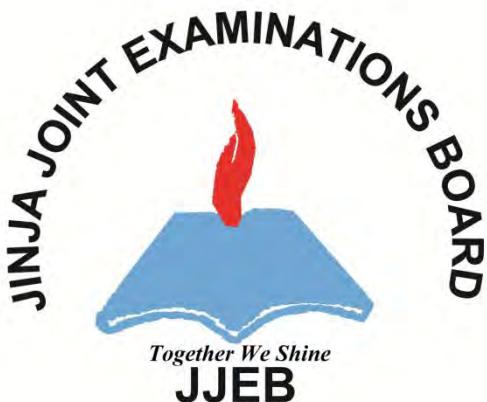


NameCentre/Index No...../

Signature

P525/1
CHEMISTRY
Paper 1
August, 2017
 $2\frac{3}{4}$ hours.



JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS –AUGUST, 2017

CHEMISTRY

(Principal Subject)

Paper 1

2 hours 45 minutes.

INSTRUCTIONS TO CANDIDATES:

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

All questions are to be answered in the spaces provided.

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

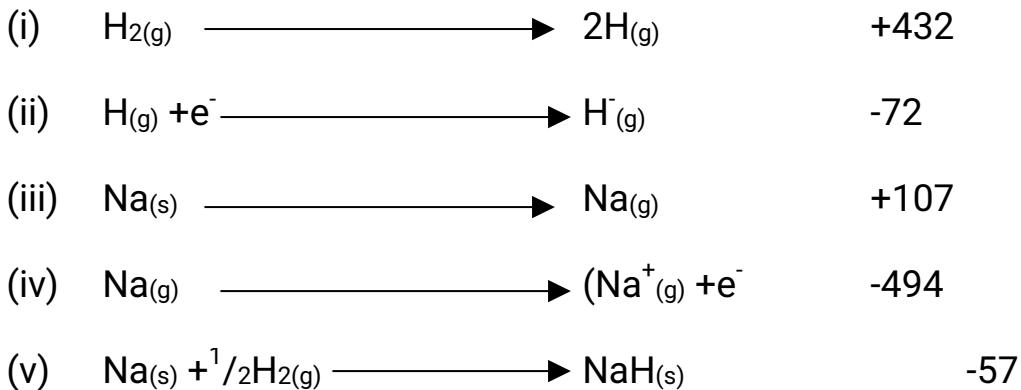
For Examiner's Use Only

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

PART A (46 MARKS)

Attempt all questions in this section

1. (a) The enthalpies of some reactions are given below.
- $$\Delta H^{\circ}(\text{kJ mol}^{-1})$$



Calculate the lattice energy of sodium (3 marks)

(b)(i) From your answer in (a); state whether sodium hydride is a stable compound or not. (½ mark)

(ii) Give a reason for your answer in b(i) (1 mark)

2. Complete the following equations and write the IUPAC names of the main organic product in each case.

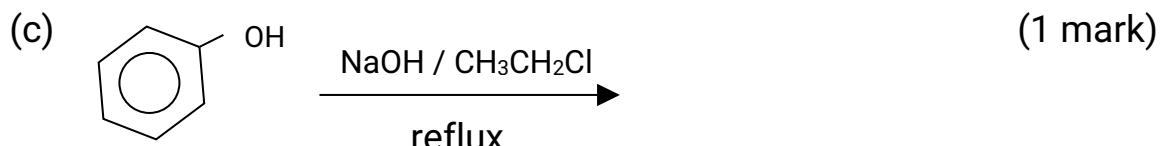


Name of product (½ mark)



(1 mark)

Name of product (½ mark)



Name of product (½ mark)

3. State the conditions and write equation for the reaction between nitric acid and

(i) Sulphur (2 ½ marks)

(ii) Tin (2 ½ marks)

4. The electrode potentials of $\text{S}_2\text{O}_8^{2-}\text{(aq)} / \text{SO}_4^{2-}\text{(aq)}$ and $\text{I}_2\text{(aq)} / \text{I}\text{(aq)}$ are + 2.01v and 0.54v respectively

(a) Write the;

(i) cell notation of the cell formed when the half cells are combined

(1 mark)

(ii) overall cell reaction

(1 ½ marks)

(b)(i) Calculate Gibbs free energy for the cell in (a)

(Faraday's constant = 95600c)

(2 marks)

5. (ii) State whether the cell reaction is feasible or not. Give a reason for your answer. (1 mark)

5. State what would be observed and write equation for the reaction that takes place when;

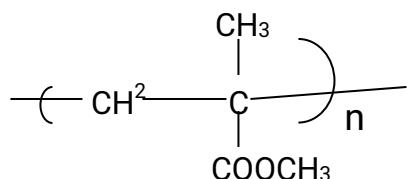
(i) benzene is warmed with a mixture of concentrated nitric acid and concentrated sulphuric acid (2 marks)

(ii) dilute sulphuric acid was added to copper(I)oxide (2 ½ marks)

(iii) aluminium powder was added to aqueous solution of iron(III)chloride

(2 marks)

6. Perspex is a polymer of structure:



(a) Name the reaction leading to the formation of Perspex (½ mark)

(b) Write the structure and

Give the IUPAC name of the monomer used to manufacture

Perspex

(2 marks)

(c) A solution containing 5.5g of Perspex in 1dm³ of benzene has an osmotic

pressure of 6.796×10^{-2} atmospheres at 25°C

Calculate the

(i) molecular mass of Perspex

(2 marks)

(ii) value of n (1 mark)

(d) state one application of perspex (½ mark)

7. The melting points of some of the chlorides of group II elements of the periodic table are given in the table below.

Formula of chloride	MgCl ₂	CaCl ₂	SrCl ₂	BaCl ₂
Melting point (°c)	708	772	878	967

(a) State how the melting points vary (1 mark)

(b) Explain your answer in(a) (3 marks)

8. Write equation to show how the following conversions can be effected

(a) propan-1-ol from propyne (3 marks)

(b) Bromocyclohexane from hydroxybenzene (2 ½ marks)

9. The conductivity of a $0.0634 \text{ mol dm}^{-3}$ solution of 2-hydioxo propanoic acid was found to be $1.138 \times 10^{-3} \text{ Scm}^{-1}$ and the molar conductivity at infinite dilution at 25°C is $388.5 \text{ cm}^3 \text{ mol}^{-1}$

Calculate the,

(i) pH of solution (2 marks)

(ii) acid dissociation constant, K_a at 25°C . (2 ½ marks)

SECTION B (54 MARKS)

(Attempt only six questions from this section)

Additional questions answered will not be marked.

10. An organic compound (R) contains 58.8% carbon, 9.8% hydrogen and the rest oxygen.

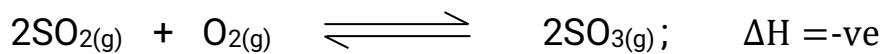
(a) Calculate the empirical formula of R. (2 ½ marks)

(b) Determine the molecular formula of R
(RFM of Y = 102) (1 ½ marks)

(c)(i) R reacts with aqueous sodium hydroxide under reflux to produce
propan-
of the products. Identify R 1-ol as one
(1 mark)

(ii) Write an equation to show how R can be synthesized from propan-
1-ol and indicate a mechanism for the reaction. (4 marks)

11. Sulphur dioxide and oxygen react to form sulphur trioxide according to the equation ;



(a) (i) Write the expression for the equilibrium constant, K_p for the reaction

(1 mark)

(ii) When 3 moles of sulphur dioxide were made to react 2 moles of oxygen at 450°C in a 1dm^3 vessel, the equilibrium mixture was found to contain 20% sulphur dioxide at 50atm .

Calculate the equilibrium constant K_p for the reaction. (4 marks)

(b) State giving reasons, how the concentration of sulphur trioxide at equilibrium would be affected when;

(i) Pressure is increased (1 $\frac{1}{2}$ marks)

(ii) temperature is increased (1 mark)

(iii) Helium is added at constant pressure (1 ½ marks)

12. (a)(i) Write the general electronic configuration of group IV elements of the periodic table. (1 mark)

(ii) State the common oxidation states exhibited by group IV elements. (1 mark)

(b)(i) Give three properties in which carbon shows a different behavior from other group IV elements. (3 marks)

(ii) Explain your answer in b(i) (1 ½ marks)

(c) Lead(IV) oxide was added to aqueous manganese(II) nitrate followed by concentrated nitric acid and the mixture heated.

(i) State what was observed (1 mark)

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

13. (a) The data showing the pH changes during the titration of $0.1\text{M}\text{oldm}^{-3}$ solution of sodium hydroxide against 10cm^3 of aqueous ethanoic (acidic) acid is given in the table below.

Volume of NaOH (cm^3)	0.0	2.0	4.0	6.0	8.0	10.0	14.0
pH	2.9	4.3	4.7	5.2	6.4	12.0	12.4

Plot a graph of pH against the volume of sodium hydroxide. (3 marks)

(b) Use your graph to determine the pH at equivalence point and volume of sodium hydroxide used to neutralize the acid.

(i) pH at equivalence point (1 mark)

(ii) volume of sodium hydroxide used to neutralize the acid. (1 mark)

(c) Calculate the molarity of ethanoic (acetic) acid. (2 ½ marks)

(d) The pH range for some indicators are given in the table below.

Indicator	pH range
Methyl orange	3.2 – 4.4
Phenolphthalein	8.3 – 10.0
Cresol red	7.2 – 8.8

Which of the indicators is suitable for this titration?

Give a reason for your answer. (1 ½ marks)

14. Complete the following equation(s) and write the mechanism(s) for the reaction(s) leading to the formation of major organic products.



15. (a) Describe the reactions of group II elements with water (5 marks)

(b) Potassium chromate solution was added to aqueous barium chroride solution followed by dilute nitric acid drop-wise until in excess.

(i) State what was observed. (1 mark)

(ii) Write equation(s) for the reaction(s) that took place. (3 marks)

16. (a) Compound F, contains 56.4% phosphorus the rest being oxygen.

(F = 220)

(i) Determine the molecular formula of F

(3 marks)

(ii) Write equations for the reaction between F and water (1 ½ marks)

(b) Write equation(s) for the reaction(s) of excess aqueous sodium hydroxide solution with

(i) Phosphorus

(1 ½ marks)

(ii) Chromium

(1 ½ marks)

(iii) Silicon

(1 ½ marks)

17. (a) Calculate the oxidation state of Bromine in the following ions

(i) BrO_3^- (1 mark)

(ii) BrO^- (1 mark)

(b) State what would be observed and write equation for the reaction that takes place when potassium bromated(V) solution was added to acidified potassium iodide.

Observation; (2 ½ marks)

Equation;

(c) Sodium hydroxide and chlorine are manufactured by electrolysis of brine in a mercury cell.

(i) Name the anode and cathode

Anode; (2 marks)

Cathode

(ii) Write equation(s) for the reactions that take place at;

Anode; (2 ½ marks)

Cathode;

Name:

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School.....

Signature.....

P525/1
CHEMISTRY
Paper 1
July/August 2017
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. (a) The oxygen-chlorine bond angles in Cl_2O and Cl_2O_7 are 111° and 119° respectively.
- (i) State the oxidation state of chlorine in each of the oxides. (01 mark)
-
.....
- (ii) Draw the structure and name the shape adopted by Cl_2O . (01 mark)
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.....
- (iii) Give a reason for the difference in bond angles of Cl_2O and Cl_2O_7 . (01 mark)
-
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- (b) Write an equation for the reaction between;
- (i) Cl_2O and water. (01 mark)
-
.....
- (ii). Cl_2O_7 and sodium hydroxide solution. (01 mark)
-
.....
.....
- (c) The product in b(ii) above was acidified and then added to Iron(II) sulphate solution.
- (i). State what was observed. ($\frac{1}{2}$ mark)
-
- (ii). Write an ionic equation for the redox reaction that takes place. (01 mark)
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2. Nitrogen gas in a 2 litre vessel at 25°C exerted a pressure of 0.62 atm. while methane gas in a 10.0 litre vessel exerted 0.612 atm. pressure. The gases were mixed in a 5.0 litre container.
- (a) State two conditions under which the mixture in the 5.0 litre container obeys Dalton's law of partial pressures. (01 mark)
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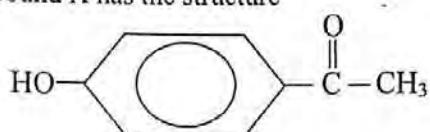
- (b) Calculate the total pressure exerted by the mixture of gases. (03 mark)

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- (c) State one reason why a mixture of ammonia and hydrogen chloride gas does not obey Dalton's law. (01 mark)

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3. An organic compound X has the structure



- (a) Name the functional group (s) in the structure of X. (01 mark)

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- (b) State what is observed and write an equation of reaction in each case that takes place when X is;

- (i) warmed with ethanoic acid in the presence of concentrated sulphuric acid.
Observation: (01 mark)

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Equation: (01 mark)

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- (ii) treated with aqueous iodine solution followed by excess sodium hydroxide solution and the mixture is heated.

Observation: (01 mark)

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Equation: (01 mark)

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4. (a) Unstable nuclides disintegrate either spontaneously or on bombardment with fast moving particles to form relatively stable nuclides. Write nuclear reactions for the following.

(i) Loss of an alpha particle by Thorium-230 (01 mark)

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(ii) Bombardment of Nitrogen-15 with a proton to give another nucleus and alpha particle. (01 mark)

.....

(iii) Beta decay by Lead-214 (01 mark)

.....

- (b). Boron has a relative atomic mass of 10.8 and two isotopes; Boron-10 and Boron-11. A sample of Boron was analysed in the mass spectrometer. Sketch the mas spectrum formed by Boron showing the percentage abundance of each isotope. (3½ marks)

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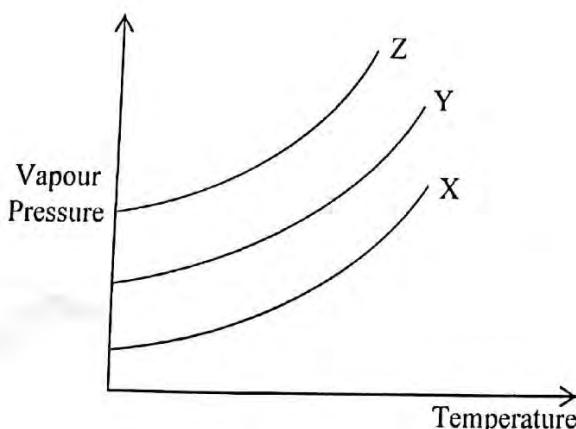
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5. The vapour pressures of pure benzene, pure water and a mixture of water and benzene vary with temperature as shown by curves X, Y and Z in the figure below. Pure benzene boils at 80°C while pure water boils at 100°C at 1.0 atm.



(a) Define the term vapour pressure. (01 mark)

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(b) Identify the curve that represents the variation of vapour pressure with temperature of;

(i) Pure benzene..... (½ mark)

(ii) Pure water..... (½ mark)

(iii) Mixture of benzene and water. (½ mark)

(c) Give a reason for your answer(s) in;

(i) a(i) and a(ii) above. (1½ marks)

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(ii). a(iii) above. (1½ marks)

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(d) Predict the boiling point of a mixture of benzene and water at 1.0 atm. Give a reason for your answer. (01 mark)

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6. (a) Compare the following properties of group I and group II elements. In each case, give a reason for your answer. (02 marks)

(i) Melting point.

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(ii) Second ionization energy. (1½ marks)

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Turn Over

- (b) The decomposition temperatures of carbonates of group II elements are given below:

Carbonate	BeCO_3	MgCO_3	CaCO_3	SrCO_3	BaCO_3
Decomposition	100	404	826	1098	1370
Temperature ($^{\circ}\text{C}$)					

State and explain the trend in decomposition temperatures of carbonates. (02 marks)

7. (a) Substance Q is an organic compound of empirical formula CHO. One mole of Q burns in excess oxygen to produce 89.60dm^3 of carbondioxide gas at s.t.p
Calculate the molecular formula of Q. (1½ marks)

- (b) Q reacts with sodium carbonate solution with effervescence. Q also decolourises both bromine water and acidified potassium manganate (VII) solution.
- Write the structural formula of Q. (½ marks)
 - Write an equation for the reaction between Q and sodium carbonate solution. (01mark)
 - Suggest a suitable mechanism for the reaction between Q and a solution of bromine in carbontetrachloride. (1½ marks)

8. Name a reagent that can be used to distinguish between the following pairs of compounds. State what would be observed if each compound is treated with the reagent you have named.

