Name: ……..

Date Due: ……..

80%	A
70%	B
60%	C
50%	D
40%	E
Below	U

1.2

Assessed Homework

Amount of Substance

%
59

.

1. (a) Define the term relative atomic mass.

……

……

(2)

(b) How would you calculate the mass of one mole of atoms from the mass of a single atom?

…….. (1)

(c) Sodium hydride reacts with water according to the following equation.

$$NaH_{(s)} + H_2O_{(l)} \rightarrow NaOH_{(aq)} + H_{2\,(g)}$$

A 1.00 g sample of sodium hydride was added to water and the resulting solution was diluted to a volume of exactly 250 cm^3

(i) Calculate the concentration in $moldm^{-3}$, of sodium hydroxide solution formed.

……

……

……

(ii) Calculate the volume of hydrogen gas evolved, measured at 293 K and 100 kPa.

……

……

……

(iii) Calculate the volume of 0.112 M hydrochloric acid which would react exactly with a 25.0 cm^3 sample of sodium hydroxide solution.

……

……

……

……

(8)

[TOTAL 11 marks]

2. (a) Sodium carbonate forms a number of hydrates of general formula $Na_2CO_3.xH_2O$

A 3.01 g sample of one of these hydrates was dissolved in water and the solution made up to 250 cm^3.
In a titration, a 25.0 cm^3 portion of this solution required 24.3 cm^3 of 0.200 mol^{-1} dm^{-3} hydrochloric acid for complete reaction.

The equation for this reaction is shown below.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

(i) Calculate the number of moles of HCl in 24.3 cm^3 of 0.200 mol dm^{-3} hydrochloric acid.

.....

(ii) Deduce the number of moles of Na_2CO_3 in 25.0 cm^3 of the Na_2CO_3 solution.

.....

(iii) Hence deduce the number of moles of Na_2CO_3 in the original 250 cm^3 of solution.

.....

(iv) Calculate the M_r of the hydrated sodium carbonate.

.....

.....

(5)

(b) In an experiment, the M_r of a different hydrated sodium carbonate was found to be 250.
Use this value to calculate the number of molecules of water of crystallisation, *x*, in this hydrated sodium carbonate, $Na_2CO_3.xH_2O$

.....

.....

.....

.....

(3)

(c) A gas cylinder, of volume 5.00×10^{-3} m^3, contains 325 g of argon gas.

(i) Give the ideal gas equation.

.....

(ii) Use the ideal gas equation to calculate the pressure of the argon gas in the cylinder at a temperature of 298 K.
(The gas constant R = 8.31 J K^{-1} mol^{-1})

.....

.....

.....

.....

(4)

[Total 12 marks]

3. (a) A sample of ethanol vapour, C_2H_5OH (M_r = 46.0), was maintained at a pressure of
100 kPa and at a temperature of 366K.

(i) State the ideal gas equation.

.....

(ii) Use the ideal gas equation to calculate the volume, in cm^3, that 1.36 g of ethanol vapour would occupy under these conditions.
(The gas constant R = 8.31 J K^{-1} mol^{-1})

.....

.....

.....

.....

.....

.....

.....

(5)

(b) Magnesium nitride reacts with water to form magnesium hydroxide and ammonia.

(i) Balance the equation, given below, for the reaction between magnesium nitride and water.

$$Mg_3N_2 + H_2O \rightarrow Mg(OH)_2 + NH_3$$

(ii) Calculate the number of moles, and hence the number of molecules, of NH_3 in 0.263 g of ammonia gas.

(The Avogadro constant $L = 6.02 \times 10^{23}$ mol^{-1})

.....

.....

.....

.....

.....

(4)

(c) Sodium carbonate is manufactured in a two-stage process as shown by the equations below.

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

Calculate the maximum mass of sodium carbonate which could be obtained from 800 g of sodium chloride.

.....

.....

.....

.....

.....

(4)

[Total 13 marks]

4. (a) The equation for the reaction between magnesium carbonate and hydrochloric acid is given below.

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$$

When 75.0 cm^3 of 0.500 mol dm^{-3} hydrochloric acid were added to 1.25 g of impure $MgCO_3$ some acid was left unreacted. This unreacted acid required 21.6 cm^3 of a 0.500 mol dm^{-3} solution of sodium hydroxide for complete reaction.

(i) Calculate the number of moles of HCl in 75.0 cm^3 of 0.500 mol dm^{-3} hydrochloric acid.

.....

(ii) Calculate the number of moles of NaOH used to neutralise the unreacted HCl.

.....

.....

(iii) Show that the number of moles of HCl which reacted with the $MgCO_3$ in the sample was 0.0267

.....

(iv) Calculate the number of moles and the mass of $MgCO_3$ in the sample, and hence deduce the percentage by mass of $MgCO_3$ in the sample.

Moles of $MgCO_3$ .....

.....

Mass of $MgCO_3$ .....

.....

Percentage of $MgCO_3$ .....

.....

(8)

(b) A compound contains 36.5% of sodium and 25.5% of sulphur by mass, the rest being oxygen.

(i) Use this information to show that the empirical formula of the compound is Na_2SO_3

.....

.....

.....

.....

.....

.....

(ii) When Na_2SO_3 is treated with an excess of hydrochloric acid, aqueous sodium chloride is formed and sulphur dioxide gas is evolved. Write an equation to represent this reaction.

.....

.....

(4)

[Total 12 marks]

5. (a) Give the meaning of the term empirical formula

……

…… …….. (1)

(b) Analysis of 3.150 g of compound X showed that it contained 0.769 g of calcium and 0.539 g of nitrogen; the remainder was oxygen. Calculate the empirical formula of X.

……

……

……

(3)

(c) What additional information is required in order to deduce the molecular formula of X.

…….. (1)

(d) A sample of X when heated in alkaline solution with an aluminium-zinc alloy produced ammonia gas. After cooling to 293 K, the ammonia occupied a volume of 1.53 x 10^{-3} m3 at a pressure of 95.0 kPa. The ammonia was dissolved in water and made up to 250 cm^3 of aqueous solution. A 25.0 cm^3 sample of this was then titrated with a 0.150 M hydrochloric acid.

(i) Calculate the number of moles of ammonia gas in 1.53x 10^{-3} m^3 , at a pressure of 95.0 kPa and a temperature of 293K.

……

……

……..

(ii) Calculate the concentration in $moldm^{-3}$ of ammonia in aqueous solution.

……

……

(iii) Calculate the volume of 0.150 M hydrochloric acid required to neutralise the 25.0 cm^3 sample of ammonia solution.

……

……..

(6)

[Total 11 marks]