

Name:
School,

Centre/Index No:
Signature.....

P525/1

CHEMISTRY

Paper 1

July/August 2011

2 ¼ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- Attempt all questions in section A and any six questions from section B.
- All questions are to be answered in the spaces provided.
- A Periodic Table with relevant atomic masses is supplied at the end of the paper.
- Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	19	11	12	13	14	15	16	17	Total

SECTION A (46 marks)

Answer all questions in this section.

1. a) State:

- i) two properties in which beryllium resembles aluminum.

(2 marks)

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- ii) one reason why the two elements show similarity. (1 mark)

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- b) i) What name is given to the above relationship? (1 mark)

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- ii) Name another pair of elements which shows the same type of relationship. (1 mark)

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2. a) Define the term solubility of a salt. (1 mark)

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- b) 25.2g of a saturated solution of copper(II) sulphate at 35°C was diluted with distilled water to make 200 cm³ of solution. To 25.0 cm³ of the diluted solution excess potassium iodine was added, the liberated iodine required 33.5 cm³ of 0.118 M sodium thiosulphate solution. Copper(II) ions react with iodide ions according to the equation.

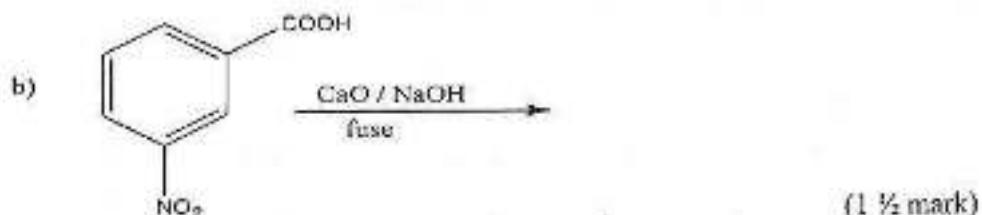


Calculate the solubility of copper(II) sulphate in grams per 100g of water at 35°C (4 marks)

3. Complete the following equations and name the major organic products(s).



Name of product



Name of product



Name of product(s)

4. When 123 g of nitrobenzene were dissolved in 1000 g of ethanoic acid, the mixture froze at a temperature $t^{\circ}\text{C}$.

a) What name is given to the temperature $t^{\circ}\text{C}$ (1 mark)

- b) Explain why the temperature $t^{\circ}\text{C}$ is lower than the freezing point of pure ethanoic acid. (1 $\frac{1}{2}$ mark)

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- c) Calculate the value of t if a solution containing 0.55 g of nitrobenzene 22 g of ethanoic acid froze at a temperature 0.78°C lower than the freezing point of ethanoic acid (2 $\frac{1}{2}$ mark)

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5. Name reagent(s) that can be used to distinguish between the following pairs of compounds. In each case state what is observed if each member of the pair is separately treated with the reagent.

a) $\text{C}_6\text{H}_5\text{CHO}$ and CH_3CHO (3 marks)

Reagent(s)

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Observations

b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ (3 marks)

Reagent(s)

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Observations

6. a) Define the term *partition coefficient* (1 mark)

- b) Explain why partition coefficient changes with temperature (1 mark)

- c) 3.33g of a compound Q in 50 cm³ of ether is in equilibrium with 1.67g of Q in 1000 cm³ of water. Calculate the mass of Q that can be extracted by a 25.0 cm³ portion of ether from a 1.0 dm³ solution containing 5g of Q. (3 marks)

7. Write equation of the reaction if any of the following compounds react with water.

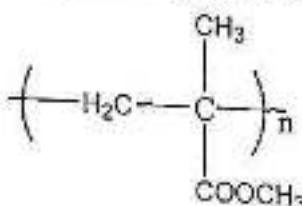
(1 ½ mark each)

- a) Boron trifluoride

- b) Aluminum chloride

c) Hydrogen fluoride

8. Perspex is a synthetic polymer with structural formula



a) Write the structural formula of the monomer of perspex. (1 mark)

b) State the type of polymerization involved in the formation of Perspex.
(1 mark)

c) When 1.25×10^3 moles of Perspex was heated in the presence of silica as a catalyst 4.85g of monomer was produced. Determine the number of monomer molecules formed. (3 marks)

9 a) Explain the term *standard electrode potential* (2 marks)

- b) The standard electrode potentials for some systems are given below

Electrode	E°/V
$\text{Cr}^{3+}(\text{aq})/\text{Cr}^{2+}(\text{aq})$	-0.402
$\text{MnO}_4^-(\text{aq})/\text{Mn}^{2+}(\text{aq})$	+1.52

- i) Write the convention of the cell formed when the electrodes are coupled. (1 mark)

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- ii) Write an equation for the cell reaction (1 ½ mark)

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- iii) Determine the standard cell potential for the cell (1 mark)

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- iii) identify the anode of the cell in (i) (1 mark)

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SECTION B (54 marks)

10. 1.5g of an impure sample of silicon tetrachloride was dissolved in water and the solution made up to 250 cm³ in a volumetric flask. 25.0 cm³ of the resultant solution required 30.0 cm³ of 0.1 M sodium hydroxide solution for complete reaction.

- a) Write equation for the reaction to show how

- i) silicon tetrachloride can be prepared in the laboratory.

(1 ½ mark)

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ii) silicon tetrachloride reacts with water. (1½ mark)

b) Calculate the percentage purity of the sample of silicon tetrachloride (4 ½ mark)

c) Explain why carbon tetrachloride does not undergo the reaction in (a) above (1½ mark)

11. Explain the following observations.

a) Lithium carbonate decomposes on heating whereas sodium carbonate does not. (3 marks)

- b) Cold concentrated hydrochloric acid reacts with lead(IV) oxide to form an oily yellow liquid, however with hot concentrated hydrochloric acid a greenish yellow gas is obtained. (4 marks)

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- c) Iron(III) chloride exists whereas iron(III) iodide does not exist
(2 marks)

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12. A calcium salt W of molecular mass 158 contains, 31.25% carbon, 3.15% hydrogen, 40% oxygen the rest being calcium. When W was heated strongly a white solid X and another compound R were formed. R reacts with iodine and excess sodium hydroxide solution forming a yellow precipitate but does not react with acidified potassium dichromate solution.

- a) Determine the formula of W. (3 marks)

- b) Identify R, X and the yellow precipitate (1 ½ marks)

R.....

X.....

Yellow precipitate:

- c) Write equation for the reaction that takes place between R and Iodine hydroxide solution. (1 ½ mark)

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- d) Write an equation and outline a mechanism for the reaction between R and ethylamine. (3 marks)

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13. 1 mole of sulphur trioxide was introduced into a 1 dm³ vessel. The vessel was heated to 1000 K until equilibrium was attained. At equilibrium 0.35 mole of sulphur trioxide was present.

- a) Write

- i) equation for the decomposition of sulphur trioxide. (1 ½ mark)

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- ii) an expression for equilibrium constant K_C (1 mark)

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- b) Calculate the value at 1000 K. (2 marks)

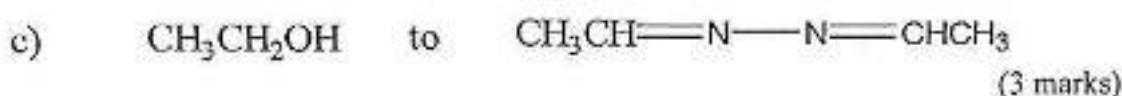
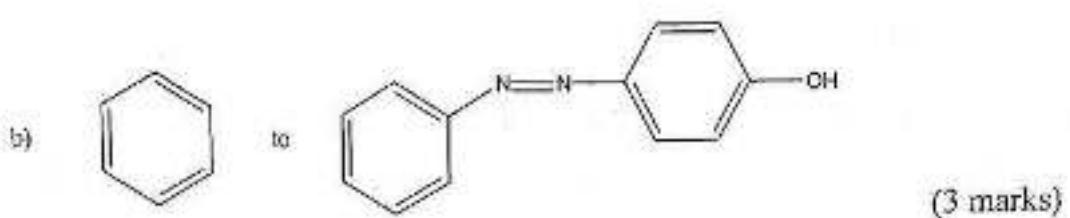
c) 0.2 mole of sulphur dioxide, 0.1 mole of oxygen and 0.7 mole of sulphur trioxide were introduced into the vessel in (a) at 1000 K.

Calculate the new value of K_c . (3 marks)

- c) From your answers in a) (ii) and b) (i) above, state how the position of the equilibrium was affected. (1½ mark)

14. Using equations only show how the following organic conversion can be carried out. Indicate reagents and conditions for the reaction.

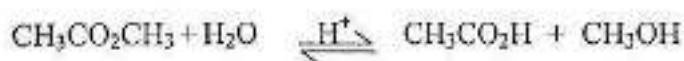
a) CH_3CHO to $\text{CH}_3(\text{CH}_2)_2\text{CH}_3$ (3 marks)



15. a) What is meant by the term *order of reaction*? (1 marks)

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b) Methyl ethanoate is hydrolyzed by water in the presence of an acid according to the following equation.



i) State the molecularity of the reaction. (½ mark)

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- ii) Determine the order of the reaction (assume that acid takes part in the reaction) (½ mark)

- iii) State the condition under which the reaction is over all first order (2 marks)

- c) The table below shows kinetic data for the reaction between A and B.

Experiment	[A]/ mol dm ⁻³	[B]/ mol dm ⁻³	Initial rate (mol dm ⁻³ s ⁻¹)
1.	0.20	0.20	1.2×10^{-3}
2.	0.20	0.60	1.2×10^{-3}
3.	0.40	0.60	4.8×10^{-3}

- i) Determine the rate law for the reaction between A and B (2 marks)

- ii) Calculate the rate constant and give its units (2 marks)

- iii) Determine the rate of reaction when [A] = 0.0125 mol dm⁻³ and [B] = 0.102 mol dm⁻³ (1 mark)

16. The table below shows the percentage ionic bond character and bond lengths of group (VII) hydrides.

Hydride	HF	HCl	HBr	HI
percentage ionic character	43	17	11	5
Bond length/nm	0.092	0.128	0.1410	0.160

- a) Arrange the hydrides in the order of acid strength and explain the order with respect to bond length. (2 ½ mark)

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- b) Explain the trend in percentage ionic character (2 ½ mark)

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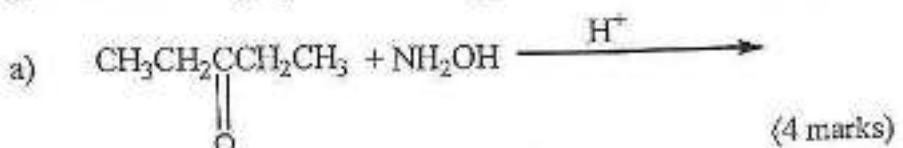
- c) An attempt to separate a mixture of hydrochloric acid and water by fractional distillation gave a solution with density 1.18 g cm^{-3} containing 36% hydrochloric acid. Explain why it is not possible to obtain 100% hydrochloric acid. (1 ½ marks)

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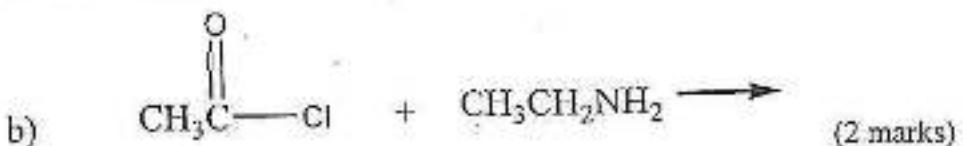
- d) Calculate the molarity of the hydrochloric acid obtained as the distillate (2 ½ mark)

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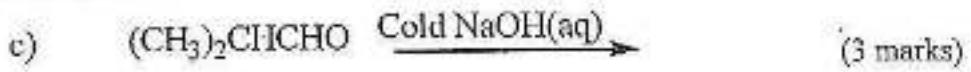
17. Complete the following equations and suggest a mechanism for the reaction.