(a) $\text{CH}_3\text{C} \equiv \text{CH}$ and $\text{BrCH}_2\text{C} \equiv \text{CH}$. (02 marks)

Reagent:

Observation: (02 marks)

(b) $\begin{array}{c} \text{COOH} \\ | \\ \text{COOH} \end{array}$ and $\begin{array}{c} \text{HC}-\text{OH} \\ || \\ \text{O} \end{array}$ (02 marks)

Reagent:

Observation:

(c) NiCO_3 and CuCO_3 . (02 marks)

Reagent:

Observation:

9. (a) Define the terms:

i) Enthalpy of reaction. (01 mark)

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ii) Lattice energy. (01 mark)

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Turn Over

(b) Given the following data;

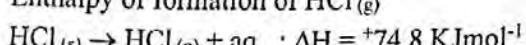
Lattice energy of magnesium chloride = -2495.6 KJmol⁻¹

Hydration energy of Mg²⁺ = -1926 KJmol⁻¹

Hydration energy of chloride ions (Cl⁻) = -378.0 KJmol⁻¹

Enthalpy of formation of Magnesium chloride= -641.62 KJmol⁻¹

Enthalpy of formation of HCl_(g) = -92.32 KJmol⁻¹



Calculate the enthalpy of the reaction between magnesium and hydrochloric acid given by the equation;



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SECTION B (54MARKS)

Answer ONLY six questions from this section.

10. Use equations to show how the following conversions can be effected. Include conditions for the reactions.

(a) Phenol to 2,4,6-tribromocyclohexanone.

(03 marks)

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(b) 2-Methylpropene to 3-methylbutanoic acid.

(03 marks)

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(c) Benzene to 1,1-dichloro-1-phenylmethane. (03 marks)

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11. (a) Zinc blende (ZnS) is a low density ore from which zinc can be extracted.

i) State one physical method by which the ore can be concentrated. (½ mark)

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(b) State the methods by which pure zinc can be obtained from impure zinc. (01 mark)

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(c) Zinc powder is used in qualitative analysis to confirm the presence of nitrate ions. A spatula endful of zinc powder is added to an alkaline solution of nitrate ions.

i) State what would be observed (01 mark)

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(d) Describe the reaction of zinc with sulphuric acid (03 marks)

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12. (a) Sodium chloroethanoate ($\text{ClCH}_2\text{COO}^-\text{Na}^+$) undergoes hydrolysis.

i) Write an equation for the hydrolysis of sodium chloroethanoate. (01 marks)

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Turn Over
9

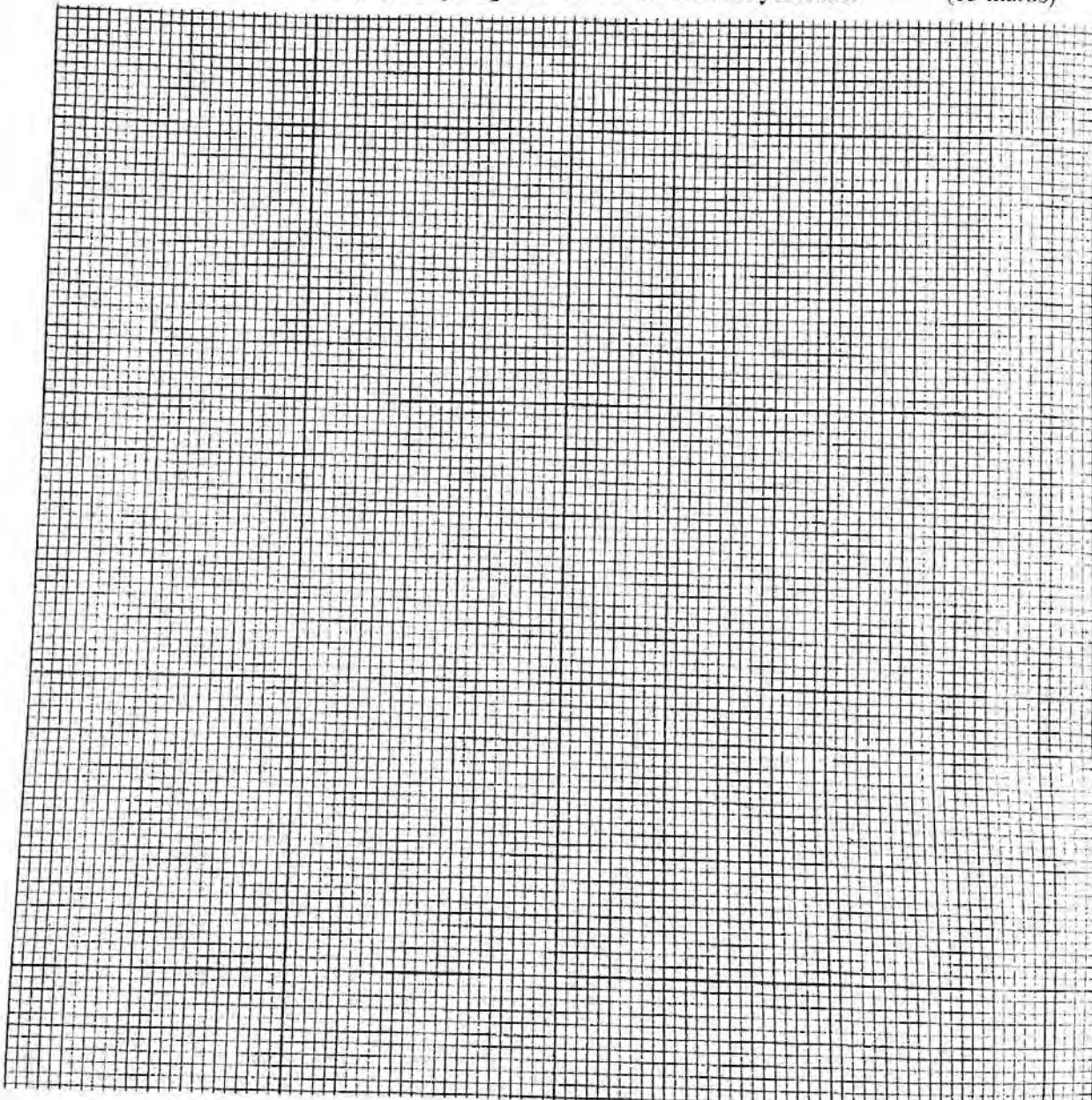
- iii) Deduce the expression for the hydrolysis constant, K_h for the reaction in (a)(i) above. (1/2 mark)

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- (b) In an experiment to determine the hydrolysis constant K_h in a(ii) above, sodium hydroxide solution was added to 25cm³ of 0.1M chloroethanoic acid and the pH of the solution measured at intervals. The results obtained are shown in the table below.

Volume of NaOH (cm ³)	0.0	4.0	8.0	12.0	16.0	20.0	22.0	23.0	24.0	28.0	32.5
pH of solution	2.8	3.5	4.0	4.5	5.1	5.8	7.0	10.4	11.4	12.3	13.0

- i) Plot a graph of pH against volume of sodium hydroxide. (03 marks)



- ii) From your graph, determine the;
pH at the end point (1/2 mark)
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- iii) volume of sodium hydroxide required to reach the end point. (1/2 mark)
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- (c) Calculate the hydrolysis constant of;
Sodium chloroethanoate using your answers in b(ii) and (iii) above. (3½ marks)
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13. State what is observed and write equation for the reaction that takes place when;

- (a) Ethanal is added to acidified 2, 4-dinitrophenyl hydrazine

Observation;
..... (01 mark)

Equation
..... (1½ mark)

- (b) Chromium (III) Sulphate solution is added to excess sodium hydroxide solution
and followed by warm hydrogen peroxide solution.

Observation;
..... (01 mark)

Equation;
..... (1½ mark)

- (c) Concentrated hydrochloric acid is added dropwise until in excess to an aqueous
solution of Cobalt(II)nitrate

Observation;
..... (01 mark)

Turn Over
11

Equation (1½ mark)

- (d) Benzene and concentrated nitric acid in the presence of concentrated sulphuric acid are heated to 55°C.
Observation; (01 mark)

Equation (1 mark)

14. Explain each of the following observations:

- (a) When dilute hydrochloric acid is added to a saturated solution of sodium thiosulphate, a pale yellow precipitate is formed and a colourless gas with an irritating smell evolved. (03 marks)

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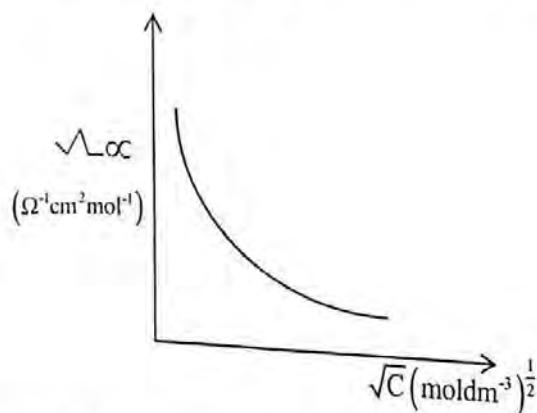
- (b) Aluminum oxide is a solid at room temperature while sulphur dioxide is a gas. (2½ marks)

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- (c) Phenol reacts with dilute nitric acid at 20°C to form 2-nitrophenol, while benzene only reacts with concentrated nitric acid on heating to 55°C in the presence of concentrated sulphuric acid.

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The figure below shows the variation of molar conductivity of ethanoic acid with concentration at constant temperature.



- (a) (i) Define the term "molar conductivity". (1 mark)

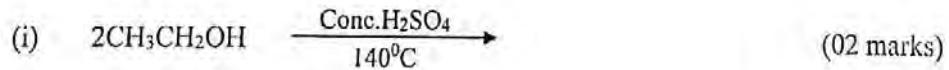
- (ii) Explain the shape of the graph. (02 marks)

- (b) (i) On the same axes, sketch a graph to show the variation of molar conductivity of Aluminium Sulphate with concentration. (01 mark)

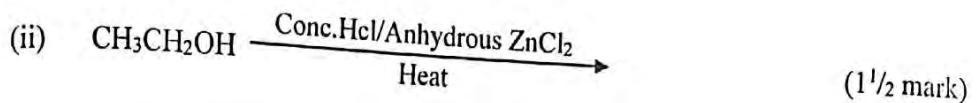
- (ii) Explain your answer in b(i) above. (03 marks)

Turn Over

- (c) The molar conductivity of Aluminium Sulphate and sulphate ions are $858\Omega^{-1}\text{cm}^2\text{mol}^{-1}$ and $160\Omega^{-1}\text{cm}^2\text{mol}^{-1}$ at infinite dilution respectively. Calculate the molar ionic conductivity of Aluminium ions. (02 marks)
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16. (a) Crude ethanol which is an azoetrope (95.4% ethanol and 4.6 % water) can be obtained by the fermentation of sucrose from molasses and distillation of the residual products.
- (i) Name two other natural sources of sucrose. (01 mark)
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- (ii) Write the equations to show how sucrose is converted to ethanol. (02 marks)
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- (b) Briefly describe how absolute (100%) ethanol can be obtained from crude ethanol using distillation with a third component. (2½ mark)
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- (c) Complete the following reactions of ethanol and in each case suggest a suitable mechanism.



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17. (a) An aqueous solution containing 9.0g of glucose($\text{C}_6\text{H}_{12}\text{O}_6$) in 250cm^3 of water freezes at the same temperature as an aqueous solution containing 1.46g of sodium chloride in 250cm^3 of water
- (i) Explain what is meant by the term "freezing point depression" (1½ marks)
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- (ii) Calculate the relative formula mass of sodium chloride in water.(03 marks)
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- (iii) State any two assumptions made in a(ii) above. (02 marks)
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- (b) Compare your answer in a(ii) above with the theoretical R.F.M of sodium chloride. Explain the difference between the two values. (2½ marks)
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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 Ti 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	33.8 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	98.9 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 Ra 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

Name:.....Signature:.....

School: personal no.

PS25/1
CHEMISTRY
Paper 1
Jul. / Aug. 2017
2 $\frac{3}{4}$ hours



UGANDA TEACHERS' EDUCATION CONSULT (UTEC)

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

Answer all questions in Section A and six questions in Section B.

All questions must be answered in the spaces provided.

Mathematical tables (3-figure) and non-programmable electronic calculators may be used.

Illustrate your answers with equations where applicable.

Molar gas constant, $R = 8.31\text{JK}^{-1}\text{mol}^{-1}$

Molar volume of a gas at s.t.p. is 22.4 litres.

Standard temperature = 273 K

Standard pressure = 101325Nm^{-2}

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
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SECTION A: (46 MARKS)

Answer all questions in this section.

1. (a) State **Graham's law** of gaseous diffusion. (01 mark)
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.....
- (b) A sample of dimethylamine was placed at one end of a glass tube held horizontally; at the other end was placed concentrated hydrochloric acid. After some time a white ring was observed 0.28m from the end containing hydrochloric acid.
- (i) Write an equation for the reaction leading to the formation of the white ring. (01 mark)
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- (ii) Calculate the length of the glass tube. (04 marks)
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2. Name a reagent which 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 reacted with the reagent.
- (a) $\text{C}_6\text{H}_5\text{COCH}_2\text{CH}_3$ and $\text{C}_6\text{H}_5\text{COCl}_3$ (2½ marks)

Reagent:

Observation:

(b) $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$ and $\text{Na}_2\text{SO}_3(\text{aq})$ (2½ marks)

Reagent:.....

Observation:.....

3. (a) (i) Write the electronic configuration of manganese. (01 mark)

.....
(ii) State the most stable oxidation state for manganese. Give a reason for
your answer. (01 mark)

Oxidation state:.....

Reason:.....

(b) Giving examples in each case, state two reasons why manganese is considered
a transition element. (03 marks)

4. (a) Distinguish between the terms electronegativity and electron affinity.
(02 marks)

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(b) Briefly explain any three factors which affect the first ionization energy of an
atom of an element. (03 marks)

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5. 1 mole of sulphur trioxide gas was introduced into a 1L vessel which was heated to 1000K until equilibrium was attained. At equilibrium the vessel contained 0.35 moles of sulphur trioxide gas.

(a) Write;

(i) an equation for the reaction that took place.

(01 mark)

(ii) expression for the equilibrium constant K_c .

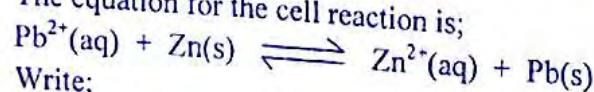
(01 mark)

(b) Calculate the equilibrium constant K_c for the reaction. Indicate its units if any.

(03 marks)

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6. (a) The equation for the cell reaction is;



Write;

(i) The notation for the cell in which the cell reaction took place.

(01 mark)

(ii) Equation for the reaction that took place at the cathode and anode of the cell.

(02 marks)

Anode:

Cathode:

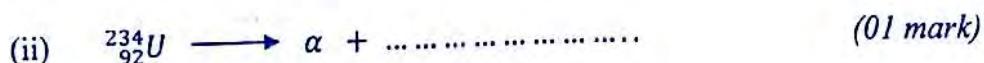
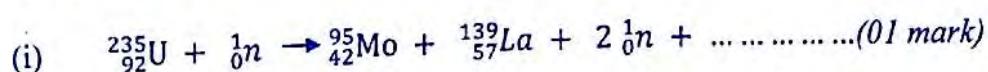
- (b) The standard electrode potentials at the cathode and anode of the cell in (a) above are -0.126V and -0.763V respectively.
(i) Calculate the e.m.f of the cell. (01 mark)
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- (ii) State whether the reaction in (a) is feasible or not. Give a reason for your answer. (01 mark)
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7. The molar ionic conductivities at infinite dilution of the silver and chloride ions are 6.2×10^{-2} and $7.6 \times 10^{-2} \text{ Sm}^2\text{mol}^{-1}$ respectively at 298K. The electrolytic conductivity of silver chloride is $1.22 \times 10^{-2} \text{ Sm}^{-1}$. Calculate the;
(a) solubility of silver chloride at 298K in mol dm^{-3} , (3½ marks)
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- (b) solubility product K_{sp} of silver chloride at the same temperature. (1½ marks)
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8. (a) Complete the following nuclear reactions.



