV) oxide is added to aqueous manganese (II) sulphate solution and the mixture heated. (2 marks)

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(b) The standard reduction potentials of some half- cells are given in the table below

|  |  |
| --- | --- |
| Half –cell reaction | Standard electrode potential (V) |
| **B**: Cr2O72-(aq) + 6e + 14H+(aq) Cr3+(aq) + 7H2O(l) | +1.33 |
| **D**: Cl2(g) + 2e 2Cl-(aq) | +1.36 |

1. Draw a diagram showing a cell made by combining the two half cells (2marks)

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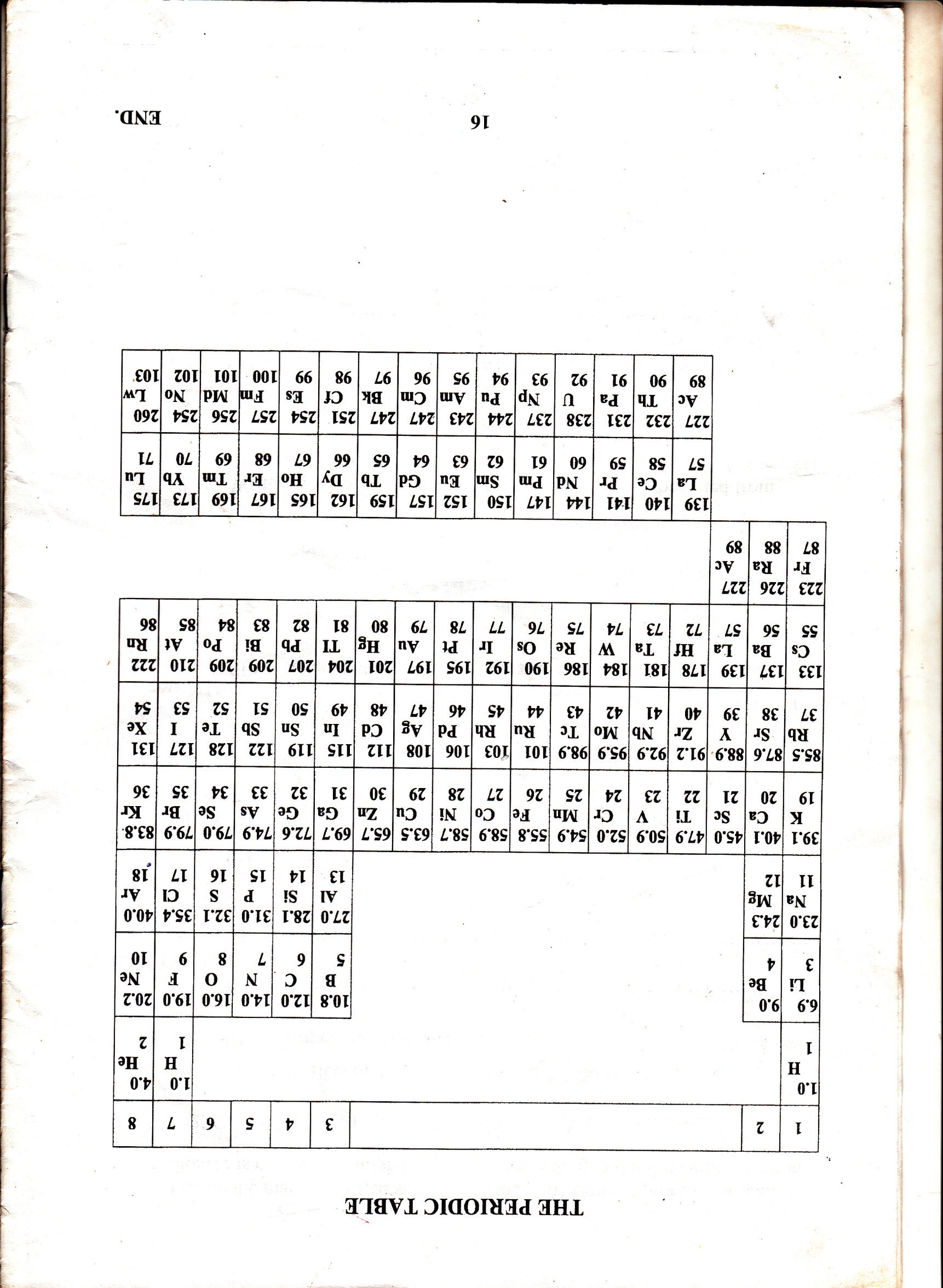
1. Calculate the emf of the cell. (1mark)

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1. Explain why the standard electrode potentials shown above for each of the two half cells cannot be determined absolutely. (2marks)

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**END**

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