Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Secondary Education
June 2006

CHEMISTRY (MODULAR) SPECIFICATION A **3423/F**
Foundation Tier

F

Wednesday 14 June 2006 9.00 am to 10.30 am

For this paper you must have:
- the Data Sheet (enclosed)
- a ruler

You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 90.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9			
10			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

LEAVE MARGIN BLANK

PATTERNS OF CHEMICAL CHANGE

1 Choose words from the box to complete the sentences.

ammonia	**fermentation**	**hydrogen**	**limestone**
limewater	**methane**	**neutralisation**	**nitrogen**

(a) In air, the most common gases are oxygen and ..... . *(1 mark)*

(b) Carbon dioxide turns ..... milky. *(1 mark)*

(c) Yeast cells convert sugar into alcohol (ethanol) and carbon dioxide by a process called ..... . *(1 mark)*

(d) Nitrogen and hydrogen combine together to make ..... . *(1 mark)*

4

2 Milk contains a sugar called lactose. The formula for lactose is $C_{12}H_{22}O_{11}$.

(a) How many carbon atoms are there in one molecule of lactose, $C_{12}H_{22}O_{11}$?

.....

(1 mark)

(b) Milk is changed into yoghurt by enzymes.

Where do the enzymes come from?

Draw a ring around the correct answer.

bacteria **fruit** **sugar** **yeast**

(1 mark)

(c) When milk is being changed into yoghurt, the temperature is kept below 43 ºC.

Explain why a higher temperature is **not** used.

.....

.....

(1 mark)