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END

	H	He	Li	Be	B	C	N	O	F	Ne
1	1.0000	1.0000	3.641	6.941	10.0000	12.0000	14.0000	16.0000	18.0000	20.0000
2	1.0000	1.0000	4.0000	7.0000	10.0000	13.0000	16.0000	19.0000	22.0000	25.0000
3	1.0000	1.0000	5.0000	11.0000	18.0000	25.0000	32.0000	39.0000	46.0000	53.0000
4	1.0000	1.0000	6.0000	12.0000	20.0000	28.0000	36.0000	44.0000	52.0000	60.0000
5	1.0000	1.0000	7.0000	13.0000	21.0000	29.0000	37.0000	45.0000	53.0000	61.0000
6	1.0000	1.0000	8.0000	14.0000	22.0000	30.0000	38.0000	46.0000	54.0000	62.0000
7	1.0000	1.0000	9.0000	15.0000	23.0000	31.0000	39.0000	47.0000	55.0000	63.0000
8	1.0000	1.0000	10.0000	16.0000	24.0000	32.0000	40.0000	48.0000	56.0000	64.0000
9	1.0000	1.0000	11.0000	17.0000	25.0000	33.0000	41.0000	49.0000	57.0000	65.0000
10	1.0000	1.0000	12.0000	18.0000	26.0000	34.0000	42.0000	50.0000	58.0000	66.0000
11	1.0000	1.0000	13.0000	19.0000	27.0000	35.0000	43.0000	51.0000	59.0000	67.0000
12	1.0000	1.0000	14.0000	20.0000	28.0000	36.0000	44.0000	52.0000	60.0000	68.0000
13	1.0000	1.0000	15.0000	21.0000	29.0000	37.0000	45.0000	53.0000	61.0000	69.0000
14	1.0000	1.0000	16.0000	22.0000	30.0000	38.0000	46.0000	54.0000	62.0000	70.0000
15	1.0000	1.0000	17.0000	23.0000	31.0000	39.0000	47.0000	55.0000	63.0000	71.0000
16	1.0000	1.0000	18.0000	24.0000	32.0000	40.0000	48.0000	56.0000	64.0000	72.0000
17	1.0000	1.0000	19.0000	25.0000	33.0000	41.0000	49.0000	57.0000	65.0000	73.0000
18	1.0000	1.0000	20.0000	26.0000	34.0000	42.0000	50.0000	58.0000	66.0000	74.0000
19	1.0000	1.0000	21.0000	27.0000	35.0000	43.0000	51.0000	59.0000	67.0000	75.0000
20	1.0000	1.0000	22.0000	28.0000	36.0000	44.0000	52.0000	60.0000	68.0000	76.0000
21	1.0000	1.0000	23.0000	29.0000	37.0000	45.0000	53.0000	61.0000	69.0000	77.0000
22	1.0000	1.0000	24.0000	30.0000	38.0000	46.0000	54.0000	62.0000	70.0000	78.0000
23	1.0000	1.0000	25.0000	31.0000	39.0000	47.0000	55.0000	63.0000	71.0000	79.0000
24	1.0000	1.0000	26.0000	32.0000	40.0000	48.0000	56.0000	64.0000	72.0000	80.0000
25	1.0000	1.0000	27.0000	33.0000	41.0000	49.0000	57.0000	65.0000	73.0000	81.0000
26	1.0000	1.0000	28.0000	34.0000	42.0000	50.0000	58.0000	66.0000	74.0000	82.0000
27	1.0000	1.0000	29.0000	35.0000	43.0000	51.0000	59.0000	67.0000	75.0000	83.0000
28	1.0000	1.0000	30.0000	36.0000	44.0000	52.0000	60.0000	68.0000	76.0000	84.0000
29	1.0000	1.0000	31.0000	37.0000	45.0000	53.0000	61.0000	69.0000	77.0000	85.0000
30	1.0000	1.0000	32.0000	38.0000	46.0000	54.0000	62.0000	70.0000	78.0000	86.0000
31	1.0000	1.0000	33.0000	39.0000	47.0000	55.0000	63.0000	71.0000	79.0000	87.0000
32	1.0000	1.0000	34.0000	40.0000	48.0000	56.0000	64.0000	72.0000	80.0000	88.0000
33	1.0000	1.0000	35.0000	41.0000	49.0000	57.0000	65.0000	73.0000	81.0000	89.0000
34	1.0000	1.0000	36.0000	42.0000	50.0000	58.0000	66.0000	74.0000	82.0000	90.0000
35	1.0000	1.0000	37.0000	43.0000	51.0000	59.0000	67.0000	75.0000	83.0000	91.0000
36	1.0000	1.0000	38.0000	44.0000	52.0000	60.0000	68.0000	76.0000	84.0000	92.0000
37	1.0000	1.0000	39.0000	45.0000	53.0000	61.0000	69.0000	77.0000	85.0000	93.0000
38	1.0000	1.0000	40.0000	46.0000	54.0000	62.0000	70.0000	78.0000	86.0000	94.0000
39	1.0000	1.0000	41.0000	47.0000	55.0000	63.0000	71.0000	79.0000	87.0000	95.0000
40	1.0000	1.0000	42.0000	48.0000	56.0000	64.0000	72.0000	80.0000	88.0000	96.0000
41	1.0000	1.0000	43.0000	49.0000	57.0000	65.0000	73.0000	81.0000	89.0000	97.0000
42	1.0000	1.0000	44.0000	50.0000	58.0000	66.0000	74.0000	82.0000	90.0000	98.0000
43	1.0000	1.0000	45.0000	51.0000	59.0000	67.0000	75.0000	83.0000	91.0000	99.0000
44	1.0000	1.0000	46.0000	52.0000	60.0000	68.0000	76.0000	84.0000	92.0000	100.0000
45	1.0000	1.0000	47.0000	53.0000	61.0000	69.0000	77.0000	85.0000	93.0000	101.0000
46	1.0000	1.0000	48.0000	54.0000	62.0000	70.0000	78.0000	86.0000	94.0000	102.0000
47	1.0000	1.0000	49.0000	55.0000	63.0000	71.0000	79.0000	87.0000	95.0000	103.0000
48	1.0000	1.0000	50.0000	56.0000	64.0000	72.0000	80.0000	88.0000	96.0000	104.0000
49	1.0000	1.0000	51.0000	57.0000	65.0000	73.0000	81.0000	90.0000	97.0000	105.0000
50	1.0000	1.0000	52.0000	58.0000	66.0000	74.0000	82.0000	91.0000	98.0000	106.0000
51	1.0000	1.0000	53.0000	59.0000	67.0000	75.0000	83.0000	92.0000	99.0000	107.0000
52	1.0000	1.0000	54.0000	60.0000	68.0000	76.0000	84.0000	93.0000	100.0000	108.0000
53	1.0000	1.0000	55.0000	61.0000	69.0000	77.0000	85.0000	94.0000	101.0000	109.0000
54	1.0000	1.0000	56.0000	62.0000	70.0000	78.0000	86.0000	95.0000	102.0000	110.0000
55	1.0000	1.0000	57.0000	63.0000	71.0000	79.0000	87.0000	96.0000	103.0000	111.0000
56	1.0000	1.0000	58.0000	64.0000	72.0000	80.0000	88.0000	97.0000	104.0000	112.0000
57	1.0000	1.0000	59.0000	65.0000	73.0000	81.0000	89.0000	98.0000	105.0000	113.0000
58	1.0000	1.0000	60.0000	66.0000	74.0000	82.0000	90.0000	99.0000	106.0000	114.0000
59	1.0000	1.0000	61.0000	67.0000	75.0000	83.0000	91.0000	100.0000	107.0000	115.0000
60	1.0000	1.0000	62.0000	68.0000	76.0000	84.0000	92.0000	101.0000	108.0000	116.0000
61	1.0000	1.0000	63.0000	69.0000	77.0000	85.0000	93.0000	102.0000	109.0000	117.0000
62	1.0000	1.0000	64.0000	70.0000	78.0000	86.0000	94.0000	103.0000	110.0000	118.0000
63	1.0000	1.0000	65.0000	71.0000	79.0000	87.0000	95.0000	104.0000	111.0000	119.0000
64	1.0000	1.0000	66.0000	72.0000	80.0000	88.0000	96.0000	105.0000	112.0000	120.0000
65	1.0000	1.0000	67.0000	73.0000	81.0000	89.0000	97.0000	106.0000	113.0000	121.0000
66	1.0000	1.0000	68.0000	74.0000	82.0000	90.0000	98.0000	107.0000	114.0000	122.0000
67	1.0000	1.0000	69.0000	75.0000	83.0000	91.0000	99.0000	108.0000	115.0000	123.0000
68	1.0000	1.0000	70.0000	76.0000	84.0000	92.0000	100.0000	116.0000	124.0000	124.0000
69	1.0000	1.0000	71.0000	77.0000	85.0000	93.0000	101.0000	117.0000	125.0000	125.0000
70	1.0000	1.0000	72.0000	78.0000	86.0000	94.0000	102.0000	118.0000	126.0000	126.0000
71	1.0000	1.0000	73.0000	79.0000	87.0000	95.0000	103.0000	119.0000	127.0000	127.0000
72	1.0000	1.0000	74.0000	80.0000	88.0000	96.0000	104.0000	120.0000	128.0000	128.0000
73	1.0000	1.0000	75.0000	81.0000	89.0000	97.0000	105.0000	121.0000	129.0000	129.0000
74	1.0000	1.0000	76.0000	82.0000	90.0000	98.0000	106.0000	122.0000	130.0000	130.0000
75	1.0000	1.0000	77.0000	83.0000	91.0000	99.0000	107.0000	123.0000	131.0000	131.0000
76	1.0000	1.0000	78.0000	84.0000	92.0000	100.0000	108.0000	124.0000	132.0000	132.0000
77	1.0000	1.0000	79.0000	85.0000	93.0000	101.0000	109.0000	125.0000	133.0000	133.0000
78	1.0000	1.0000	80.0000	86.0000	94.0000	102.0000	110.0000	126.0000	134.0000	134.0000
79	1.0000	1.0000	81.0000	87.0000	95.0000	103.0000	111.0000	127.0000	135.0000	135.0000
80	1.0000	1.0000	82.0000	88.0000	96.0000	104.0000	112.0000	128.0000	136.0000	136.0000
81	1.0000	1.0000	83.0000	89.0000	97.0000	105.0000	113.0000	129.0000	137.0000	137.0000
82	1.0000	1.0000	84.0000	90.0000	98.0000	106.0000	114.0000	130.0000	138.0000	138.0000
83	1.0000	1.0000	85.0000	91.0000	99.0000	107.0000	115.0000	131.0000	139.0000	139.0000
84	1.0000	1.0000	86.0000	92.0000	100.0000	108.0000	116.0000	132.0000	140.0000	140.0000
85	1.0000	1.0000	87.0000	93.0000	101.0000	109.0000	117.0000	133.0000	141.0000	141.0000
86	1.0000	1.0000	88.0000	94.0000	102.0000	110.0000	118.0000	134.0000	142.0000	142.0000
87	1.0000	1.0000	89.0000	95.0000	103.0000	111.0000	119.0000	135.0000	143.0000	143.0000
88	1.0000	1.0000	90.0000	96.0000	104.0000	112.0000	120.0000	136.0000	144.0000	144.0000
89	1.0000	1.0000	91.0000	97.0000	105.0000	113.0000	121.0000	137.0000	145.0000	145.0000
90	1.0000	1.0000	92.0000	98.0000	106.0000	114.0000	122.0000	138.0000	146.0000	146.0000
91	1.0000	1.0000	93.0000	99.0000	107.0000	115.0000	123.0000	139.0000	147.0000	147.0000
92	1.0000	1.0000	94.0000	100.0000	108.0000	116.0000	124.0000	140.0000	148.0000	148.0000
93										

*Lanthanide series

Actinide series

57	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
DISTANT	MEDIUM	INTERMEDIATE												
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
OXYGEN	FLUORINE	NEON	ARGON	KRYPTON	CHLORINE	SULFUR	PHOSPHORUS	SILICON	GERMANIUM	ARSENIC	ANTIMONY	TELLURIUM	POLONIUM	ASTATINE
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Ro
127m	232-4	233-4	238-9	239	238-9	235-6	244-5	247-8	249-50	253-4	252-3	253-4	254-5	255-6

Name:.....

Centre/Index No:

School.....

Signature.....

PS25/1

CHEMISTRY

Paper 1

July/August 2012

2 ½ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

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- All questions are to be answered in the spaces provided.
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- Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.

For Examiner's Use Only

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SECTION A (46 marks)

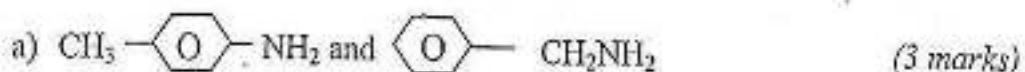
1. a) Draw the shape and name the structures of each of the following species. (1 mark each)

Species	Shape	Name
i) H ₂ S		
ii) CO ₂		
iii) PBr ₃		

- b) Explain why the molecule in (a) i) adopts the shape. (2 marks)

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2. Name reagent(s) that can be used to distinguish between the following pairs of compounds. In each case state what would be observed if each member of the pair is treated with the reagent.



Reagent(s)

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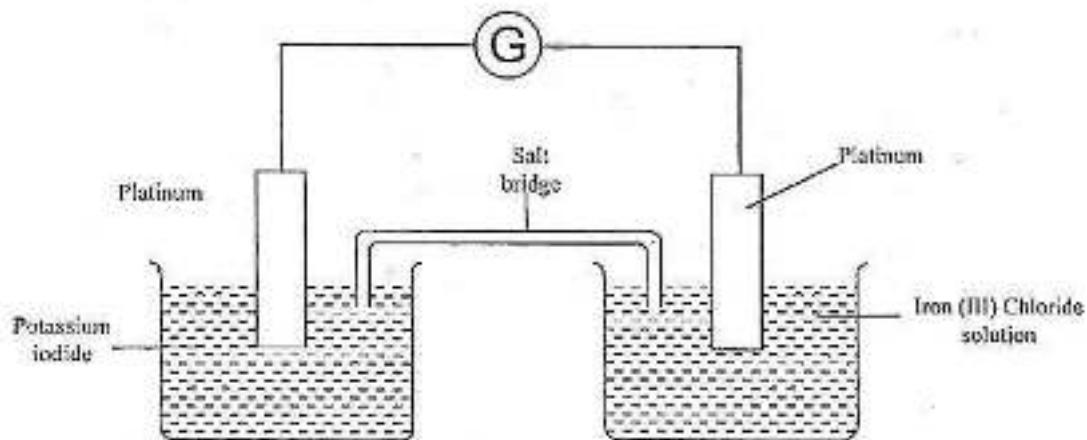
Observations



Reagent(s)

Observations

3. The diagram below shows the e.m.f cell for the reaction between iron(III) chloride and potassium iodide solution.



- a) Indicate on the diagram the direction of flow of electrons. (½ mark)
- b) State what would be observed at the
- positive electrode (1 mark)
 - negative electrode. (1 mark)
- c) i) Write an equation for the overall reaction. (1 ½ marks)

ii) Write a convention for the cell above. (1 mark)

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4. a) A solution of substance X ($\text{RFM} = 240$) in 200 g of water at $1.01325 \times 10^5 \text{ Pa}$ is boiled at 100.12°C . Calculate the mass of X dissolved. [K_b for water = $0.52^\circ\text{C mol}^{-1}\text{kg}^{-1}$] (3 marks)
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- b) State two limitations of your calculations in a) above. (2 marks)
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5. Compound Z ($\text{C}_7\text{H}_8\text{O}$) burns with a sooty flame and has no effect on a solution of silver nitrate in ammonia.

a) Write the structural formula and name IUPAC of Z (1 mark)

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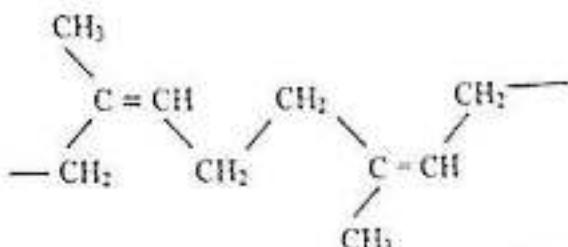
b) i) State what would be observed when Z is reacted with 2, 4-dinitrophenyl hydrazine in acid medium. (½ mark)

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ii) Outline a mechanism for the reaction in b) i) above. (4 ½ marks)

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6. The structure of a polymer Y is



- a) Write the structural formula and IUPAC name of the monomer of Y.
Structure of monomer (1 mark)

IUPAC name (½ mark)

- b) Name the type of polymerization by which Y is formed. (1 mark)

- c) Describe briefly how the strength of Y can be improved. (2 marks)

7. a) Write an equation for the reaction between sodium hydroxide and
i) Silicon (IV) oxide (1 ½ marks)

ii) Chromium (III) oxide (1 ½ marks)

- b) State what would be observed and write equation(s) for the reaction
when copper metal is added to a fairly concentrated nitric acid
solution. (2 marks)

Turn Over
5

8. An aqueous solution of substance Q was made and divided into 3 portions. When sodium hydroxide solution was added to the first portion, a green precipitate insoluble in excess alkali was formed. The second portion formed a green precipitate soluble in excess ammonia forming a blue solution. The third portion formed a white precipitate when heated with lead (II) nitrate solution.

a) Identify

i) the cation in Q *(½ mark)*

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.....

ii) the anion(s) in Q *(1 ½ marks)*

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.....

b) Write an ionic equation for the reaction leading to the blue solution. *(1 mark)*

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.....

c) i) State what would be observed if concentrated hydrochloric acid is added to a solution containing the cations in Q. *(1 mark)*

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ii) Write an equation for the reaction. *(1 ½ marks)*

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9. a) Define the following terms

i) Isotopes *(1 mark)*

.....
.....

ii) relative atomic mass *(1 mark)*

.....
.....

b) Element X has two isotopes with isotopic mass 34.97 and 36.96. If the relative atomic mass of X is 35.45. Calculate the relative abundance of the isotopes. *(2 marks)*

SECTION B (54 marks)

Answer six questions from this section.

