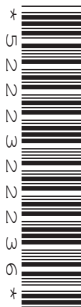

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For Examiner's Use

- 1 A student was given two test-tubes, one containing aqueous ammonia; the other aqueous copper(II) sulfate.

For
Examiner's
Use

- (a) A few drops of litmus solution were added to aqueous ammonia.
What colour is litmus solution in aqueous ammonia?

..... [1]

- (b) What colour is aqueous copper(II) sulfate?

..... [1]

- (c) What observations were made when

- (i) a few drops of aqueous ammonia were added to aqueous copper(II) sulfate,

..... [1]

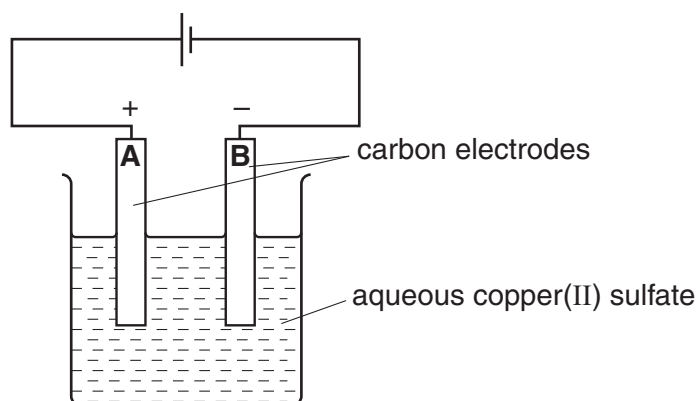
- (ii) an excess of aqueous ammonia was added to the solution from (i)?

..... [2]

[Total: 5]

- 2 A student electrolysed aqueous copper(II) sulfate, using carbon electrodes. The apparatus is shown below.

For
Examiner's
Use



After a few minutes, a pink solid was deposited on one electrode and a gas was evolved at the other electrode.

- (a) (i) At which electrode, **A** or **B**, was the pink solid deposited? Explain your answer.

.....
..... [1]

- (ii) Name the pink solid.

..... [1]

Eventually, no more pink solid was formed. Instead, a gas was produced at this electrode.

- (b) (i) Name this gas.

..... [1]

- (ii) Give a positive test for this gas.

..... [1]

- (c) (i) Name the gas evolved at the other electrode.

..... [1]

- (ii) Give a positive test for this gas.

..... [1]

- (d) (i) How does the colour of the electrolyte change during the electrolysis?

The colour changes from to [1]

- (ii) Explain why this colour change takes place.

..... [1]

[Total: 8]

- 3** A student was given some hydrated iron(II) sulfate crystals, $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$. They were placed in a previously weighed crucible which was reweighed.

For
Examiner's
Use

Mass of crucible + iron(II) sulfate crystals = 10.45 g

Mass of crucible = 6.60 g

- (a)** Calculate the mass of iron(II) sulfate crystals used in the experiment.

..... g [1]

- (b)** The crystals were gently heated until no more water vapour was given off.

- (i)** What word describes the iron(II) sulfate now that it has lost all of its water of crystallisation?

..... [1]

The crucible and contents were reweighed.

Mass of crucible + iron(II) sulfate after heating = 8.90 g

- (ii)** Calculate the mass of iron(II) sulfate which remained after heating.

..... g [1]

- (iii)** Calculate the mass of water lost from the crystals.

..... g [1]

- (c) (i)** Calculate the relative formula mass of iron(II) sulfate, FeSO_4 .

[A_r : Fe, 56; S, 32; O, 16]

.....

- (ii)** Calculate the relative formula mass of water.

[A_r : H, 1; O, 16]

.....

[1]

(d) Using your answers to (b)(ii) and (iii), and (c)(i) and (ii), calculate

(i) how many moles of iron(II) sulfate remained after heating,

..... [1]

(ii) how many moles of water were lost during heating.

..... [1]

(e) The value of **x** in the formula $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ can be found using the following formula.

$$x = \frac{\text{answer to (d)(ii)}}{\text{answer to (d)(i)}}$$

Calculate the value of **x** and hence write the formula of hydrated iron(II) sulfate.

x = [1]

The formula of hydrated iron(II) sulfate is [1]

[Total: 9]

For
Examiner's
Use

In questions 4 to 6 inclusive, place a tick (✓) in the box against the best answer.

