

P525/1

CHEMISTRY

Paper 1

2018

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

RESOURCE EXAM 2018
Uganda Advanced Certificate of Education
CHEMISTRY
Paper 1
Time: 2 Hours 45 Minutes

INSTRUCTIONS TO CANDIDATES

- Answer **all** questions in section **A** and **six** questions from section **B**.
- All answers **MUST** be written in the spaces provided.
- Illustrate your answers with equations where applicable.
- Molar gas constant, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
- Molar volume of gas at s.t.p is 22.4 litres

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

1. a) Define the term "osmotic pressure".

(01 mark)

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b) The osmotic pressure of an aqueous solution which contains 5g of potassium nitrate in 1dm³ is 221kPa at 15°C. Calculate the degree of dissociation of potassium nitrate.

(3 ½ marks)

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2. The standard electrode potentials of some half cells are shown below;

	$E^{\ominus} / V$
$Ce_{(aq)}^{4+}, Ce_{(aq)}^{3+} / Pt_{(s)}$	+1,61
$Al_{(aq)}^{3+} / Al_{(s)}$	-1,66

a) Write the cell concentration for the combined cell.

(1 ½ marks)

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b) Write equation for the;

(i) reaction at the positive electrode. (01 mark)

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(ii) reaction at the negative electrode. (01 mark)

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(iii) overall cell reaction. (01 mark)

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c) Calculate the e.m.f. of the combined cell. (01 mark)

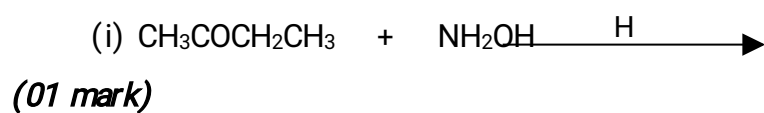
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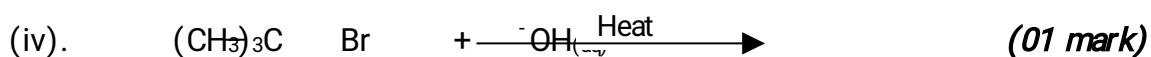
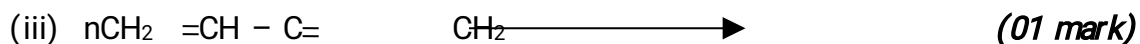
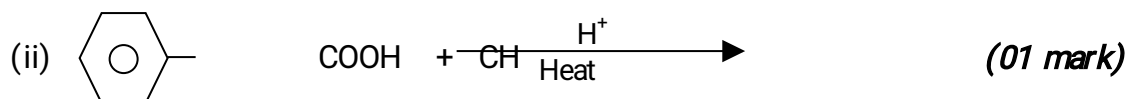
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3. a) Complete each of the following equations





b) State the mechanism of the reaction in a(iv) (01 mark)

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4. Write equation for the reaction for each of the salts with water. State whether the resulting solution will be neutral, acidic or alkaline.

a) Aluminium chloride (02 marks)

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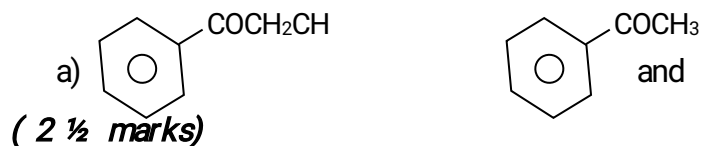
b) Ammonium methanoate. (02 marks)

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c) Sodium sulphate (01 mark)

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



Reagent(s)

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Observation(s)

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b) Butn- 1- ol and 2- methylpropan- 2- ol **(2 ½ marks)**

Reagent(s)

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Observation(s)

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6. a) Define the term “Bond energy” **(01 mark)**

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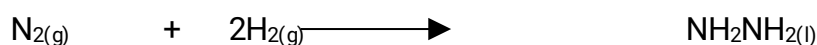
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b) Some bond energies are given below

Bond	Bond energy (kJmol^{-1})
H — H	436
N — H	389
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N — N	159
N $\equiv$ N	946

Nitrogen reacts with hydrogen according to the following equation to form hydrazine.