10. A constant boiling point mixture containing 77% methanoic acid boils at 108°C . The boiling point of pure methanoic acid is 101°C .

a) Sketch a labeled boiling point-composition diagram for a mixture of methanoic acid and water. (3 marks)

- b) Explain the factors that lead to methanoic acid and water forming a maximum boiling point mixture. (3 marks)

- b) i) Describe briefly what happens when a mixture containing 40% methanoic acid is fractionally distilled. (2 marks)

- ii) State one method by which pure methanoic acid can be obtained from the maximum boiling point mixture. (I mark)

Turn Over

11. a) Group (II) metals form few complexes. However the tendency to form complexes decreases down the group.

i) What is meant by the term complex? (2 marks)

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.....

ii) Why does the tendency to form complexes decrease down the group. (3 marks)

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.....

b) Explain the following observations.

i) A clear solution of sodium thiosulphate becomes cloudy when left standing in air. (3 marks)

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.....

ii) Aluminium forms stable compounds in the + 3 oxidation state only. (1 mark)

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12. Explain the following observations.

a) The boiling point of hydrogen fluoride is higher than that of hydrogen chloride. (2 marks)

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b) The acid strength of the acids, $\text{ClCH}_2\text{CH}_2\text{COOH}$, CICH_2COOH and CH_3COOH are in this order.

$\text{CICH}_2\text{COOH} > \text{ClCH}_2\text{CH}_2\text{COOH} > \text{CH}_3\text{COOH}$ (3 marks)

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.....

c) HClO_2 is a weaker acid than HClO_4 (2 marks)

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- d) Copper(II) chloride is green while copper(I) chloride is a white solid.
(2 marks)

13. The table below shows the rates of the reaction $X + Y \rightarrow Z$ for different initial concentrations of X and Y.

Expt	[X]/Moldm ⁻³	[Y]/Moldm ⁻³	Initial rate/Moldm ⁻³ s ⁻¹
1	0.05	0.05	2.0×10^{-5}
2	0.10	0.05	8.0×10^{-5}
3	0.10	0.10	1.6×10^{-4}

- a) Determine
- the order of the reaction with respect to X. (1 mark)
 - the overall order of the reaction. (2 marks)
- b) i) Write an expression for the rate of the reaction between X and Y. (1 mark)
- Calculate the rate constant for the reaction and state its units. (2 marks)
- c) How does the rate of the reaction vary when
- the concentration of X is halved leaving that of Y constant? (1 mark)

ii) the concentration of A is halved and that of Y double? (1 mark)

.....
.....
.....
iii) the concentration of both X and Y are halved? (1 mark)

14. a) Write equation for
i) ionization of ammonia in water (1mark)

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.....
.....
ii) ionization of water (1mark)

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.....
b) Write an expression for the ionization constant
i) for ammonia (1mark)

.....
.....
.....
ii) for water (1mark)

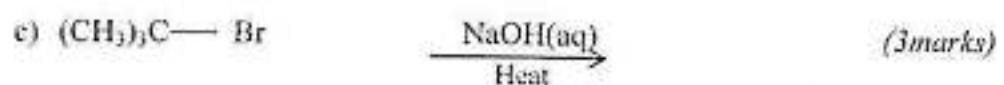
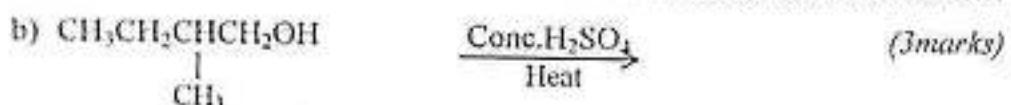
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c) Ammonium chloride undergoes hydrolysis in water.
i) Write an equation for the hydrolysis of ammonium chloride
in water. (1 mark)

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.....
.....
ii) Calculate the hydrolysis constant K_b for ammonium chloride
[$K_b = 1.8 \times 10^{-5} \text{ mol dm}^{-3}$, $K_b = 1.0 \times 10^{-14} \text{ mol}^2 \text{dm}^{-6}$ at 25°C] (2 marks)

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.....
d) Determine the pH of a 0.01 M ammonium chloride solution at 25°C .
(2 marks)

15. a) Define the term oxidation number. (1mark)
- b) Determine the oxidation number of
- Nitrogen in hydrazine. (1mark)
- ii) Chromium in hydrated chloropentaaquachromium(III) chloride. (1 mark)
- iii) Cobalt in $[\text{Co}(\text{CN})_6]^{3-}$ (1 mark)
- c) i) Write an equation for the oxidation of sodium nitrite in aqueous solution. (1½ marks)
- ii) Determine the oxidation state of nitrogen in the product. (1 mark)
- d) Peroxodisulphuric acid was added to potassium iodide solution.
- State what was observed. (1 mark)
 - Write an ionic equation for the reaction that took place. (1½ marks)

16. Complete the following reactions and in each case outline a mechanism for the reaction.



17. a) i) State Kohlrausch's law of independent migration of ions.
(1 mark)
-
.....

ii) Given $\lambda_o(\text{HCOONa}) = 9.5 \times 10^{-2} \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$

$$\lambda_o(\text{NaCl}) = 1.26 \times 10^{-2} \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$$

$$\lambda_o(\text{HCl}) = 4.26 \times 10^{-2} \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$$

Calculate the molar conductivity of methanoic acid at infinite dilution.
(2 marks)

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.....

- b) Ionic conductivities of Ag^+ and Cl^- ions at infinite dilution are 6.2×10^{-2} and $7.6 \times 10^{-2} \text{Sm}^2 \text{mol}^{-1}$ respectively at 298 K. The electrolytic conductivity of silver chloride at 298K is $1.22 \times 10^{-1} \text{Sm}^{-1}$. Calculate the solubility of silver chloride in mol dm^{-3} at 298 K.
(3 marks)
-
.....

- ii) Determine the K_{sp} of silver chloride using the data in i) above
(1 mark)
-
.....

- c) State two applications of conductance measurements other than determination of solubility of sparingly soluble salts.
(2 marks)
-
.....

END

Turn Over

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H

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Li

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Be

¹¹
Na

¹²
Mg

¹⁹
K

²⁰
Ca

²¹
Sc

²²
Ti

²³
V

²⁴
Cr

²⁵
Mn

²⁶
Fe

²⁷
Co

²⁸
Ni

²⁹
Cu

³⁰
Zn

³¹
Ga

³²
Ge

³³
As

³⁴
Se

³⁵
Br

³⁶
Kr

³⁷
Ar

³⁸
He

³⁹
Ne

⁵ B	⁶ C	⁷ N	⁸ O	⁹ F	¹⁰ Ne
¹¹ Al	¹² Si	¹³ P	¹⁴ S	¹⁵ Cl	¹⁶ Ar
¹⁷ Al	¹⁸ Si	¹⁹ P	²⁰ S	²¹ Cl	²² Ar
²³ Al	²⁴ Si	²⁵ P	²⁶ S	²⁷ Cl	²⁸ Ar
²⁹ Al	³⁰ Si	³¹ P	³² S	³³ Cl	³⁴ Ar
³⁵ Al	³⁶ Si	³⁷ P	³⁸ S	³⁹ Cl	⁴⁰ Ar
⁴¹ Al	⁴² Si	⁴³ P	⁴⁴ S	⁴⁵ Cl	⁴⁶ Ar
⁴⁷ Al	⁴⁸ Si	⁴⁹ P	⁵⁰ S	⁵¹ Cl	⁵² Ar
⁵³ Al	⁵⁴ Si	⁵⁵ P	⁵⁶ S	⁵⁷ Cl	⁵⁸ Ar
⁵⁹ Al	⁶⁰ Si	⁶¹ P	⁶² S	⁶³ Cl	⁶⁴ Ar
⁶⁵ Al	⁶⁶ Si	⁶⁷ P	⁶⁸ S	⁶⁹ Cl	⁷⁰ Ar
⁷¹ Al	⁷² Si	⁷³ P	⁷⁴ S	⁷⁵ Cl	⁷⁶ Ar
⁷⁷ Al	⁷⁸ Si	⁷⁹ P	⁸⁰ S	⁸¹ Cl	⁸² Ar
⁸³ Al	⁸⁴ Si	⁸⁵ P	⁸⁶ S	⁸⁷ Cl	⁸⁸ Ar
⁸⁹ Al	⁹⁰ Si	⁹¹ P	⁹² S	⁹³ Cl	⁹⁴ Ar
⁹⁵ Al	⁹⁶ Si	⁹⁷ P	⁹⁸ S	⁹⁹ Cl	¹⁰⁰ Ar
¹⁰¹ Al	¹⁰² Si	¹⁰³ P	¹⁰⁴ S	¹⁰⁵ Cl	¹⁰⁶ Ar
¹⁰⁷ Al	¹⁰⁸ Si	¹⁰⁹ P	¹¹⁰ S	¹¹¹ Cl	¹¹² Ar
¹¹³ Al	¹¹⁴ Si	¹¹⁵ P	¹¹⁶ S	¹¹⁷ Cl	¹¹⁸ Ar
¹¹⁹ Al	¹²⁰ Si	¹²¹ P	¹²² S	¹²³ Cl	¹²⁴ Ar
¹²⁵ Al	¹²⁶ Si	¹²⁷ P	¹²⁸ S	¹²⁹ Cl	¹³⁰ Ar
¹³¹ Al	¹³² Si	¹³³ P	¹³⁴ S	¹³⁵ Cl	¹³⁶ Ar
¹³⁷ Al	¹³⁸ Si	¹³⁹ P	¹⁴⁰ S	¹⁴¹ Cl	¹⁴² Ar
¹⁴³ Al	¹⁴⁴ Si	¹⁴⁵ P	¹⁴⁶ S	¹⁴⁷ Cl	¹⁴⁸ Ar
¹⁴⁹ Al	¹⁵⁰ Si	¹⁵¹ P	¹⁵² S	¹⁵³ Cl	¹⁵⁴ Ar
¹⁵⁵ Al	¹⁵⁶ Si	¹⁵⁷ P	¹⁵⁸ S	¹⁵⁹ Cl	¹⁶⁰ Ar
¹⁶¹ Al	¹⁶² Si	¹⁶³ P	¹⁶⁴ S	¹⁶⁵ Cl	¹⁶⁶ Ar
¹⁶⁷ Al	¹⁶⁸ Si	¹⁶⁹ P	¹⁷⁰ S	¹⁷¹ Cl	¹⁷² Ar
¹⁷³ Al	¹⁷⁴ Si	¹⁷⁵ P	¹⁷⁶ S	¹⁷⁷ Cl	¹⁷⁸ Ar
¹⁷⁹ Al	¹⁸⁰ Si	¹⁸¹ P	¹⁸² S	¹⁸³ Cl	¹⁸⁴ Ar
¹⁸⁵ Al	¹⁸⁶ Si	¹⁸⁷ P	¹⁸⁸ S	¹⁸⁹ Cl	¹⁹⁰ Ar
¹⁹¹ Al	¹⁹² Si	¹⁹³ P	¹⁹⁴ S	¹⁹⁵ Cl	¹⁹⁶ Ar
¹⁹⁷ Al	¹⁹⁸ Si	¹⁹⁹ P	²⁰⁰ S	²⁰¹ Cl	²⁰² Ar
²⁰³ Al	²⁰⁴ Si	²⁰⁵ P	²⁰⁶ S	²⁰⁷ Cl	²⁰⁸ Ar
²⁰⁹ Al	²¹⁰ Si	²¹¹ P	²¹² S	²¹³ Cl	²¹⁴ Ar
²¹⁵ Al	²¹⁶ Si	²¹⁷ P	²¹⁸ S	²¹⁹ Cl	²²⁰ Ar
²²¹ Al	²²² Si	²²³ P	²²⁴ S	²²⁵ Cl	²²⁶ Ar
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²⁸¹ Al	²⁸² Si	²⁸³ P	²⁸⁴ S	²⁸⁵ Cl	²⁸⁶ Ar
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³¹¹ Al	³¹² Si	³¹³ P	³¹⁴ S	³¹⁵ Cl	³¹⁶ Ar
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³²⁹ Al	³³⁰ Si	³³¹ P	³³² S	³³³ Cl	³³⁴ Ar
³³⁵ Al	³³⁶ Si	³³⁷ P	³³⁸ S	³³⁹ Cl	³⁴⁰ Ar
³⁴¹ Al	³⁴² Si	³⁴³ P	³⁴⁴ S	³⁴⁵ Cl	³⁴⁶ Ar
³⁴⁷ Al	³⁴⁸ Si	³⁴⁹ P	³⁵⁰ S	³⁵¹ Cl	³⁵² Ar
³⁵³ Al	³⁵⁴ Si	³⁵⁵ P	³⁵⁶ S	³⁵⁷ Cl	³⁵⁸ Ar
³⁵⁹ Al	³⁶⁰ Si	³⁶¹ P	³⁶² S	³⁶³ Cl	³⁶⁴ Ar
³⁶⁵ Al	³⁶⁶ Si	³⁶⁷ P	³⁶⁸ S	³⁶⁹ Cl	³⁷⁰ Ar
³⁷¹ Al	³⁷² Si	³⁷³ P	³⁷⁴ S	³⁷⁵ Cl	³⁷⁶ Ar
³⁷⁷ Al	³⁷⁸ Si	³⁷⁹ P	³⁸⁰ S	³⁸¹ Cl	³⁸² Ar
³⁸³ Al	³⁸⁴ Si	³⁸⁵ P	³⁸⁶ S	³⁸⁷ Cl	³⁸⁸ Ar
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³⁹⁷ Al	³⁹⁸ Si	³⁹⁹ P	⁴⁰⁰ S	⁴⁰¹ Cl	⁴⁰² Ar
⁴⁰³ Al	⁴⁰⁴ Si	⁴⁰⁵ P	⁴⁰⁶ S	⁴⁰⁷ Cl	⁴⁰⁸ Ar
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⁴¹⁷ Al	⁴¹⁸ Si	⁴¹⁹ P	⁴²⁰ S	⁴²¹ Cl	⁴²² Ar
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⁴³³ Al	⁴³⁴ Si	⁴³⁵ P	⁴³⁶ S	⁴³⁷ Cl	⁴³⁸ Ar
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⁴³⁷ Al	⁴³⁸ Si	⁴³⁹ P	⁴⁴⁰ S	⁴⁴¹ Cl	⁴⁴² Ar
⁴⁴³ Al	⁴⁴⁴ Si	⁴⁴⁵ P	⁴⁴⁶ S	⁴⁴⁷ Cl	⁴⁴⁸ Ar
⁴⁴⁵ Al	⁴⁴⁶ Si	⁴⁴⁷ P	⁴⁴⁸ S	⁴⁴⁹ Cl	⁴⁵⁰ Ar
⁴⁴⁷ Al	⁴⁴⁸ Si	⁴⁴⁹ P	⁴⁵⁰ S	⁴⁵¹ Cl	⁴⁵² Ar
⁴⁵³ Al	⁴⁵⁴ Si	⁴⁵⁵ P	⁴⁵⁶ S	⁴⁵⁷ Cl	⁴⁵⁸ Ar
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⁴⁶³ Al	⁴⁶⁴ Si	⁴⁶⁵ P	⁴⁶⁶ S	⁴⁶⁷ Cl	⁴⁶⁸ Ar
⁴⁶⁵ Al	⁴⁶⁶ Si	⁴⁶⁷ P	⁴⁶⁸ S	⁴⁶⁹ Cl	⁴⁷⁰ Ar
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⁴⁷³ Al	⁴⁷⁴ Si	⁴⁷⁵ P	⁴⁷⁶ S	⁴⁷⁷ Cl	⁴⁷⁸ Ar
⁴⁷⁵ Al	⁴⁷⁶ Si	⁴⁷⁷ P	⁴⁷⁸ S	⁴⁷⁹ Cl	⁴⁸⁰ Ar
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⁴⁸³ Al	⁴⁸⁴ Si	⁴⁸⁵ P	⁴⁸⁶ S	⁴⁸⁷ Cl	⁴⁸⁸ Ar
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⁴⁹³ Al	⁴⁹⁴ Si	⁴⁹⁵ P	⁴⁹⁶ S	⁴⁹⁷ Cl	⁴⁹⁸ Ar
⁴⁹⁵ Al	⁴⁹⁶ Si	⁴⁹⁷ P	⁴⁹⁸ S	⁴⁹⁹ Cl	⁵⁰⁰ Ar
⁴⁹⁷ Al	⁴⁹⁸ Si	⁴⁹⁹ P	⁵⁰⁰ S	⁵⁰¹ Cl	⁵⁰² Ar
⁵⁰³ Al	⁵⁰⁴ Si	⁵⁰⁵ P	⁵⁰⁶ S	⁵⁰⁷ Cl	⁵⁰⁸ Ar
⁵⁰⁵ Al	⁵⁰⁶ Si	⁵⁰⁷ P	⁵⁰⁸ S	⁵⁰⁹ Cl	⁵¹⁰ Ar
⁵⁰⁷ Al	⁵⁰⁸ Si	⁵⁰⁹ P	⁵¹⁰ S	⁵¹¹ Cl	⁵¹² Ar
⁵¹³ Al	⁵¹⁴ Si	<			

