

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Foundation Tier and Higher Tier
November 2012

Science A

Unit Chemistry C1a (Products from Rocks)

Chemistry

Unit Chemistry C1a (Products from Rocks)

CHY1AP
F&H

Tuesday 6 November 2012 Afternoon Session

For this paper you must have:

- a black ball-point pen
- an objective test answer sheet
- a ruler.

You may use a calculator.

Time allowed

- 30 minutes

Instructions

- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Chemistry Unit 1a' printed on it.
- Attempt **one Tier only**, either the Foundation Tier or the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only.
- Do all rough work in this book, **not** on your answer sheet.

Instructions for recording answers

- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown.
- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown.
- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown.

1 2 3 4
○ ● ○ ○

1 2 3 4
○ ⊗ ○ ●

1 2 3 4
○ ⊗ ○ ⊗

Information

- The maximum mark for this paper is 36.

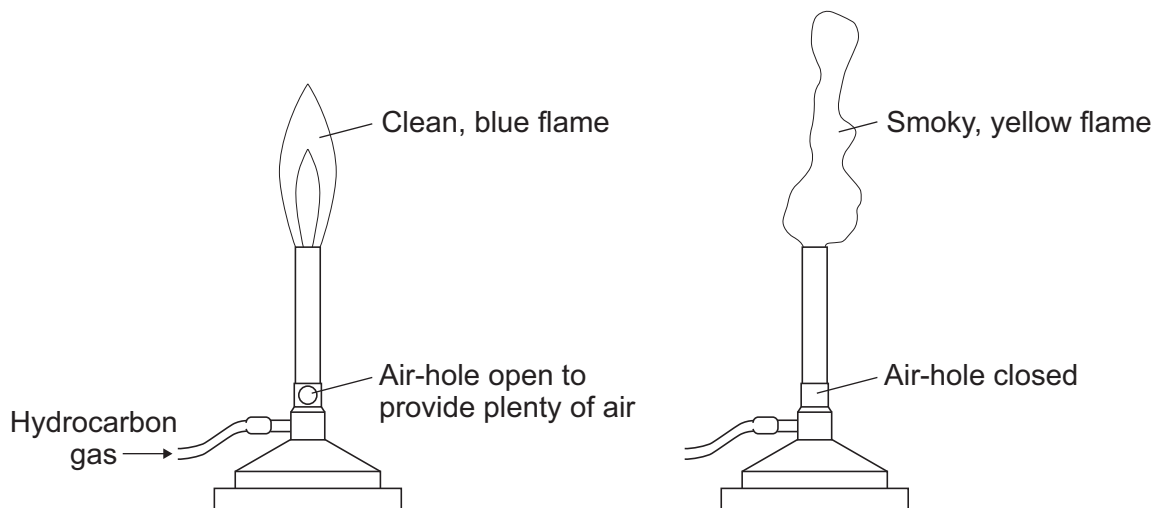
Advice

- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

QUESTION TWO

The diagram shows a hydrocarbon gas burning from a Bunsen burner.

The flame is different when the air-hole is open compared with when it is closed.



Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

- A** carbon
- B** carbon monoxide
- C** carbon dioxide
- D** oxygen

With the air-hole open, the two main products of combustion are water and . . . **1**

Water is formed when hydrogen in the hydrocarbon gas reacts with . . . **2**

With the air-hole closed, another gas produced during combustion is . . . **3**

The smoky, yellow flame contains black particles of . . . **4**

Turn over for the next question

Turn over ►

QUESTION THREE

These are some of the properties of four metals.

Metal		Electrical conductivity	Density in grams per cm ³	Melting point in °C	Boiling point in °C
A	Aluminium	very good	2.7	660	2470
B	Iron	good	7.8	1535	2750
C	Mercury	very good	13.6	-39	357
D	Potassium	good	0.9	64	774

Match metals, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table below.

What we can say about the metal	
1	It is a liquid at room temperature (20 °C).
2	It is used in making overhead electricity cables because it is a very good conductor and has a low density.
3	It has the highest melting and boiling points.
4	It will float on a liquid that has a density of 1.0 grams per cm ³ .

QUESTION FOUR

The table shows information about four fuels, **A**, **B**, **C** and **D**.

	Fuel	Type of substance	Number of carbon atoms per molecule	Energy released per gram of fuel	Mass of carbon dioxide produced per gram of fuel
A	LPG	Alkanes	3 or 4	50 kJ	3.0 g
B	Diesel	Alkanes	16–20	53 kJ	3.1 g
C	Ethanol	Alcohol	2	30 kJ	1.9 g
D	Hydrogen	Element	0	118 kJ	0.0 g

Match fuels, **A**, **B**, **C** and **D**, with the sentences **1–4** below.