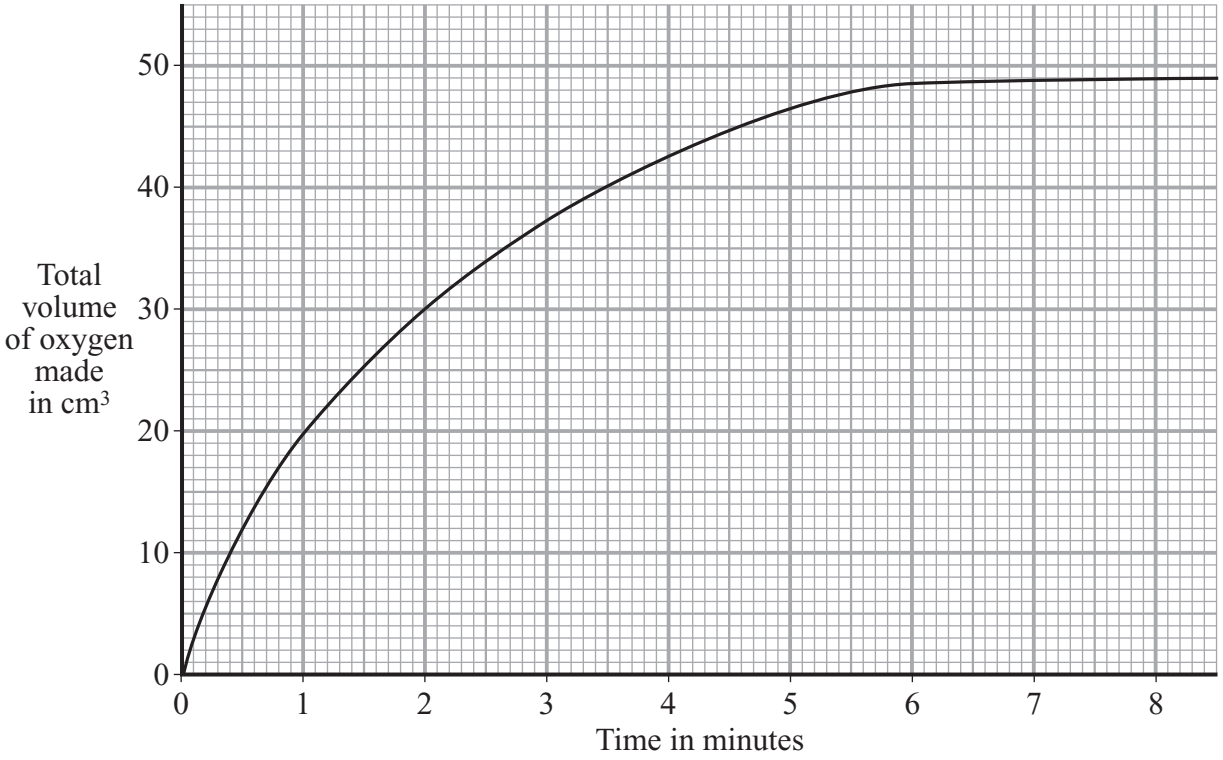
3

3 (a) Hydrogen peroxide, H_2O_2, is both an oxidising agent and an irritant to the skin. Draw rings around the **two** hazard symbols that should be on a bottle of hydrogen peroxide.

(2 marks)

(b) When the catalyst manganese(IV) oxide is added to a solution of hydrogen peroxide, oxygen gas is given off.

The graph shows the total volume of oxygen made during the experiment.



(i) What total volume of oxygen had been made after 2 minutes?

..... cm^3

(1 mark)

(ii) Why does the reaction rate slow down during the experiment?

.....

(1 mark)

(iii) Why does the reaction stop?

.....

(1 mark)

(iv) On the graph paper above, draw a curve to show the results if the same experiment were carried out at a higher temperature. *(2 marks)*

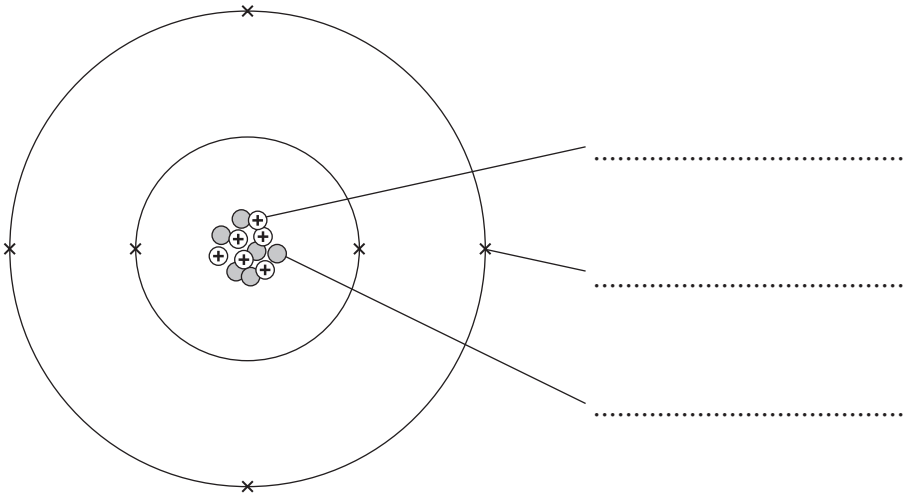
7

Turn over ▶

STRUCTURES AND BONDING

4 (a) The diagram shows an atom of carbon. Choose words from the box to label it.

electron	**neutron**	**proton**



(2 marks)

(b) Give the name of the particle in part (a) that has a negative charge.

.....

(1 mark)

(c) (i) What is the atomic number (proton number) of carbon?

.....

(1 mark)

(ii) What is the mass number of the atom of carbon shown in the diagram above?

.....

(1 mark)

(d) Another atom of carbon can be shown as $^{14}_{6}C$.

How is this atom of carbon different from the atom shown in part (a)?

.....