- (b) When a radioactive isotope was stored for 45 days, it retained 14% of its initial activity. Determine the half-life of the isotope. (03 marks)

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9. (a) Define the term bond energy. (01 mark)

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- (b) The bond dissociation energies of oxygen, nitrogen and nitrogen(II)oxide are + 496, + 946 and + 630 kJmol^{-1} respectively. Calculate the heat of formation of nitrogen(II)oxide. (04 marks)

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SECTION B:
Answer six questions from this section.

10. (a) Phenylamine is a weaker base than phenylmethylamine. Explain this observation. (03 marks)

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(b) Write an;

(i) equation for the ionization of phenylmethylamine in water.

(01 mark)

(ii) Expression for the ionization constant K_b of phenylmethylamine in water.

(01 mark)

(c) (i) The hydrogen ion concentration of a 0.1M phenylmethylamine solution is 6.8×10^{-12} M. Calculate the ionization constant K_b of phenylmethylamine.

(03 marks)

(ii) State what would happen to the hydrogen ion concentration in (c) (i) if water was added to the solution. Give a reason for your answer.

(01 mark)

11. The elements fluorine chlorine bromine and iodine belong to the halogen group of elements in the periodic table;

(a) State three main differences between fluorine and the other halogens.

(03 marks)

(b) Explain the anomalous behaviour of fluorine.

(03 marks)

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(c) State and explain the acid strength of the hydrides of the elements.

(03 marks)

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12. (a) Define the term **order of reaction**

(01 mark)

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(b) The following kinetic data was obtained for the reaction between chloromethane and sodium hydroxide solution at 60°C.

Expt. No	Initial $[\text{CH}_3\text{Cl}]$ (mol dm^{-3})	Initial $[\text{HO}^-]$ (mol dm^{-3})	Initial rate ($\text{mol dm}^{-3}\text{s}^{-1}$)
1	0.001	1.0	4.9×10^{-7}
2	0.002	1.0	9.8×10^{-7}
3	0.001	2.0	9.8×10^{-7}

Using the data,

(i) Deduce the rate law for the reaction.

(03 marks)

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(ii) Calculate the rate constant for the reaction and state its units.
(02 marks)

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(c) Draw a labeled energy versus reaction coordinate for the reaction.
(03 marks)

13. (a) Define the term **freezing point constant**. *(01 mark)*

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(b) When 1.2g of sulphur was dissolved in 20.0g of carbon disulphide, the solution froze at 1.43°C lower than the freezing point of carbon disulphide.
 $[K_f = 6.10^{\circ}\text{C mol}^{-1} \text{kg}^{-1}]$

(i) Calculate the relative molecular mass of sulphur in carbon disulphide.
(03 marks)

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- (ii) Deduce the molecular formula of sulphur in carbon disulphide and comment on your answer. (03 marks)

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- (c) On the same axes, draw the cooling curve for carbon disulphide and for a solution of sulphur in carbon disulphide. (03 marks)

14. State what would be observed and write equation for the reaction when;
- (a) Hydrogen sulphide is bubbled through acidified potassium chromate solution. (03 marks)

Observation:

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Equation:

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- (b) 3 drops of ammoniacal silver nitrate are added to propyne. (02 marks)

Observation:

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Equation:

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- (c) Ethene is bubbled through alkaline potassium manganate(VII)solution. (02 marks)

Observation:

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Equation:

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- (d) Chlorine is bubbled through potassium iodide solution. (02 marks)

Observation:

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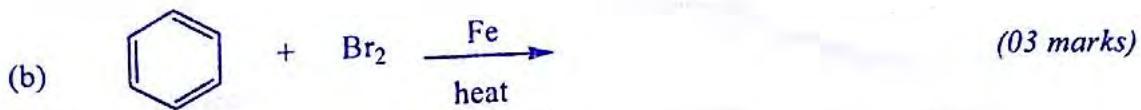
Equation:

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15. Complete the following equations and outline a mechanism for the reaction.



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16. Write equations to show how the following compounds can be synthesized. Indicate reagents and conditions for the reactions.

(a) Aminobenzene from benzoic acid. (05marks)

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(b) Ethanoic acid from ethene. (04 marks)

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17. (a) Define the term **partition coefficient**. (01 mark)

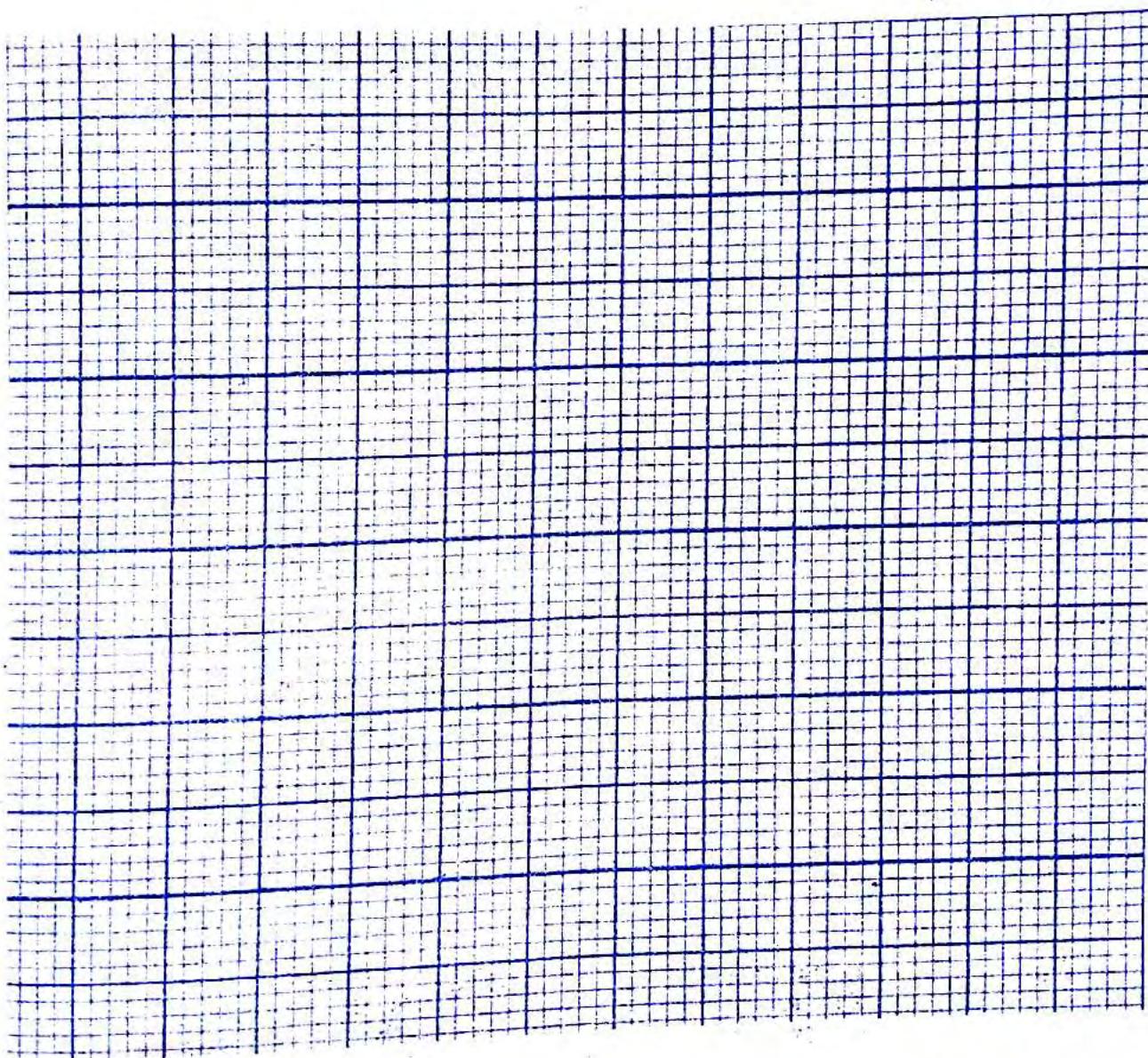
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- (b) The table below shows the results for the partition of ammonia between cobalt(II)sulphate solution and trichloromethane.

Concentration of NH_3 in CoSO_4 (mol dm^{-3})	0.72	0.94	1.19	1.43	1.70	1.92
Concentration of NH_3 in CHCl_3 (mol dm^{-2})	0.01	0.03	0.05	0.07	0.09	0.11

- (i) Plot a graph of concentration of ammonia in cobalt(II)sulphate solution against concentration of ammonia in trichloromethane on the graph paper below.

(04 marks)



- (ii) Determine the molar concentration of cobalt(II)sulphate solution. (04 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 Ti 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	98.9 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

Answer all questions from this section

1. (a) (i) Define the term first electron affinity. (1 mks)

To the energy released when one mole of electrons is gained by one mole of an isolated neutral gaseous atom to form one mole of a unipositively charged gaseous ion at standard temperature and pressure.

- (ii) State three factors which affect the value of the first electron affinity. (1½ mks)

..... Atomic radius ✓
 Nature of orbital ✓
 Nuclear charge X
 Screening effect .

- (b) Explain why

- (i) first electron affinity of magnesium is positive. (1½ mks)

$^{12}_{\text{Mg}}$; $1s^2 2s^2 2p^6 3s^2$ ✓
 Because the electron is added to completely filled s-orbital which is stable ✓

- (ii) first electron affinity for phosphorus is much lower than for silicon.

$^{15}_{\text{P}}$; $1s^2 2s^2 2p^6 3s^2 3p^3$ ✓ $^{14}_{\text{Si}}$; $1s^2 2s^2 2p^6 3s^2 3p^2$ ✓ (2 mks)

In Phosphorus the electron is added to a half-filled 3P-orbital which is stable ✓ while in silicon the electron is added 3P-orbital which is neither half-filled nor completely filled; which is unstable it thus increases nuclear attraction for the incom. electron thus more energy is emitted therefore the first electron affinity for Phosphorus is much lower than that for silicon ✓

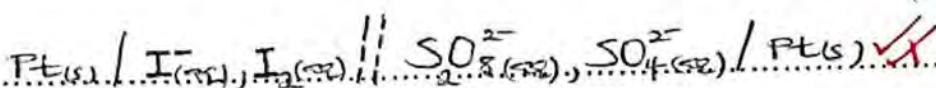
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2. The electrode potentials for some half cells are given below.

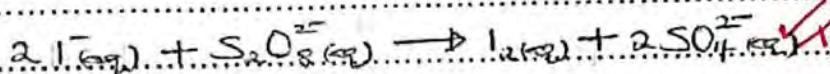
Half equation	$E^\ominus(V)$
$S_2O_8^{2-}(aq) + 2e^- \rightarrow 2SO_4^{2-}(aq)$	+2.01
$I_2(aq) + 2e^- \rightarrow 2I^-(aq)$	+0.54

(a) Write

- (i) the cell notation of cell formed when the half cells are combined. (1½ mks)



- (ii) equation for the overall cell reaction. (1½ mks)



- (b)(i) Calculate the e.m.f of the cell. (1 mk)

$$E_{cell} = E_r^\ominus - E_L^\ominus = +2.01 - (+0.54) = +1.47V$$

- (ii) State whether the cell reaction is feasible or not. Give a reason for your answer. (2 mks)

..... feasible ✓ because the emf is positive

- (c) State one application of electrode potentials. (1 mk)

..... Selecting a suitable oxidising or reducing agent ✓

..... Determining the feasibility of a chemical reaction

..... Determining equilibrium constant and solubility product constant

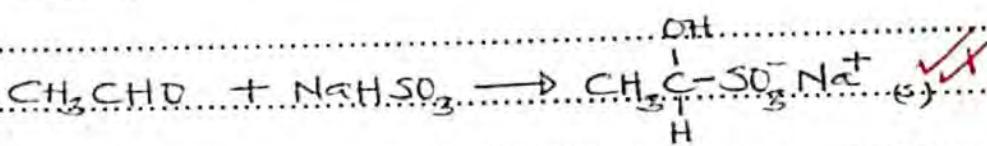
3. (a) State what would be observed and write equation for the reaction that would take place when

- (i) ethanal is mixed with a saturated solution of sodium hydrogensulphite. (2 mks)

Observation

..... white precipitate ✓

Equation

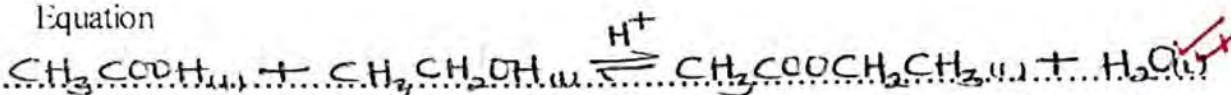


- (ii) ethanol added to a mixture of ethanoic acid and concentrated sulphuric acid and the mixture warmed. (2 mks)

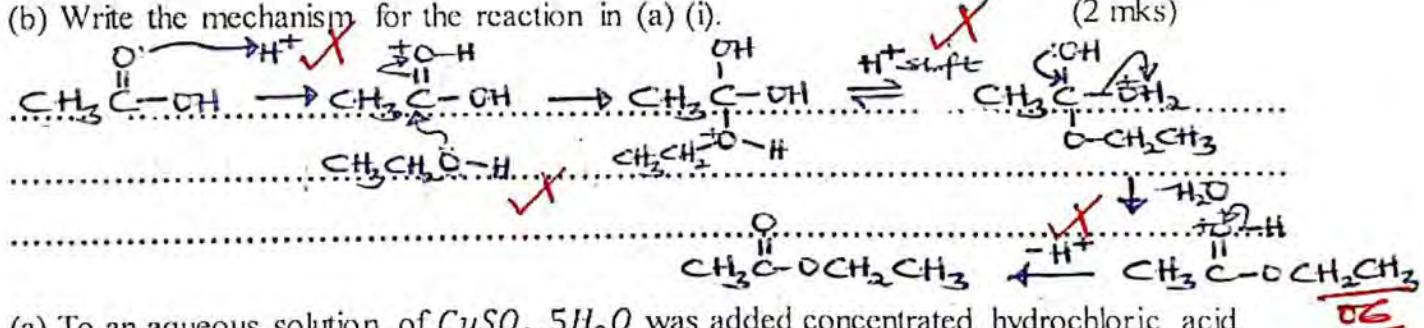
Observation

colourless solution with a fruity sweet smell \checkmark

Equation



- (b) Write the mechanism for the reaction in (a) (i). (2 mks)

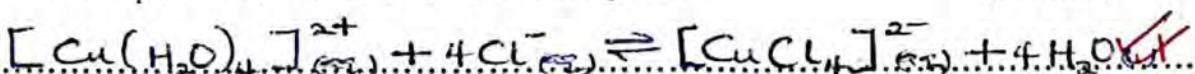


4. (a) To an aqueous solution of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ was added concentrated hydrochloric acid drop wise until in excess.

- (i) State what was observed. (1 mk)

Blue solution turns yellow \checkmark

- (ii) Write equation for the reaction that took place. (1½ mks)

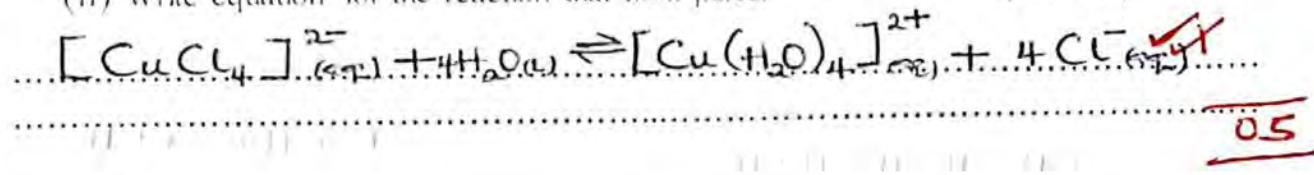


- (b) The resultant solution in (a) diluted with water.

- (i) State what was observed. (1 mk)

Yellow solution turns blue \checkmark

(ii) Write equation for the reaction that took place. (1½ mks)



5. 2.0 g of magnesium hydroxide was added to 1 dm³ of water and the mixture shaken vigorously at 25°C.

