



Our country, our future

525/1

## **S6 CHEMISTRY**

**Exam 3**

### ***PAPER 1***

**DURATION: 2 HOUR 45 MINUTES**

**For Marking guide contact and consultations: Dr. Bbosa Science 0776 802709.**

#### INSTRUCTIONS

Attempt all questions in Section A and only six in Section B.

#### SECTION A

1. (a) Explain why an azeotrope is a mixture and not a compound

.....

.....

.....

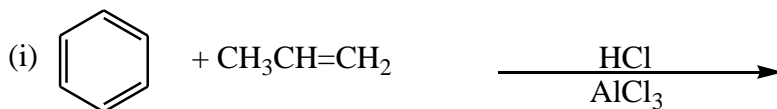
- (b) Name three methods for separating azeotropic mixtures

.....

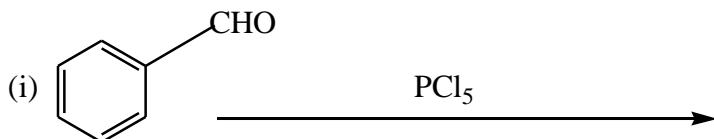
.....

- .....
- (b) Naphthalene ( $C_{10}H_8$ ) distils in steam at  $98.3^{\circ}C$  under a pressure of 753mmHg. The vapor pressure of water at this temperature is 715mmHg. Calculate the percentage by mass of Naphthalene in the distillate.
- .....
- .....
- .....

2. (a) complete the following equations and name the major product.



Name of the product .....



Name of the product .....

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

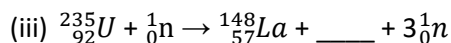
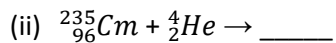
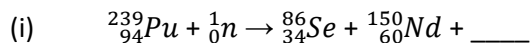
3. (a) State three properties of beta particles.

.....

.....

.....

(b) Complete the following nuclear transformations



(c) Francium isotope ( ${}_{87}^{223}\text{Fr}$ ) emits beta particles. the rate of emission reduces from 14.0 to 7.5 counter in 80 second. Calculate the half life of isotopes.

.....

.....

.....

.....

.....

.....

4. (a) Draw the structures and name the shapes of the following species

Species	Structure	shape
$\text{HCO}_3^-$		
$\text{NO}_2^-$		
$\text{SO}_3^{2-}$		

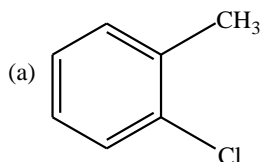
(b) Explain why the nitrite ion ( $\text{NO}_2^-$ ) adopts the shape you have named in (a)

.....

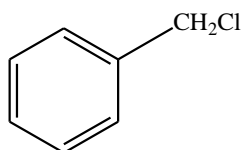
.....

.....

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



and



Reagents .....

.....

Observations(s)

.....

.....

(b)  $\text{CH}_3\text{COCH}_3$  and  $\text{CH}_3\text{CH}_2\text{CHO}$

Reagents .....