- 1** This fuel has the lowest boiling point of the alkane fuels.
- 2** This fuel does not produce carbon dioxide when burned.
- 3** This fuel releases the least amount of energy per gram when burned.
- 4** This fuel has the most carbon atoms in its molecules.

Turn over for the next question

Turn over ►

QUESTION FIVE

A mixture of iron oxide and aluminium reacts when heated.

This is the balanced equation for the reaction:

**Symbols**

Fe	Iron
O	Oxygen
Al	Aluminium

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

- A** electrons
- B** bonds
- C** products
- D** elements

Iron oxide and aluminium are the reactants. Aluminium oxide and iron are the ... **1**

Aluminium atoms and oxygen atoms combine by transferring ... **2**

The particles (ions) in aluminium oxide are held together by ... **3**

The equation is balanced because, in the reaction, there is no change in the total number of atoms of each of the ... **4**

Turn over for the next question

Turn over ►

Section TwoQuestions **SIX** to **NINE**.

Each of these questions has four parts.

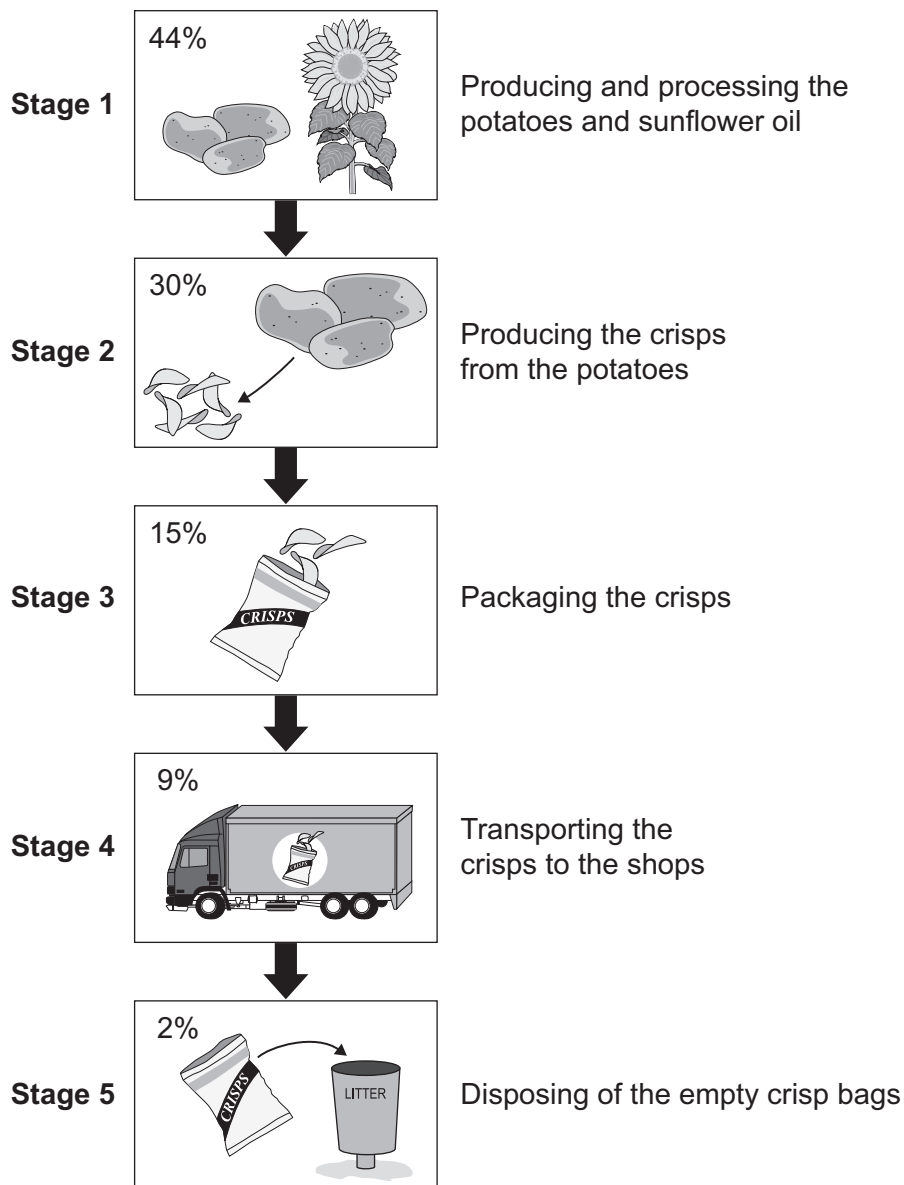
In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION SIX

The carbon footprint of a food product is the amount of carbon dioxide produced in its preparation, transportation and disposal.