(a) Calculate the percentage of magnesium hydroxide that dissolved. (The solubility product of magnesium hydroxide is 1.2×10^{-11} at 25°C). (3 mks)

Let the solubility of $\text{Mg}(\text{OH})_2$ be s ; $[\text{Mg}^{2+}] = s$; $[\text{OH}^-] = 2s$

$$K_{\text{SP}} = [\text{Mg}^{2+}][\text{OH}^-]^2$$

$$K_{\text{SP}} = s \cdot (2s)^2$$

$$K_{\text{SP}} = 4s^3$$

$$1.2 \times 10^{-11} = 4s^3$$

$$s = \sqrt[3]{\frac{1.2 \times 10^{-11}}{4}}$$

$$\text{RFM of } \text{Mg}(\text{OH})_2 = 24 + (16 + 1) \times 2 \\ = 58$$

$$\text{Mass of } \text{Mg}(\text{OH})_2 \text{ dissolved} = 58 \times$$

(b) State

(i) one factor which affects the value solubility product of magnesium hydroxide. (½ mk)

Temperature ✓

(ii) how the solubility of magnesium hydroxide would be affected if few drops of dilute hydrochloric acid were added. (½ mk)

It would increase ✓

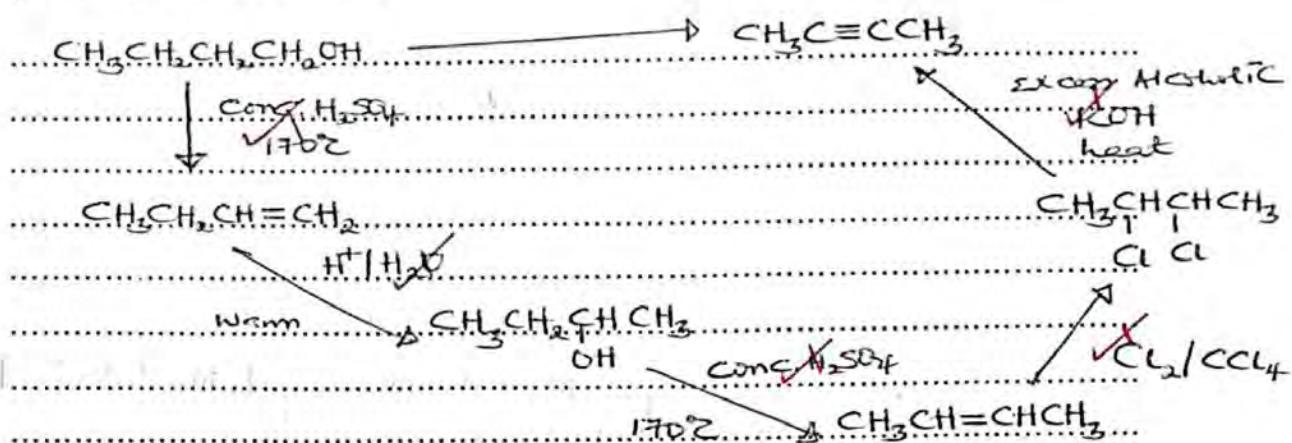
(iii) one application of solubility product. (1 mk)

Predicting Precipitation of Salts ✓
Salting out of Salt

6. Write equations to show the following compounds can be synthesized.

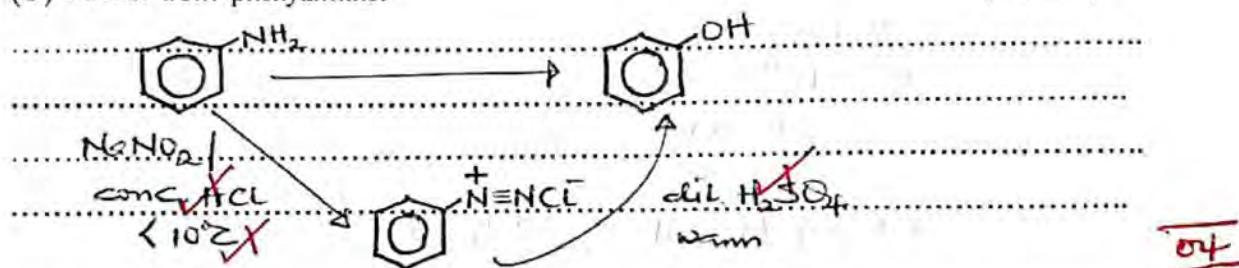
(a) But-2-yne from butan-1-ol.

(2½ mks)



(b) Phenol from phenylamine.

(1½ mks)



7. (a) State two reasons why beryllium behaves differently from the other group II elements in the Periodic Table.

(2 mks)

Beryllium forms ion with highest charge density;

Beryllium forms ion with smallest ionic radius;

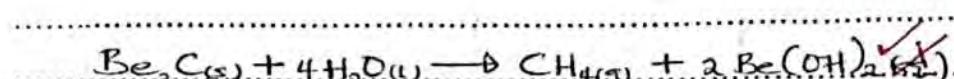
(b) Write equation for the reaction that occurs when

(i) calcium fluoride is dissolved in water.

(1½ mks)

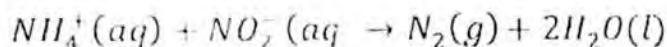
(ii) water is added to beryllium carbide.

(1½ mks)



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(b) Ammonium ion reacts with nitrite ion according to the following equation.



The table below shows the data obtained from the reaction.

Experiment number	$[NH_4^+]$ (mol dm ⁻³)	$[NO_2^-]$ (mol dm ⁻³)	Initial rate (mol dm ^{-3 s} ⁻¹)
1	0.1	0.005	1.35×10^{-7}
2	0.1	0.01	2.70×10^{-7}
3	0.2	0.01	5.40×10^{-7}

(i) Write the rate equation. (1 mk)

$$\text{Rate} = K[NH_4^+][NO_2^-] \quad \text{where } K = \text{rate constant}$$

(ii) Calculate the rate constant and state its units. (2½ mks)

using expt ①

$$1.35 \times 10^{-7} = K(0.1)(0.005)$$

$$K = \frac{1.35 \times 10^{-7}}{0.0005} = 2.7 \times 10^{-4} \text{ mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$$

(c) Explain how temperature affects the rate of a chemical reaction. (3½ mk)

Increasing the temperature of the reactants increases the rate of reaction.

At higher temperature the thermal molecules of the reactants have more energy moving with greater average velocity and collide more frequently and with more force.

Increased collision frequency results in a higher rate of reaction.

11. The elements; carbon, silicon, germanium, tin and lead belong to group IV of the Periodic Table.

(a) State the common oxidation states exhibited by the elements in their ions or compounds. (1 mk)

..... +2 ~~X~~ and +4 ~~X~~

(b) Using lead(IV) oxide and carbon(II) oxide explain the stability of the two oxidation states shown by the elements. (4 mks)

The stability of +2 oxidation state increases from carbon to lead while the stability of +4 oxidation state decreases from carbon to lead.
carbon(II) oxide is unstable and is readily oxidised to carbon(IV) oxide by atmospheric oxygen.
 $2\text{CO}_{(g)} + \text{O}_{2(g)} \rightarrow 2\text{CO}_{2(g)}$
lead(IV) oxide is unstable, decomposes on heating to form the more stable lead(II) oxide and oxygen gas.
 $2\text{PbO}_{(s)} \rightarrow 2\text{PbO}_{(s)} + \text{O}_{2(g)}$

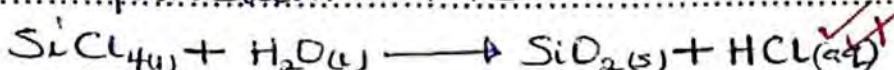
(c) Describe the reactions if any between each of carbon tetrachloride and silicon tetrachloride with water.

(i) Carbon tetrachloride. (½ mk)

Forms two distinct layers ~~X~~

(ii) Silicon tetrachloride. (1½ mks)

Silicon tetrachloride hydrolyses to form silicon dioxide and hydrochloric acid.



(d) Explain the differences in the reactions in (c).

(2 mks)

Carbon atom in carbon tetrachloride lacks vacant 2d-orbitals to accommodate lone pairs of electrons from water molecules while silicon atom in silicon tetrachloride has empty d-orbitals of the right energy which can accommodate lone pairs of electrons from water molecules.

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12. Name a reagent that can be used to distinguish between the following pairs of compounds. In each case, state what would be observed if each compound is separately treated with the reagent you have named.

(a) HCO_2H and CH_3CO_2H

(03 mks)

Reagent

Ammonical silver nitrate solution ✓

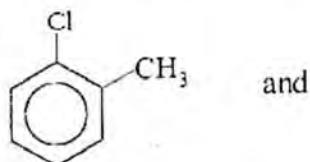
OR silver nitrate solution in ammonia solution

Observation

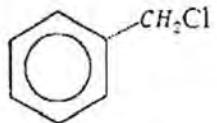
HCO_2H i. Silver mirror ✓

CH_3CO_2H i. No observable change ✓

(b)



and



(03 mks)

Reagent

Hot sodium hydroxide solution, dilute nitric acid followed by silver nitrate solution ✓

Observation

No observable change ✓

A white precipitate ✓

(c) $\text{CH}_3\text{CH}_2\text{OH}$ and $(\text{CH}_3)_2\text{CHOH}$.

(03 mks)

Reagent

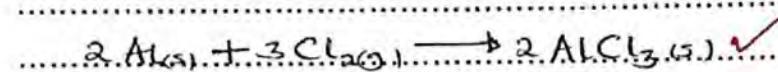
Anhydrous zinc chloride in concentrated hydrochloric acid

Observation

$\text{CH}_3\text{CH}_2\text{OH}$: No observable change at room temperature
 $(\text{CH}_3)_2\text{CHOH}$: cloudy solution forms between 5-10 minutes

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13. (a) (i) Write equation to show how aluminium chloride can be prepared. (1 mk)

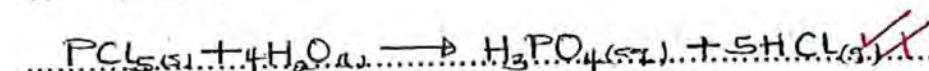


(ii) State the condition(s) required for the reaction in (a)(i). (½ mk)

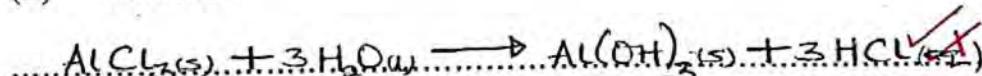
Heat \times

(b) Write equation for the reaction between water and the chloride of

(i) phosphorus. (1½ mks)



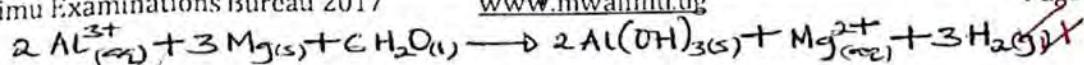
(ii) aluminium. (1½ mks)



(b) A piece of clean magnesium ribbon was added to the resultant solution in (a)(ii).

State and explain what was observed. (4½ mks)

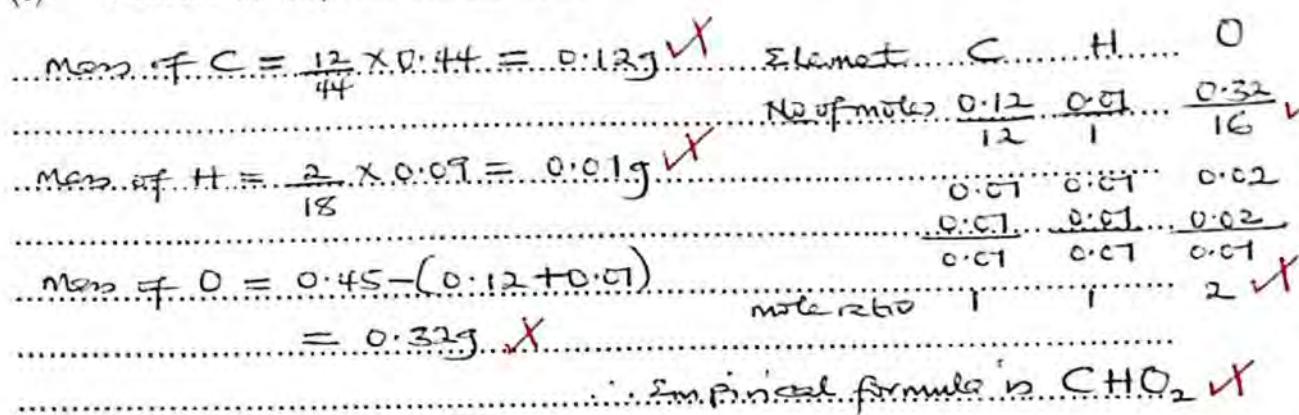
Aluminium chloride soln contains hydrated aluminium ions which undergo hydrolysis to form hydrogen ions which react with magnesium ribbon to form hydrogen gas which bubbles out as a colourless gas and insoluble aluminium hydroxide as a white solid



09

16. (a) Complete combustion of 0.45 g of an organic compound Y, molecular mass 90 yielded 0.44 g of carbon dioxide and 0.09 g of water.

(i) Calculate the empirical formula of Y. (3 mks)



(ii) Determine the molecular formula of Y. (1 mk)

$$(C_2H_2O_2)_n = 90 \quad \therefore \text{Molecular formula is } C_2H_2O_4$$

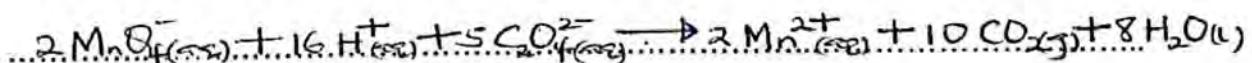
$$(12+1+16 \times 2)_n = 90$$

$$45n = 90$$

$$n = 2$$

- (b) 0.9875 g of impure potassium manganate(VII) was dissolved in water to make 250 cm³ of solution. When 20.0 cm³ of this solution was acidified, warmed and titrated against a solution containing 4.5 g of Y per litre, 24.4 cm³ of the solution was required for complete reaction.

(i) Write an ionic equation for the reaction that took place. (1 mk)



(ii) Calculate the percentage purity of potassium manganate(VII) solution.

(3 mks)

$$70 \text{ g of Y contain 1 mole}$$

$$4.5 \text{ g of Y contain } \left(\frac{1 \times 4.5}{70}\right) = 0.05 \text{ mole}$$

$$1000 \text{ cm}^3 \text{ of solution contain } 0.05 \text{ mole of } \text{C}_2\text{O}_4^{2-} \text{ ions}$$

$$24.4 \text{ cm}^3 \text{ of solution contains } \left(\frac{0.05 \times 24.4}{1000}\right) \text{ mole}$$

$$= 0.00122 \text{ mole}$$

5 moles of $\text{C}_2\text{O}_4^{2-}$ react with 2 moles of MnO_4^- ions.

$$0.00122 \text{ mole of } \text{C}_2\text{O}_4^{2-} \text{ react with } \left(\frac{2}{5} \times 0.00122\right) \text{ moles of } \text{MnO}_4^- \text{ ions}$$

$$= 4.88 \times 10^{-5} \text{ moles.}$$

..... 20 cm^3 of solution contains 4.88×10^{-4} mole of MnO_4^- ions.
 25 cm^3 of solution contains $(4.88 \times 10^{-4} \times 250)$ mole of MnO_4^-
 $\frac{20}{250}$
 $= 0.0061$ mole.

$$\text{R.F.M of } \text{KMnO}_4 = 39 + 55 + 16 \times 4 = 158$$

$$\text{Mass of } \text{KMnO}_4 = 158 \times 0.0061 = 0.9638\text{ g}$$

$$\% \text{ a.p.e purity} = \frac{0.9638}{0.9895} \times 100 = 97.6\%$$

(c) State two advantages of using potassium manganate(VII) as a reagent in volumetric analysis.

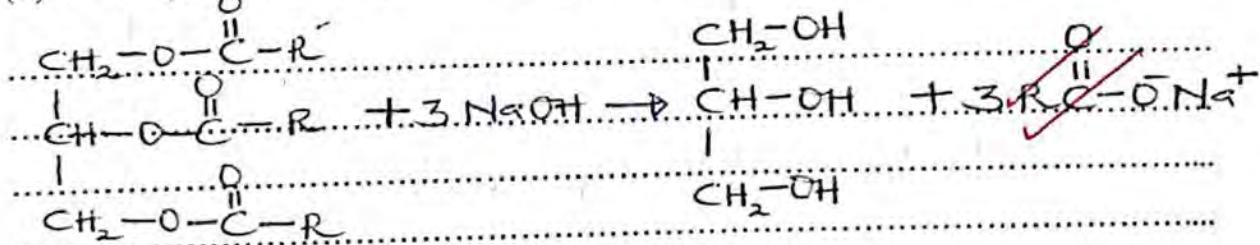
It is the most powerful oxidising agent and is stable in water.

It is a self indicator.