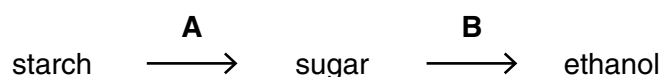
- 4 Ethene, C_2H_4 , reacts with bromine water.
Which of the following observations is correct?

- (a) A brown gas is evolved.
(b) Effervescence occurs.
(c) The colour of the bromine water changes from brown to colourless.
(d) The product of the reaction is a solid.

☐
☐
☐
☐

[Total: 1]

- 5 A student converted starch into ethanol by a two-stage process.
An acid was used in stage **A** and yeast in stage **B**.



What type of reaction takes place in each of stages **A** and **B**?

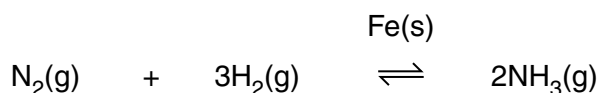
	A	B	
(a)	reduction	esterification	☐
(b)	hydrolysis	fermentation	☐
(c)	fermentation	reduction	☐
(d)	oxidation	hydrolysis	☐

[Total: 1]

For
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Use

- 6 In the Haber process nitrogen and hydrogen are reacted together in the presence of iron to produce ammonia.

For
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Use



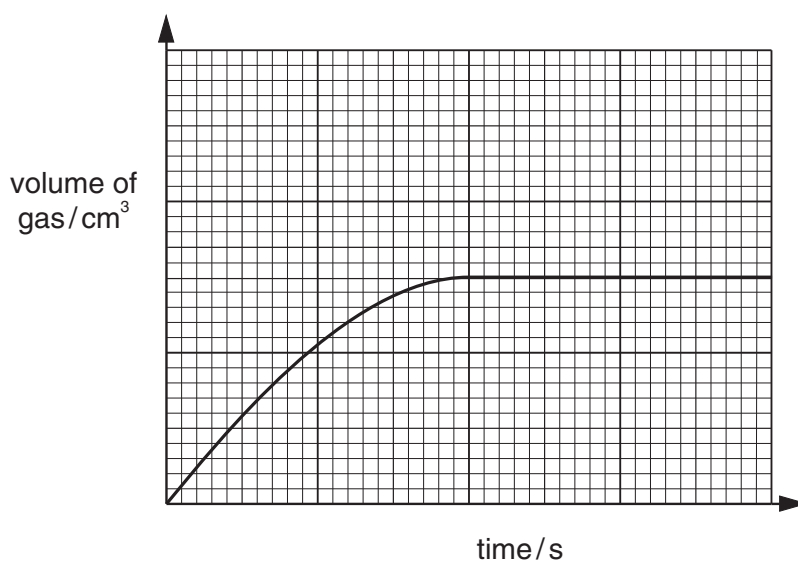
Which of the following statements regarding iron is correct?

- (a) It increases the yield of ammonia. ☐
- (b) Its mass decreases as the experiment proceeds. ☐
- (c) It increases the rate at which ammonia is produced. ☐
- (d) It reacts with nitrogen and hydrogen. ☐

[Total: 1]

- 7 A student reacted 10 cm³ of 1.0 mol/dm³ hydrochloric acid with excess powdered zinc and collected the gas evolved in a gas syringe.

The graph below shows the volume of gas produced against time for this experiment.



The student repeated the experiment, this time reacting 10 cm³ of 2.0 mol/dm³ hydrochloric acid with excess powdered zinc, and collected the gas.

On the same grid, draw a graph to show the volume of gas produced against time for the second experiment.

[Total: 2]

- 8 A student did an experiment to find the relative molecular mass of an organic acid. He titrated solution **R**, an aqueous solution containing 8.50 g/dm^3 of the organic acid, with solution **S**, containing 0.100 mol/dm^3 of sodium hydroxide.