The diagram shows the percentage (%) of the carbon footprint for each stage for a bag of crisps.

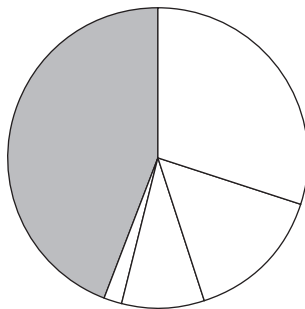


6A How is most of the carbon dioxide produced in **Stage 4**?

- 1 It is produced when the lorries use fuel.
- 2 It is breathed out by the driver.
- 3 It escapes from the crisp bags.
- 4 It escapes from the tyres of the lorries.

6B Which stage on the diagram is shown by the shaded area on the pie chart?

Percentage (%) of carbon footprint for a bag of crisps



- 1 **Stage 1**
- 2 **Stage 2**
- 3 **Stage 3**
- 4 **Stage 4**

6C If the company reduces the carbon footprint for a bag of crisps, this will help to . . .

- 1 reduce the acid rain that it causes.
- 2 meet government targets on global warming.
- 3 reduce the sale of crisps which contribute to obesity.
- 4 reduce the use of sunflower oil.

6D Which of the following changes would reduce the carbon footprint for the bag of crisps?

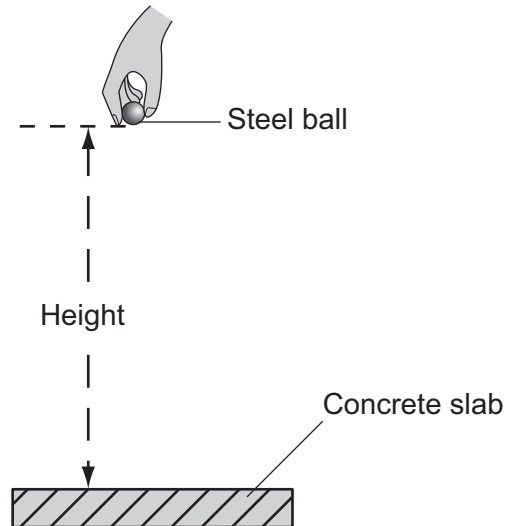
- 1 increase the sales of the crisps
- 2 change the colour of the crisp bags
- 3 pack many more bags of crisps into each lorry
- 4 increase the number of lorries used for transporting the crisps

Turn over ►

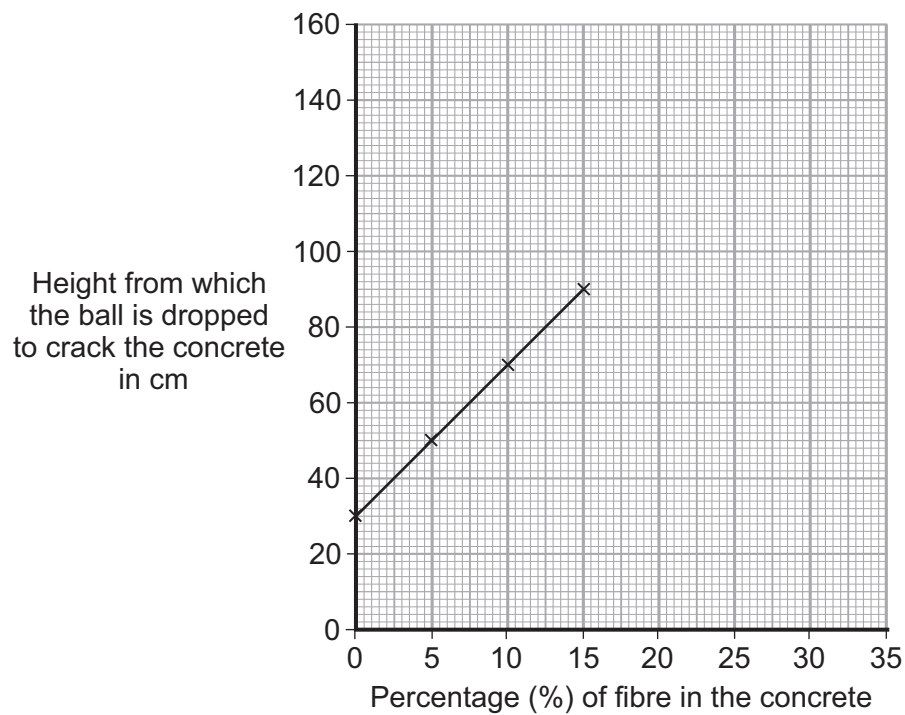
QUESTION SEVEN

Concrete is used as a building material.