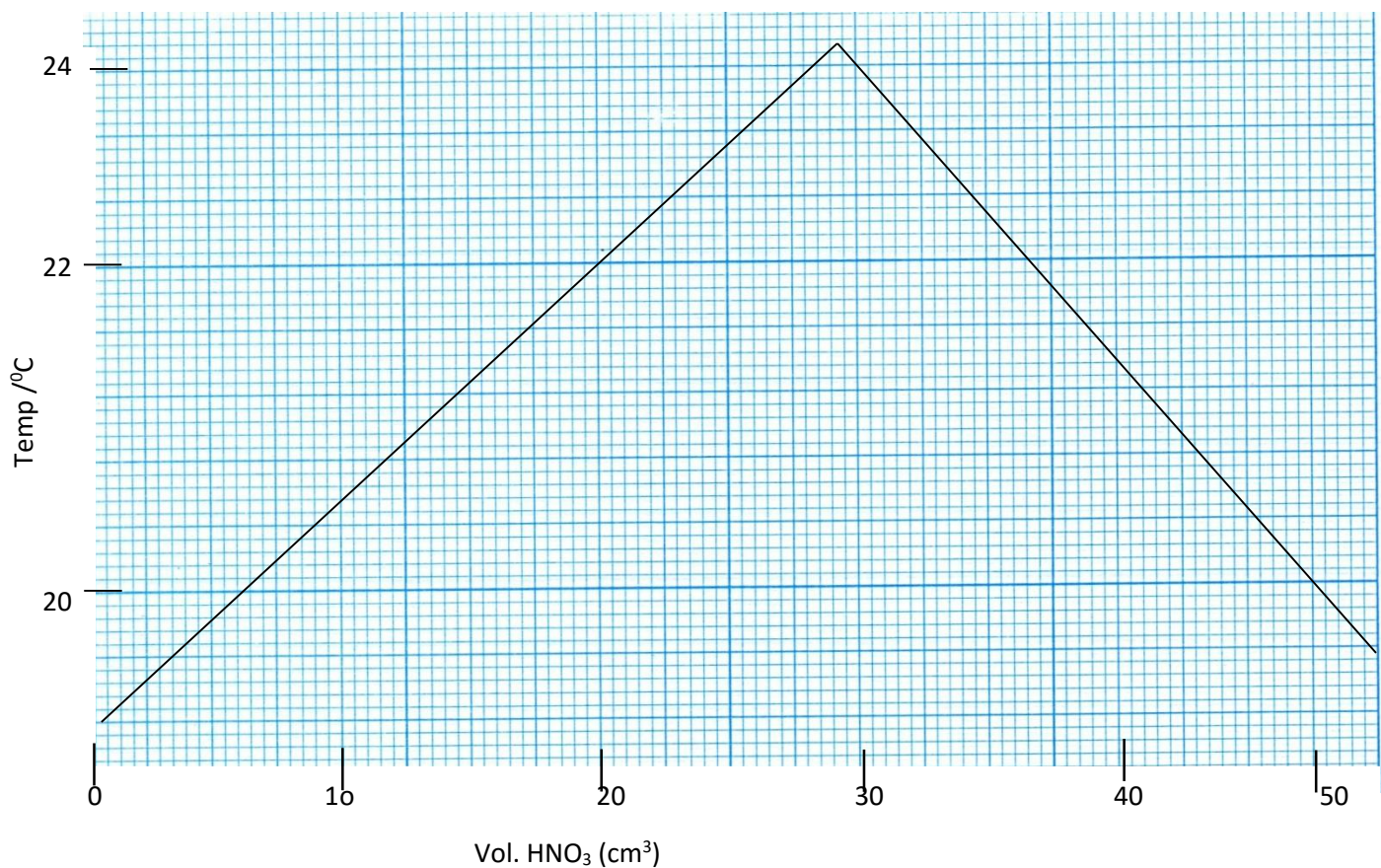
.....

Observations(s)

.....

.....

6. The graph below was obtained when nitric acid was gradually added to  $50\text{cm}^3$  of  $0.72\text{M}$  potassium hydroxide in a calorimeter of negligible heat capacity



(a) Determine the volume of nitric acid required to neutralize potassium hydroxide?

.....

.....

(b) Calculate

(i) Molarity of nitric acid

.....

.....

.....

.....

.....

.....

.....

- .....
- (ii) Heat of neutralization of nitric acid by potassium hydroxide (Density of solution =  $1.0\text{gcm}^3$ )

.....

.....

.....

.....

.....

.....

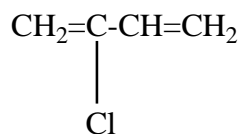
.....

.....

.....

.....

7. (a) A synthetic rubber, Z, was made from (n) monomers with structure



- (i) State the condition for the reaction

.....

.....