Name:

Centre/Index No:

School.....

Signature.....

P525/1

CHEMISTRY

Paper 1

July/August 2013

2 $\frac{3}{4}$ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- Attempt all questions in section A and any six questions from section B.
- All questions are to be answered in the spaces provided.
- A Periodic Table with relevant atomic masses is supplied at the end of the paper.
- Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 marks)

1. (a) Define the term bond dissociation energy. (1 mark)

.....
.....
.....

- (b) Given the following data:

Enthalpy of formation of butane = -116 kJ mol⁻¹

Enthalpy of hydrogenation of buta -1,3 - diene = -240KJmol⁻¹

Atomization energy of carbon = +715 KJmol⁻¹

- i) Calculate the enthalpy of formation of buta - 1,3 - diene.

(1½ mark)

- ii) If the average bond energies of C – C, H – H and C – H are 348, 436 and 412 KJmol⁻¹ respectively, use your answer in b(i) to determine the bond dissociation energy of the C = C bond. (3½ marks)

2. (a) Transition metals form complexes through dative bonding with ligands.

- i) Define a transition metal

(1 mark)

ii) State any two other properties of transition metals.

(1mark)

- (a) Ethane - 1,2-diamine ($\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$) can react both as a base and a ligand. An excess aqueous solution of ethane - 1,2-diamine was separately added to copper (II) sulphate solution and Aluminium sulphate solution. State what would be observed in each case and write an equation for the reaction that occurs with:

i) Copper (II) sulphate solution
Observation

(½ mark)

Equation

.....
(1½ mark)

ii) Aluminium sulphate solution

Observation

(½ mark)

Equation

(1¹/₂ mark)

3. Silver (I) chromate is sparingly soluble in water and its solubility product (K_{sp}) is $8.21 \times 10^{-8} \text{ mol}^3 \text{dm}^{-9}$ at 298K.

a) Write an equation for the solubility equilibrium of silver(I) chromate. Deduce the expression for the K_{sp} of silver (I) chromate.

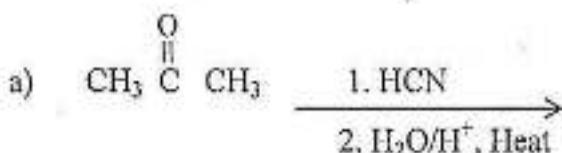
(1½ mark)

b) Calculate the solubility of silver (I) chromate in potassium chromate solution of concentration 9.70 gdm^{-3} . (3 marks)

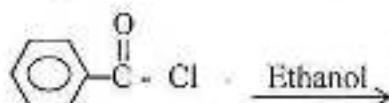
- c) State whether the solubility of silver (I) chromate in pure water at 298K is equal to, greater than or less than your answer in (b) above. Explain (1½ mark)

.....
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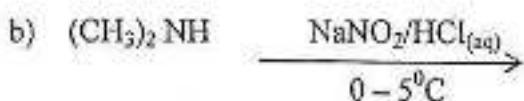
4. Complete each of the following equations and in each case give the systematic (IUPAC) name of the major organic product.



Name of the product (1½ mark)



Name of the product (1½ mark)



Name of the product. (1½ mark)

5. Carbon and silicon form tetrachlorides with a simple molecule structure and the same shape.

- a) Write the electronic configuration of;

i) Carbon (1½ mark)

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ii) Silicon (1½ mark)

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- b) (i) Briefly explain why the tetrachloride molecules have the same shape.

(1½ mark)

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- c) Water was added to each of the tetrachlorides of carbon and silicon.

i) State what would be observed in each case. (1½ marks)

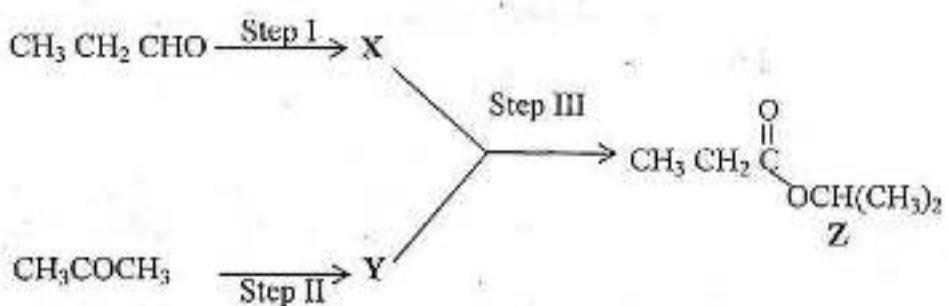
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ii) Explain your observations in c (i) above. (1½ marks)

6. a) Describe a simple chemical test to distinguish between $\text{CH}_3\text{CH}_2\text{CHO}$ and CH_3COCH_3 . (2 marks)

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- b) Compound Z can be synthesized by the reaction between X and Y as shown below.



i) Identify compounds X and Y (1mark)

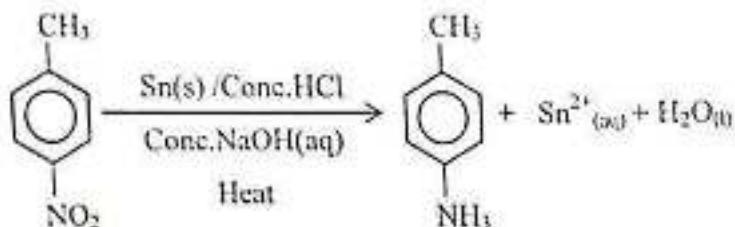
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ii) Name the type of reaction that occurs in steps I and II. (1 mark)

- c) Identify the reagents and state the conditions necessary for the reaction in:
i) Step I (1½ mark)
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.....

- ii) Step III (1½ mark)
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7. 4 - aminomethylbenzene is synthesized from 4 - nitromethylbenzene according to the equation.



The liquid amine is extracted from the aqueous mixture of products at least twice with ethoxyethane.

- a) State three advantages of using ethoxyethane as the extractant for 4-aminomethylbenzene. (1½ marks)
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- b) The ratio of solubility of 4 - aminomethylbenzene in water to its solubility in ethoxyethane is 1:4. Given that water was added to the products in (a) above to form 250cm³ of an aqueous solution which was shaken with 200cm³ of ethoxyethane, at equilibrium the aqueous layer contained 0.728gdm⁻³ of solute.

Calculate the mass of 4 – aminomethylbenzene formed from 4- nitromethylbenzene. (3 marks)

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8. Using equations to illustrate your answer, state any two chemical properties to show the;

a) Similarity between lead and manganese. (3 marks)

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b) Difference between chromium and Magnesium. (3marks)

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9. Name the reagent(s) that can be used to distinguish between the following pairs of compounds. In each case, state what would be observed when each member of the pair is separately treated with the reagent (s)

a) $\text{KI}_{(\text{aq})}$ and $\text{NaCl}_{(\text{aq})}$ (2 marks)
Reagent
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Observation



Reagent (s)

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Observation

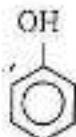
SECTION B

Answer six questions from this section.

Additional questions answered will not be marked.

10. Write equation to show how the following conversions can be effected. Indicate the conditions for each reaction.

a)

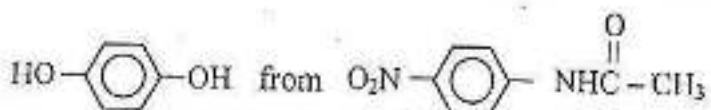


to HOOC(CH₂)₄COOH

(3 marks)

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b)



(4marks)

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- c) Propanone to 2-methylpropan -2 – ol. (2 marks)

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11. Explain each of the following observations.

- a) When potassium iodide solution is added to copper (II) sulphate solution, a white precipitate in a brown solution is formed. The solution turns colourless on addition of sodium thiosulphate solution. (3½ marks)

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- b) Ethanal undergoes nucleophilic addition reaction with hydrogen cyanide. (3 marks)

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- c) Aqueous solutions of 0.05M KCl and 0.1M sucrose have the same boiling point. (2½ marks)

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12. a) Explain the term electrolytic conductivity. (1 mark)

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- b) The resistance of 0.01M methanoic acid and 0.01M potassium chloride solutions are 95.20Ω and 25.0Ω respectively.

The electrolytic conductivity of potassium chloride is $1.164 \times 10^{-3}\Omega^{-1} \text{ cm}^{-1}$ and the molar conductivity of methanoate and hydrogen ions are 39.8 and $349.8\Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$ respectively at infinite dilution.

- i) Calculate the molar conductivity of 0.01M methanoic acid. (04 marks)

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- ii) Determine the pH of 0.01M methanoic acid. (2 marks)

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- c) Given the electrodes

Electrode	E°/V
$\text{Mn}^{3+}(\text{aq})/\text{Mn}^{2+}(\text{aq})$	*1.50
$\text{V}^{3+}(\text{aq})/\text{V}^{2+}(\text{aq})$	-0.26

- i) Write the convention for the cell formed by coupling the electrodes. (1 mark)

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ii) Calculate the emf of the cell formed.

(1 mark)

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13. Copper (I) oxide, potassium manganate (VI) and chlorine disproportionate in some of their reactions.

a) State what would be observed and write an equation (s) that take place during the disproportionation of;

i) Copper (I) oxide in dilute sulphuric acid. (2½ marks)

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ii) an aqueous solution of potassium manganate (VI). (2½ marks)

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iii) Chloride gas bubbled through cold dilute sodium hydroxide solution. (2½ marks)

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b) The product in b(iii) was heated to about 70°C to form a colourless solution.