A student tests four concrete slabs by dropping a steel ball onto them. The concrete slabs are of equal thickness but contain different amounts of fibre. The student drops the steel ball from increasing heights, until the concrete cracks.



The results are shown on the graph.



7A The student is testing . . .

- 1 the composition of the concrete slab.
- 2 the flexibility of the concrete slab.
- 3 the hardness of the concrete slab.
- 4 the thickness of the concrete slab.

7B The student then tests a concrete slab that contains 30% fibre.

From what height do you estimate the ball will need to be dropped to crack this concrete slab?

- 1 140 cm
- 2 145 cm
- 3 150 cm
- 4 155 cm

7C The dependent variable in this experiment is . . .

- 1 the percentage of fibre in the concrete slab.
- 2 the height from which the ball is dropped to crack the concrete slab.
- 3 the thickness of the concrete slab.
- 4 the size of the ball.

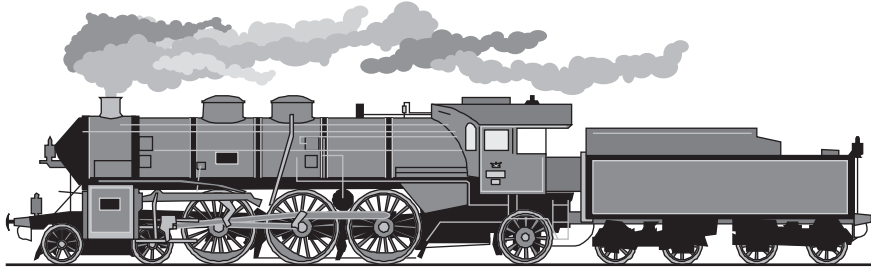
7D The best conclusion that can be made from the results is that a concrete slab cracks more easily . . .

- 1 as the size of the slab increases.
- 2 as the thickness of the slab increases.
- 3 as the percentage of fibre the slab contains increases.
- 4 as the percentage of fibre the slab contains decreases.

Turn over ►

QUESTION EIGHT

Read the following newspaper extract.

Copper shortage puts the brakes on Flying Scotsman renovation

A major overhaul of the steam locomotive Flying Scotsman has been delayed by more than a year because of a shortage of copper for the engine's firebox.

Copper is at a record high price because of huge demand from China's rapidly growing economy. The price had been falling over the previous 30 years, which had discouraged exploration for new supplies.

Other users of copper have been forced to switch to cheaper materials, with plumbers using plastic rather than copper pipes, and telecoms companies using fibre-optic cables rather than copper wire.

8A The firebox of a steam locomotive is where coal is burned to boil water.

Which of these properties is **not** important when copper is used for the engine's firebox?

- 1 Copper is a good conductor of heat.
- 2 Copper has a high melting point.
- 3 Copper is a good conductor of electricity.
- 4 Copper is easily hammered and bent into shape.

8B Which row in the table gives the important properties of copper for plumbers and telecoms companies?

	Plumbers	Telecoms companies
1	High melting point	Good heat conductor
2	Good electrical conductor	High melting point
3	Resistant to corrosion	Good electrical conductor
4	High boiling point	Good electrical conductor

8C Which of the following would make the copper shortage in China and other countries worse?

- 1 recycling scrap copper rather than burying it in landfill sites
- 2 developing alternative materials to do the same job as copper
- 3 extracting copper from low-grade ores
- 4 forcing suppliers to reduce the price of copper

8D Why is it environmentally important to recycle copper rather than extract copper from its ore?