- (ii) Write the equation leading the formation of Z.

.....

.....

- (b) Name the type reaction in a (i).

.....

.....

(c) A solution containing 5.0g of Z in 200cm<sup>3</sup> of benzene is found to have an osmotic pressure of 34kPa at 17°C. Calculate the:

(i) Molar mass of Z

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Number of moles of monomers

.....

.....

.....

.....

8. (a) State Raoult's law of relative lowering of vapour pressure.

.....

.....

.....

(b) (i) Calculate the vapour pressure of a solution containing 18g of glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) in 50g of water at 60°C. (vapour pressure of water at 60°C is 150mmHg.)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) State any assumptions made in (b)(i)

.....

.....

.....

9. (a) State three properties in which boron resembles silicon

(1 ½ mark)

.....

.....

.....

.....

.....

.....

(b) Write equation(s) for the reaction of the chloride of boron and silicon with water (3marks)

.....

.....

.....



**SECTION B**

Attempt any six questions from this section

10. Bauxite is the principal ore used for the extraction of aluminium.

(a) (i) Write the formula of bauxite. (½ mark)

.....

Name **two** impurities in bauxite (1mark)

.....

.....

(b) Briefly explain how pure aluminium can be obtained from bauxite.  
(Include appropriate equations where necessary) (3marks)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Sodium carbonate solution was added to an aqueous solution of aluminium chloride

(i) State what was observed (1mark)

.....

(ii) Write equation of the reaction that took place (1 ½ mark)

.....

.....

11. (a) State three reasons why fluorine differs in some of its properties from the rest of group (VII) elements. (3marks)

.....

.....

.....

.....

.....

.....

(b) Write equation for ionization of hydrogen fluoride in aqueous solution that are

(i) Dilute (1 ½ marks)

.....  
.....

(ii) Concentrated

(1 ½ marks)

.....  
.....

(c) Explain why hydrogen fluoride is a weaker acid than hydrogen chloride

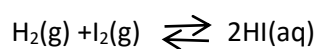
(3marks)

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

12. (a) State three characteristics of a chemical equilibrium

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

(b) Hydrogen and iodine react according to the following equations



Write the expression for the equilibrium constant  $K_c$ .

.....  
.....

(c) 0.5 molar quantities of hydrogen and iodine were sealed in a glass bulb at  $445^\circ\text{C}$  until equilibrium was reached. The glass bulb was then rapidly cooled and broken under alkali.

- (i) Explain why the glass bulb was rapidly cooled and broken under alkalis.

.....  
 .....

The equilibrium mixture was found to contain 0.78 moles of hydrogen iodide. Calculate the value of the equilibrium constant,  $K_c$  for the reaction at  $445^\circ\text{C}$ .

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

- (d) State what would happen to the position of equilibrium of the reaction in (b) when

- (i) Sodium thiosulphate solution is added to the equilibrium mixture.

.....  
 .....

- (ii) Argon gas is added at constant volume.

.....  
 .....

13. (a) A compound Z contains 19.1% nitrogen, 43.6% oxygen and rest manganese.

- (i) Calculate the empirical formula of Z.

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

- (ii) 10g of Z in 1000g of water lowered the freezing point by  $0.127^\circ\text{C}$ . Calculate the molecular formula of Z. ( $K_f$  for water is  $1.86^\circ\text{C mol}^{-1}\text{kg}^{-1}$ ).

.....

.....

.....

.....

.....

.....

- (b) When Z was strongly heated brown fumes were given off. Z dissolved in water to form a pink solution which decolorizes acidified potassium permanganate (VII). Identify Z.

.....

.....

.....

- (c) State what would be observed and write equation(s) for the reaction(s) that took place in the reaction in (b) when:

- (i) Concentrated nitric acid and lead (IV) oxide was added and the mixture boiled.

Observation

.....

.....

Equation

.....

.....

- (ii) Sodium carbonate solution was added

Observation

.....

.....