Explain this observation with the aid of an equation of reaction. (1½ marks)

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Turn Over

11

15. 0.88g of a vaporized sample of an organic compound W (molar mass = 88.0g) containing carbon, hydrogen and oxygen were exploded with 2.20 dm³ of oxygen. The total volume of the gaseous product at room temperature was 1.96 dm³. On treatment with concentrated potassium hydroxide solution, there was a contraction in volume of 0.96 dm³.

- a) Calculate the molecular formula of the organic compound W
 (molar gas volume at room temperature = 24 dm³) (5 marks)

- b) W has a sweet pleasant smell and it undergoes hydrolysis in alkaline medium. Write the equation for the hydrolysis and suggest a suitable mechanism. (4 marks)

Write the equation for the hydrolysis and suggest a suitable mechanism. (4 marks)

16. (a) Fluorine belongs to group VII of the periodic table, however its properties differ from the other elements in the same group.

- i) Briefly explain why fluorine behaves differently. (2 marks)

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Turn Over

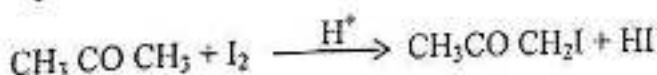
- ii) State any three chemical properties to show the anomalous behaviour of fluorine. (1½ marks)
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- b) Describe the reactions of fluorine and chlorine with;
i) Carbon (2½ marks)
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- ii) hot concentrated potassium hydroxide solution. (3 marks)
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- 17.a) Explain what is meant by the term "Rate equation". (2 marks)
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- b) The iodination of propanone in the presence of an acid occurs according to the equation.



Given that the acid is a catalyst and the reaction is zero order with respect to iodine, the following kinetic data was obtained.

Time (seconds)	00	3600	7200	10800	14400
Concentration of propanone (mol dm^{-3})	0.2405	0.1565	0.1045	0.0685	0.0455

Plot a suitable graph and use it to determine the;

USE A GRAPH PAPER AND INSERT IT & STAPLE IT ON THIS PAGE (15)

- i) Order of reaction with respect to propanone. (4 marks)

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- ii) Value of the rate constant hence deduce. (2 marks)

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- iii) the rate equation. (1 mark)

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END

Name: Centre/Index No:

School: Signature.....

P52S/1
CHEMISTRY
Paper 1
July/August 2014
2 $\frac{3}{4}$ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY
Paper 1

2 hours 45 minutes

Instructions to Candidates

Attempt all questions in section A and any six questions from section B.

All questions are to be answered in the spaces provided.

A Periodic Table with relevant atomic masses is supplied at the end of the paper.

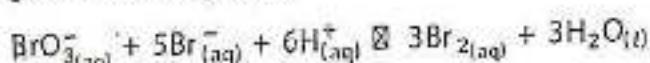
Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.

For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 marks)

Answer all questions in this section.

1. Sodium bromate(V) reacts with sodium bromide solution in the presence of sulphuric acid according to the ionic equation:



0.05M sodium bromate (V) was reacted with various concentrations of sodium bromide and sulphuric acid. The initial rate in each experiment was determined.

Experiment Number	$[Br^-_{(aq)}]$	$[H^+_{(aq)}]$	Initial rate (moldm $^{-3}$ s $^{-1}$)
1	0.02	0.01	1.76×10^{-6}
2	0.02	0.03	1.584×10^{-5}
3	0.04	0.03	3.168×10^{-5}

- a) What is meant by the term "initial rate". (1mark)

.....

- b) (i) Given that the reaction is overall fourth order, determine the rate equation for the above ionic reaction. (3½marks)

- (ii) Calculate the value of the rate constant and state its units. (11 marks)

2. (a) Solid ammonium hexachloroplumbate (IV) when gradually treated with ice-cold concentrated sulphuric acid forms a yellow covalent liquid.

- (i) Name the covalent liquid

- (ii) Write an equation for the reaction leading to the formation of the covalent liquid. (1 mark)

.....

- (b) Water is added to the liquid in (a) above.
- (i) State what would be observed. (1 mark)

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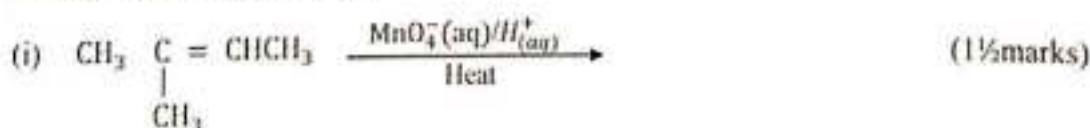
- (ii) Write an equation for the reaction that occurs between water and the yellow covalent liquid. (1½ marks)

.....

- (c) Carbon forms a colourless liquid of similar molecular structure as the compound in a (i) above, however it does not react with water under any conditions. Explain why the colourless liquid formed by carbon does not react with water. (1½marks)

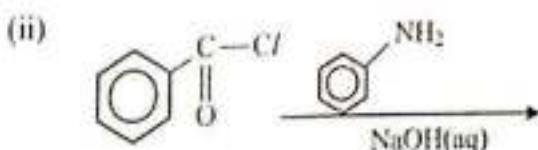
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3. (a) Complete each of the following equations and in each case give the systematic name of the major organic product(s).



Name the product.

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Name the product (1 mark)

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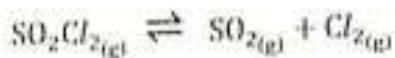
- (b) Write the mechanism for the reaction in a (ii) above. (1½marks)

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Turn Over

4. (a) 2.696g of SO_2Cl_2 dissociates at 375°C and 101.325 kN m^{-2} pressure according to the reversible reaction.



What is meant by the term degree of dissociation? (1 mark)

- (a) The vessel containing the equilibrium mixture was rapidly cooled and broken under 250cm^3 of potassium iodide solution. 20cm^3 of the resultant solution were titrated with 26.1cm^3 of 0.1M sodium thiosulphate solution in the presence of starch indicator.

(i) Calculate the degree of dissociation of SO_2Cl_2 at 375°C . (3% marks)

- (ii) Deduce the value of the partial pressure equilibrium constant from the expression;
 $K_p = \frac{\alpha^2 P}{1 - \alpha^2}$ where P = total pressure of the equilibrium mixture and α = degree of dissociation at 375°C . (1 mark)

5. Name the reagent (s) that can be used to distinguish between the following pairs of compounds. In each case state what would be observed when each compound is separately treated with the reagent (s).

(a) $\text{MgCO}_{3(s)}$ and $\text{BaCO}_{3(s)}$.
Reagent (s) (1½marks)

Observations.

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- (b)  CHO and HOCH₂CHO. (1½marks)

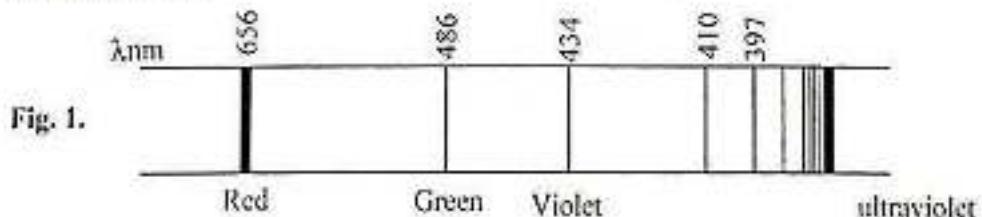
Reagent (s)

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- (c) Na₂SO₃_(aq) and Na₂SO₄_(aq). (1½marks)

Reagent (s)

Observations.

6. The figure 1. below shows part of the emission spectrum of hydrogen corresponding to Balmer series.



- (a) State any two characteristics of the emission spectrum of hydrogen. (2marks)

- (b) Calculate the quantum of energy evolved in KJmol^{-1} corresponding to the green line in the above Spectrum. (plank's constant = $6.625 \times 10^{-34} \text{ Js}$. Velocity of radiation, $c = 3.0 \times 10^8 \text{ ms}^{-1}$, Avogadro's No. = 6.02×10^{23}). (2marks)
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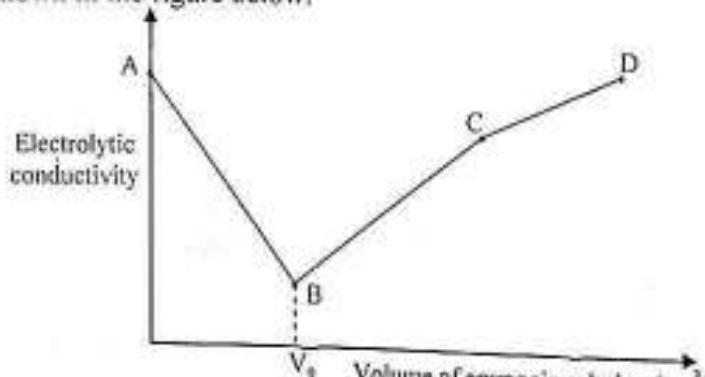
- (c) State one practical application of the spectral lines in the emission spectrum of any element other than hydrogen. (1mark)
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7. Boron and silicon form a series of volatile hydrides and binary compounds (Mg_2Si and CaB_6) with metals.

- (a) State any two other chemical properties to show the diagonal relationship between Boron and silicon. (2marks)
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- (b) Write an equation to represent each of your answers in (a) above. (Use different elements to illustrate the properties). (2marks)
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8. A fixed volume of copper (II) sulphate solution was titrated with ammonia solution. The electrolytic conductivity of the solution varies with volume of aqueous ammonia added as shown in the figure below.



- (a) Define the term electrolytic conductivity. (1mark)
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- (b) Explain why the conductivity;
(i) At A is initially high. (1½marks)
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(ii) Increases along curve BC. (1½marks)

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(iii) Gradually increases along CD. (1½marks)

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(c) Write an ionic equation for the reaction responsible for the decrease in conductivity along AB. Deduce the significance of volume, V_0 . (1mark)

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9. (a) Be, Mg, Ca and Ba belong to group II of the periodic table. Briefly describe how the elements react with

(i) hot concentrated sodium hydroxide. (2marks)

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(ii) concentrated nitric acid. (2marks)

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(b) The carbonates of the elements in (a) above undergo thermal decomposition at different temperatures as shown in the table below.

BeCO_3	MgCO_3	CaCO_3	BaCO_3
100°C	380°C	900°C	1350°C

State and explain the trend in the decomposition temperatures of the carbonates. (1½marks)

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Turn Over

SECTION B (54 MARKS)

Answer only six questions from this section.

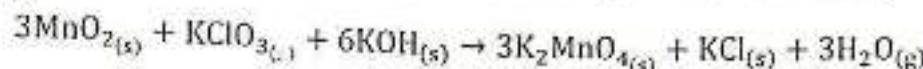
Additional questions answered will not be marked.

10. Using equations, show how each of the following conversions can be effected.
 a) Phenol to 1, 2 - dibromo-4-methylcyclohexane. (3½marks)

- b) Bromoethane to 2,2-dichloropropane. (3marks)

- c) Propene to trichloromethane. (2½marks)

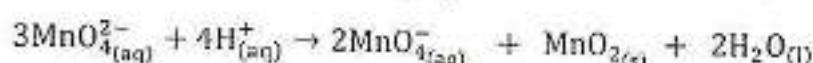
11. (a) Manganese (IV) oxide is oxidized to potassium manganate (VI) according to the equation.



- (i) Name the oxidizing agent in the above reaction. (1%marks)

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- (b) The manganate (VI) ions disproportionate in acidic medium to form manganate (VII) ion which is a stronger oxidizing agent.



State what would be observed and write an equation for the REDOX reaction that occurs when an acidified solution containing manganate (vii) ions is reacted with;

- (i) Aqueous sodium iodide solution. (2marks)

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- (ii) Hydrogen sulphide gas. (2%marks)

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- (c) State one practical application of acidified manganate (VII) ions in volumetric analysis. (1%mark)

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12. (a) Define the term lattice energy. (1%marks)

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Turn Over

(b) The enthalpy changes for some reactions are given below.

Reaction	$\Delta H(\text{KJmol}^{-1})$
$\text{F}_{\text{(g)}} \longrightarrow 2\text{F}_{\text{(g)}}$	$\Delta H_1 = +158\text{KJmol}^{-1}$
$\text{Ag}_{\text{(s)}} \longrightarrow \text{Ag}_{\text{(g)}}$	$\Delta H_2 = +2.8\text{KJmol}^{-1}$
$\text{Ag'}_{\text{(aq)}} + \text{F'}_{\text{(aq)}} \longrightarrow \text{Ag'}_{\text{(s)}} + \text{F}_{\text{(g)}}$	$\Delta H_3 = +991\text{KJmol}^{-1}$
$\text{Ag}_{\text{(g)}} \longrightarrow \text{Ag'}_{\text{(g)}} + e^-$	$\Delta H_4 = +731\text{KJmol}^{-1}$
$\text{F}_{\text{(g)}} + e^- \longrightarrow \text{F}_{\text{(g)}}$	$\Delta H_5 = -322\text{KJmol}^{-1}$
$\text{Ag}_{\text{(s)}} + \frac{1}{2}\text{F}_{\text{(g)}} \longrightarrow \text{AgF}_{\text{(s)}}$	$\Delta H_6 = -203\text{KJmol}^{-1}$

- (i) Calculate the enthalpy of a solution of silver (I) fluoride from the above data. (4½ marks)

- (ii) Comment on the solubility of silver (I) fluoride in water.
Give a reason for your answer. (1 mark)

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- (c) Compare the solubility of silver (I) fluoride with the solubilities of other halides of silver (AgX ; $X = \text{Cl}, \text{Br}, \text{I}$). Explain your answer. (2marks)

13. An organic compound W has an empirical formula C_2H_3Cl . When steam is distilled from its mixture with non-volatile impurities at atmospheric pressure (760mmHg), the distillate was found to contain 25.08% of W by mass. The vapour pressure of water at the boiling point of the mixture is 725mmHg.

