

P525/2

CHEMISTRY

Paper 2

August 2023

$2\frac{1}{2}$ hours.

Uganda Advanced Certificate of Education

END OF TERM TWO EXAMINATIONS

S5 CHEMISTRY

Paper 2

Time: 2 hours 30 minutes.

INSTRUCTIONS TO CANDIDATES:

- Attempt **five** questions including **three** questions from section **A** and any **two** questions from section **B**.
- Begin each question on a fresh page.
- Mathematical tables and graph papers are provided.
- Non programmable scientific electronic calculators may be used.
- Where necessary, use the following values;
 - 1 mole of gas occupies 22.4dm^3 at stp;
 - molar gas constant (**R**) is $0.0821\text{ atm dm}^3\text{K}^{-1}$

Turnover

SECTION A

Attempt any *three* questions in this section.

1. (a) What is meant by the term isotope. (01 mark)

(b) Describe the main steps involved in the operation of a mass spectrometer. (09 marks)

(c) The table below shows the information from a mass spectrum of a lead sample

Isotope	204	206	207	208
Detector current (mA)	0.16	2.72	2.5	5.92

Calculate

(i) The relative abundance of the different isotopes of lead in this sample. (02mks)

(ii) The relative atomic mass of lead. (03 marks)

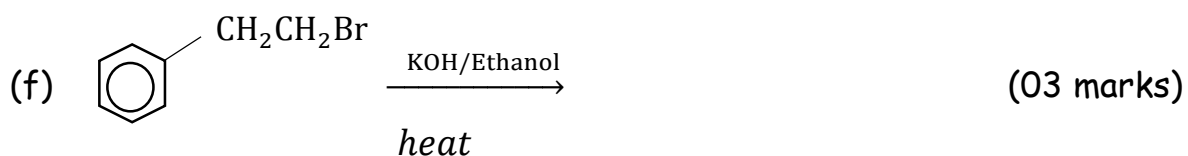
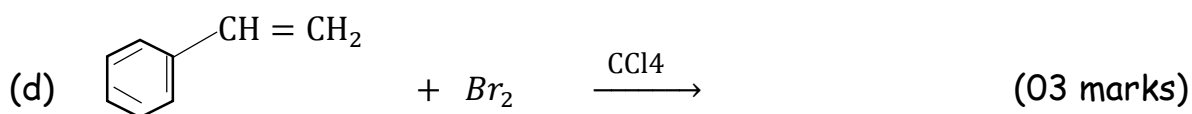
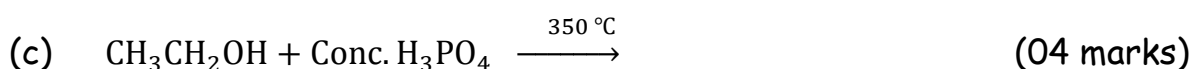
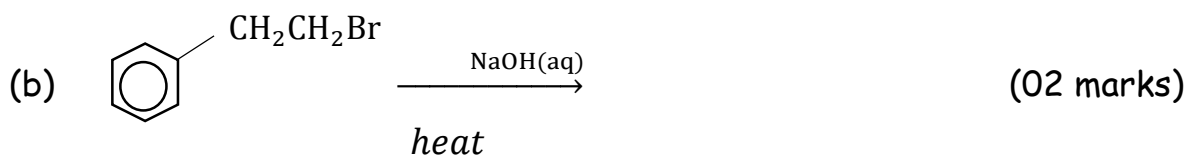
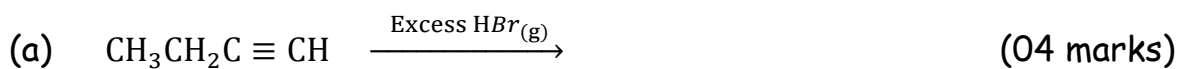
(d) State two advantages of using a mass spectrometer over any other method of determining R.A.M (02 marks)

(e) The initial count of a radioactive nucleus was 680 per second. After 350seconds, the count rate was 125 per second. Calculate the

(i) decay constant. (01½ marks)

(ii) half-life of the nucleus. (01½ marks)

2. Complete the following equations and write the accepted mechanism for each of the reactions.



3. (a) . The atomic numbers and melting points of some elements in period 3 of the period 3 of the periodic table are shown below.