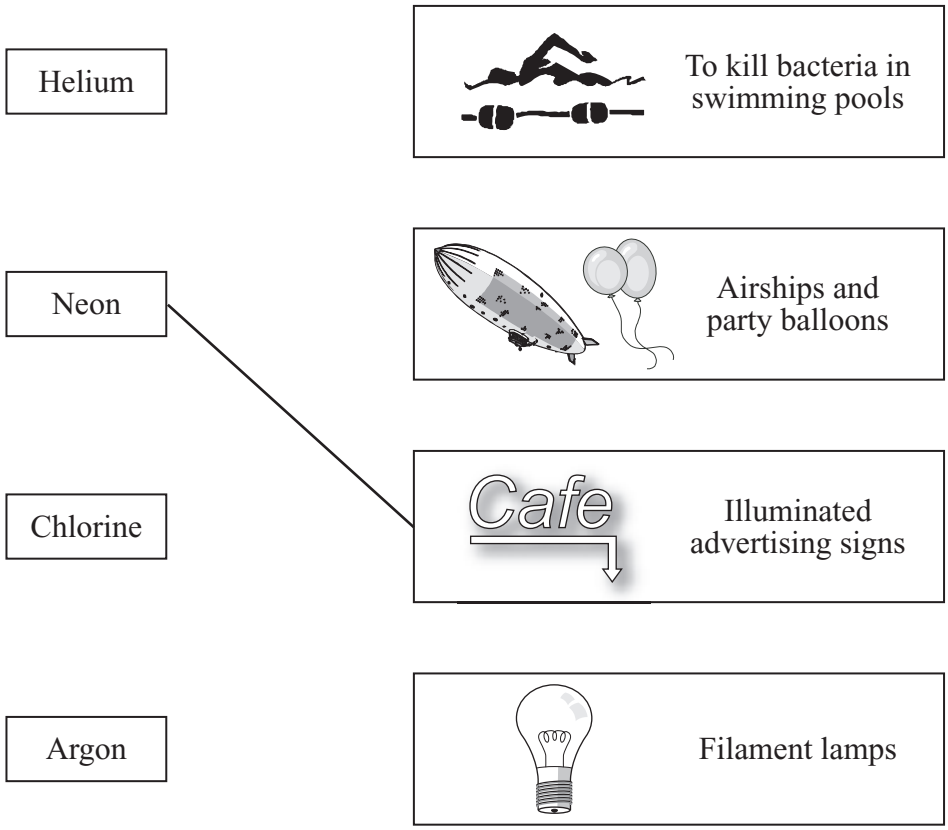
.....

(1 mark)

6

5 (a) The boxes show four gases and a use for each.

Match each gas to its use by drawing straight lines between the boxes.
One has been completed for you.



(2 marks)

(b) Describe a simple test for hydrogen gas. Give the result of the test.

Test.....

.....

Result.....

.....

(2 marks)

4

6 The diagram below shows an outline of the periodic table.
Some elements are identified by letters. These letters are **not** the chemical symbols of the elements.

								D									
A																**J**	
																	E
			R									**G**					**M**
																L	
	T																
Q																	

Choose letters from the table above to answer the following questions.

You may find the periodic table on the Data Sheet helpful when answering these questions.

You do **not** need to identify the elements.

		Letter
(a)	Which element is in Group 3?	
(b)	Which element is the least reactive metal in Group 1?	
(c)	Which element is a halogen and a gas at room temperature?	
(d)	Which element is a noble gas in period 3?	
(e)	Which element has atoms with the lowest mass?	

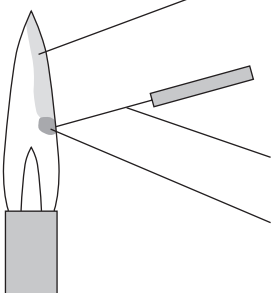
(5 marks)

5

CHEMISTRY IN ACTION

7 Some tests were carried out as shown below. Identify the substances **A**, **B**, **C** and **D**.

(a)

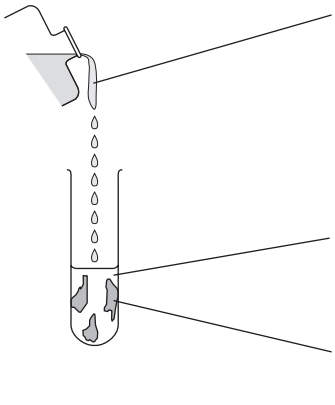


Name the metal ion in solid **A**.

