TUTOR ZONE

Name

Percentage	
Grade	

GCSE Chemistry

Moles

Duration: 45 mins

Total Marks: 47

Information for Candidates:

- Use black or blue ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional paper is used, the question number(s) must be clearly shown
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

Do not write in this table	
Question	Mark
TOTAL	

0 5 A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid.

In both reactions one of the products is copper chloride.

0 5 . 1 Describe how a sample of copper chloride crystals could be made from copper carbonate and dilute hydrochloric acid.

[4 marks]

0 5 . 2 A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:

$$CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + CO_2$$

Relative atomic masses, A_r: H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.

[4 marks]

Mass of copper carbonate = _____ g

0 5 . 3 The percentage yield of copper chloride was 79.1 %.

Calculate the mass of copper chloride the student actually produced.

[2 marks]

Actual mass of copper chloride produced = _____ g

Question 5 continues on the next page

0 5 . 4 Look at the equations for the two reactions:

Reaction 1 $CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$

Reaction 2 $CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$

Reactive formula masses: CuO = 79.5; HCl = 36.5; $CuCl_2$ = 134.5; H_2O = 18

The percentage atom economy for a reaction is calculated using:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$$

Calculate the percentage atom economy for Reaction 2.

[3 marks]

Percentage atom economy = _____ %

0 5 . 5 The atom economy for Reaction 1 is 68.45 %.
Compare the atom economies of the two reactions for making copper chloride.

Give a reason for the difference.

[1 mark]

0 8 Sodium hydroxide neutralises sulfuric acid.

The equation for the reaction is:

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

0 8 . 1 Sulfuric acid is a strong acid.

What is meant by a strong acid?

[2 marks]

0 8 . 2 Write the ionic equation for this neutralisation reaction. Include state symbols.

[2 marks]

A student used a pipette to add 25.0 cm^3 of sodium hydroxide of unknown concentration to a conical flask.

The student carried out a titration to find out the volume of 0.100 mol/dm^3 sulfuric acid needed to neutralise the sodium hydroxide.

0 8 . 3 Describe how the student would complete the titration.

You should name a suitable indicator and give the colour change that would be seen.

[4 marks]

Question 8 continues on the next page

The student carried out five titrations. Her results are shown in **Table 5**.

Table 5

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of 0.100 mol/dm^3 sulfuric acid in cm^3	27.40	28.15	27.05	27.15	27.15

0 8 . 4 Concordant results are within 0.10 cm^3 of each other.

Use the student's concordant results to work out the mean volume of 0.100 mol/dm^3 sulfuric acid added.

[2 marks]

Mean volume = _____ cm^3

0 8 . 5 The equation for the reaction is:

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

Calculate the concentration of the sodium hydroxide.

Give your answer to three significant figures.

[4 marks]

Concentration = _____ mol/dm^3

0 8 . 6 The student did another experiment using 20 cm^3 of sodium hydroxide solution with a concentration of 0.18 mol/dm^3.

Relative formula mass (M_r) of NaOH = 40

Calculate the mass of sodium hydroxide in 20 cm^3 of this solution.

[2 marks]

Mass = _____ g

Turn over for the next question

10 (a) In an experiment, ammonia gas is made by heating a mixture of ammonium chloride and calcium hydroxide.

$$2NH_4Cl(s) + Ca(OH)_2(s) \rightarrow CaCl_2(s) + 2NH_3(g) + 2H_2O(l)$$

10.0 g of ammonium chloride is added to an excess of calcium hydroxide.

Calculate the maximum volume of ammonia gas that could be formed.

(relative atomic mass H = 1.00, N = 14.0, O = 16.0 and Ca = 40.0; one mole of any gas occupies 24 dm^3 at room temperature and pressure)

(2)

volume = ... dm^3

(b) Sodium hydroxide solution reacts with hydrochloric acid.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

(i) 25.0 cm^3 of 0.100 mol dm^{-3} sodium hydroxide, NaOH, solution is added to 35.0 cm^3 of 0.0750 mol dm^{-3} dilute hydrochloric acid, HCl.