Use the above energy values to estimate the heat of formation of hydrazine. **(03 marks)**

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c) The actual value of the heat of formation of hydrazine is $+95.4\text{kJmol}^{-1}$. Explain the difference in experimental value and the calculated value of heat of formation. **(01 mark)**

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7. A 0.111M solution of ethanoic has an electrolytic conductivity of $5.21 \times 10^{-2} \text{Sm}^{-1}$ at 25°C.

The molar conductivity of ethanoic acid at infinite dilution at this temperature is $3.91 \times 10^{-2} \text{Sm}^2 \text{mol}^{-1}$. Calculate;

a) the degree of dissociation of ethanoic acid. (2 ½ marks)

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b) the pH of the solution. (1 ½ marks)

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c) The dissociation constant, K_a of the acid. (1 ½ marks)

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8. Draw the shapes adopted by the following species and name them. (06 marks)

Species	Shape	Name
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PCl_5		
SO_2		
SO_4^{2-}		
ClO_3^-		

9. Write equations of reaction between hot concentrated sodium hydroxide solution and

a) Lead (IV) oxide (1 ½ marks)

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b) Aluminium (III) oxide (1 ½ marks)

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c) Iodine

(1 ½ marks)

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10. a) Nitrogen reacts with hydrogen according to the following equation.

Equation;



(i) Write an expression for the equilibrium constant, K_p . (½

mark)

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(ii) One mole of nitrogen and 3 moles of hydrogen were heated at 450°C under pressure of 80 atmospheres, the equilibrium mixture was found to contain 21.2% ammonia by volume.

Calculate the value of K_p under these conditions.

(04

marks)

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b) State, giving reasons, how the partial pressure of ammonia would be affected if at equilibrium.

(i) the temperature was increased.

(1 ½

marks)

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(ii) the pressure was increased. (1 ½ marks)

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(iii) Iron was added. (1 ½ marks)

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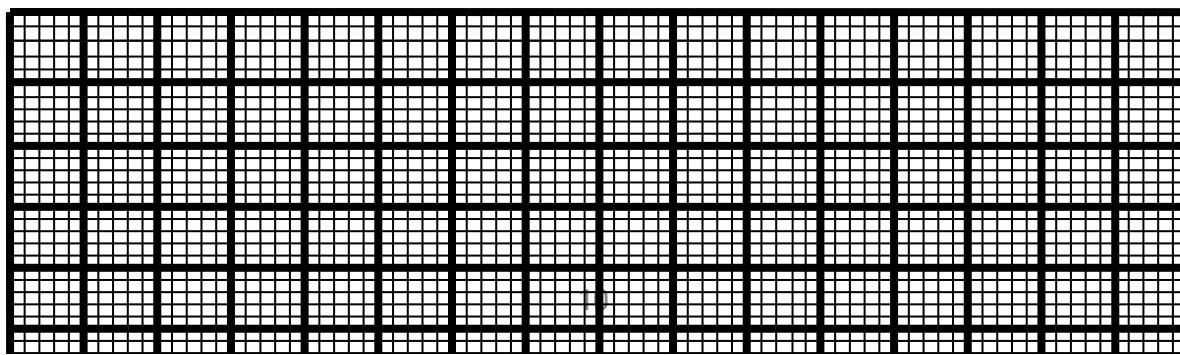
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11. The boiling points and molecular masses of the hydrides of elements in group (II) in the periodic table are given in the table below.

Hydride	HF	HCl	HBr	HI
Boiling point (°C)	19.5	- 85	- 67	- 35
Molecular mass	20	36.4	80.9	128

a) Draw a graph of boiling point versus molecular mass of the hydride. (03 marks)



b) Explain;

(i) the abnormally high boiling point of HF.

(2 ½

marks)

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(ii) the general trend in the boiling points of HCl, HBr and HI (1 ½ marks)

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c) State what would be observed and write equation for the reaction that takes place if concentrated sulphuric acid is added to hydriodic acid.