.....

(1 mark)

(b)

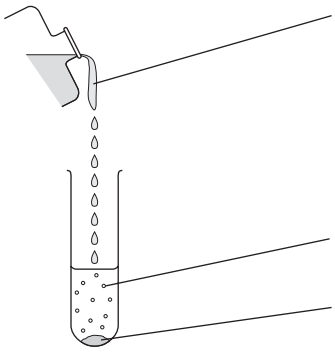


Name the metal ion in solution **B**.

.....

(1 mark)

(c)

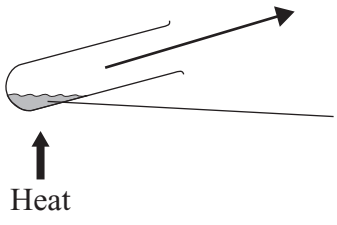


Name the ion in solid **C** that gives gas bubbles when dilute acid is added.

.....

(1 mark)

(d)



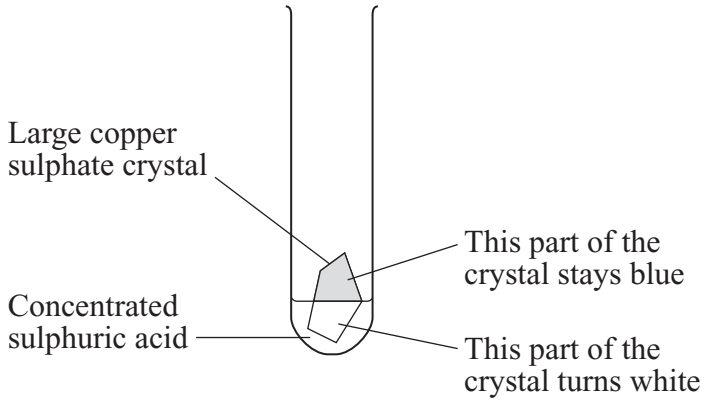
Name the green powder **D**.

.....

(2 marks)

5

8 Copper sulphate crystals are blue. Their chemical formula is $CuSO_4.5H_2O$.
A large crystal of copper sulphate was placed in a test tube containing some concentrated sulphuric acid. Only the lower part of the crystal was in the acid.



(a) (i) Why does the part of the crystal that is in the acid turn white?

.....

.....

(1 mark)

(ii) What property of concentrated sulphuric acid does this experiment show?

.....

(1 mark)

(b) What would you **see** if the crystal was removed from the acid and a few drops of water were added to the white part?

.....

.....

(1 mark)

(c) When warm dilute sulphuric acid is added to a piece of aluminium, there is no immediate reaction. After a few minutes, a very vigorous reaction happens.

Why does the aluminium **not** react immediately with the warm dilute sulphuric acid?

.....

.....

.....

.....

(2 marks)

5

LEAVE MARGIN BLANK

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

9 Pure tartaric acid is a white crystalline solid.
Concentrated sulphuric acid is a colourless liquid.

(a) (i) What must be added to both acids to allow them to show their acidic properties?

.....

(1 mark)

(ii) Give the **formula** of the ion produced in (a)(i) which is responsible for acidity.

.....

(1 mark)

(b) The table shows the results of tests done on solutions of sulphuric and tartaric acids. The solutions were of equal concentration.

	Name of acid	
Test	**Sulphuric acid**	**Tartaric acid**
pH of the solution	1.0	3.0
Reaction with magnesium ribbon	Fast reaction Lots of bubbles	Slow reaction A few bubbles

The results suggest that one of the acids is a *weak acid*.

(i) What is meant by the term *weak acid*?

.....

.....

(1 mark)

(ii) Which acid shown in the table is a *weak acid*?

.....

(1 mark)

(iii) Give the name of a weak alkali.