- (i) State any three physical properties of W that enable its isolation from the mixture by steam distillation. (1½marks)

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- (ii) Calculate the relative molecular mass of W; hence determine its molecular formula. (4marks)

- (b) W forms geometrical isomers X and Y. Using x-ray analysis of X and Y, the inter chlorine distance was found to be 0.35nm and 0.41nm respectively.

- (i) Identify W by its I.U.P.A.C name. (½ mark)

(ii) Write the structural formulae and I.U.P.A.C names of isomers X and Y.
(2marks)

Turn Over

(iii) Explain your answer in b (ii) above.

(1mark)

14. Explain each of the following observations. Illustrate your answers with equations of reactions (where applicable).

- (a) When an aqueous solution of dimethylamine is added to manganese (II) chloride solution, a white precipitate insoluble in excess was formed and it rapidly turned brown. (3marks)

- (b) The boiling points of water and bromobenzene at 760mmHg are 100° and 156°C respectively, however a mixture of the two liquids boils at 95.6°C at the same atmospheric pressure. (3marks)

- (c) 2-bromo - 2-methyl propane undergoes a unimolecular elimination reaction when refluxed with sodium hydroxide solution in the presence of methanol. (3marks)

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15. Phenol and dimethylsulphate ($\text{CH}_3\text{}_2\text{SO}_4$) react in hot alkaline medium to form an ether.
- (a) Distinguish between an ether and a phenol. (2marks)
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- (b) (i) Write an equation for the reaction that takes place and name the major organic product. (1½marks)
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- (ii) Identify one compound that can be used instead of dimethylsulphate to form the same product in b (i) above. (½mark)
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- (iii) Write a suitable mechanism for the reaction that occurs between phenol and your answer in b(ii) above. (2marks)
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- (c) (i) State what would be observed when phenol and the ether formed are separately treated with universal indicator. (1mark)
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Turn Over
13

(ii) Explain your observations in c (i) above. (2marks)

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16. Both aminomethane and magnesium hydroxide are weak electrolytes.

(a) (i) Define the term weak electrolyte. (1mark)

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(ii) Write an equation to show that each of the electrolytes above is weak in aqueous solution. (2marks)

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(b) 0.2M aminomethane solution is 40% ionized at 25°C and the solubility product of magnesium hydroxide is $1.8 \times 10^{-12} \text{ mol}^3 \text{ dm}^{-9}$. Calculate the;

(i) concentration of hydroxide ions in the saturated solution of magnesium hydroxide. (02marks)

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(ii) pH of 0.2M aminomethane at 25°C. (02marks)

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- (c) Determine the solubility of magnesium hydroxide in 0.2M aminomethane at 25°C.
(02marks)

17. Anhydrous sodium carbonate manufactured from brine by the solvay process is used as a primary standard for hydrochloric acid.

- (a) Briefly describe with equations how anhydrous sodium carbonate is obtained by the solvay process. (3½marks)

- (b) Concentrated hydrochloric acid is an azeotrope of water and hydrochloric acid. The composition of hydrochloric acid in the azeotrope is 36% w/w at atmospheric pressure. 2.1422cm^3 of the azeotrope were diluted with water to make 250ml of solution. 20cm^3 of the dilute solution required 10cm^3 of sodium carbonate solution of concentrated 10.6gdm^{-3} for complete neutralization in the presence of methyl orange indicator.

Calculate the density of the azeotrope in g/cm³. (5marks)

- (c) State one other use of sodium carbonate. (½mark)

END

Turn Over

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H

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Li

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Be

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Na

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Mg

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K

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Ca

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Sc

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Ti

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V

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Mn

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Ni

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Cu

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Ga

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Ge

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Kr

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Xe

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Rb

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Sr

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Cs

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Ba

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Fr

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Ra

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Lr

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Rf

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Db

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Sg

39

Bh

40

Hs

41

Mt

42

Uuu

43

Uub

44

Uuo

45

Uup

46

No

* Lanthanide series

** Actinide series

57	58	59	60	61	62	63	64	65	66	67	68	69	70
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
89	90	91	92	93	94	95	96	97	98	99	100	101	102
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No
137	138	139	140	141	142	143	144	145	146	147	148	149	150

Name:

Centre/Inlet No:

School.....

Signature.....

P525/1

CHEMISTRY

Paper 1

July/August 2015

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



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- Attempt all questions in section A and any six questions from section B
- All questions are to be answered in the spaces provided.
- A Periodic Table with relevant atomic masses is supplied at the end of the paper.
- Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.
- Illustrate your answers with equations where applicable.

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 marks)

Answer all questions in this section.

1. (a) X, Y and Z are structural isomers of $C_4H_{10}O$. The isomers react with sodium metal liberating hydrogen gas.

(i) Name the functional group in the isomers of $C_4H_{10}O$. (1½ mark)

(ii) Write an equation for the general reaction that occur between $C_4H_{10}O$ and sodium metal. (1 mark)

- (b) Isomer x reacts with hot concentrated sulphuric acid but it gives no observable change on addition of warm acidified potassium dichromate solution.

(i) identify x. (1mark)

(ii) Suggest a suitable mechanism for the reaction between x and hot concentrated sulphuric acid. (2 marks)

(iii) State the molecularity of the reaction in b(ii) above. Give a reason for your answer. (1½ mark)

2. (a) Copper like other transition elements forms compounds in oxidation states: +1 and +2.

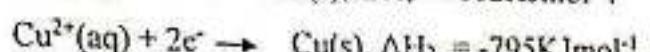
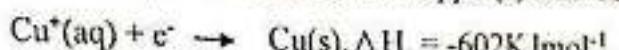
Write the electronic configuration of:

(i) Copper (I) ions. (1½ mark)

(ii) Copper (II) ions,

(1/2 mark)

(b) The enthalpies of reduction of copper(I) and copper(II) ions are given below:



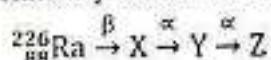
(i) Calculate the enthalpy for the disproportionation of copper(I) ions to Copper(II) ions and copper.

(2 marks)

(ii) Using your answer in b(i), comment on the stability of copper(I) ions with respect to copper(II) ions. Give a reason for your answer. (1 mark)

(c) State any two other properties that make copper a typical transition metal. (1 mark)

3. Radium undergoes radioactive decay according to the following equation forming relatively stable nuclides X, Y and Z.



(a) Identify the species X, Y and Z. (1½ marks)

X _____

Y _____

Z _____

(b) 0.02 mole of ${}_{88}^{226}\text{Ra}$ were allowed to decay for 2.40×10^4 years. The half life of Radium – 226 is 1600 years. Calculate the number of atoms of Radium – 226 left at the end of 2.40×10^4 years. (Avogadro's constant = 6.02×10^{23} atoms per mole.)

Turn Over

- (c) State any two practical applications of radioactive isotopes. (1 mark)

4. Name the reagent(s) that can be used to distinguish between each of the following pairs of compounds. State the observation(s) when each compound is separately treated with the reagent(s).

- (a) $\text{CH}_3\text{COONH}_4$ (aq) and NH_4F (aq) (1½ marks each)

Reagent(s)

Observations.

- (b) $\begin{matrix} \text{CH}_3 & \text{CH} & \text{CH}_2\text{NH}_2 \\ | & & \\ \text{OH} & & \end{matrix}$ and $\begin{matrix} \text{CH}_3 & \text{CH} & \text{NH} & \text{CH}_3 \\ | & & | & \\ \text{OH} & & \text{OH} & \end{matrix}$

Reagent(s)

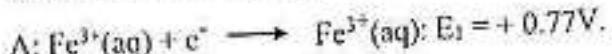
Observations.

(c) NiO and FeO.

Reagent(s)

Observations.

5. Given the following reduction reactions and their corresponding electrode potentials.



The two half cell reactions; A and B form a feasible cell reaction with reaction A at the cathode and $E^\circ_{\text{cell}} = +0.23\text{V}$.

(1 mark)

- (a) (i) Write the equation for the reaction that occurs at the anode.

(1mark)

- (ii) Calculate the value of E_2 .

- (b) Draw a well labelled diagram to show how the $E^\circ_{\text{cell}} = +0.23\text{V}$ can be measured practically from the half-cell reactions.

(3 marks)

Turn Over

- (c) State two conditions under which the cell in (b) above is set-up. (1 mark)

6. Iron and lead form mixed oxides Fe_3O_4 and Pb_3O_4 respectively.

- (a) Write the;

- (i) IUPAC name of the oxide of lead (Pb_3O_4) that represents the ratio in which the oxides mix.

- (ii) Equation to show that Fe_3O_4 is a mixed oxide. (1 mark)

- (b) Pb_3O_4 oxidises hot concentrated hydrochloric acid to a pale green gas and itself reduced to a colourless solution which forms a white precipitate on cooling.

- (i) Identify the;

Pale green gas. (1/2 mark)

White precipitate. (1/2 mark)

- (ii) Write the equation for the reaction between Pb_3O_4 and hot concentrated hydrochloric acid. (1 mark)

- (c) State any two other chemical properties to show the similarity between iron and lead. (1 mark)

7. At 100°C , the dissociation pressures of carbon dioxide in equilibrium with the carbonates of Lithium, sodium and potassium are given in the table below.

Li_2CO_3	Na_2CO_3	K_2CO_3
90mmHg	19mmHg	8mmHg

- (a) Which one of these carbonates is thermally most stable at 100°C ?

Give a reason for your answer.

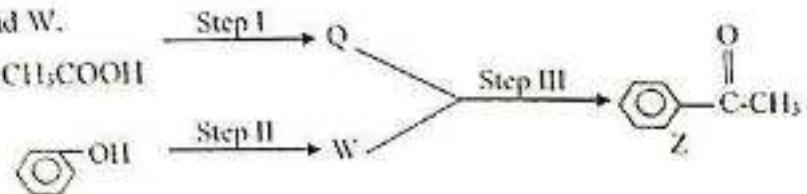
- (b) (i) Identify the least stable carbonate. (1/2 mark)

- (ii) Write an equation for the reaction to show the equilibrium at 100°C for the carbonate in b(i) above. (1 mark)
-
-
-

- (iii) Explain why the element forms the least stable carbonate identified in b(i) above. (2 marks)
-
-
-
-
-

- (c) State any two other properties to show how the chemical properties of the element in b(ii) above differs from group I elements. (1 mark)
-
-
-

- g. The figure below shows an organic reaction scheme leading to the formation of Z from Q and W.



Turn Over
7

(a) Name the compounds:

(i) Q _____ (1/2 mark)

(ii) W _____ (1/2 mark)

(b) State the condition(s) necessary for the formation of:

(i) Q from CH_3COOH (1/2 mark)

(ii) W from 

(c) (i) Name the type of reaction that occurs in step III. (1/2 mark)

(ii) Explain why W reacts with Q to form Z under the conditions in step III. (1 1/2 mark)

(d) (i) State what would be observed when compound Q is reacted with  (1/2 mark)

(ii) Write an equation for the reaction in d(i) above. (1 mark)

9. Pure water boils at 100°C at 1013.25 kNm^{-2} pressure. However aqueous solutions of nitric acid and ethanol boil at temperatures shown below:

Solution	Composition	Boiling point ($^\circ\text{C}$)
Aqueous nitric acid	68.0% HNO_3	120.5
Aqueous ethanol	95.6% $\text{CH}_3\text{CH}_2\text{OH}$	78.2

- (a) If pure nitric acid boils at 87°C at 1013.25KNm^{-2} pressure, sketch a graph (well labelled phase diagram) to show how the boiling point of aqueous nitric acid varies with the mole fraction of water in the solution. (2 marks)

- (b) A solution containing 26% ethanol, 74% water was fractionally distilled. Identify the; (1/2 mark)

(i) Distillate.

- (c) Using the table of boiling points and composition above, state the effect of adding ethanol to water on the; (1/2 mark)

(i) Intermolecular forces in water.

Turn Over

SECTION B

Answer only six questions from this section.

Any additional questions answer will not be marked.

10. In an experiment to determine the formula of an alkylhalide, RCH_2I , the alkylhalide is refluxed with concentrated aqueous sodium hydroxide followed by acidified silver nitrate. The mixture is filtered and the mass of dry residue measured.

- (a) (i) Write equation(s) for the reaction(s) that take place in the experiment. (2 marks)

- (ii) Why is the silver nitrate solution acidified? (1 mark)

- (iii) Name the type of reaction that occurs on reflux. ($\frac{1}{2}$ mark)

- (b) 3.4g of an alkylhalide RCH_2I were refluxed with excess 2M sodium hydroxide solution. To the resultant mixture, excess acidified silver nitrate was added and the product filtered. The mass of the dry residue was found to be 4.70g.

- (i) Calculate the formula mass of R. (2 marks)

- (ii) Deduce the structural formula of RCH_2I from your answer in b(i) above.

- (c) Using equations, show any alkylhalide RCH_2I can be converted to RI. ($2\frac{1}{2}$ marks)

11. Explain each of the following observations. Illustrate your answer with equations of reactions (where applicable).

(a) When potassium methanoate solution is added to copper (II) sulphate solution, a blue precipitate is formed. (3 marks)

(a) When potassium methanoate solution is added to copper (II) sulphate solution, a blue precipitate is formed. (3 marks)

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- (b) When boiled with Fehling's solution, aliphatic alkanals form a reddish brown precipitate. (3 marks)

- (c) Helium can be separated from Argon by diffusion however a mixture of ethane and nitrogen cannot be separated by diffusion. (3 marks)

12. (a) 3.0g of solid calcium iodate(v) were vigorously shaken with water in a stoppered bottle and the mixture allowed to stand at 25°C for about 30 minutes. The resultant mixture was filtered to obtain exactly 200cm^3 of the filtrate. Given that calcium iodate (v) is sparingly soluble in water;

(i) Name the filtrate. ($1/2$ mark)

(ii) Write an equation for the reaction that occurs at 25°C at the end of the 30 minutes. (1 marks)

- (b) 20cm^3 of the filtrate were pipetted into excess acidified potassium iodide solution and the mixture titrated with exactly 6.75cm^3 of 0.1M sodium thiosulphate solution in the presence of starch indicator.

Calculate the percentage by mass of calcium iodate(V) in 200cm^3 of the filtrate.