For
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Use

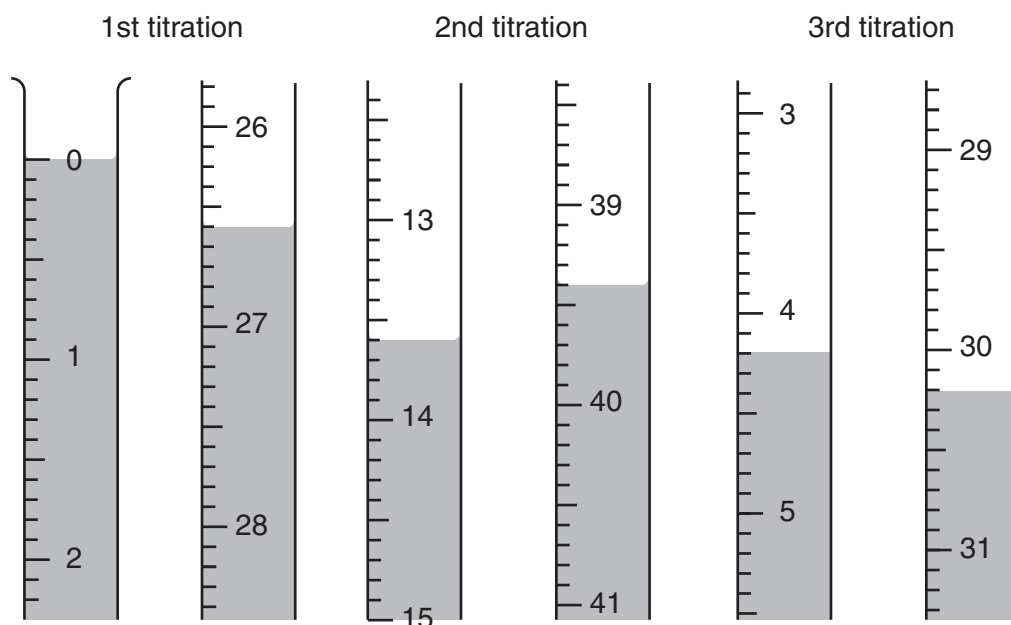
25.0 cm^3 of **S** was transferred into a conical flask and a few drops of phenolphthalein indicator were added. (Phenolphthalein is colourless in acid and pink in alkali.)

R was put into a burette and run into the conical flask containing **S** until the end-point was reached.

- (a) What was the colour change at the end-point?

The colour changed from to [1]

Three titrations were done. The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.



- (b) Use these diagrams to complete the table of results.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of R / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of **R** was cm^3 .
[4]

- (c) Calculate the number of moles of sodium hydroxide in 25.0 cm³ of **S**.

..... moles [1]

- (d) Given that 1 mol of acid neutralises 1 mol of sodium hydroxide, use your answer to (c) to deduce the number of moles of the organic acid in the average volume of **R**.

..... moles [1]

- (e) Calculate the number of moles of the acid in 1.00 dm³ of **R**.

..... moles [1]

- (f) Using your answer to (e) and the information that **R** contains 8.50 g/dm³ of the acid, calculate the relative molecular mass of the acid.

..... [1]

- (g) (i) The general formula of an organic acid is C_nH_{2n+1}CO₂H.

Calculate the value of n in the formula for the organic acid in **R**.

[A_r: C, 12; O, 16; H, 1]

n = [1]

- (ii) Deduce the formula for the organic acid in **R**.

The formula for the organic acid in **R** is [1]

- (h) A sample of the organic acid was reacted with an excess of ethanol, $\text{C}_2\text{H}_5\text{OH}$, in the presence of a small volume of concentrated sulfuric acid to give an organic product, **T**, and water.

For
Examiner's
Use

- (i) Suggest the formula for **T**.

The formula for **T** is[1]