.....

(1 mark)

(c) What would be the colour of litmus paper if it were added to a solution of tartaric acid?

.....

(1 mark)

6

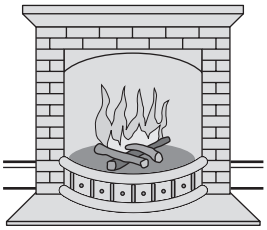
10 Fuels contain organic compounds.

(a) Which element is in **all** organic compounds?

.....

(1 mark)

(b) To burn fuels safely, a good supply of air is needed.



(i) Name the poisonous gas formed when fuels burn in a poor supply of air.

.....

(1 mark)

(ii) Explain why the gas in (b)(i) is poisonous.

.....

.....

(1 mark)

(c) The table compares some properties of four fuels.

Fuel type	**How easy it is to ignite (1 easy : 4 difficult)**	**Cost in pence for 1 unit of energy**	**Burning properties**
Wood	3	1.2	Smoky at first, then clean flame. Ash left.
Natural gas	1	1.5	Very clean flame. No solid residue.
Coal	4	2.3	Very smoky at first, then clean flame. Ash left.
Oil	2	2.8	Clean flame. No solid residue.

(i) Which fuel in the table is the best fuel to use in the home?

.....

(1 mark)

(ii) Give a reason for your answer to part (c)(i).

.....

.....

(1 mark)

5

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PATTERNS OF CHEMICAL CHANGE

11 Ammonia can be changed into nitric acid in three stages.

Stage number	Reaction taking place	Name of substance made
1	Ammonia and oxygen are passed over a catalyst at 900 ºC	Nitrogen monoxide
2	The nitrogen monoxide is cooled and reacted with more oxygen	Nitrogen dioxide
3	The nitrogen dioxide is reacted with water and oxygen	Nitric acid

(a) Name the catalyst used in Stage 1.

.....

(1 mark)

(b) Complete the word equation for Stage 3.

→ nitric acid

(1 mark)

(c) Nitric acid can be changed into the fertiliser ammonium nitrate, NH_4NO_3.

(i) Calculate the relative formula mass (M_r) of ammonium nitrate, NH_4NO_3.
Relative atomic masses: H = 1; N = 14; O = 16

.....

.....

.....

.....

(2 marks)

(ii) Calculate the percentage of nitrogen in ammonium nitrate, NH_4NO_3.

.....

.....

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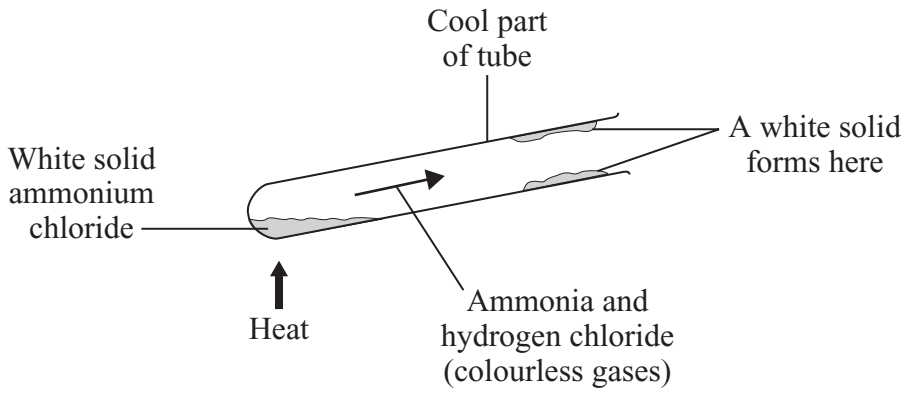
.....

(2 marks)

6

LEAVE MARGIN BLANK

12 Ammonium chloride can be heated as shown in the diagram.



Use the information in the diagram to explain why this reaction is called a *reversible reaction*.