Use the information to determine which reagent is in excess.

(3)

(ii) To find the exact amount of dilute hydrochloric acid that reacts with 25.0 cm^3 of the sodium hydroxide solution, a titration is carried out. Figure 14 shows the results for the titrations.

	1st titration	2nd titration	3rd titration	4th titration
final burette reading / cm^3	37.60	36.20	39.15	38.40
initial burette reading / cm^3	1.80	0.00	3.95	2.10
volume of acid used / cm^3	35.80	36.20	35.20	36.30

Figure 14

In this titration, the accurate volumes of acid used that are within 0.20 cm^3 of each other are considered concordant volumes.

Use the concordant results to calculate the mean volume of hydrochloric acid required.

(1)

mean volume = ... cm^3

(iii) During the titration, the indicator used changed colour at the end point.

Which of the following shows an indicator with the colour change that would be seen in this titration?

(1)

		indicator	colour in alkali	colour at end point
☒	**A**	phenolphthalein	colourless	pink
☒	**B**	phenolphthalein	pink	yellow
☒	**C**	methyl orange	red	yellow
☒	**D**	methyl orange	yellow	orange

(c) In another titration, 25.0 cm^3 of a different sodium hydroxide solution is titrated with 0.200 mol dm^{-3} sulfuric acid, H_2SO_4.

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

24.80 cm^3 of acid are required to neutralise 25.0 cm^3 of the sodium hydroxide solution.

Calculate the concentration of the sodium hydroxide solution, NaOH, in mol dm^{-3}.

(4)

concentration = ... mol dm^{-3}

(Total for Question 10 = 11 marks)

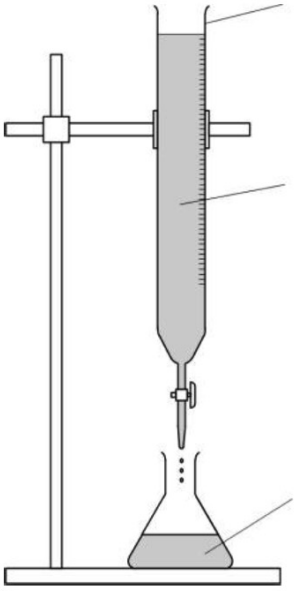
TOTAL FOR PAPER = 100 MARKS

19 A student does three titrations with dilute hydrochloric acid and potassium hydroxide solution.

Hydrochloric acid neutralises the alkali potassium hydroxide.

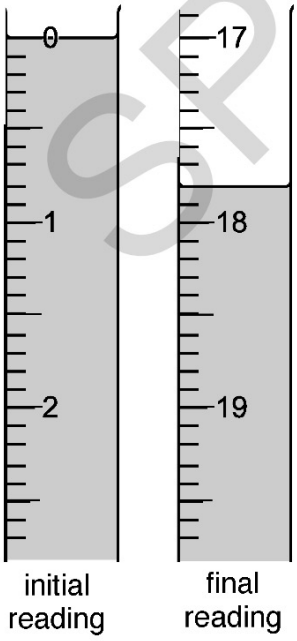
$HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$

Look at the apparatus she uses.



Look at the diagrams. They show parts of the burette during the first titration.

First titration



Here is the student's results table.

Titration number	1	2	3
Final reading (cm^3)		37.5	32.1
Initial reading (cm^3)		20.4	15.0
Titre (volume of acid added) (cm^3)		17.1	17.1

(a) Using the diagrams and table, calculate the mean titre.

Explain your answer.

.....

.....

Answer = ... cm^3 **[2]**

(b) The student uses 25.0 cm^3 of potassium hydroxide solution, KOH.

She also uses hydrochloric acid with a concentration of 0.100 mol/dm^3.

Calculate the concentration, in mol/dm^3, of the KOH(aq).

Answer = ... mol/dm^3 **[2]**

(c) Use your answer to **(b)** to calculate the concentration of the KOH(aq) in g/dm^3.

Answer = ... g/dm^3 **[2]**