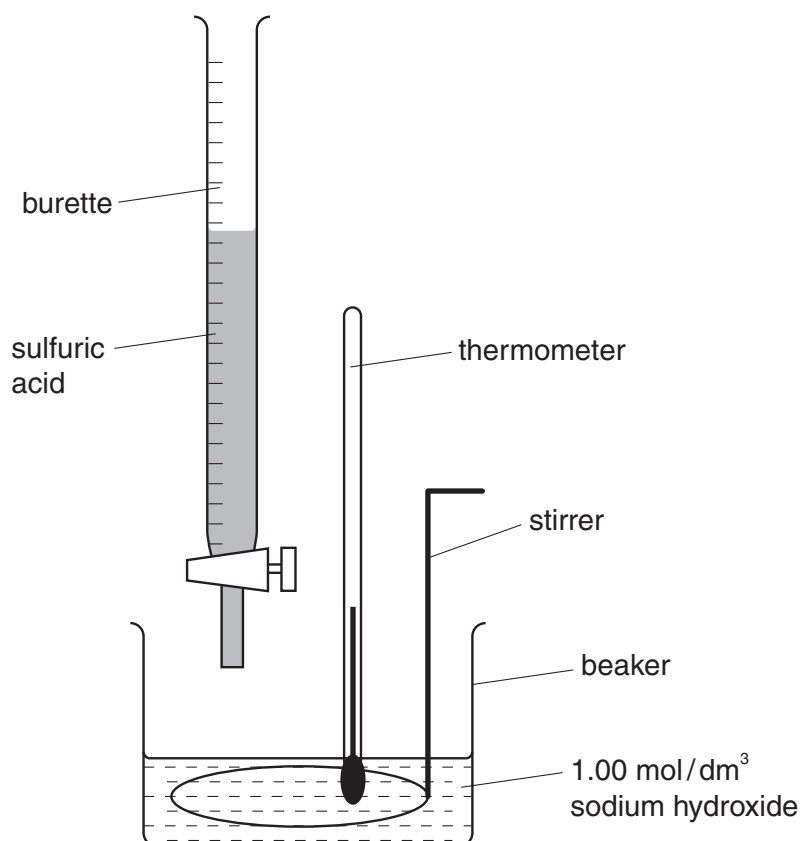
- (ii) To which homologous series does **T** belong?

.....[1]

[Total: 13]

- 10 A student investigated the rise in temperature when sulfuric acid was added to a solution containing 1.00 mol/dm^3 sodium hydroxide, using the apparatus shown below.

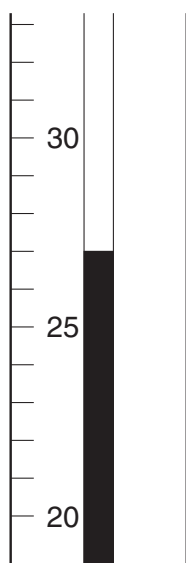
For
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Use



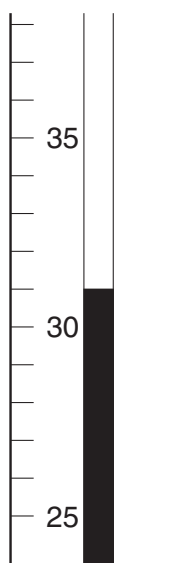
20.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide was poured into a beaker. The temperature of both this solution and the sulfuric acid was 25°C .

Following successive additions of 5.0 cm^3 volumes of sulfuric acid from the burette, further temperature readings were taken.

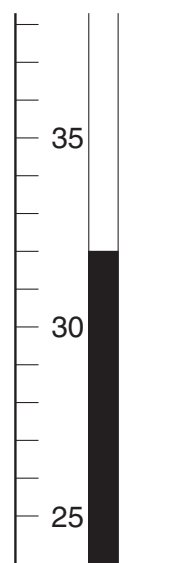
The diagrams below show parts of the thermometer stem giving the temperature after the addition of 5.0 , 15.0 and 25.0 cm^3 of sulfuric acid.