09

17. One of the large scale uses of sodium hydroxide is in the soap production.

(a) Write equation for the reaction leading to formation of soap. (2 mks)



(b) Explain the cleansing action of soap. (3 mks)

A molecule of S.O.P. contains a water-loving part which is $\text{P}(\text{O})(\text{OH})_3$ called hydrophilic part and the non-polar part RCH_2 called the hydrophobic part.

During wash, the molecules are dispersed and they form a spherical cluster around grease or dirt called micelle with the polar end attracted by water. The dirt combines with the hydrophobic part while water dissolves in the hydrophilic part.

As water molecule attracts the polar end, the surface tension of water is lowered. Repulsion between the polar ends of soap and rinsing help remove the dirt.

(c) State one advantage and one disadvantage of using a soapless detergent instead of soap in washing.

(i) Advantage (1 mk)

.....Are fairly soluble in water ✓

.....Not affected by hard water

(ii) Disadvantage (1 mk)

.....Attack the skin ✓

.....Are non biodegradable

.....Encourage growth of algae

(d) Give a reason why the following compounds are added to the soapless detergents.

(i) Inorganic phosphates. (1 mk)

.....Used to soften water since it forms complexes with calcium or magnesium ions in water ✓

(ii) Sodium peroxoborate (1 mk)

.....Used as bleaching agent ✓

OT

End

NAME.....COMB.....

SIGN.....

P525/1

JUL/AUG 2019

CHEMISTRY

2 ½ HOURS



UGANDA ADVANCED CERTIFICATE OF EDUCATION

END OF TERM TWO EXAMINATIONS

CHEMISRTY

(Principal subject)

Paper one

2 Hours 30 minutes.

INSTRUCTION TO CANDIDATES:

- Answer all questions in this paper
- Illustrate your answer with equations where applicable

SECTION A (46 MARKS)

1. A compound contains 79.78% chlorine and the rest aluminium. The vapor of this compound has density $2.28 \times 10 \text{ gm}^{-3}$ at 1427K and $1.013 \times 10^5 \text{ pa}$.

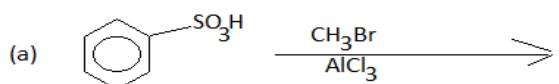
- (a) Determine the molecular formula of Q and draw its structure(3marks)

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- (b) State the conditions under which the above structure exists.(1mark)

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2. Complete the following equations and in each case state the IUPAC name for the major product (6marks)



Name



Name.....

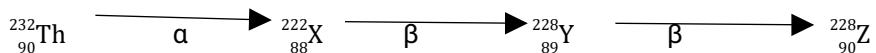


Name.....



Name

3. (a) a radioactive isotope of the element Thorium $^{232}_{90}\text{Th}$ decays according to the following scheme.



Identify X, Y and Z. (1 ½ marks)

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- (b). (i) what is meant by stability of nucleus? (1mark)

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- (ii) explain the factors that determine the stability of the nucleus. (2marks)

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4. Two isomeric compounds X and Y have the following percentage compositions by mass, carbon, hydrogen and chlorine with 66.6%, 5.5% and 28.1% respectively. the molecular mass of compounds is 126.5.

(a) Determine the molecular formula of X and Y. (3 marks)

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(b) (i) one of the compounds X, yields a white precipitate when warmed with aqueous silver nitrate, but Y does not. Explain the observation. (1 ½ marks)

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(ii) suggest a structure for X, and give one of possible structures for Y (1mark)

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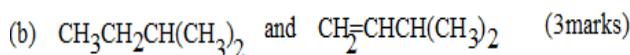
5. Distinguish between the following pair of compounds using suitable reagents and in each case state the observations.

(a) Ethyne and ethanol (3marks)

Reagent

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Observation



Reagent

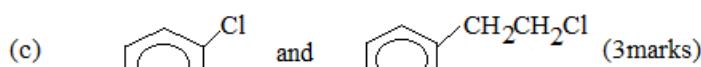
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Observation

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Reagent

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Observation

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6. (a) Explain why lithium does not form peroxide or super oxide when burnt in oxygen. (2marks)

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- (b) State what is observed when potassium superoxide is dropped in water. write equation for

the reaction. (2 ½ marks)

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7. (a). what is meant by; (1mark @)

(i) Osmosis

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(ii) Osmotic pressure

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(b). state the significance of osmosis (1marks)

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(c) the osmotic pressure of solution containing 1.24% of a polymer is 3.1×10^{-3} atmospheres at 25°C . Determine the relative molecular mass of the polymer. ($R=0.0821 \text{ atm mol}^{-1}\text{Cl}^{-1}$). (2 ½ marks)

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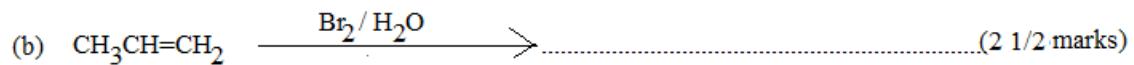
8. Complete the equations below and outline the mechanism of each reaction.



Mechanism

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Mechanism

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9. Given the following thermochemical data;

Salt	Hydration energy (KJmol-1)	Lattice energy (KJmol-1)
AX	880	860
BX	790	800

(a) Which salt is more soluble (1mark)

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(b) Explain your answer (2 ½ marks)

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SECTION B (54 MARKS)

10. (a) State Boyles law (1mark)

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(b). The table below shows the time (t) taken for gases of different molecular mass (Mr) to diffuse through a narrow opening under similar conditions.

t (s)	25.00	34.23	41.67	47.62
Mr	16	30	44	58

Plot a graph of rate of diffusion, $(1/t)$ against $\sqrt{\frac{1}{Mr}}$ (4marks)

c) Using your graph in (b) above, find the molecular mass of a gas;

i) whose rate of diffusion is 0.025s^{-1} (1mark)

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ii) that takes 38.42s to diffuse (2marks)

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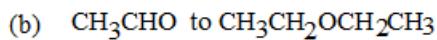
d) State four applications of gaseous diffusion (2marks)

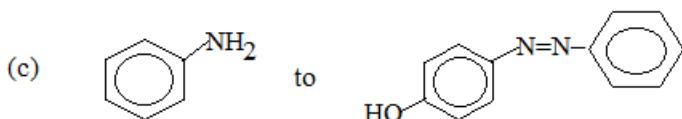
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11. Write equations to show how each of the following conversions can be effected and indicate the reagents and conditions for the reactions.(1 ½ marks @)

(a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ to CH_3CH_3

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12. The table below shows the first ionization energy in KJmol-1 of the elements A, B and C. one of the elements belongs to group VII.

Element	1 st I.E	2 nd I.E	3 rd I.E	4 th I.E
A	730	1500	7730	10500
B	500	4560	6900	9010
C	580	1815	2740	8720
D	1310	3460	5300	7020

- (a) (i) define the term ionization energy (1mark)

- (ii). Identify element that belong to group I of periodic table and give reason for your answer.

(1 ½ marks)

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(iii). Which of the following elements form a cation with charge +3? (1 ½ marks)

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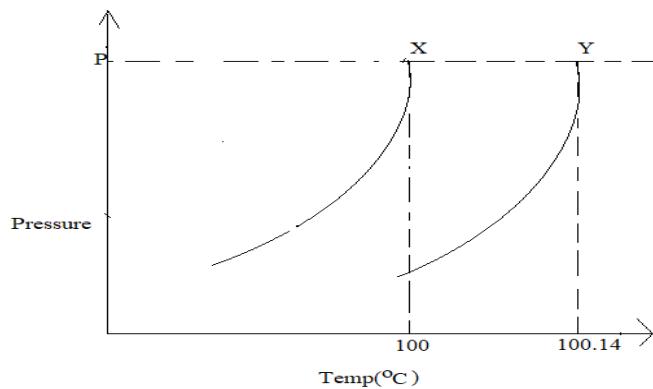
(iv). Write the formula of the compound between atoms of the element B and D. (1 ½ marks)

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(b) Explain why there is increase in successive ionization energy. (2 ½ marks)

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13. 5.5g of a non-volatile substances B was dissolved in 125g of a solute. The vapour pressure curve of the solution and pure solvent at constant pressure P are shown.



a) identify the curve for the solution and the solvent (½ mark @)

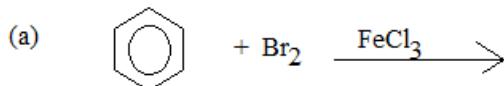
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- b) calculate the molecular mass of B (boiling point elevation constant for the solvent; K_b is $0.52^{\circ}\text{Cmol}^{-1}\text{kg}^{-1}$) (3marks)

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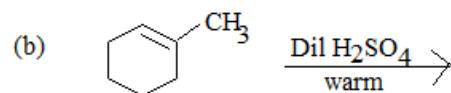
- c) state the limitations of your calculations(2marks)

14. complete the following organic reactions and outline the accepted reaction mechanism. (3 ½ marks @)



Mechanism

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Mechanism

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15. Explain the following observations

- (a) the heat of hydrogenation of cyclohexane is -120 KJmol^{-1} and that of benzene is -210 KJmol^{-1} . (3marks)

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- (b) the melting point of methylbenzene is -95°C lower than that of benzene which has the highest molecular weight. (3marks)

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- (c) methylbenzene reacts bromine in presence of Aluminium chloride catalyst to form two products, while benzenesulphonic acid forms one product. (4marks)

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16. a mass spectrum of chlorine shows the molecular peaks at 70, 72 and 74.

- (a) Explain this observation (2marks)

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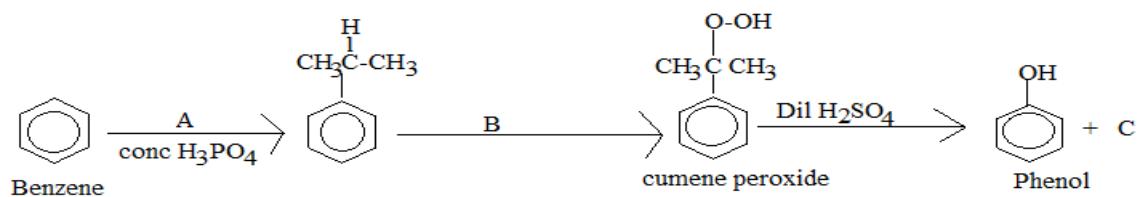
(b) The peaks at 70, 72 and 74 are in the ratio of 9:6:1. calculate the average atomic mass of chlorine. (3marks)

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(c) Calculate the relative abundance of Cl³⁵ and Cl³⁷ (2marks)

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17. The flow chart below shows how phenol (hydroxybenzene) can be made from benzene and compound A in the process below.



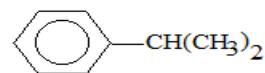
(a) (i) identify compounds A, B and C. (3marks)

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(ii). What is the name given to the process above? (1mark)

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(b) Outline the mechanism for formation of



(2 ½ marks)

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END

NAME.....

INDEX No..... SIGNATURE.....

545/1
CHEMISTRY
PAPER 1
JULY/AUGUST 2016
1HOUR 30MIN

WESTERN JOINT MOCK EXAMINATIONS

Uganda Certificate of Education

CHEMISTRY

PAPER 1

1HOUR 30MINUTES

INSTRUCTIONS TO CANDIDATES:

- This paper consists of 50 objective – typed questions
- Answer all questions.
- You are required to write the correct answer, A, B, C or D in the box provided on the right-hand side of each question.
- Do not use pencil

FOR EXAMINERS' USE ONLY

1. Which of the following salts can be prepared by direct synthesis?

- A. Sodium Chloride
C. Sodium Carbonate

- B. Sodium Sulphate
D. Sodium nitrate

2. Permanent hard water can be softened by

- A. Boiling the water
C. Adding aqueous ammonia

- B. Adding calcium hydroxide
D. Adding sodium carbonate

3. An anhydrous salt R has a relative formula mass of 158 and form a hydrated salt with formula R.n H₂O. 79g of R combined with 45g of water. What is the value of n? (H=1, O=16)

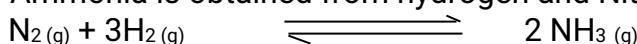
- A. 2 B. 3 C. 5

D. 10

4. Which one of the following is an oxidizing agent?

- A. CO B. H₂S C. Cl₂ D. NH₃

5. Ammonia is obtained from hydrogen and Nitrogen according to the equation.



The volume of Ammonia produced when 25 litres of nitrogen reacts with excess Hydrogen at s.t.p is

(1 mole of gas occupies 22.4 L at s.t.p)

- A. 12.5L B. 25.0L C. 50.0L D. 75.0L

6. Which of the following is a soluble base?

- A. Copper (ii) oxide
C. Sodium oxide

- B. Carbondioxide
D. Iron (ii) oxide

7. Calculate the relative molecular mass of gas T if 8.4 dm³ of the gas has a mass of 0.93g (1mole of a gas occupies 22.4 dm³ at s.t.p)

A. $\frac{0.93*22.4}{8.4}$

B. $\frac{22.4*8.4}{0.93}$

C. $\frac{0.93*8.4}{22.4*8.4}$

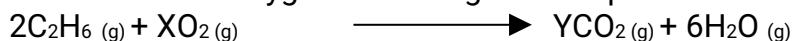
D. $\frac{0.93}{22.4*8.4}$

8. The full symbols of atoms of elements R, T, X, Y and Z are $^{29}_{14}R$, $^{31}_{15}T$, $^{30}_{15}Y$, $^{34}_{16}X$, $^{35}_{17}Z$ respectively. Which of this is an isotopy of Y?

- A. R B. T C. X

D. Z

9. Ethane burns in oxygen according to the equation below.



What are the values of X and Y?

- A. X=2, Y=2 B. X=7, Y=6 C. X=7, Y=4 D. X=4, Y=6

10. Most metals reacts with dilute mineral acids to form

- A. Hydrogen only. B. The salt of the metal and water.
C. The salt of the metal only. D. The salt of the metal and hydrogen gas.

11. Which one of the following hydro carbon will produce the least heat energy per mole on complete combustion?

- A. CH₃CH₂CH₂CH₃. B. CH₃CH₂CH₃. C. CH₃CH₃ D. CH₄.

12. A dilute solution of potassium bromide is electrolysed using carbon electrode. The product at the positive electrode is.

- A. Hydrogen. B. Bromine. C. Oxygen. D. Potassium.

13. The substance that will dissolve in water with absorption of heat is
 A. Sulphuric acid B. Ammonia
 C. Hydrogen chloride D. Potassium hydroxide

14. During the manufacture of sulphuric acid by the contact process, sulphur dioxide combines with oxygen to form sulphur trioxide according to the following equation

$$2\text{SO}_2 \text{(g)} + \text{O}_2 \text{(g)} \longrightarrow 2\text{SO}_3 \text{(g)} + \text{H} \equiv 192 \text{ KJmol}^{-1}$$

 Which of the following conditions would favor maximum yield of sulphur trioxide?
 A. Low temperature and low pressure B. High temperature and low pressure
 C. Low temperature and high pressure D. High temperature and high pressure

- 15 When 2.3g of ethanol was completely burnt in oxygen, the heat evolved raised the temperature of 100g of water by 30°C. The molar heat of combustion of ethanol in joules is. (The molar mass of ethanol = 46 and the specific heat capacity of water = 4.2 J g⁻¹ k⁻¹)

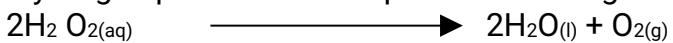
$$\text{A. } \frac{100*4.2*30*46}{2.3} \quad \text{B. } \frac{30*4.2*2.3*100}{46} \quad \text{C. } \frac{20*4.2*2.3*100}{46} \quad \text{D. } \frac{20*4.2*46*100}{2.3}$$

16. The gas that changes the colour of potassium dichromate from orange to green is
 A. Carbondioxide B. Hydrogen chloride
 C. Sulpurdioxide D. Hydrogen sulphide

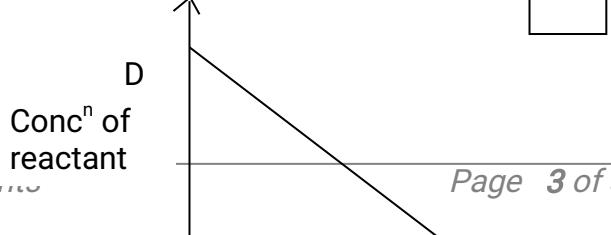
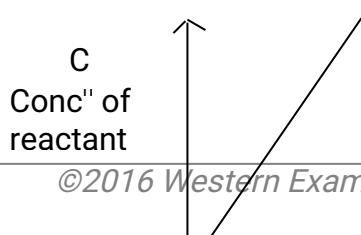
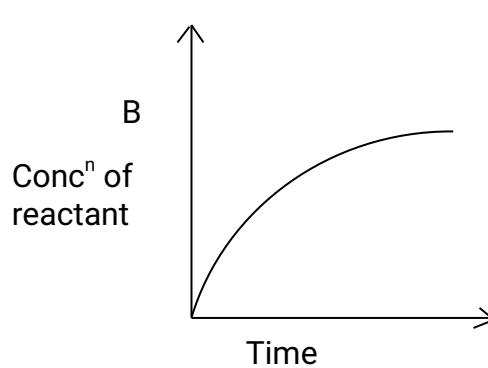
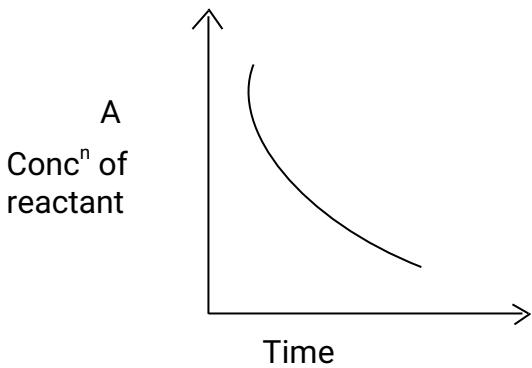
17. The element which is added to natural rubber during vulcanization is.
 A. Silicon B. Iodine C. Phosphorus D. Sulphur

18. Which one of the following contains the same number of moles of hydrogen ions as number of moles of sodium ions in 50cm³ of a 0.2M Na₂SO₄? (H=1, Cl=35.5)
 A. 1.83g of HCl B. 0.73g of HCl
 C. 100cm³ of a 0.2M H₂SO₄ D. 100 cm³ of a 2M HCl

19. Hydrogen peroxide decomposes according to the following equation.



Which one of the following graphs represents how the concentration of the reactant varies with time during the reaction?