($4 \frac{1}{2}$ marks)

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- (c) The experiment in (a) above was repeated with potassium iodate solution instead of water at 25°C .
- (i) State whether the percentage of calcium iodate(v) in the filtrate would be less, equal to or greater than the calculated value in (b) above. (1 mark)
- _____
- (ii) Explain your answer in c(i) above. (2 marks)
- _____
- _____
- _____
- _____
- _____
- _____

13. (a) F_2 , Cl_2 , Br_2 and I_2 are diatomic molecules of group VII elements of the periodic table. Briefly describe how the elements react with;
- (i) Potassium bromide solution, (2 marks)
- _____
- _____
- _____
- _____
- _____

- (ii) Hydrogen sulphide. (2 marks)
- _____
- _____
- _____
- _____

- (b) The hydride of the elements in (a) above boil at different temperatures shown in the table below.

HF	HCl	HBr	HI
+20°C	-85°C	-67°C	-35°C

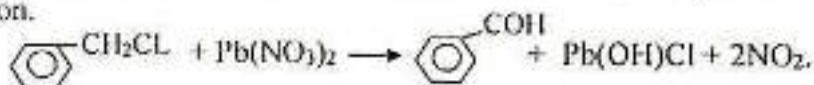
State and explain the trend in the boiling points of the hydrides.

(3 marks)

- (d) (i) State the order in reducing strength of the hydrides.

- (ii) Write a general equation for the reaction between aqueous solutions of halogen acids (hydrides) with solid sodium carbonate. (1 mark)

14. (a) In the hydrolysis – oxidation reaction, benzyl chloride is boiled under air-reflux with lead (II) nitrate solution for about 3 hours to form Benzaldehyde according to the equation.



Benzaldehyde is obtained by steam distillation from the reaction mixture and extracted by ether from the distillate. State the reason(s) why:

- (i) the basic chloride of lead $\text{Pb}(\text{OH})\text{Cl}$ is not found in the steam distillate? (1/2 mark)

- (ii) ether is used to extract benzaldehyde from the distillate. (1 mark)

- (b) Benzaldehyde is separately treated with cold concentrated potassium hydroxide followed by dilute hydrochloric acid and hydroxylamine in acidic medium.

- (i) Write an equation for the reaction between benzaldehyde and potassium hydroxide followed by dilute hydrochloric acid. (1 mark)

- (ii) Suggest a suitable mechanism for the reaction between benzaldehyde and hydroxylamine in acidic medium. (3 marks)

- (c) Using equations only, show how benzaldehyde can be;
(i) Prepared from methyl benzene. (1 1/2 marks)

- (ii) Converted to benzylethanoate. (2 marks)

15. (a) Define the following terms as applied in ionic equilibria.
(i) Ionisation. (1 mark)

- (ii) Salt hydrolysis (1 mark)

Turn Over

- (b) Write an equation for the;
 (i) Ionisation of ammonia in water. (1 mark)

(ii) hydrolysis of ammonium sulphate. (1 mark)

- (c) You are provided with solid anhydrous ammonium sulphate, water and 250ml volumetric flask. Briefly outline how a solution of ammonium sulphate of pH = 5.20 can be prepared in the laboratory. (K_b for ammonia = 1.78×10^{-5} mol dm $^{-3}$ and ionic product of water at 25°C, $K_w = 1.0 \times 10^{-14}$ mol 2 dm $^{-6}$) (5 marks)

16. (a) Powdered chromite (FeCr_2O_4) is roasted with anhydrous sodium carbonate in air and calcium oxide.



Hot water is added to the products of the reaction and a yellow solid crystallises out.

- (i) Name the yellow solid. (½mark)

- (ii) Draw the structure and name the shape adopted by the anion in the ionic crystal lattice of the yellow solid in a(i) above. (1 mark)

- (b) The yellow solid dissolves in excess dilute sulphuric acid to form an orange solution which is a strong oxidizing agent. State what would be observed and write an equation for the REDOX reaction (where applicable) that occurs when the orange solution is reacted with;

- (i) Concentrated sodium hydroxide solution, (1½ marks)

- (ii) A saturated solution of potassium Sulphite. (2 marks)

- (iii) Excess warm ethanol. (2 marks)

- (c) Other than acting as an oxidizing agent in volumetric analysis, the aqueous solution of the yellow solid in a(i) above is used in precipitation titration involving silver nitrate solution.

- (i) State the role of the yellow aqueous solution in precipitation titration. (½ mark)

- (ii) Write an equation for the reaction that occurs and state the observation at the end point. (1 mark)

7. (a) (i) Define the term vapour pressure. (1 mark)

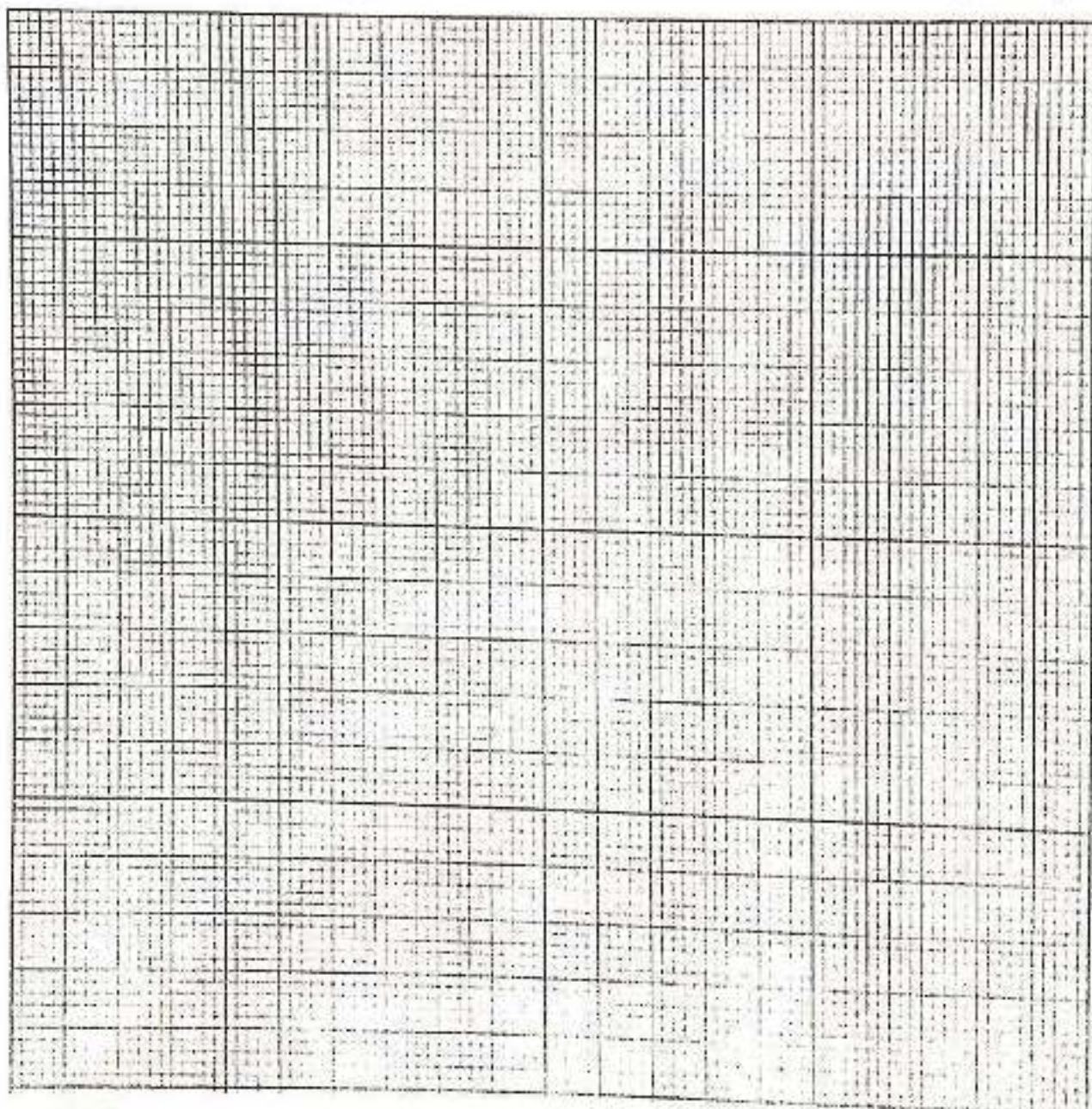
(ii) State Raoult's law of vapour pressure lowering.

(1 mark)

- (b) The vapour pressure of aqueous solutions of glucose containing 9.0g of water at 27°C varies with the mass of glucose dissolved as shown in the table below.

Mass of glucose dissolved in 9.0g of water	0.00	0.45	0.90	1.80	3.60	4.50	7.20
Vapour pressure of solution (mmHg)	31.82	31.66	31.50	31.32	30.55	30.23	29.27

- (i) Plot a graph of lowering in vapour pressure (ΔP) against mass of glucose dissolved in 9.0g of water. (4 marks)



- (ii) Use your graph in b(i) above to determine the molar mass of glucose. (2 marks)

- (e) State the effect of water on the molecular state of glucose. Give a reason for your answer using the molar mass calculated in b(ii) above. (1 mark)

END

1	H
2	Li
3	Be

4	Mg
5	

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7	N

8	O
9	F

10	Ne
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13	Al

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15	P

16	S
17	Cl

18	Ar
19	He

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3	Be
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13	Al
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15	P
16	S
17	Cl
18	Ar
19	He
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21	B
22	C
23	V
24	Cr
25	Mn
26	Fe
27	Co
28	Ni
29	Cu
30	Zn
31	Ga
32	Ge
33	As
34	Se
35	Br
36	Kr
37	
38	Sc
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40	V
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42	Mn
43	Fe
44	Co
45	Ni
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101	Uuo
102	Uq

* Lanthanide series

** Actinide series

37	La
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42	Sm
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P525/1
CHEMISTRY
Paper 1
July/August 2018
2 $\frac{3}{4}$ hours



WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- Attempt all questions in section A and any six questions from section B.
- All questions are to be answered in the spaces provided.
- A Periodic Table with relevant atomic masses is supplied at the end of the paper.
- Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.
- Illustrate your answers with equations where applicable.

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 MARKS)

Attempt all questions in this section.

1. The atomization energies of carbon, hydrogen and chlorine are +715, +218 and +122 kJmol⁻¹ respectively.

Given the bond energies in the table below.

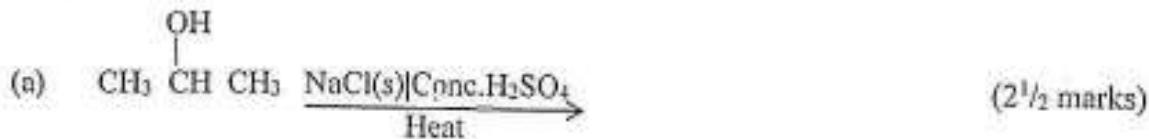
Bond	B.E (kJ mol ⁻¹)
C-H	413
C-CL	325.4

- (a) Distinguish between bond energy and atomization energy. (2marks)

- (b) (i) Calculate the enthalpy of formation of chloromethane. (3marks)

- (ii) State whether chloromethane is stable or not. Give a reason for your answer. (1mark)

2. Complete each of the organic reactions below and write a suitable mechanism for the reaction.





3. (a) Iodine is sparingly soluble in water but readily dissolves in potassium iodide according to the equilibrium.
 $\text{I}_2(\text{aq}) + \text{I}^-(\text{aq}) \rightleftharpoons \text{I}_3^-(\text{aq})$.

(i) Write an expression for the concentration equilibrium constant K_c . (1 mark)

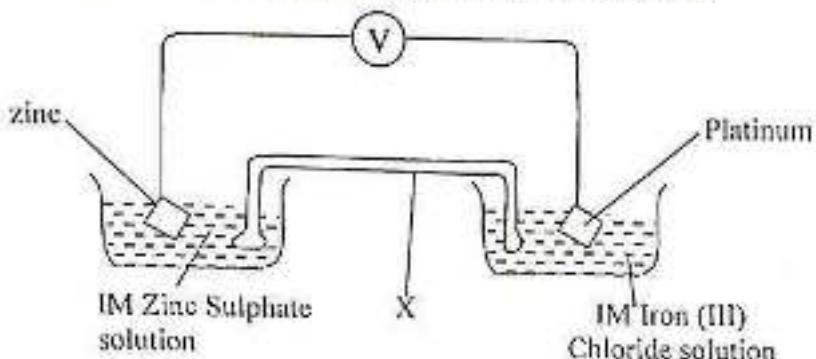
(ii) State any two characteristics of the above equilibrium. (1 mark)

- b) State and explain the effect of adding sodium thiosulphate solution to the position of equilibrium. (2marks)
-

4. (a) Aluminium chloride is covalent and rapidly undergoes hydrolysis in moist air.
- (i) State three other properties to show that aluminium chloride is covalent. (1½ marks)
-
-
-
- (ii) Write an equation for the hydrolysis of aluminium chloride in moist air. (1mark)
-

- (b) (i) Name one element of period 2 whose chemical properties resemble those of aluminium. (1/2 marks)

5. The figure below shows a voltaic cell setup between two electrodes.



- (a) (i) Define the term "voltaic cell" (1 mark)

- (ii) Name x and state its role in the above setup. (1 mark)

- (b) The reading on the voltmeter above was +1.53 volts.

- (i) Write an equation for the redox reaction that takes place. (1 mark)

- (ii) State whether the reaction in b(i) above is feasible. Give a reason for your answer. (1 mark)

- (c) Calculate the electrode potential of the left hand electrode if the electrode potential of the right hand electrode is +0.77V. (1 mark)

- (d) Write the cell convention for the voltaic cell above. (1 mark)

6. Neoprene $\left[\text{CH}_2 \underset{\text{Cl}}{\overset{\parallel}{\text{C}}} = \text{CH} \text{CH}_2 \right]_n$ and Nylon-6,10

$\left[\text{C}=\text{O} - (\text{CH}_2)_4 - \text{C}=\text{O} - \text{NH} - (\text{CH}_2)_6 - \text{NH} \right]_n$ are synthetic polymers.