Your explanation should include:

- what happens to the solid ammonium chloride when it is heated;
- why a white solid forms in the cool part of the tube;
- why the reaction is known as a *reversible reaction*.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

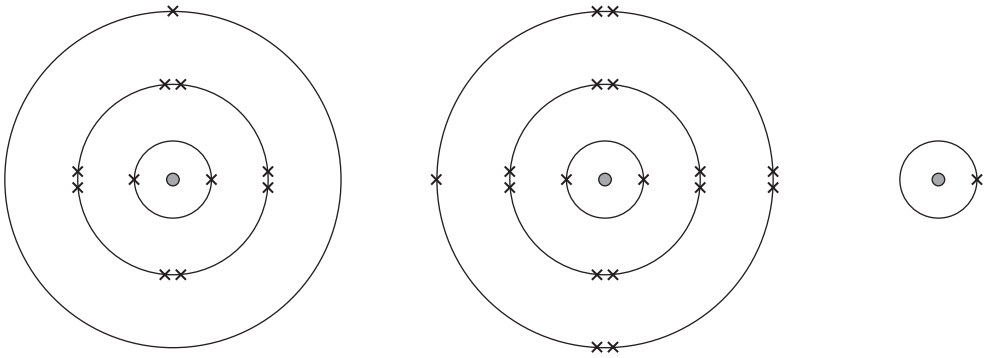
.....

(4 marks)

4

STRUCTURES AND BONDING

13 Chlorine can combine with sodium to form sodium chloride. It can also combine with hydrogen to form hydrogen chloride.
The electronic structures of sodium, chlorine and hydrogen atoms are shown below.



A sodium atom A chlorine atom A hydrogen atom

(a) Describe the changes that take place in the outer energy levels (shells) of sodium and chlorine atoms when they combine to form sodium chloride.

.....

.....

.....

.....

(2 marks)

(b) Describe what happens to the electrons in the outer energy levels (shells) of hydrogen and chlorine atoms when they combine to form hydrogen chloride.

.....

.....

.....

.....

(2 marks)

(c) Name the type of bonding in sodium chloride and in hydrogen chloride.

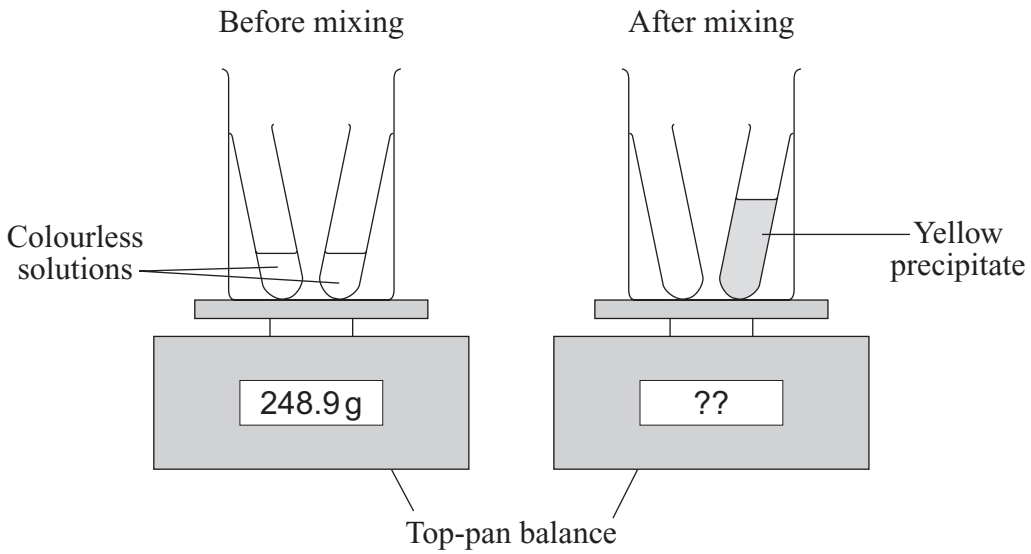
Substance	Type of bonding
sodium chloride	
hydrogen chloride	

(2 marks)

6

14 (a) When solutions of lead nitrate and potassium iodide are mixed together, a bright yellow precipitate is formed.