>

20. Which of the following will react with concentrated nitric acid to form a yellow solution?

- A. $\text{Cl}^{-}_{(\text{aq})}$ B. $\text{Fe}^{2+}_{(\text{aq})}$ C. $\text{Br}^{-}_{(\text{aq})}$ D. $\text{Cu}^{2+}_{(\text{aq})}$

21. The atomic number of elements P, Q, R and T are 19, 17, 14, and 6 respectively.

The pair of elements that can react to form an ionic compound is

- A. Q and T B. R and Q C. Q and P D. R and T

22. Which of the following substances is an element?

- A. Ice B. Sand C. Graphite D. Polyethene

23. The reaction in which ethane forms solid whose molecular mass is more than 10,000 is called

- A. Polymerisation B. Hydrogenation C. Vulcanisation D. Cracking

24. The compound which does not cause hardness of water is

- A. Calcium hydrogen carbonate B. Calcium Sulphate
C. Sodium Carbonate D. Magnesium Sulphate

25. The gas that can diffuse at the same rate as oxygen at room temperature is (H=1, C=12, N=14, S=32, O=16; one mole of a gas occupies 24.0dm³ at room temperature)

- A. SO_2 B. NH_3 C. CO_2 D. NO

26. Which one of the following cations when treated with aqueous sodium hydroxide will give a precipitate that does not dissolve in excess alkali?

- A. Al^{3+} B. Pb^{2+} C. Zn^{2+} D. Fe^{3+}

27. 20cm³ of 0.1M sodium carbonate reacted completely with 10cm³ of dilute hydrochloric acid. The molarity of the acid is

- A. 0.1M B. 0.2M C. 0.4M D. 0.8M

28. Which of the following is an alloy of lead?

- A. Brass B. Bronze C. Duralumin D. Solder

29. Which of the following can burn in air to form a compound with nitrogen?

- A. Copper B. Zinc C. Iron D. Magnesium

30. The Carbonate which does not decompose when heated strongly is

- A. Zinc Carbonate B. Potassium Carbonate
C. Calcium Carbonate D. Magnesium Carbonate

31. When sodium hydroxide solution was added to an aqueous solution of salt X, a white precipitate insoluble in excess alkali was formed. X contained.

- A. Lead (ii) ions B. Zinc ions C. Magnesium ions D. Aluminium ions

32. The percentage by mass of phosphorus in Calcium Phosphate, $\text{Ca}_3(\text{PO}_4)_2$ is (O = 16, P = 31, Ca = 40)

- A. 8.0 B. 17.0 C. 10.0 D. 19.4

33. The concentration in grammes per litre of a 0.05M Sodium Carbonate solution is (Na=23, O=16, C=12)

A. 0.05×83

B. $\frac{106}{0.05}$

C. 0.05×106

D. $\frac{83}{0.05}$

34. Which one of the following reagents can be used to distinguish between $Zn^{2+}_{(aq)}$ and $Al^{3+}_{(aq)}$?

- A. Lead (ii) nitrate solution
C. Aqueous Ammonia

- B. Calcium Chloride
D. Aqueous Sodium hydroxide

35. The metal which can be extracted from its ore by electrolysis is

- A. Magnesium

- B. Iron

- C. Zinc

- D. Copper

36. The nitrate that decomposes when heated strongly to form a metal is

- A. KNO_3

- B. $Ca(NO_3)_2$

- C. $Zn(NO_3)_2$

- D. $AgNO_3$

37. The reaction of metals J, M and L with water under different conditions are described below

J. reacts with steam when the metal is strongly heated

M. reacts with water at room temperature

L. reacts with steam when the metal is red-hot

The order of reactivity of the metals, starting with the least reactive is

- A. M, J and L

- B. L, J and M C. M, L and J D. J, L and M.

38. The solid that shows an increase in mass when heated strongly is

- A. Sulphur

- C. Calcium carbonate

- B. Sodium Carbonate

- D. Magnesium

39. Which one of the following potassium salts will dissolve in water to give a solution that turns red litmus paper to blue

- A. K_2CO_3

- B. KCL

- C. KNO_3

- D. K_2SO_4

40. Acidified Lead (ii) nitrate solution was added to an aqueous solution of X, a white Precipitate was formed. The likely anions in X are

- A. Carbonate and Sulphate ions

- B. Chloride and Carbonate ions

- C. Carbonate and Sulphite

- D. Chloride and Sulphate

Each of the questions 41 to 45 consists of an assertion (statement) on the left hand side and a reason on the right hand side. Select

- A. If both the assertion and reason are true statements and the reason is a correct explanation of the assertion
- B. If both the assertion and the reason are true statements but the reason is not a correct explanation of the assertion
- C. If the assertion is true but the reason is not a correct statement
- D. If the assertion is not correct but the reason is a correct statement

INSTRUCTIONS SUMMARISED

Assertion

- A. True
B. True
C. True
D. Incorrect

Reason

- True (reason is a correct explanation)
True (reason is not a correct explanation)
Incorrect
Correct

41. When aqueous potassium

Lead (ii) Iodide

Iodine is added to a solution of lead (ii) nitrate, a yellow precipitate is observed.

because is soluble in water

42. 25.0 cm³ of a solution containing 4.0g of Sodium hydroxide in a litre of solution will require exactly 12.50cm³ of 0.1M Sulphuric acid for complete reaction

because Sulphuric acid reacts with Sodium hydroxide in the mole ratio of 1:2

43 A solution of hydrogen chloride in methylbenzene does not conduct electricity

because Methylbenzene does not conduct electricity

44. Copper (ii) hydroxide dissolves in excess aqueous ammonia to form a deep blue solution

because copper (ii) ions form a complex ion with ammonia

45. Coke is used to extract iron from its ore

because coke is an oxidizing agent

In each of the questions 46 to 50, one or more of the answers given may be correct. Read each question carefully and then indicate the answer according to the following.

- A. If 1, 2 and 3 only one correct
- B. If 2 and 4 only one correct
- C. If 1 and 3 only one correct
- D. If 4 only is correct.

46. Which of the following substance(s) can be used to test for water of crystallisation?

- 1. Copper (II) sulphate
- 2. Potassium dichromate
- 3. Cobalt (II) chloride
- 4. Potassium permanganate

47. Which of the following is / are true about diamond and graphite

- 1. They have the same mass number
- 2. They are isotopes
- 3. They are allotropes
- 4. They show similar physical properties

48. Which of the following properties is/are shown by hydrochloric acid? The acid reacts with

- 1. Copper to form hydrogen
- 2. Zinc to form hydrogen
- 3. Sodium hydroxide to give an acid salt
- 4. Calcium carbonate to form carbon dioxide

49. Which of the following properties make carbon dioxide useful in fire extinguishers?

- 1. It is denser than air
- 2. It is lighter than air
- 3. It is non-flammable
- 4. It is an inert gas

50. Which of the compound(s) has/have a multiple bonds

- 1. C₄H₁₀
- 2. C₂H₂
- 3. C₂H₆
- 4. C₂H₄

Candidate's Name:
.....

Random No.					Personal No.	

Signature:

(Do not write your School/Centre Name or Number anywhere on this booklet)

P525/1
CHEMISTRY
Paper 1
Jul./Aug. 2019
2 3/4 hrs

Uganda Advanced Certificate of Education

MOCK Examinations 2019

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

Answer all questions in Sections A and six questions in Section B.

All questions must be answered in the spaces provided.

The Periodic Table, with relative atomic masses, is attached at the end of the paper.

Mathematical tables (3-figure table) are adequate or non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

Where necessary, use the following:

Molar gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

Molar volume of gas at s.t.p is 22.4 litres.

Standard temperature = 273K.

Standard pressure = 101325 N m⁻²

For Examiners' 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) State **Graham's law** of gaseous diffusion. (01 mark)

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- (b) A sample of concentrated amine solution was placed at one end of a 1.0m glass tube held horizontally. At the other end was placed a sample of concentrated hydrochloric acid and both ends of the tube sealed. When the tube was left for some time, a white ring was observed 0.52m from the end containing the amine. Calculate the molecular mass of the amine. (04 marks)

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2. (a) Sketch the shapes of the following molecules.



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(iii) CO_2

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(1½ marks)

- (b) Give reasons why molecules in (a)(i) and (a)(ii) adapts the shape you have sketched. (03 marks)

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3. One property of chromium as a transition metal is its ability to form complexes, for example $[\text{Cr}(\text{NH}_3)_6]^{3+}$.

- (a) State **two** other properties of chromium as a transition metal. (02 marks)

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.....

- (b) Chromium(III) chloride-6-water, $\text{CrCl}_3 \cdot 6 \text{H}_2\text{O}$, is an example of hydrate isomerism. Write the structural formulae of **three** possible isomers of $\text{CrCl}_3 \cdot 6 \text{H}_2\text{O}$. (1½ marks)

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- (c) The coordination number of chromium is the same in the isomers of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$.
(i) What is meant by the term **coordination number**. (01 mark)

.....
.....

- (ii) What is the coordination number of chromium in $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$? (01 mark)

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



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5. (a) State what would be observed and write equation for the reaction that would take place if potassium iodide was added to acidified potassium dichromate solution. (2½ marks)

Observation

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Equation

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- (b) Sodium thiosulphate solution was added to the mixture in (a), state what was observed and write equation for the reaction that took place. *(2½ marks)*

Observation

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Equation

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6. (a) Define the term **ionisation energy**. *(01 mark)*

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- (b) The data given below are for the elements P, Q and R which belong to the same group in the Periodic Table.

Element	P	Q	R
First ionisation energy(kJ mol^{-1})	580	790	1255

- (i) Which one of the elements P, Q and R is a metal? Explain your answer. *(02 marks)*

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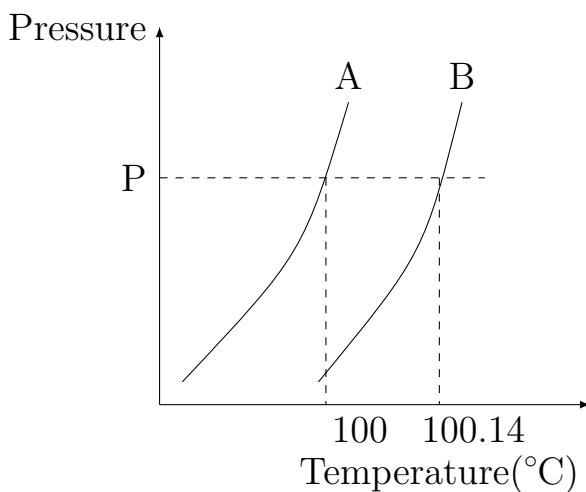
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- (ii) The second, third and fourth ionisation energy of element P are 1500, 7700 and 10500 kJ mol^{-1} respectively. To what group in the Periodic Table does P belong? Give reasons for your answer. (03 marks)

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7. 5.5g of a non-volatile substance L was dissolved in 125g of a solvent. The vapour pressure curve of the solution and the pure solvent at constant pressure P are shown below.



- (a) Identify the curve for the solution and the solvent. (01 mark)
solution

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- (b) Calculate the molecular mass of L (boiling point elevation constant for the solvent, K_b , is $0.52\text{ }^{\circ}\text{C kg}^{-1}\text{ mol}^{-1}$). (03 marks)

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8. Name **one** reagent that can be used to distinguish between each of the following pairs of compounds. In each case, state what is observed if the reagent is separately treated with each member of the pair.

- (a) Bromobenzene and bromoethane (03 marks)

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- (b) Propan-1-ol and propan-2-ol (03 marks)

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9. (a) (i) State **two** important oxidation states exhibited by carbon, silicon, tin and lead. (01 mark)

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(ii) Describe how the stability of the two oxidation states vary from carbon to lead. Use carbon(IV) oxide and lead(IV) oxide to illustrate your answer. (03 marks)

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- (b) State what would happen if silicon(IV) chloride is shaken with water.
Write equation to illustrate your answer. (02 marks)

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SECTION B: (54 MARKS)

Answer six questions in this section

- 10.** In an experiment, 1cm^3 of a hydrocarbon W requires 4cm^3 of oxygen for complete combustion to give 3cm^3 of carbon dioxide, all gas volumes being measured at s.t.p.

- (a) Determine the molecular formula of W . (02 marks)

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- (b) Write the structural formulae and names of all possible isomers of W . (02 marks)

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- (c) When W was reacted with ammoniacal silver nitrate solution, white precipitate of compound X was formed. Identify W . $(0\frac{1}{2} \text{ mark})$

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- (d) Outline a mechanism for the reaction between W and water in the presence of sulphuric acid and mercury(II) sulphate. $(4\frac{1}{2} \text{ marks})$

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- 11.** Phosphorus(V) chloride when heated decomposed according to the following equation.



A sample of pure phosphorus(V) chloride was heated in a closed vessel to 250°C . When equilibrium was attained, the vessel was found to contain 40.7% of chlorine.

- (a) Calculate the

- (i) molar concentration of phosphorus(V) chloride. $(4\frac{1}{2} \text{ marks})$

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(ii) equilibrium constant, K_c for the reaction at 250°C. (2½ marks)

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(b) Explain what would happen to the concentration of chlorine if the pressure in the vessel was decreased while the temperature was maintained at 250°C. (02 marks)

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12. Complete the following equations and write a mechanism for the reaction in each case.



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13. (a) (i) State **three** factors that can affect bond energy. (1½ marks)

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(ii) Explain how the factors you have stated in (a)(i) affect bond energy. (3½ marks)

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(b) The standard enthalpy change of formation of tin(IV) chloride is -508 kJ mol^{-1} . The standard enthalpy changes of atomization of tin and chlorine are $+301$ and $+121\text{ kJ mol}^{-1}$ respectively. Use these values to construct a Born-Haber cycle for the formation of tin(IV) chloride from its elements. (02 marks)

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(c) Calculate the average bond energy of the Sn–Cl bond. (02 marks)

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14. (a) (i) Write the general outermost electronic structure of Group VII elements. (01 mark)

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(b) Write equations for reactions of fluorine with

(i) water (1½ marks)

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(ii) cold concentrated sodium hydroxide solution (1½ marks)

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(iii) hot concentrated sodium hydroxide solution (1½ marks)

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(c) Write an equation for the reaction between hydrofluoric acid and silicon dioxide. (1½ marks)

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15. Write equations to show how the following conversions can be carried out.
Indicate the reagents and conditions for the reactions.

