

# UNEB UACE CHEMISTRY PAPER 1 2018

1. Various concentrations of X and Y were reacted at a constant temperature. The table below shows the initial concentrations of X and Y and their initial rates for the reaction.

| Experiment | [X] (mol dm <sup>-3</sup> ) | [Y] (mol dm <sup>-3</sup> ) | Initial rate (mol s <sup>-1</sup> ) |
|------------|-----------------------------|-----------------------------|-------------------------------------|
| 1          | 0.2                         | 0.2                         | $3.5 \times 10^{-4}$                |
| 2          | 0.4                         | 0.4                         | $1.4 \times 10^{-3}$                |
| 3          | 0.8                         | 0.4                         | $5.6 \times 10^{-3}$                |

a) State the order of reaction with respect to X and Y

i) X

ii) Y

b) Give reasons for your answers in (a)

c) Determine the overall order of the reaction

d) Calculate the value for the rate constant for the reaction

2.a) A solid Q contains 9.37% by mass of magnesium, 10.39% nitrogen and 42.18% water.

i) Calculate the empirical formula of Q

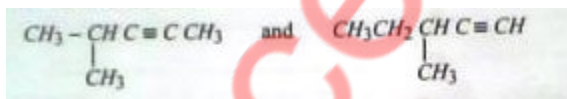
ii) Determine the molecular formula of Q (RFM of Q = 256)

b) Solution of Q reacts with iron(II)sulphate in the presence of concentrated sulphuric acid to form a brown ring. Identify Q.

c) Write equation for the reaction that would take place if Q was heated.

3. 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 member of the pair was treated with the reagent you have named.



a)

Reagent

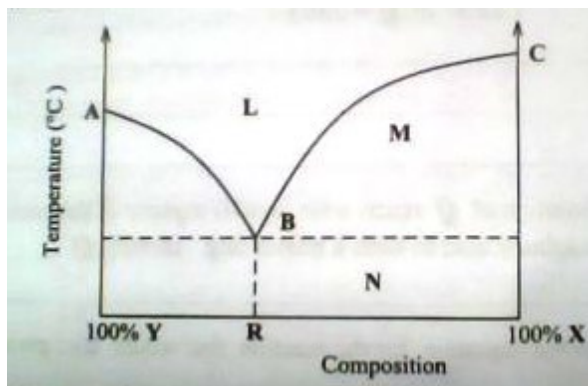
Observation

b) Image

Reagent

Observation

4. The temperature – composition diagram for a system containing two components X and Y is shown below



a) State what the following represents;

i) Regions:

L

M

N

ii) Points

A

B

C

iii) Curves

AB

BC

b) State what would happen when a mixture of composition R is heated.

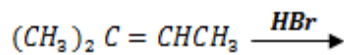
5. Write equation for the reaction between aqueous sodium hydroxide and

a) chromium(III)oxide

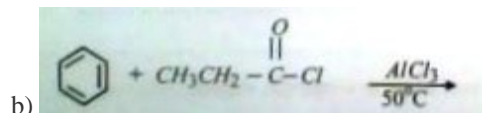
b) beryllium oxide

c) tin(II)oxide

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



Mechanism:



Mechanism:

7. When a current of 0.65 A was passed through copper(II)sulphate solution using platinum electrodes for 35 minutes, 0.0143 g of hydrogen and 0.113 g of oxygen were evolved.

a) Write equation for the reaction that took place at the

i) anode

ii) cathode

b) Determine the quantity of electricity required to evolve 1 mole gas at each electrode

i) At the anode

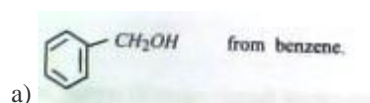
ii) At the cathode

8. State what would be observed and write equation for the reaction that would take place when:

a) excess concentrated hydrochloric acid was added to lead(II)oxide

b) potassium iodide was added to copper(II)sulphate solution

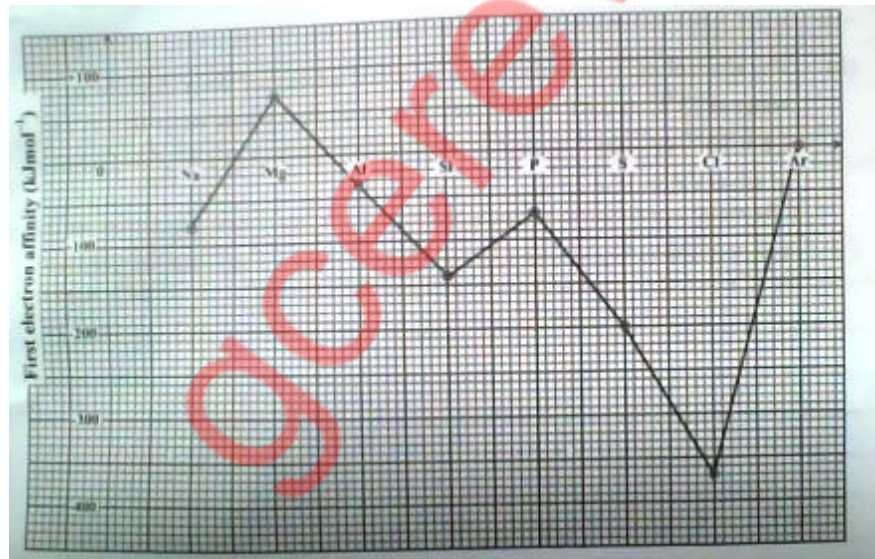
9. Write equation in each case to show how the following conversions can be effected:



b)  $\text{CH}_3\text{CONH}_2$  from chloroethane

#### SECTION B

10. The figure below shows the variation of the first electron affinity of the elements in Period 3 of the Periodic Table