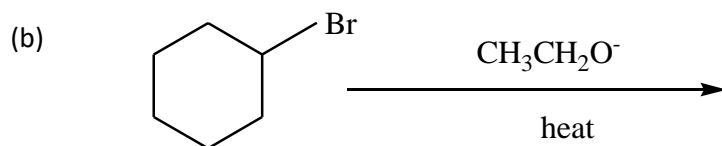
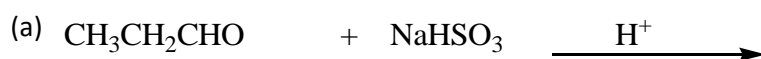
(iii) Equation

.....

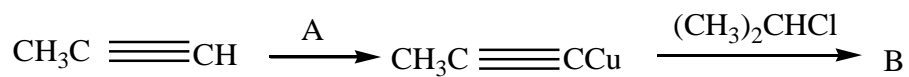
.....

14. Complete the following equations and in each case write acceptable mechanism of the reaction.

(3marks each)



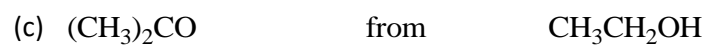
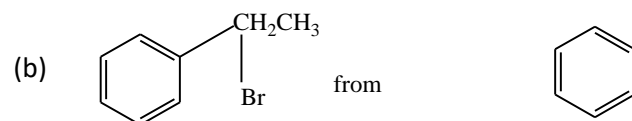
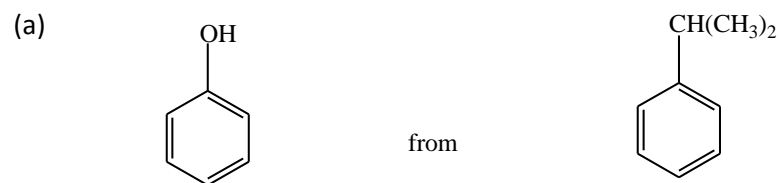
(c) Identify condition and reagent A and product B in the following equation



Reagent A .....

Product B .....

15. Show how the following conversions can be attained. In each case indicate the reagent and conditions for the reaction. (3marks each)



16. (a) The solubility of lead (II) iodide is 0.122g in 100cm<sup>3</sup> of water at 40°C.

(i) Write equation for the solubility of lead (II) iodide in water.

.....

.....

(ii) Write expression for the solubility product of lead (II) iodide.

.....

.....

(iii) Calculate the solubility product of lead (II) iodide.

.....

.....

.....

.....

.....

.....

(c) 50cm<sup>3</sup> of 0.001M lead (II) nitrate was mixed with 50cm<sup>3</sup> of 0.001M potassium iodide. Deduce whether lead (II) iodide will be precipitated or not. Show your working.

.....

.....

.....

.....



.....

.....

.....

.....

.....

.....

.....

.....

17. (a) State factors that can affect standard electrode potential of an element.

.....

.....

.....

.....

(b) The standard electrode potential  $M^{2+}(aq)/M(s)$  for group II elements are given in the table below:

Element	Be	Mg	Ca	Sr	Ba
S.E.P $M^{2+}(aq)/M(s)$	-1.85	-2.37	-2.87	-2.89	-2.91

(i) State and explain the trend in the variation of standard electrode potential

.....

.....

.....

(ii) Explain why the values of standard electrode potentials are negative.

.....

.....

.....

(c) Electrode potential for some cells are given below

Half cell	$E^0/V$
Pt(s)/ $SO_4^{2-}$ , $SO_3^{2-}$	-0.90
$Cu^{2+}(aq)$ , Cu(s)	+0.34

- (i) Write the equation of reaction that takes place at the  
Anode

.....

Cathode

.....

Overall equation

.....

- (ii) Calculate the emf of the cell.

.....

.....

.....

- (iii) State whether the reaction in (a)(ii) above is feasible or not. Give a reason for your answer.

.....

.....

.....

END