The diagrams show the apparatus and chemicals being weighed before and after mixing.



(i) Balance the equation for the reaction.

$Pb(NO_3)_2(aq)$ + ...$KI(aq)$ → .....$KNO_3(aq)$ + $PbI_2(s)$

(1 mark)

(ii) What would be the reading on the top-pan balance after mixing?

..... g

(1 mark)

(iii) Explain your answer to part (a)(ii).

.....

.....

(1 mark)

(b) A student repeated the experiment using magnesium carbonate and dilute sulphuric acid.

The equation for the reaction is:

$$MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + CO_2(g) + H_2O(l)$$

The reading on the top-pan balance before mixing the magnesium carbonate and dilute sulphuric acid was 342.5 g.

(i) Complete the following sentence about the result of the experiment.
Show the correct answer in the box by crossing out the two incorrect ones.

The reading on the top-pan balance after the reaction will be | more than / equal to / less than | 342.5 g

(1 mark)

(ii) Explain your answer to part (b)(i).

.....

.....

(1 mark)

5

Turn over for the next question

CHEMISTRY IN ACTION

15 (a) The iron that comes from a blast furnace contains impurities that make it brittle. Molten iron is mixed with recycled scrap iron and is then changed into a mild steel in three stages:

- pure oxygen is passed into the molten mixture;
- calcium carbonate is added;
- a calculated quantity of carbon is added.

Explain what happens in each of the above three stages.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

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.....

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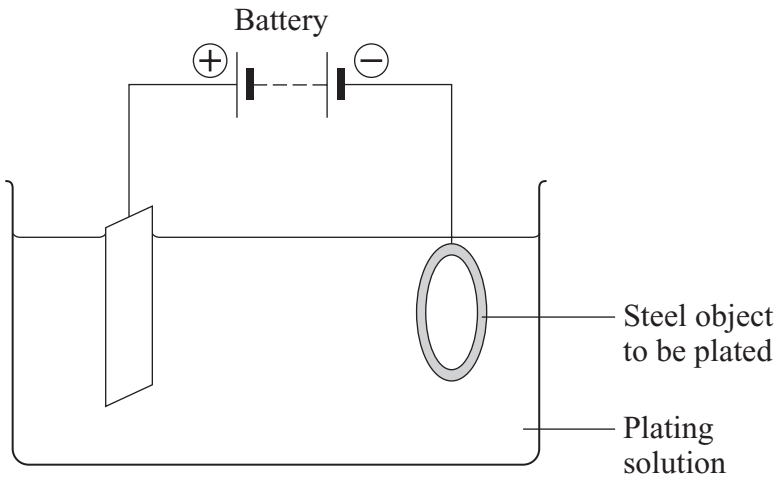
.....

.....

(4 marks)

(b) The appearance of steel can be improved by covering it with a layer of silver. This is called silver plating. The diagram below shows how this can be done.



(i) Name the substance that should be used as the positive electrode in this cell.

.....

(1 mark)

(ii) Give the formula of the positive ion that must be in solution for silver plating to occur.

.....

(1 mark)

6

Turn over for the next question

16 (a) Name the **three** raw materials used to manufacture sulphuric acid by the Contact process.

.....

.....

(2 marks)

(b) One stage in the process involves passing a mixture of sulphur dioxide and air over hot vanadium oxide, V_2O_5. The equation for this stage is:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Why is vanadium oxide used in this process?

.....

(1 mark)

(c) The sulphur trioxide formed is usually dissolved in concentrated sulphuric acid. The liquid formed is then carefully diluted with water to form concentrated sulphuric acid.

Why is the sulphur trioxide not added directly to water?

.....

.....