(a) Phenylethanol to phenylethyne *(05 marks)*

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(b) Chloroethane to ethanoic acid. *(02 marks)*

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(c) Benzene to aminobenzene *(02 marks)*

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16. (a) Element A with atomic number 84 and mass number 216 decays by loss of an alpha particle to give element B. B decays further by loss of a beta particle to give element C and C also decays by loss of a beta particle to give element D. State the mass number and atomic number of the element B, C and D. *(04 marks)*

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(b) (i) State what is meant by the term **half-life**.

(01 mark)

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(ii) A sample of Y had an initial activity of 260 counts per second on a Geiger counter. After 30 minutes the activity had declined to 250 counts per second. Calculate the half-life of Y.

(04 marks)

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17. In the extraction of iron, haematite, Fe_2O_3 is mixed with coke and limestone and the mixture heated in a blast furnace.

(a) State the purpose of adding

(i) limestone

(01 mark)

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(ii) coke

(01 mark)

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(b) Write equations for the reactions in which haematite is converted to iron in the blast furnace.

(03 marks)

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(c) Explain why it is possible to extract iron by method described above. (02 marks)

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(d) (i) Name **one** other method that could be used to extract iron from its ore. (01 mark)

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(ii) Suggest a reason why the method you have named in (d)(i) is **not** commonly used in the extraction of iron. (01 mark)

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 Ti 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	98.9 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		

P525/2
Chemistry
Paper 2
2½ Hours

STANDARD HIGH SCHOOL ZZANA

Uganda Advanced Certificate of Education

MID TERM I EXAMINATIONS, 2020

CHEMISTRY

PAPER 2

TIME: 2Hours 30 Minutes

INSTRUCTIONS

- Answer **five** questions including **three** questions from section **A** and any **two** from section **B**.
- Write answers in the answer booklet provided.
- Mathematical tables and graph papers are provided.
- Non-programmable scientific electronic calculators may be used.
- Use equations where necessary to illustrate your answers.
- Where necessary use (Cu = 64, S = 32, O = 16, Br = 79.9, H = 1)
- Faraday's constant is 96500c.
- FORWARD SCANNED ANSWERS TO stahiza2020@gmail.com

SECTION A
(Answer three questions from this section)

1. (a) State Hess's law of constant heat summation. (01mark)
- (b) Explain what is meant by each of the following terms and in each case write an equation to illustrate your answer.
- (i) Hydration energy. (02marks)
- (ii) Lattice energy. (02marks)
- (c) Explain two factors that affect the value of lattice energy of a compound. (03marks)
- (d) In an experiment to determine lattice energy of anhydrous copper (II) sulphate, 4.0g anhydrous copper (II) sulphate was added to 50g of water and the temperature rose by 8.0°C . When 4.0g hydrated copper(II) Sulphate was added to 50g of water dropped from 24.5°C to 23.6°C .
- [$S.H.C \text{ of solution} = 4.2\text{Jg}^{-1}\text{K}^{-1}$]
- Calculate the enthalpy of solution of;
- (i) Anhydrous copper (II) sulphate. (03marks)
- (ii) Copper (II) sulphate-5-water. (03marks)
- (e) (i) State which one of the two copper (II) salts in (d) is more soluble in water and explain your answer. (03marks)
- (iii) Using a Born-Haber cycle determine the hydration energy of hydrous copper (II) sulphate. (03marks)
2. (a) Both phenol and ethanol contain the same functional group.
- (i) Name one reagent that can be used to distinguish between the two compounds. (01mark)
- (ii) State what would be observed if each of the compounds is treated with the reagent you have named and write the equation for the reaction that occurs if any. (03marks)
- (iii) Describe three ways in which the chemistry of phenol is similar to that of ethanol. (03marks)
- (iv) Mention two uses of phenol. (02marks)
- (b) An aqueous solution of phenol turns blue litmus paper red whereas that of ethanol has no effect. Explain this observation. (04½ marks)
- (c) Write the equation and mechanism for the reaction between
- (i) Phenol and 2-chloropropane in alkaline conditions. (02marks)
- (ii) Ethanol and methanoic acid in presence of sulphuric acid. (04½ marks)

3. The elements beryllium, magnesium, calcium, strontium and barium belong to group (II) of the periodic table.

(a) Write the equation and state the conditions under which group (II) elements react with.

(i) air (04marks)

(ii) water (04marks)

(iii) dilute sulphuric acid (04marks)

(b) The atomic radii and melting points of group (II) elements in the periodic Table is given in the table below:

Element	Atomic radius (nm)	Melting point °C
Beryllium	0.112	1283
Magnesium	0.160	650
Calcium	0.197	848
Strontium	0.215	770
Barium	0.222	710

Explain the trend in

(i) Atomic radii (03marks)

(ii) Melting points of group (II) elements. (03marks)

(c) Although beryllium is in group (II) in the Periodic Table, in some of its properties resemble aluminum in group (III).

State the reasons why beryllium differs in some of its properties from the rest of the elements in group (II). (02marks)

4. (a)(i) Describe how the molecular mass of a substance can be determined using the freezing point depression method.

(Diagram not required). (07marks)

(ii) Explain why the method you have described in a(i) is not suitable for determining the molecular mass of a polymer. (02marks)

(b) Calculate the freezing point of a solution containing 4.2g of ethane -1,2 – diol. (Molecular mass = 62) in 30g of water

(K_f of water = 1.86°C mol⁻¹kg⁻¹) (4marks)

(c) The osmotic pressure of various concentrations of solute X in methyl benzene at 25°C are given in the table below.

Concentration /g dm ⁻³	1.0	2.0	3.0	4.0	5.0	6.0
Osmotic pressure/ Nm ⁻²	23	37	53	75	92	99

(i) Plot a graph of osmotic pressure against concentration. (03marks)

(ii) Use the graph you have drawn to determine the molecular mass of X
 $(R = 8.3, 4KJmol^{-1})$ (04marks)

SECTION B (40MARKRS)

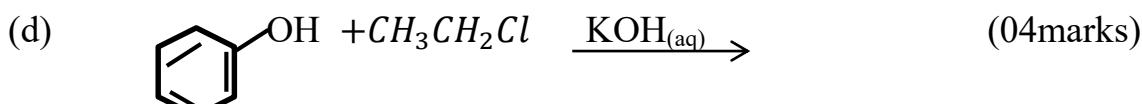
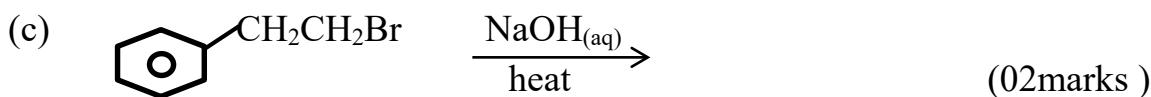
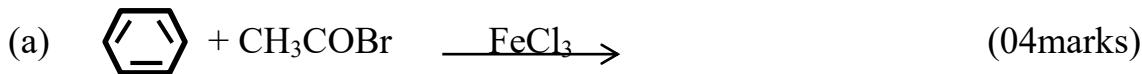
(Answer two questions from this section)

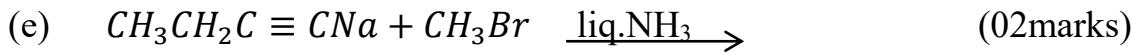
5. The boiling points of chlorides of period 3 elements are shown in the table below.

Formula of the chloride	NaCl	MgCl ₂	AlCl ₃	SiCl ₄	PCl ₃	S ₂ Cl ₂	Cl ₂
Boiling points (°C)	1465	1418	423	57	74	136	-35

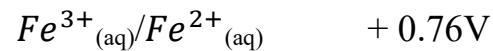
- (a) Explain the trend in boiling points. (10marks)
- (b) State the conditions and write the equation for the reaction between
- i. AlCl₃ and water. (02marks)
 - ii. S₂Cl₂ and dilute sodium hydroxide solution. (02marks)
 - iii. Chlorine and iron. (02marks)
 - iv. SiCl₄ and calcium hydroxide powder. (02marks)
 - v. MgCl₂ and sulphuric acid. (02marks)
6. Describe how aluminium can be extracted from bauxite.
 Your answer should include equations for the reactions that take place.
 (diagram not required) (10marks)
- (b) (i) Briefly describe how hydrated aluminium chloride; AlCl₃.6H₂O can be prepared from aluminium.
- (ii) State what would be observed when hydrated aluminium is strongly heated and write equation for reaction. (2½ marks)
- (iii) State what would be observed when sodium carbonate solution is added to concentrated solution of aluminium chloride. (4½ marks)

7. Complete and write a mechanism for





8. (a) The standard electrode potential for some half cells are shown below



(i) What is meant by the term standard electrode potential? (01mark)

(ii) Using a well labeled diagram, describe how the standard electrode potential of iron (III) sulphate can be determined. (06marks)

(iii) Why is it not possible to measure the standard electrode potential of iron (III) sulphate absolutely? (02marks)

(c)(i) Write the cell convention and equation for the overall reaction that occurs when the electrode potentials in (a) above are combined. (2½ marks)

(ii) Calculate the overall electrode potential for the cell. (1½ mark)

(iii) State whether the reaction in c (i) is feasible or not. Give a reason for your answer.

(d) A current of 40.5A was passed through molten lead(II) bromide for 4 hours and the bromine liberated reacted with 94.0g of hydroxyl benzene.

Calculate the number of moles of;

(i) Bromine liberated.

(ii) Hydroxybenzene that reacted. (04marks)

(e) State what is observed and write equation for the reaction that took place between Bromine and hydroxyl benzene in (d) above. (02marks)

END

NAME.....COMB.....

SIGN.....

P525/1

JUL/AUG 2019

CHEMISTRY

2 ½ HOURS

CENTRAL COLLEGE KAMULI (CCK)

UGANDA ADVANCED CERTIFICATE OF EDUCATION

END OF TERM TWO EXAMINATIONS

CHEMISRTY

(*Principal subject*)

Paper one

2 Hours 30 minutes.

INSTRUCTION TO CANDIDATES:

- Answer all questions in this paper
- Illustrate your answer with equations where applicable

SECTION A (46 MARKS)

1. A compound contains 79.78% chlorine and the rest aluminium. The vapor of this compound has density $2.28 \times 10^{-3} \text{ gm}^{-3}$ at 1427K and $1.013 \times 10^5 \text{ pa}$.

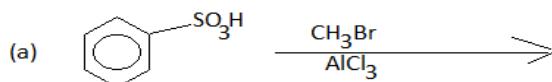
(a) Determine the molecular formula of Q and draw its structure (3marks)

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(b) State the conditions under which the above structure exists. (1mark)

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2. Complete the following equations and in each case state the IUPAC name for the major product (6marks)



Name



Name

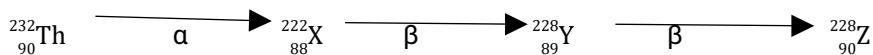


Name



Name

3. (a) a radioactive isotope of the element Thorium $^{232}_{90}\text{Th}$ decays according to the following scheme.



Identify X, Y and Z. (1 ½ marks)

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- (b). (i) what is meant by stability of nucleus? (1mark)

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- (ii) explain the factors that determine the stability of the nucleus. (2marks)

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4. Two isomeric compounds X and Y have the following percentage compositions by mass, carbon, hydrogen and chlorine with 66.6%, 5.5% and 28.1% respectively. the molecular mass of compounds is 126.5.

- (a) Determine the molecular formula of X and Y. (3 marks)

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- (b) (i) one of the compounds X, yields a white precipitate when warmed with aqueous silver nitrate, but Y does not. Explain the observation. (1 ½ marks)

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(ii) suggest a structure for X, and give one of possible structures for Y (1mark)

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5. Distinguish between the following pair of compounds using suitable reagents and in each case state the observations.

(a) Ethyne and ethanol (3marks)

Reagent

.....
.....

Observation

.....
.....

...

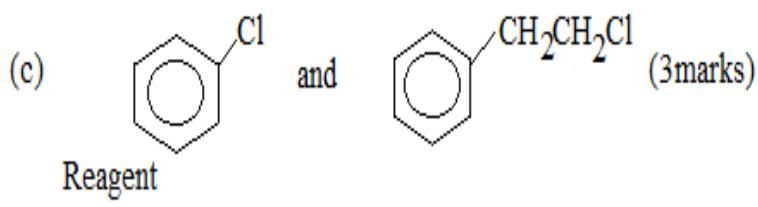
(b) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)_2$ and $\text{CH}_2=\text{CHCH}(\text{CH}_3)_2$ (3marks)

Reagent

.....

Observation

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.....
.....



Observation

6. (a) Explain why lithium does not form peroxide or super oxide when burnt in oxygen. (2marks)

- (b) State what is observed when potassium superoxide is dropped in water. write equation for the reaction. (2 ½ marks)

7. (a). what is meant by; (1mark @)

- (i) Osmosis

- (ii) Osmotic pressure

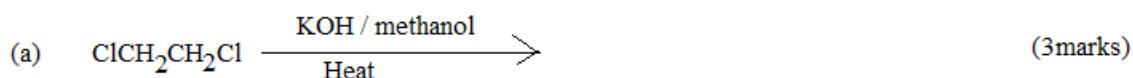
(b). state the significance of osmosis (1marks)

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(c) the osmotic pressure of solution containing 1.24% of a polymer is 3.1×10^{-3} atmospheres at 25°C . Determine the relative molecular mass of the polymer. ($R=0.0821 \text{ atm mol}^{-1}\text{Cl}^{-1}$). (2 ½ marks)

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8. Complete the equations below and outline the mechanism of each reaction.



Mechanism

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Mechanism

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9. Given the following thermochemical data;

Salt	Hydration energy (KJmol ⁻¹)	Lattice energy (KJmol ⁻¹)
AX	880	860
BX	790	800

(a) Which salt is more soluble (1mark)

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(b) Explain your answer (2 ½ marks)

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SECTION B (54 MARKS)

10. (a) State Boyles law (1mark)

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(b). The table below shows the time (t) taken for gases of different molecular mass (Mr) to diffuse through a narrow opening under similar conditions.

t (s)	25.00	34.23	41.67	47.62
Mr	16	30	44	58

Plot a graph of rate of diffusion, $(1/t)$ against $\sqrt{\frac{1}{Mr}}$ (4marks)

c) Using your graph in (b) above, find the molecular mass of a gas;

i) whose rate of diffusion is 0.025s^{-1} (1mark)

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ii) that takes 38.42s to diffuse (2marks)

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d) State four applications of gaseous diffusion (2marks)

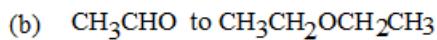
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11. Write equations to show how each of the following conversions can be effected and indicate the reagents and conditions for the reactions.(1 ½ marks @)

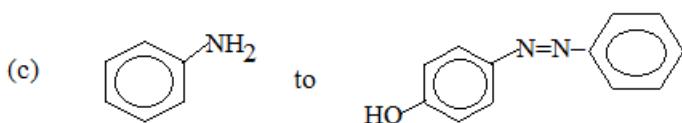
(a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ to CH_3CH_3

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12. The table below shows the first ionization energy in KJmol-1 of the elements A, B and C. one of the elements belongs to group VII.

Element	1 st I.E	2 nd I.E	3 rd I.E	4 th I.E
A	730	1500	7730	10500
B	500	4560	6900	9010
C	580	1815	2740	8720
D	1310	3460	5300	7020

- (a) (i) define the term ionization energy (1mark)

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- (ii). Identify element that belong to group I of periodic table and give reason for your answer.