Element	Na	Mg	Al	Si	P	S	Cl
Atomic number	11	12	13	14	15	16	17
Melting point ($^\circ\text{C}$)	98	650	660	1423	44	120	-11

i) Plot a graph of melting point against atomic number. (03 marks)

ii) Explain the shape of the graph. (05 marks)

b). Describe how the elements react with water (12 marks)

4. (a) (i) What is meant by the term colligative property. (01 mark)
(ii) State any four colligative properties. (02 marks)

(iii) State two limitations of any colligative property. (01 mark)

(b) Describe an experiment that can be used to determine the relative molecular mass of a compound **Q** by the method of elevation of boiling point of a liquid. (08 marks)

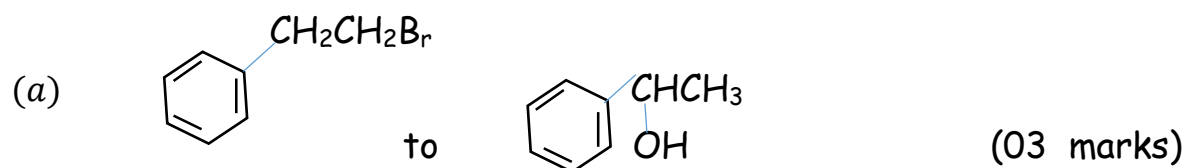
(c) Explain why the method you have described is not suitable for determining the relative molecular mass of ethanoic acid in aqueous solution. (03 marks)

(d) A solution of 2.8g of cadmium iodide (CdI_2) in 20g of water boiled at 100.2°C at normal pressure. Calculate the relative molecular mass of cadmium iodide and comment in your result.
(K_b for water is $0.52^\circ\text{C mol}^{-1} \text{ kg}^{-1}$, $\text{Cd} = 112$; $\text{I} = 127$) (05 marks)

SECTION B

Attempt any *two* questions in this section.

5. Write equations to show how the following compounds can be synthesised. Indicate the condition(s) for the reaction(s).



(b) Calcium carbide to ethane-1,2-diol (04 marks)

(c) Ethanol to benzene (04½ marks)

(d) Ethene to but-1-yne (04½ marks)

(e) CH_3Br to CH_3COOH (03marks)

6. (a). Data for thermo-energy changes for some processes are shown in the table below.

Energy process	kJmol^{-1}
Atomisation energy of calcium	= +178
Ionisation energy of calcium	= +590
Second ionisation energy of calcium	= +1146
Heat of formation of calcium fluoride	= -1220
Electron affinity of fluorine	= -328
Bond dissociation energy of fluorine	= +242.7

Use the above information and construct an energy level diagram for the heat of formation of calcium fluoride. (05 marks)

(b) (i) Calculate the lattice energy of calcium fluoride crystal. (02 marks)

(ii) Determine the enthalpy of solution of calcium fluoride.

(Enthalpy of hydration of calcium and fluoride ions are -1587 and -515kJmol^{-1} respectively) (03 marks)

(c) (i) Define the term enthalpy of solution. (01 mark)

(ii) Using sodium chloride, draw a Born Haber cycle to show how lattice energy, hydration and enthalpy of solution are related. (03 marks)

(d) Describe an experiment that can be used to determine the enthalpy of solution of sodium chloride. (06 marks)

7. (a) (i) Write the formula and name of any ore of aluminium (01 mk).
(ii) Describe how pure aluminium can be obtained from the ore you have named above. (*Illustrate your answer with equations where necessary*) (10 marks)

(b) State what would be observed and in each case write the equation(s) for the reactions between

- (i) Hot concentrated sodium hydroxide solution and aluminium powder. (03 marks)
- (ii) Sodium carbonate solution and aluminium sulphate solution (03 marks)
- (iii) Magnesium powder in aluminium nitrate solution
Sodium hydroxide solution added to aluminium chloride solution dropwise until in excess. (03 marks)

8. Explain the following observations

- (a) Hexane boils at 68°C whereas 2-methylpentane boils at 60.3°C yet the two compounds have the same molecular mass. (04 marks)
- (b) propan-1-ol is a liquid whereas propene is a gas both at room temperature. (04 marks)
- (c) Pure water boils at 100°C but when sodium chloride is dissolved in this water, it boils at a slightly higher temperature. (04 marks)
- (d) The atomic radius of sodium atom is **0.156nm** while the ionic radius of sodium ion is **0.095nm**. (04 marks)
- (e) The first ionisation energy of magnesium is higher than that of aluminium. (04 marks)

END