(i) Observation (½ mark)

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(ii) Equation (1 ½ marks)

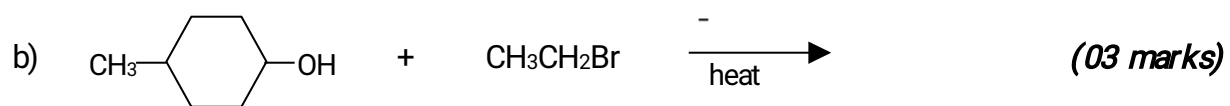
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12. Complete the following reactions and suggest mechanisms of reaction.





13. a) State two properties in which chromium differs from aluminium. **(01 mark)**

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b) Write equation for the reaction between chromium and
(i) dilute sulphuric acid. **(01 mark)**

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(ii) hot concentrated sulphuric acid. **(1 ½ marks)**

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c) State what would be observed and write equation(s) for the reaction that takes place if to chromium (III) sulphate solution was added to aqueous sodium hydroxide solution dropwise until in excess followed by hydrogen peroxide solution.

Observation

(1 ½ marks)

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Equation(s)

(04 marks)

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14. a) State three reasons why azeotropes are considered to be mixtures and not compounds.

(1 ½ marks)

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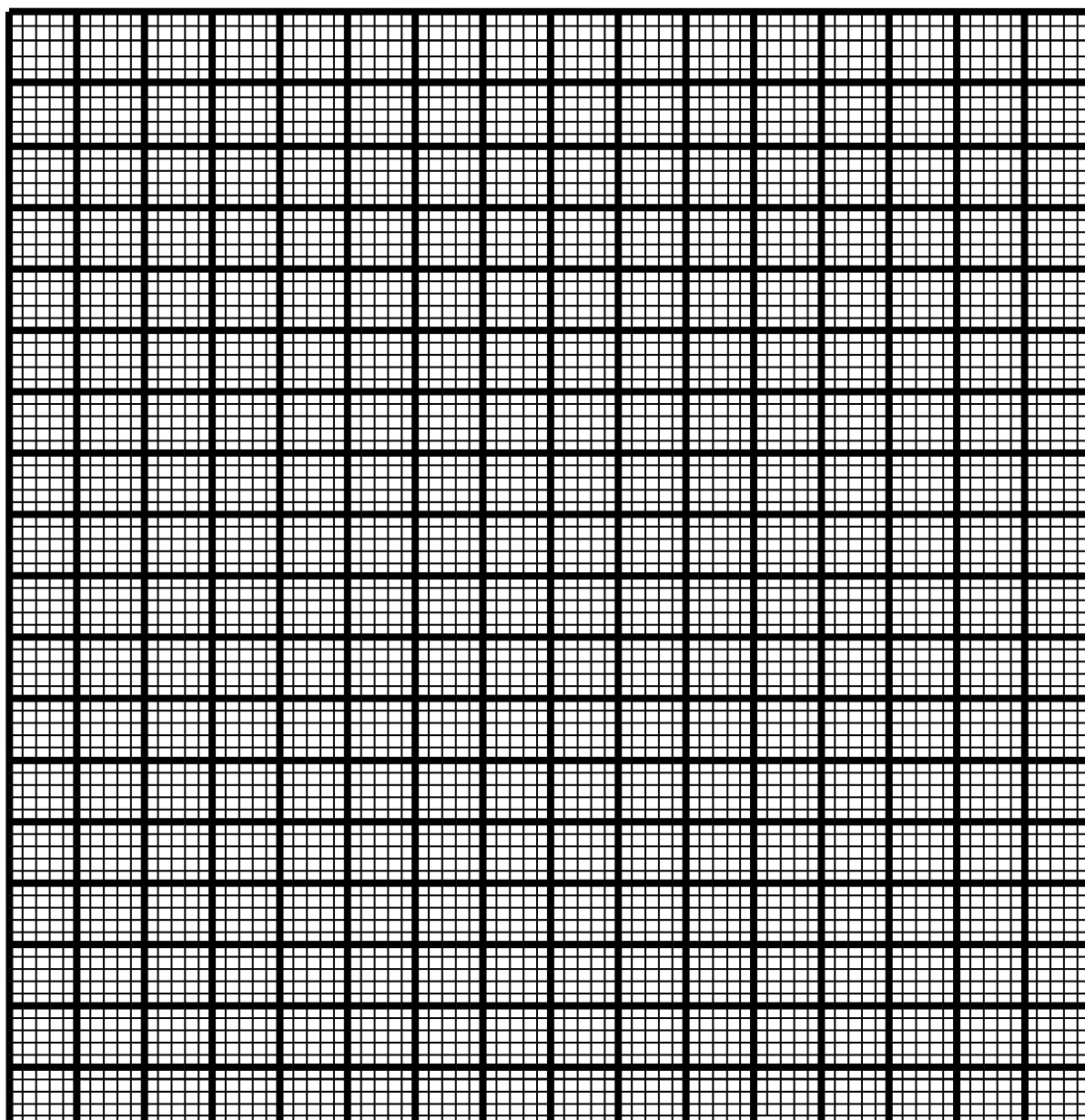
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b) The total pressure of a mixture of propanone and trichloromethane and the mole fraction of propane at constant temperature are given in the table below.