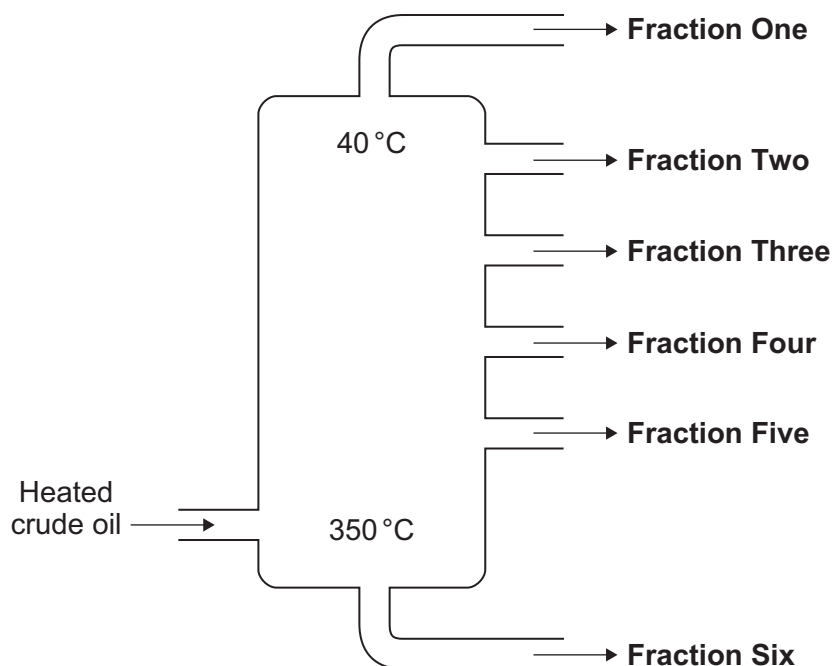
- 1 Copper ores are non-renewable, and a lot of energy is needed to extract copper from its ore.
- 2 There are enormous reserves of copper ore which are not expected to run out for hundreds of years.
- 3 Copper ores are cheap, and scrap copper is easy to dispose of in landfill sites.
- 4 Copper recycling is difficult and uses more energy when compared with processing new ores.

Turn over for the next question

Turn over ►

QUESTION NINE

In a fractionating column, crude oil is separated into a number of fractions.



9A Each fraction contains . . .

- 1 only alkanes that are liquids.
- 2 only alkanes that condense at temperatures above 40 °C.
- 3 alkanes with similar boiling points.
- 4 alkanes with the same chemical formula.

9B Which statement is true for the alkanes in **Fraction One**?

- 1 They burn to produce carbon dioxide and sulfur dioxide only.
- 2 They have the general formula C_nH_{2n-2}
- 3 They are saturated compounds.
- 4 They are compounds of carbon, hydrogen and oxygen.

9C When compared with the alkanes in **Fraction Five**, the alkanes in **Fraction Two** . . .

- 1 will ignite more easily.
- 2 will be more viscous.
- 3 will have higher boiling points.
- 4 will have larger molecules.

9D Propane is an alkane. There are eight hydrogen atoms in one molecule of propane.

The formula for propane is . . .

- 1 C_2H_8
- 2 C_3H_8
- 3 C_4H_8
- 4 C_3H_8O

END OF TEST

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Foundation Tier is earlier in this booklet.

HIGHER TIER

Section One

Questions **ONE** and **TWO**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

A mixture of iron oxide and aluminium reacts when heated.

This is the balanced equation for the reaction:



Symbols	
Fe	Iron
O	Oxygen
Al	Aluminium

Fe	Iron
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Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

- A** electrons
- B** bonds
- C** products
- D** elements

Iron oxide and aluminium are the reactants. Aluminium oxide and iron are the ... **1**

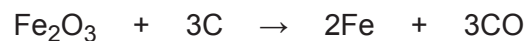
Aluminium atoms and oxygen atoms combine by transferring ... **2**

The particles (ions) in aluminium oxide are held together by ... **3**

The equation is balanced because, in the reaction, there is no change in the total number of atoms of each of the ... **4**

QUESTION TWO

This question is about the substances in this reaction:



Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

- A** C
B Fe
C CO
D Fe₂O₃

1	In the reaction, it is reduced.
2	It is a transition element.
3	In the reaction, it is oxidised.
4	It is formed by oxidation of a non-metal element.

Turn over for the next question

Turn over ►

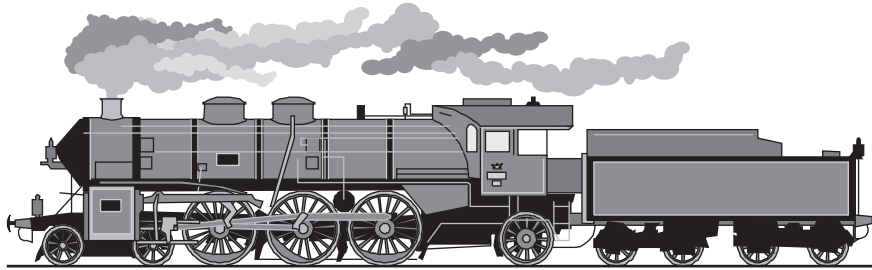
Section TwoQuestions **THREE** to **NINE**.