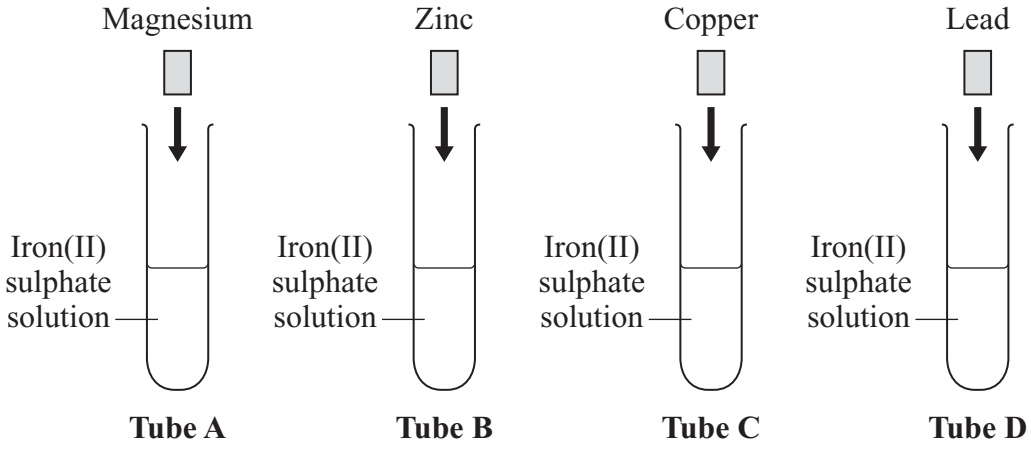
(1 mark)

4

QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES

17 Use the information on the Data Sheet to help you answer these questions.

Iron(II) sulphate solution, $FeSO_4(aq)$, was poured into four test tubes.
A different metal was added to each tube as shown below.



(a) (i) Give the letter of each tube in which a chemical reaction would take place.

.....

(2 marks)

(ii) Explain why a chemical reaction takes place in these tubes.

.....

.....

(1 mark)

(b) Both copper and iron are transition metals.

In which area of the periodic table would you find transition metals?

.....

(1 mark)

(c) Give the name of a metal which, when added to copper sulphate solution, would **not** give a chemical reaction.

.....

(1 mark)

5

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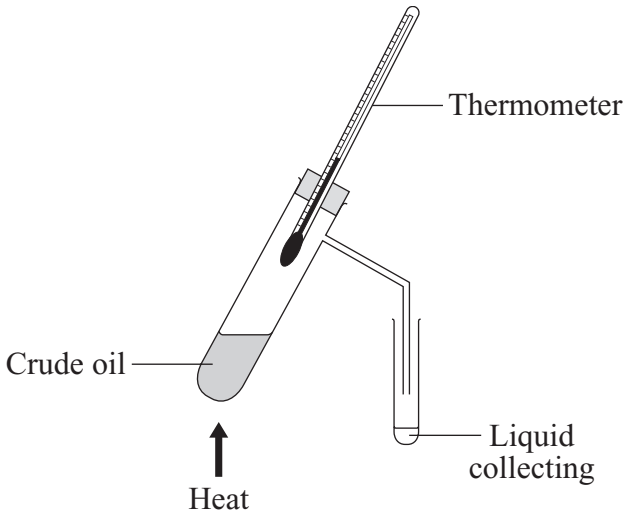
18 The diagram shows how crude oil can be separated into fractions and collected in the laboratory.



(a) Name the separation process demonstrated in this experiment.

.....

(1 mark)

(b) The table below gives some information about four fractions collected during the experiment.

	Fraction number			
	1	**2**	**3**	**4**
Boiling point range	20 – 70 °C	71 – 120 °C	121 – 170 °C	171 – 220 °C

Which fraction (1, 2, 3 or 4) will contain the largest molecules? .....

(1 mark)

(c) Describe how large hydrocarbon molecules can be cracked to produce smaller, more useful molecules.

.....

.....

.....

.....

(2 marks)

4

END OF QUESTIONS