(1 ½ marks)

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(iii). Which of the following elements form a cation with charge +3? (1 ½ marks)

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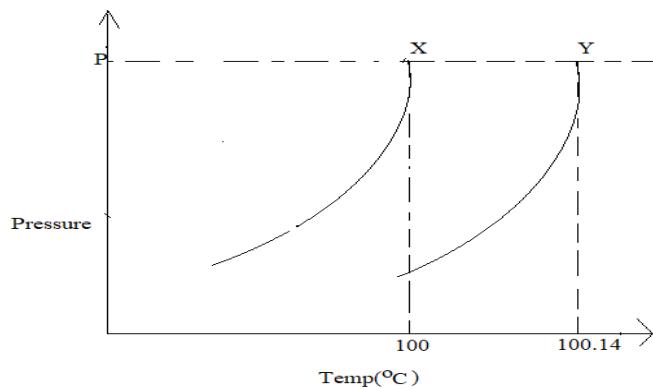
(iv). Write the formula of the compound between atoms of the element B and D. (1 ½ marks)

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(b) Explain why there is increase in successive ionization energy. (2 ½ marks)

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13. 5.5g of a non-volatile substances B was dissolved in 125g of a solute. The vapour pressure curve of the solution and pure solvent at constant pressure P are shown.



a) identify the curve for the solution and the solvent (½ mark @)

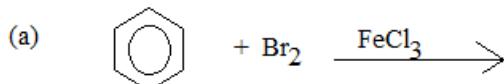
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- b) calculate the molecular mass of B (boiling point elevation constant for the solvent; K_b is $0.52^{\circ}\text{Cmol}^{-1}\text{kg}^{-1}$) (3marks)

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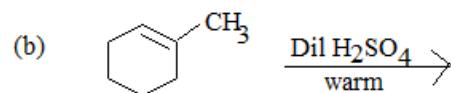
- c) state the limitations of your calculations(2marks)

14. complete the following organic reactions and outline the accepted reaction mechanism. (3 ½ marks @)



Mechanism

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Mechanism

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15. Explain the following observations

- (a) the heat of hydrogenation of cyclohexane is -120 KJmol^{-1} and that of benzene is -210 KJmol^{-1} . (3marks)

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- (b) the melting point of methylbenzene is -95°C lower than that of benzene which has the highest molecular weight. (3marks)

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- (c) methylbenzene reacts bromine in presence of Aluminium chloride catalyst to form two products, while benzenesulphonic acid forms one product. (4marks)

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16. a mass spectrum of chlorine shows the molecular peaks at 70, 72 and 74.

- (a) Explain this observation (2marks)

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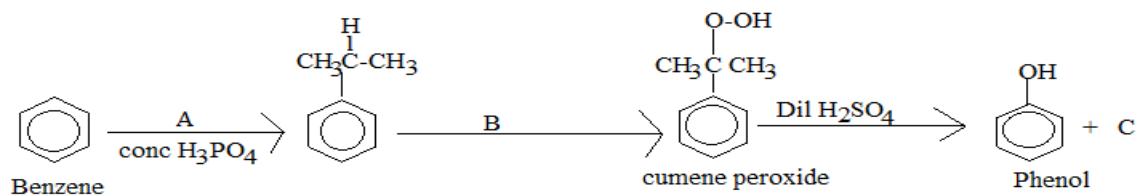
(b) The peaks at 70, 72 and 74 are in the ratio of 9:6:1. calculate the average atomic mass of chlorine. (3marks)

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(c) Calculate the relative abundance of Cl^{35} and Cl^{37} (2marks)

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17. The flow chart below shows how phenol (hydroxybenzene) can be made from benzene and compound A in the process below.

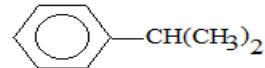


(a) (i) identify compounds A, B and C. (3marks)

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(ii). What is the name given to the process above? (1mark)

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(b) Outline the mechanism for formation of

(2 ½ marks)

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END

Candidate's Name:
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P525/1
CHEMISTRY
Paper 1
Jul. 2019
2 3/4 hrs

Uganda Advanced Certificate of Education

S.5 Promotional Examinations 4 of 7

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

Answer all the questions in both Sections.

All questions must be answered in the spaces provided.

The Periodic Table, with relative atomic masses, is attached at the end of the paper.

Mathematical tables (3-figure table) are adequate or non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

Where necessary, use the following:

Molar gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

Molar volume of gas at s.t.p is 22.4 litres.

Standard temperature = 273K.

Standard pressure = 101325 N m⁻²

For Examiners' 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) A piece of freshly cut sodium metal was dropped in excess ethanol, 1500cm^3 of hydrogen measured at 25°C and 740mmHg was evolved.

- (i) Write the equation for the reaction between sodium and ethanol. (01 mark)

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- (ii) Calculate the mass of sodium metal that reacted with ethanol. (03 marks)

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- (b) Write the equation for the formation of ethoxyethane from ethanol. (01 mark)

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2. Write equations for the reaction(s) between concentrated sodium hydroxide solution and

(a) silicon(IV) oxide

(1½ marks)

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(b) beryllium oxide

(1½ marks)

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(c) chlorine

(1½ marks)

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3. (a) 0.72 g of a compound X was dissolved in 80.0 g of water and the resulting solution had a freezing point of -0.14°C . When 2.9 g of the same compound was dissolved in 111 g of benzene the freezing point was depressed by 0.6°C . Calculate the apparent molecular mass of X in

(i) water (K_f for water = $1.96^{\circ}\text{C kg}^{-1} \text{ mol}^{-1}$).

(2½ marks)

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(ii) benzene (K_f for water = $5.5^{\circ}\text{C kg}^{-1} \text{ mol}^{-1}$).

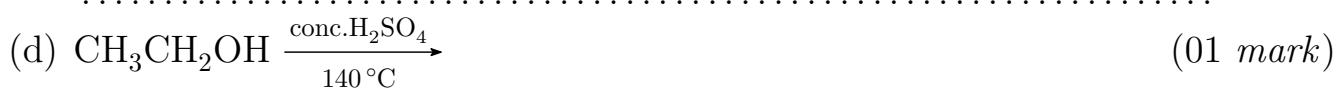
(2½ marks)

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(b) Explain why the molecular mass of X differs in the two solvents. (1½ marks)

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4. Complete the following equations and write IUPAC name of the main organic compound in each case.



5. (a) State **Graham's law** (1½ marks)

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- (b) A certain volume of oxygen diffused through a porous membrane in 120s. Under the same conditions the same volume of a gas W diffuses in 112s. Calculate the relative molecular mass of W. (3½ marks)

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6. (a) Write the equation and state the conditions for the reaction leading to the formation of

- (i) tin(II) chloride (2½ marks)
Equation

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Conditions

- (ii) tin(IV) chloride (2½ marks)
Equation

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Conditions

- (b) Write the equation for the reaction between tin(II) chloride and iron(III) sulphate solution. (01 mark)

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7. A bromo alkane Z with molecular formula, C_4H_9Br formed compound X when heated with sodium hydroxide solution. X when reacted with concentrated hydrochloric acid in the presence of anhydrous zinc chloride formed two layers of liquids immediately.

(a) Write the name and the structural formula of Z.

(01 mark)

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(b) Write an equation and indicate a mechanism for the reaction between Z and sodium methoxide in methanol.

(03 marks)

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8. The table below gives values for the atomic and ionic radii of the alkali metal.

Element	Atomic radius(nm)	Ionic radius(nm)
Lithium	1.23	0.68
Sodium	1.57	0.97
Potassium	2.03	1.33
Rubidium	2.16	1.47
Caesium	2.35	1.67

(a) In every case, the radius of an ion is smaller than that of the corresponding atom. Explain.

(02 marks)

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- (b) Explain the increase in atomic radius along the series Lithium to Caesium. (02 marks)

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- (c) Which **one** of the alkali metal ions in the gaseous state is likely to have the highest hydration energy? Give a reason. (02 marks)

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9. Name a reagent that can be used to distinguish between each of the following pairs and in each case state what is observed when the reagent named is used.

- (a) Propan-1-ol and propan-2-ol (03 marks)

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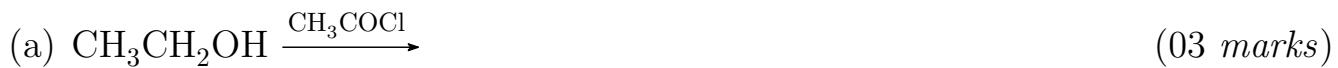
- (b) But-1-yne and but-2-yne. (03 marks)

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SECTION B: (54 MARKS)

Answer all questions in this section

10. Complete the following equations and in each case outline a mechanism for the reaction.



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11. (a) (i) Explain what is meant by the term **osmotic pressure**. (03 marks)

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- (ii) State the conditions under which solutions do not obey the laws of osmotic pressure. (03 marks)

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- (b) The osmotic pressure of a solution containing 1.24% of a polymer is 3.1×10^{-3} atmosphere, at 25°C. Determine the relative molecular mass of the polymer. (03 marks)

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12. The table below shows the first electron affinities of the elements of group (VII).

Element	F	Cl	Br	I
First electron affinity(kJ mol ⁻¹)	-354	-370	-348	-320

- (a) Explain what is meant by the term **first electron affinity**. (02 marks)

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(b) (i) Explain the general trend in the variation of the first electron affinities. (03 marks)

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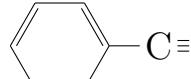
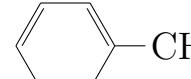
(ii) Explain why fluorine has an abnormal value. (02 marks)

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(c) State **two** properties in which fluorine differs from the rest of the group members. (02 marks)

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13. Write equations to show how the following compounds can be synthesized. Indicate the reagents and conditions.

(a) -C≡CCH₃ from -CH₂CH₂OH (06 marks)

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(b) CH_3COCl from $\text{CH}_2=\text{CH}_2$

(03 marks)

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14. 25.0cm^3 of a mixture of sodium hydroxide and sodium carbonate required 18.70cm^3 of 0.05M sulphuric acid using phenolphthalein indicator. Another 25.0cm^3 of the mixture required 23.50cm^3 of 0.05M sulphuric acid using methyl orange indicator. Calculate the concentration of sodium hydroxide and sodium carbonate in grams per litre. (09 marks)

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15. Explain the following observations.

- (a) The tendency of group (II) elements to form complex ions is in the order Be > Mg > Ca > Ba. *(04 marks)*

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- (b) Hydrogen fluoride is a weaker acid than hydrogen chloride. *(05 marks)*

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Candidate's Name:
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Random No.					Personal No.	

Signature:

(Do not write your School/Centre Name or Number anywhere on this booklet)

P525/1
CHEMISTRY
Paper 1
Aug. 2019
2 3/4 hrs

Uganda Advanced Certificate of Education

S.5 Promotional Examinations 5 of 7

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES

Answer all the questions in both Sections.

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The Periodic Table, with relative atomic masses, is attached at the end of the paper.

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Illustrate your answers with equations where applicable.

Where necessary, use the following:

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Molar volume of gas at s.t.p is 22.4 litres.

Standard temperature = 273K.

Standard pressure = 101325 N m⁻²

For Examiners' 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. 17.25g of ferrous ammonium sulphate, $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot x\text{H}_2\text{O}$, was dissolved in water and made to one litre in a volumetric flask. 25.0cm^3 of this solution was acidified and reacted with 23.6cm^3 of 0.0094M potassium manganate(VII). Calculate the value of x . (06 marks)

- 2.** (a) Write the general outermost shell electronic configuration of group II elements. (01 mark)

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- (b) The decomposition temperature of the carbonates of group II elements are given below.

Carbonate	MgCO ₃	CaCO ₃	SrCO ₃	BaCO ₃
Decomposition temperature(°C)	404	826	1098	1370

- (i) State the trend in variation of decomposition temperatures of the carbonates. (01 mark)

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(ii) Explain your answer in (a) (i) above.

(03 marks)

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3. A sample of concentrated amine solution was placed at one end of a 1.0m glass tube held horizontally. At the other end was placed a sample of concentrated hydrochloric acid and both ends of the tube sealed. When the tube was left for some time, a white ring was observed 0.52m from the end containing the amine.

- (a) Write equation for the reaction leading to the formation of the white ring. (01 mark)

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- (b) Calculate the molecular mass of the amine. (03 marks)

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4. (a) Define the term **ionisation energy**.

(01 mark)

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(b) The data given below are for the elements P, Q and R which belong to the same group in the Periodic Table.

Element	P	Q	R
First ionisation energy(kJ mol^{-1})	580	790	1255

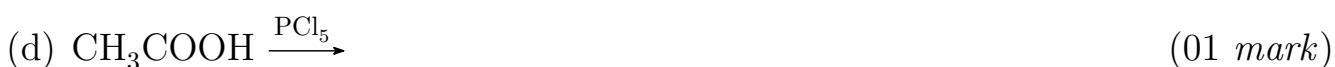
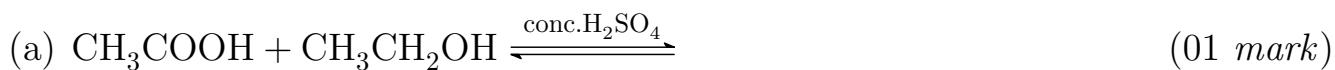
(i) Which one of the elements P, Q and R is a metal? Explain your answer. (02 marks)

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(ii) The second, third and fourth ionisation energy of element P are 1500, 7700 and 10500 kJ mol^{-1} respectively. To what group in the Periodic Table does P belong? Give reasons for your answer. (03 marks)

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5. Complete the following equations and write IUPAC names of the major organic product.



6. Name **one** reagent that can be used to distinguish between each of the following ions. In each case state what would be observed if each member of the pairs is treated with the reagent.

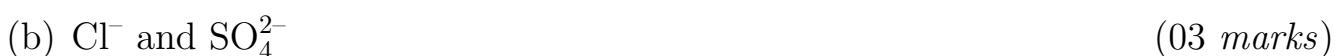


Reagent

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Observation

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Reagent

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Observation

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7. 2-bromo-2-methylpropane reacts with aqueous sodium hydroxide to form 2-methylpropan-2-ol.

- (a) Write the rate equation for the reaction. (01 mark)

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- (b) Draw the energy diagram for the reaction. (03 marks)

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8. In an experiment, 1cm^3 of a hydrocarbon W requires 4cm^3 of oxygen for complete combustion to give 3cm^3 of carbon dioxide, all gas volumes being measured at s.t.p.

- (a) Determine the molecular formula of W . (02 marks)

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- (b) Write the structural formulae and names of all possible isomers of W . (03 marks)

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- (c) When W was reacted with ammoniacal silver nitrate solution, white precipitate of compound X was formed. Identify W . (01 mark)

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9. (a) State **Raoult's law**. (01 mark)

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- (b) A solvent Z of molecular mass 62 has a vapour pressure of $1.0 \times 10^4 \text{ N m}^{-2}$ at 298K. 23.3g of non-volatile solute of molecular mass 270 was added to 100g of Z at 298K. Calculate the vapour pressure of the solution. (04 marks)

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SECTION B: (54 MARKS)

Answer all questions in this section

10. (a) State what is meant by the term **boiling point constant** of a liquid. (02 marks)

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- (b) A solution contains 30g of ethane-1,2-diol and 40g of water.
- (i) Calculate the boiling point of the solution
(K_b for water is 0.52°C mol⁻¹ kg⁻¹). (04 marks)

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- (ii) State **three** assumption made in the calculations above. (03 marks)

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11. Complete the following equations and in each case outline a mechanism for the reaction.



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12. (a) When red lead, Pb_3O_4 was reacted with nitric acid a solid was formed.
Write the equation for the reaction. (02 marks)

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- (b) The mixture from (a) was filtered and the residue warmed with concentrated hydrochloric acid.
(i) What was observed? Explain your answer (01 mark)

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- (ii) Write the equation for the reaction. ($1\frac{1}{2}$ marks)

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- (c) The filtrate from (b) was divided into two parts.
- (i) To the first part was added aqueous potassium iodide. State what was observed and write equation for the reaction. (02 marks)

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- (ii) The second part was evaporated to dryness and heated strongly. Explain what was observed and write the equation for the reaction that took place. (2½ marks)

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13. (a) State **three** factors that can affect electron affinity. (1½ marks)

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- (b) Write equation for the first electron affinity of sulphur. (01 mark)

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- (c) The first and second electron affinities of sulphur are -200 and $+649\text{ kJ mol}^{-1}$ respectively. Explain the difference in the electron affinities. (03 marks)

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- (d) The first electron affinity of phosphorous is less than that of sulphur.
Explain the observation. *(3½ marks)*

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- 14.** Write equations to show how the following compounds can be synthesized.
Indicate the condition(s) for the reaction(s).

- (a) Ethanol from ethanoylchloride. *(03 marks)*

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- (b) Methylbenzene from chlorobenzene *(04 marks)*

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- (c) Acetic acid from ethyne *(02 marks)*

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15. Explain the following observations:

- (a) 1-bromobutane undergoes nucleophilic substitution reaction when heated with aqueous sodium hydroxide whereas bromobenzene does not react under similar conditions. *(04 marks)*

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- (b) Iodine is sparingly soluble in water but dissolves readily in aqueous solution of potassium iodide. *(03 marks)*

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- (c) Hydroxyl benzene is sparingly soluble in water but very soluble in dilute sodium hydroxide. *(02 marks)*

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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 Ti 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	98.9 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		