- (a) Name the type of polymerization by which each polymer is obtained.

Neoprene _____ (½ mark)

Nylon-6,10 _____ (½ mark)

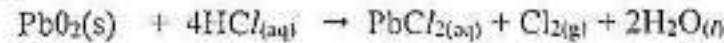
- b) Write the structural formulae of the monomer(s) of each polymer.

(i) Neoprene _____ (1 mark)

(ii) Nylon -6,10 _____ (1 mark)

- (c) State one use of each polymer (1 mark)

7. (a) Lead(iv) oxide reacts with hydrochloric acid according to the redox reaction below.



- (i) State the condition(s) for the above reaction. (1 mark)

- (ii) Write the half reduction and oxidation reactions from the overall redox reaction above. (2 mark)

- (b) Lead (iv) oxide was added to a solution of manganese(II) sulphate in the presence of concentrated nitric acid.

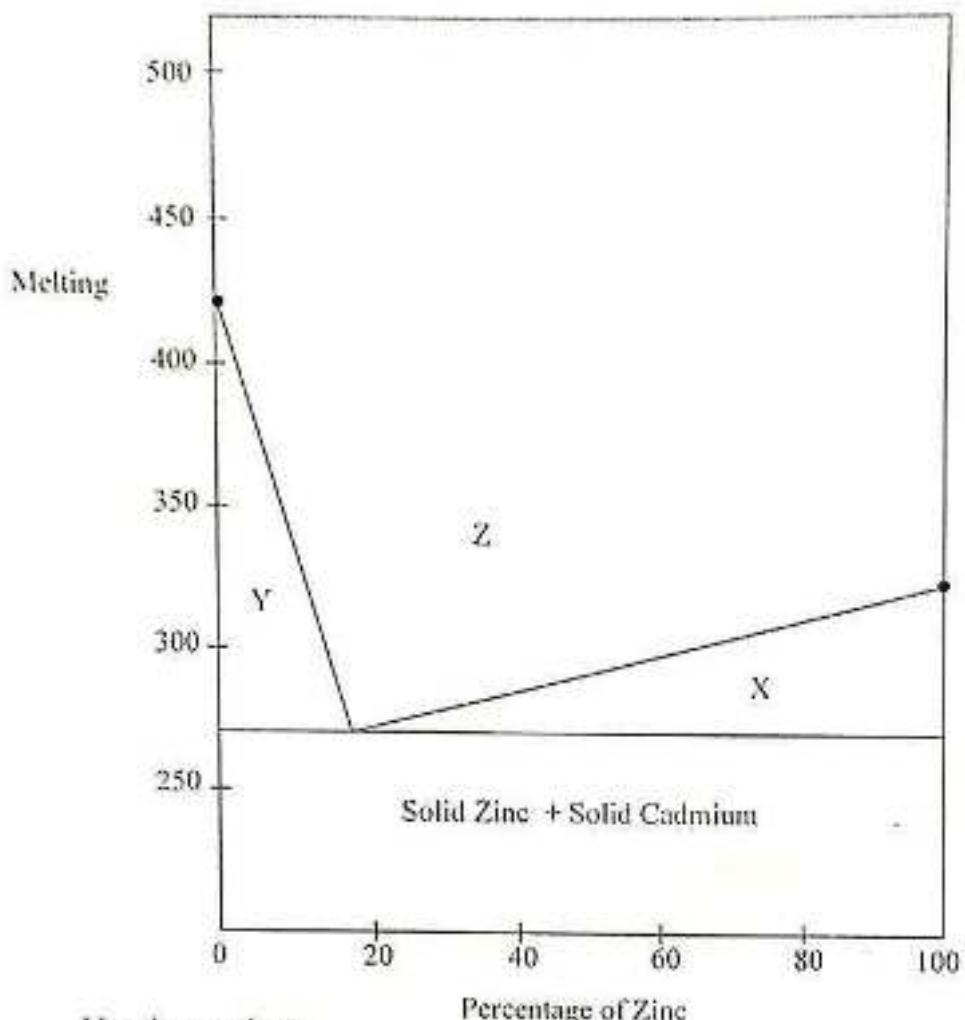
- (i) State what was observed. (½ mark)

Turn Over

(ii) Write the equation for the reaction that took place. (1 ½ marks)

8. (a) The graph shows the variation in melting point of a mixture of zinc and cadmium with composition.

EUTECTIC PHASE DIAGRAM FOR ZINC-CADMIUM SYSTEM



Use the graph to:

- (i) Determine the eutectic point of the system.

(1 mark)

- (ii) Name the phases in region:

(1 ½ marks)

X _____

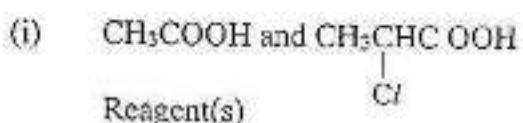
Y _____

Z _____

- (b) Describe the changes that take place when a mixture containing 88% zinc is cooled from 450°C to 280°C. (2 ½ marks)

- (c) Calculate the mass of zinc that remained in solution when 120g of the liquid mixture containing 12% cadmium was cooled from 450°C to 280°C . (2marks)

9. (a) Name the reagents that can be used to distinguish between the following pairs of compounds. In each case state what would be observed. (2marks)



Observation(s)

(ii) CH₃CH₂OH and CH₃OH (2marks)

Reagent(s)

Observation(s)

(b) Write equation(s) for the reaction(s) that take place in a (ii) above. (1 mark)

SECTION B (54MARKS)

Answer only six questions from this section.

10. (a) An organic compound Q contains 54.55% carbon, 9.09% hydrogen and the rest being oxygen. The density of Q at 50°C and 2.0 atm pressure is 3.3185 g dm^{-3} . Calculate the;
- (i) empirical formula of Q (1 ½ marks)

- (ii) molecular formula of Q (2 marks)

- (b) Q forms a yellow precipitate with a solution of 2, 4-dinitrophenylhydrazine in ethanol and concentrated sulphuric acid.

- (i) Identify Q by its structural formula and IUPAC name. (1mark)

- (ii) State what would be observed when Q is added to ammoniacal silver nitrate solution and the mixture warmed. (½ mark)

- (iii) Write an equation for the reaction that occurs in b(ii) above. (1mark)

- (c) Suggest a suitable mechanism for the reaction between Q and acidified hydroxylamine (H_2NOH). (3marks)

11. (a) Chromium like other transition elements forms an orange coloured solution of potassium dichromate and a complex ion of the formula: $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{2-}$.
(i) State any two other properties to show that chromium is a typical transition element. Illustrate each answer with an example. (2marks)

- (ii) Explain why chromium forms a complex. (1 ½ marks)
-
-
-
- (b) (i) State the co-ordination number and oxidation state of chromium in $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{2-}$.
Co-ordination number _____ (½ marks)
Oxidation state _____ (½ marks)
- (ii) Name the donor atom in the ligands of $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{2-}$. (½ marks)

- (c) State what would be observed and write an equation for the reaction that occurs when each of the following is added to an aqueous solution of potassium dichromate.

- (i) acidified hydrogen peroxide solution.
Observation:

Equation: (1 ½ marks)

- (ii) Dilute sodium hydroxide solution.
Observation:

Equation: (1 ½ marks)

12. (a) The solubility of lead (II) Iodide in 0.2M potassium iodide solution at 25°C is $8.544 \times 10^{-4} \text{ gdm}^{-3}$.
(i) Define the term solubility. (1mark)

Turn Over

(ii) Write an equation for the solubility equilibrium reaction of lead (II) iodide.

(1mark)

(b) Calculate the:

(i) Solubility product (K_{sp}) of lead(II) iodide at 40°C . (3½marks)

(ii) Solubility of lead (II) Iodide in water at 40°C . (1 ½ marks)

(c) Explain the difference between your answer in b (ii) above and the solubility of lead (II) iodide in 0.2M potassium iodide. (1 ½ marks)

(d) State any two practical applications of solubility product. (1mark)

13. Use equations to show how each of the following compounds can be synthesized.

(a) Ethoxycyclohexane from nitrobenzene. (3 ½ marks)

- (b) Ethanol from propanoic acid. (3 marks)
-
-
-
-
- (c) Propan -2-ol to propanone phenylhydrazone. (2½ marks)
-
-
-
-
14. (a) The melting points of magnesium and sulphur are 660°C and 119°C respectively. Explain the difference in the melting points. (2 ½ marks)
-
-
-
-
- (b) (i) Write the formulae of the oxides formed by magnesium and sulphur. State the types of bond in each oxide. (2 ½ marks)
- | Element | Formula of oxide | Type of bond |
|-----------|------------------|--------------|
| Magnesium | | |
| Sulphur | | |
- (ii) Write an equation for the reaction between each oxide in b (i) above with sodium hydroxide solution. (2 marks)
-
-
-
-
- (c) Both magnesium and sulphur react with silicon to form silicides of the formulae Mg_2Si and SiS_2 respectively.
Write an equation for the reaction between:
(i) Mg_2Si and dilute hydrochloric acid. (1 mark)
-
- (ii) SiS_2 and cold water. (1 mark)
-

15. Explain each of the following observations.

- (a) When separately added to copper (II) sulphate solution, potassium iodide forms a white precipitate in a brown solution while potassium chloride solution gives no observable change. (3marks)

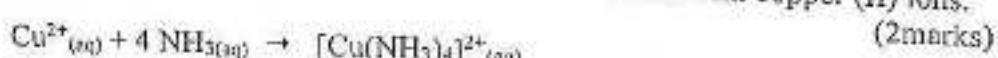
- (b) Neutrons are preferred to protons for bombardment in nuclear fission. (2marks)

- (c) Both halogens and oxygen are diatomic however halogens react more readily with metals than oxygen. (2marks)

- (d). Pentane and 2,2-dimethylpropane have the same relative formula mass but different boiling points. (2 marks)

16. (a) In an experiment to determine the partition coefficient of ammonia between water and trichloromethane, equal volumes of 0.1M copper (II) sulphate solution and 2M ammonia were mixed and the mixture shaken with trichloromethane in a closed vessel. At equilibrium, the concentration of ammonia in trichloromethane was 0.0308M.

- (i) Calculate the concentration of ammonia that reacted with copper (II) ions. (2marks)

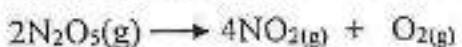


- (ii) Determine the partition coefficient K_D of ammonia between water and trichloromethane. (4marks)

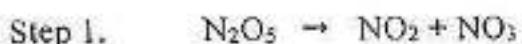
- (b) State any two;
(i) assumptions made in a(ii) above (2marks)

- (ii) practical applications of the partition law other than determining the formulae of complexes. (1mark)

17. (a) Dinitrogen pentoxide decomposes according to the equation.



Mechanism

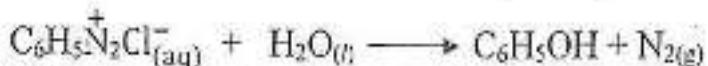


- (i) Define the term molecularity (1 mark)

- (ii) Given that the above reaction is unimolecular identify the slowest step in the mechanism. Give a reason for your answer. (1mark)

Turn Over

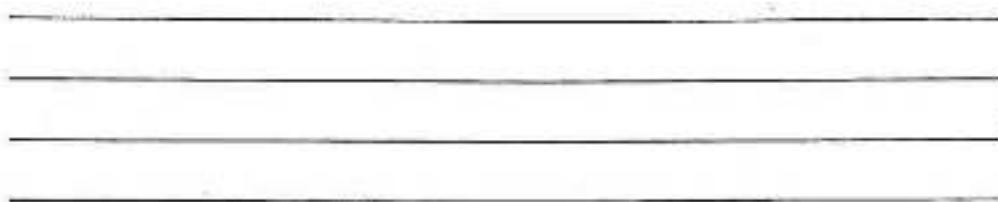
- (b) 0.2M benzene diazonium chloride decomposes in the presence of water by the equation:



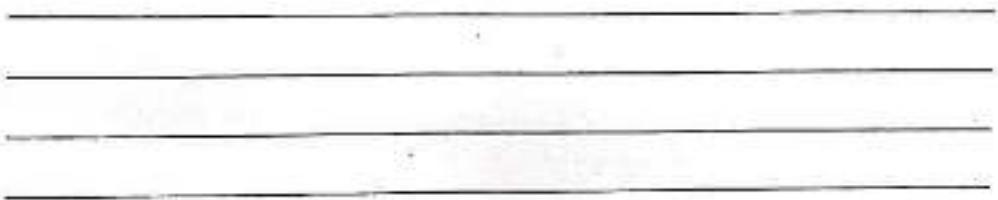
The volume of nitrogen gas evolved was recorded at different time intervals shown below.

Time (seconds)	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0
Volume of N_2 (dm^3)	0.0	0.42	0.70	0.90	1.08	1.22	1.28	1.30	1.30

- i) Plot a graph of volume of nitrogen gas against time.
Use your graph to determine the initial rate. (4marks)



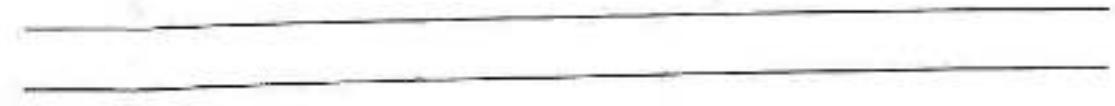
- ii) The experiment was repeated with 0.05M benzene diazonium chloride at 40°C and the initial rate was $0.0205\text{dm}^3/\text{s}$.
Calculate the order of reaction with respect to Benzene diazonium chloride. (1½ marks)



- (c) Write the rate equation if the concentration of water remains constant during the reaction. (1mark)



- (d) State the effect of increasing temperature on the value of the rate constant. (½ marks)



THE PERIODIC TABLE

1	2													3	4	5	6	7	8									
1.0 H 1														1.0 H 1	4.0 He 2													
6.9 Li 3	9.0 Be 4													10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10									
23.0 Na 11	24.3 Mg 12													27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18									
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Tl 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36											
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	99.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54											
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86											
223 Fr 87	226 Ra 88	227 Ac 89												139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
														227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

END