Each of these questions has four parts.

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QUESTION THREE

Read the following newspaper extract.

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3D Why is it environmentally important to recycle copper rather than extract copper from its ore?

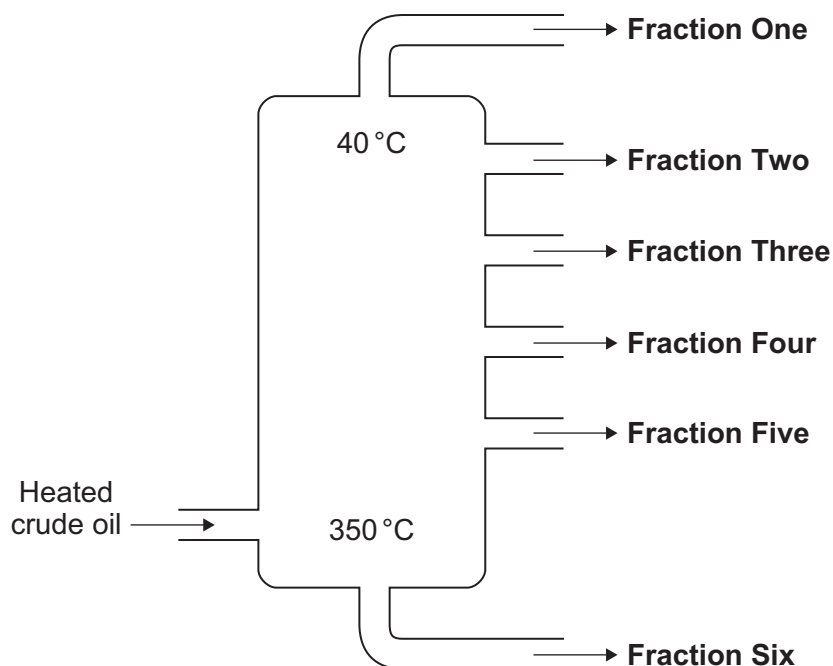
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Turn over for the next question

Turn over ►

QUESTION FOUR

In a fractionating column, crude oil is separated into a number of fractions.



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The formula for propane is . . .

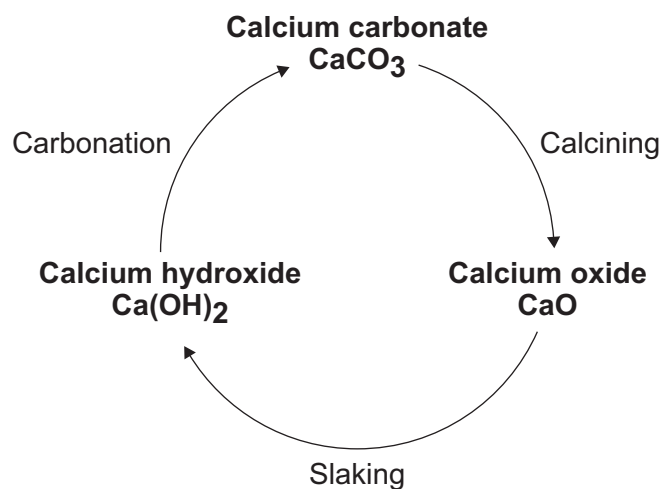
- 1 C_2H_8
- 2 C_3H_8
- 3 C_4H_8
- 4 C_3H_8O

Turn over for the next question

Turn over ►

QUESTION FIVE

The diagram shows substances and processes in the lime cycle.



The words calcining, slaking and carbonation are used in the lime industry to name the processes in the lime cycle.

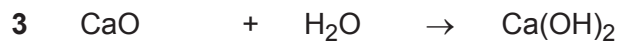
5A What type of reaction is described as *calcining* in the diagram?

- 1 neutralisation
- 2 thermal decomposition
- 3 combustion
- 4 hydration

5B What substance reacts with calcium oxide during *slaking*?

- 1 carbon dioxide
- 2 calcium hydroxide
- 3 hydrogen
- 4 water

5C Which of the following is the correct equation for *carbonation*?



5D Which of the following parts of the lime cycle contributes to global warming?

1 calcining only

2 slaking only

3 carbonation only

4 slaking and carbonation

Turn over for the next question

Turn over ►

QUESTION SIX

In 1774, a Frenchman called Antoine Lavoisier put forward this theory:

“Matter can neither be created nor destroyed, and in every chemical reaction there is just as much matter present before, as after the reaction has taken place.”