addition of
 5.0 cm^3 of
sulfuric acid



addition of
 15.0 cm^3 of
sulfuric acid



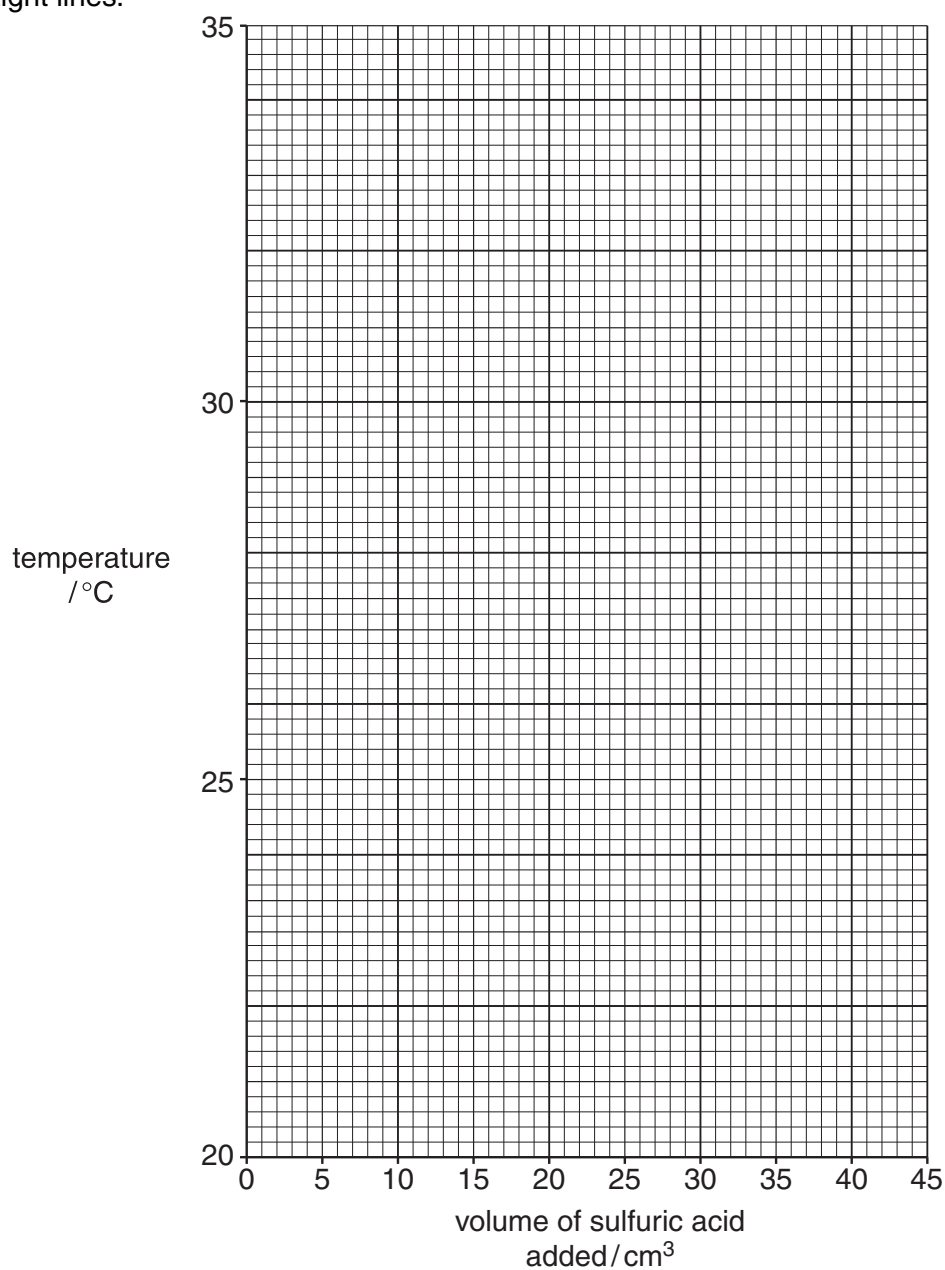
addition of
 25.0 cm^3 of
sulfuric acid

(a) Use the diagrams to complete the following table of results.

volume of sulfuric acid / cm ³	temperature / °C
0.0	25
5.0	
10.0	29
15.0	
20.0	33
25.0	
30.0	29
35.0	26

[1]

(b) Plot these results on the grid below and connect the points with **two** intersecting straight lines.



[3]

Use the graph to answer the following questions.

For
Examiner's
Use

- (c) (i) State the temperature at the intersection of the two lines (highest temperature).

..... °C [1]

- (ii) What volume of sulfuric acid produced this temperature?

..... cm³ [1]

- (d) 20.0 cm³ of 1.00 mol/dm³ sodium hydroxide was used in the experiment.

- (i) Write an equation for the reaction between sodium hydroxide and sulfuric acid.

..... [1]

- (ii) Using your answer to (c)(ii) calculate the concentration of the sulfuric acid.

..... mol/dm³ [2]

- (e) After the highest temperature was reached, explain why the temperature of the solution decreased as more sulfuric acid was added.

.....

.....

..... [2]

[Total: 11]

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