

Name:

Date Due:

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

1.2

**Assessed Homework
Amount of Substance**

%

59

10.2 Assessed Homework

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

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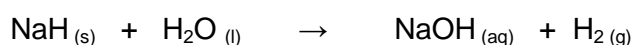
(2)

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

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(1)

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



A 1.00 g sample of sodium hydride was added to water and the resulting solution was diluted to a volume of exactly 250 cm³

- (i) Calculate the concentration in mol dm⁻³, of sodium hydroxide solution formed.

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

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- (iii) Calculate the volume of 0.112 M hydrochloric acid which would react exactly with a 25.0 cm³ sample of sodium hydroxide solution.

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(8)

[TOTAL 11 marks]

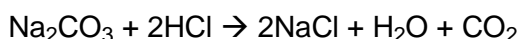
10.2 Assessed Homework

2. (a) Sodium carbonate forms a number of hydrates of general formula $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$

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 $0.200 \text{ mol dm}^{-3}$ hydrochloric acid for complete reaction.

The equation for this reaction is shown below.



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

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

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

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

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(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, $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$

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(3)

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

- (i) Give the ideal gas equation.

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10.2 Assessed Homework

- (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 $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

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(4)

[Total 12 marks]

3. (a) A sample of ethanol vapour, $\text{C}_2\text{H}_5\text{OH}$ ($M_r = 46.0$), was maintained at a pressure of 100 kPa and at a temperature of 366K.

- (i) State the ideal gas equation.

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- (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 $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

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(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.



10.2 Assessed Homework

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

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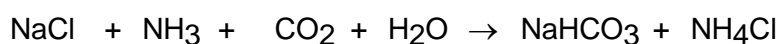
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(4)

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



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

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(4)

[Total 13 marks]

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



When 75.0 cm^3 of $0.500 \text{ mol dm}^{-3}$ 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 $0.500 \text{ mol dm}^{-3}$ solution of sodium hydroxide for complete reaction.

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

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10.2 Assessed Homework

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

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

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- (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

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(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

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- (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.

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(4)

[Total 12 marks]

10.2 Assessed Homework

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

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..... (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.

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..... (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 $1.53 \times 10^{-3} \text{ m}^3$ 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 $1.53 \times 10^{-3} \text{ m}^3$, at a pressure of 95.0 kPa and a temperature of 293K.

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

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

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(6)

[Total 11 marks]