6A This theory is now an accepted law of chemistry.

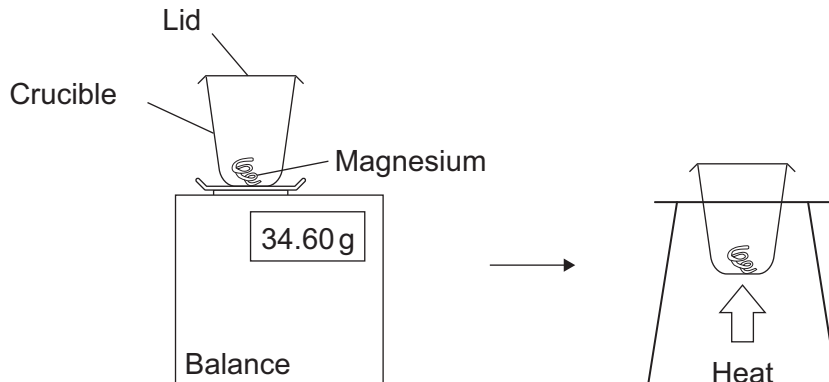
This law means that in any chemical reaction . . .

- 1 the mass of the products is equal to the mass of the reactants.
- 2 new atoms are produced from the atoms which make up the reactants.
- 3 the number of molecules of reactants is equal to the number of molecules of products.
- 4 atoms of elements react by giving, taking or sharing electrons.

A student investigated the reaction when some magnesium burned completely in oxygen.



The student weighed a crucible, its lid and a piece of magnesium.



The student then:

- heated the crucible for one minute, raising the lid occasionally
- allowed the crucible, lid and contents to cool, and then reweighed them
- repeated the heating, cooling and reweighing several times.

The results are shown in the table.

Total time of heating in minutes	0	1	2	3	4	5	6
Mass of crucible, lid and contents in grams	34.60	34.92	35.00	35.07	35.10	35.10	35.10

6B Which row in the table below correctly explains the procedures in the experiment?

Reason for:		
	raising the crucible lid occasionally	repeating the heating, cooling and reweighing
1	so the crucible would not get too hot	to check the accuracy of the balance
2	to allow air to enter the crucible	to make sure that all the magnesium had reacted
3	to allow air to enter the crucible	to check the accuracy of the balance
4	so the crucible would not get too hot	to make sure that all the magnesium had reacted

6C Why do the results in this experiment appear to contradict Lavoisier's theory?

- 1 The mass of reacting oxygen was not included in the weighings.
- 2 Magnesium oxide is a compound but magnesium and oxygen are elements.
- 3 There was not enough oxygen for all of the magnesium to react.
- 4 The mass of magnesium used was too small.

6D From calculations done before the experiment, the student expected the final mass of the crucible, lid and contents to be 35.32 grams rather than 35.10 grams.

The best explanation for this difference is that . . .

- 1 the student did not heat the crucible to a high enough temperature.
- 2 some magnesium oxide escaped from the crucible.
- 3 magnesium oxide begins to decompose at the temperature of the Bunsen burner.
- 4 the student did not allow the crucible to completely cool each time.

Turn over for the next question

Turn over ►

QUESTION SEVEN

This question is about the properties of iron and steel.

7A Production of cast iron from iron ore is an example of . . .

- 1 distillation.
- 2 reduction.
- 3 electrolysis.
- 4 combustion.

7B What is the best explanation for the softness of pure iron?

- 1 Iron atoms are very small so they move around easily.
- 2 There are bigger spaces in the metal after the impurities have been removed.
- 3 Pure materials are always softer than impure materials.
- 4 The layers of atoms can easily slide over each other.

7C To produce stainless steel from cast iron, it is necessary to . . .

- 1 remove the impurities.
- 2 remove the impurities and add other metals.
- 3 add other metals.
- 4 add extra carbon.

7D Aluminium is used in preference to iron for making cans for soft drinks.

The main reason is that . . .

- 1 aluminium is harder.
- 2 aluminium is more resistant to corrosion.
- 3 aluminium has a higher density.
- 4 aluminium is more reactive.

Turn over for the next question

Turn over ►

QUESTION EIGHT

Cars are being developed that use hydrogen as a fuel instead of petrol or diesel. When hydrogen burns, the only product is water. Hydrogen can be used to power fuel cells that produce electricity to run the car, rather than burning hydrogen in a traditional car engine.