Explain each of the following observations:

i) There is a general increase in the first electron affinity from sodium to argon

ii) The first electron affinity of magnesium is higher than that of aluminum

iii) The first electron affinity of phosphorous is less than that of sulphur

11. a) Silver chloride dissolves in water according to the following equation



Write the expression for the solubility product,  $K_{sp}$  of silver chloride

b) The electrolytic conductivity of a saturated solution of silver chloride in water at  $25^\circ\text{C}$  is  $3.41 \times 10^{-6} \text{ S cm}^{-1}$  and that of pure water is  $1.6 \times 10^{-6} \text{ S cm}^{-1}$ . Calculate the solubility product of a saturated solution of silver chloride at  $25^\circ\text{C}$ .

(The molar conductivities at infinite dilution of silver nitrate, potassium nitrate and potassium chloride are 133.4, 145.0 and  $149.9 \text{ S cm}^2 \text{ mol}^{-1}$  respectively at  $25^\circ\text{C}$ )

- c) Ammonia solution was added to a solution containing silver chloride  
i) State how the solubility of silver chloride was affected  
ii) Explain your answer in (c) (i) above.

12. Compound T,  $C_3H_6O$  reacts with 2,4- dinitrophenylhydrazine to form a yellow precipitate

- a) Write the names and the structural formulae of all possible isomers of T  
b) T reacts with ammoniacal silver nitrate solution to form silver  
Identify T  
c) Write equation and indicate a mechanism for the reaction between T and 2, 4 – dinitrophenylhydrazine under acidic condition

13. Manganese is a d-block element in the Periodic Table

- a) Define the term d-block element  
b) i) Write the electronic configuration of manganese  
ii) State the common oxidation states exhibited by manganese in its compounds  
iii) Write the formulae of oxides of manganese each of the oxidation states you have stated in (b) (ii)  
c) A black oxide, Y of manganese was fused with a mixture of potassium hydroxide and potassium nitrate to give a compound which when treated with water gave a green solution.  
The green solution turned purple when acidified with sulphuric acid.  
Identify:  
i) Y  
ii) the ion that gives the green solution its color  
iii) the ion that gives the purple solution its color  
d) Write ionic equation for the reaction leading to the formation of the purple solution

14 a) i) Sketch a graph to show the pH change when hydrochloric acid is titrated with ammonia solution

ii) Explain the shape of your sketch graph in (a) (i)

b) Calculate the pH of a resultant solution formed when  $10\text{cm}^3$  of a 0.1M sodium hydroxide solution is added to  $25\text{cm}^3$  of a 0.1M Ethanoic acid at  $25^\circ\text{C}$ .

(Dissociation constant of Ethanoic acid at  $25^\circ\text{C} = 1.8 \times 10^{-5} \text{ mol dm}^{-3}$ )

15. a) Beryllium, magnesium, calcium and barium are some of the elements that belong to Group II of the Periodic Table.

State how the elements react with sulphuric acid and give the conditions for the reactions

- b) i) State how the solubilities of the sulphates of Group II elements vary down the group.  
ii) Explain your answer in (b) (i)  
c) Write equation for the reaction of:  
i) beryllium with sodium hydroxide solution  
ii) Explain your answer in (b) (i)

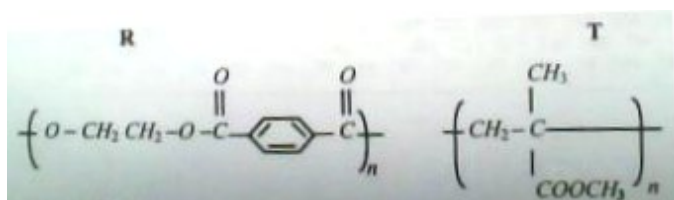
16. In the manufacture of ammonia, nitrogen is catalytically hydrogenated to give ammonia according to the following equation.

Image

- a) i) Name the catalyst used in the reaction  
ii) Write the expression for the equilibrium constant,  $K_p$  for the reaction.  
b) State what would happen to the position of the equilibrium if:  
i) pressure was increased  
ii) temperature was increased  
c) When 3 moles of hydrogen and 1 mole of nitrogen were mixed and allowed to attain equilibrium at 100 atms and  $400^\circ\text{C}$ , the equilibrium mixture contained 25% of ammonia by volume.  
Calculate the:  
i) number of moles of nitrogen and hydrogen at equilibrium  
ii) value of the equilibrium constant,  $K_p$  at  $400^\circ\text{C}$

17. a) Differentiate between addition and condensation polymers

b) The structural formulae of two polymers R and T are shown below



Name the polymer;

i) R

ii) T

c) Write the structural formula(e) of monomer(s) of the polymers R and T respectively

d) Give one use of:

i) R

ii) T

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