Mole fraction of propanone	0.0	0.2	0.4	0.6	0.8	1.0
Total vapour pressure of the mixture	293	256	244	267	305	347

(i) Plot a graph of total vapour pressure of the mixture against the mole fraction of propanone. (03 marks)



(ii) Use the graph to deduce how the mixture deviates from Raoult's law. Give a reason for your answer. **(02 marks)**

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(iii) Explain the causes of deviation you have stated in b(ii). **(1 ½ marks)**

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(iv) Determine the composition of the azeotrope. **(01 mark)**

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15. Write equations for the reactions which take place and in each case, state what would be observed.

a) Concentrated ammonia solution is added drop wise until in excess to an aqueous solution of cobalt (II) sulphate and the resulting solution allowed to stand in air.

(04 marks)

Equation(s)

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Observation(s)

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b) Aqueous potassium iodide is added to acidified potassium dichromate (IV).

(2 ½ marks)

Equation(s)

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Observation(s)

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c) Magnesium powder is added to aqueous solution of Iron (III) chloride. (2 ½ marks)

Equation(s)

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Observation(s)

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16. The solubility product of lead (II) sulphate is $1.5 \times 10^{-4} \text{ mol}^2 \text{ l}^{-2}$.

a) (i) Write the expression for the solubility of lead (II) sulphate. (1 ½ marks)

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(ii) Write the expression for the solubility product of Lead (II) sulphate. (01 mark)

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b) Calculate the solubility of lead (II) sulphate in mol l^{-1} . (02 marks)

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c) When a solution of sodium sulphate was added to a saturated solution of lead (II) sulphate a precipitate of lead (II) sulphate was formed. Explain. (02 marks)

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d) The solubility product of calcium sulphate at 25°C is $2.0 \times 10^{-4} \text{ mol}^2 \text{ dm}^{-6}$. A solution contains calcium and lead (II) ions. Using your result from part(b) which ion will be precipitated first on addition of sulphate ions to Q. Explain your answer. (2 ½

marks)

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17. a) An aqueous solution containing 3.6g of a non- cyclic compound R in 125g of water freezes at -0.744°C . The freezing point constant, K_f for water is $1.86^{\circ}\text{C mol}^{-1}\text{Kg}^{-1}$
Calculate the molecular mass of R. **(2 ½ marks)**

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b) If R contains carbon, 66.7%, hydrogen 11.1% and oxygen 22.2%,
(i) Calculate the simplest formula of R (C = 12, H = 1, O = 16)

(02 marks)

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(ii) Determine the molecular formula of R.

(01 mark)

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(iii) Write the structures of three possible isomers of R.

(1 ½ marks)

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c) R forms a yellow precipitate with phenyl hydrazine and iodine solution in presence of sodium hydroxide solution.

(i) Identify R. (½ mark)

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(ii) Write an equation for the reaction between R and phenyl hydrazine. (1 ½ marks)

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END