Hydrogen can be obtained from water by electrolysis. This method is both expensive and slow, so scientists are trying other methods of producing hydrogen.

A company has developed solar cells that can convert 8% of solar energy into hydrogen. The solar cells must achieve a conversion of 10% before these cells become cost-effective.

8A In the electrolysis of water, the products are hydrogen and . . .

- 1 oxygen only.
- 2 oxygen and carbon dioxide.
- 3 carbon dioxide only.
- 4 carbon dioxide and nitrogen.

8B One advantage that a hydrogen-powered car that uses fuel cells has over a petrol-powered car is that . . .

- 1 less sulfur dioxide is produced by the car.
- 2 it causes only half the global dimming.
- 3 hydrogen-powered cars need to use solar energy.
- 4 it is safer because the hydrogen does not burn.

8C Hydrogen-powered cars are **not** common on roads yet because . . .

- 1 hydrogen resources are scarce.
- 2 fuel cell technology has been expensive to develop.
- 3 the only product is water.
- 4 electrolysis is a slow process.

A scientist has claimed that there are a number of technical and financial problems with hydrogen-powered cars. He said that the development of hydrogen-powered cars also required development of an economic way to produce hydrogen. He described this by saying, 'there is a chicken and egg issue here'.

8D The statement, 'there is a chicken and egg issue here' made by the scientist means that . . .

- 1 the technology is basic at the moment but it will develop well by 2020.
- 2 there is no point producing hydrogen-powered cars if hydrogen fuel is not widely available.
- 3 people will **not** want to buy the first hydrogen-powered cars because they will be slow.
- 4 we must develop other fuels before oil runs out.

Turn over for the next question

Turn over ►

QUESTION NINE

This question is about metals.

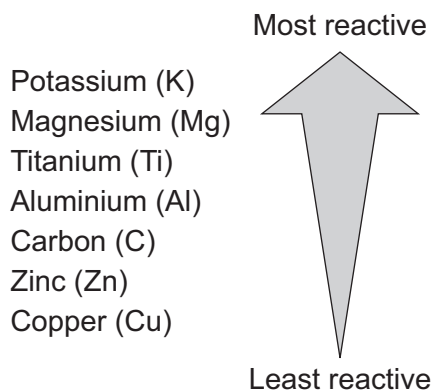
9A A scientist investigated some reactions of three metals, **K**, **L** and **M**.

- Metal **L** can be extracted by mixing its oxide with carbon and heating.
- Metal **M** cannot be extracted by mixing its oxide with carbon and heating.
- Hydrogen will displace metal **K** from its oxide but will not displace metal **L** from its oxide.
- The oxide of metal **K** is decomposed to the metal on heating alone.

The order of reactivity for the three metals, with the most reactive first, is . . .

- 1 **K, L, M.**
- 2 **M, L, K.**
- 3 **L, K, M.**
- 4 **K, M, L.**

9B The order of reactivity for some metals and carbon is shown below.



Which of the following shows a correctly balanced equation for a possible reaction?

- 1 $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}_2$
- 2 $\text{Cu} + \text{MgO} \rightarrow \text{CuO} + \text{Mg}$
- 3 $2\text{Mg} + \text{K}_2\text{O} \rightarrow 2\text{MgO} + 2\text{K}$
- 4 $2\text{Al} + 3\text{ZnO} \rightarrow 3\text{Zn} + \text{Al}_2\text{O}_3$

Titanium is extracted from titanium chloride. A mixture of titanium chloride and sodium is heated. The reaction takes place in a furnace above 500 °C.

It is a batch process; this means that the furnace does not operate continuously but is cooled after each operation so that the titanium can be removed.

9C Which row in the table correctly describes the reaction for the extraction of titanium?

	Why the reaction occurs	Products of the reaction
1	Sodium is more reactive than titanium	Titanium, sodium and chlorine
2	Titanium is more reactive than sodium	Titanium and chlorine
3	Titanium is more reactive than sodium	Titanium and sodium chloride
4	Sodium is more reactive than titanium	Titanium and sodium chloride

9D The extraction of iron in a blast furnace is a continuous process.

Over a period of 12 months, the batch method for extraction of titanium needs much more energy per tonne of metal than the continuous method for the extraction of iron.

This is because . . .

- 1** the batch process is completed more quickly.
- 2** titanium is less reactive than iron.
- 3** the titanium furnace is not kept at the reaction temperature.
- 4** titanium chloride is not as pure as iron oxide.

END OF TEST

There are no questions printed on this page