Write your name here

Surname	Other names

Edexcel
International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit: 4CH0
Science (Double Award) 4SC0
Paper: 1CR

Monday 20 May 2013 – Afternoon
Time: 2 hours

Paper Reference
4CH0/1CR
4SC0/1CR

You must have:
Ruler
Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Information

- The total mark for this paper is 120.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P43317A

1/1/1/1/

P 4 3 3 1 7 A 0 1 3 6

PEARSON

THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass
Symbol
Name
Atomic number

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Answer ALL questions.

1 Some of the gases used in industry are stored in cylinders.

(a) The cylinders are painted in different colours according to which gas is stored in them.

Why is it an advantage to use different colours?

(1)

.....

.....

(b) The table gives information about five gases. There is no information given about air.

Name of gas	argon	carbon dioxide	helium	oxygen	hydrogen	air
Formula of gas	Ar	CO_2	He	O_2	H_2	
Relative formula mass (M_r) of gas	40	44	4	32	2	

(i) Which two gases in the table are noble gases?

(1)

..... and .....

(ii) Which gas in the table makes up approximately 21% of air?

(1)

.....

(iii) Why is it not possible to give the information about air in the table?

(1)

.....

.....

(iv) Hydrogen and helium have both been used in balloons.

State one advantage of using helium instead of hydrogen.

(1)

.....

(c) State which one of the gases in the table is used in

(i) the manufacture of ammonia

(1)

.....

(ii) the manufacture of fire extinguishers

(1)

.....

(iii) the manufacture of fizzy drinks

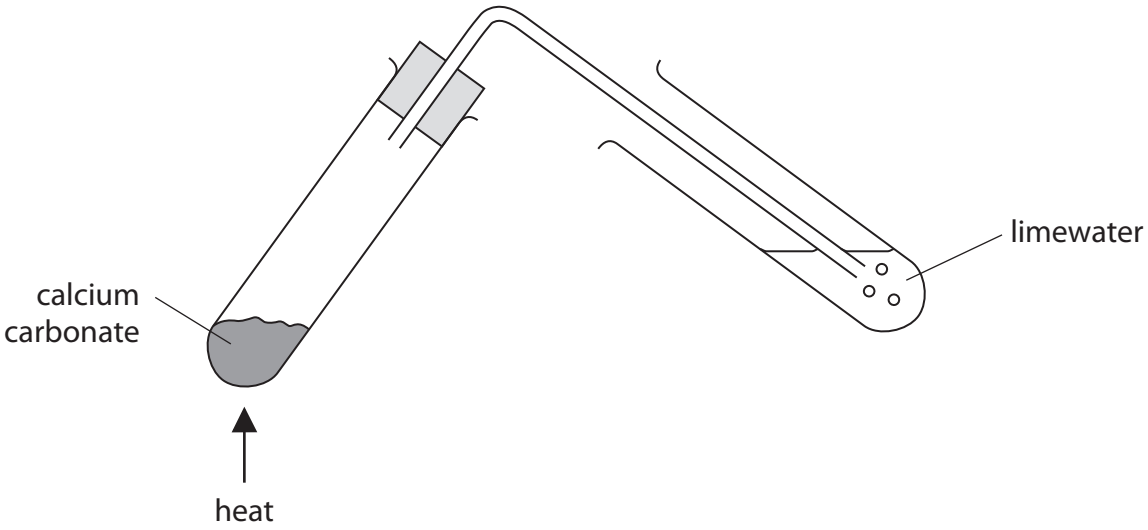
(1)

.....

(Total for Question 1 = 8 marks)

2 Some powdered calcium carbonate was heated strongly in a test tube.

The gas given off was bubbled through limewater.



The equation for the reaction taking place in the heated tube is

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

(a) What type of chemical reaction is taking place when calcium carbonate is heated?

(1)

- ☒ **A** dehydration
- ☒ **B** oxidation
- ☒ **C** reduction
- ☒ **D** thermal decomposition

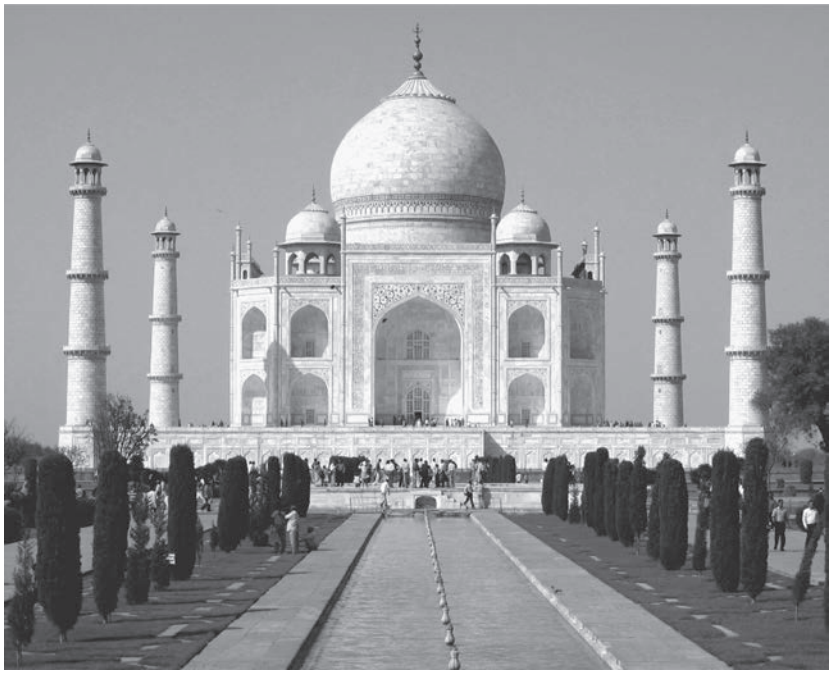
(b) State the appearance of the limewater before and after the gas was bubbled through it.

(2)

appearance before .....

appearance after .....

(c) The Taj Mahal is a famous building in India. It is made out of a form of calcium carbonate called marble.



The appearance of the marble has changed gradually over the years because of the effects of sulfur dioxide in the atmosphere.

Describe how sulfur dioxide has caused this change in appearance.

(3)

(Total for Question 2 = 6 marks)

3 The table gives information about barium salts.

Barium salt	Formula	Solubility in water	Toxic (poisonous)
barium chloride		soluble	yes
barium nitrate	$Ba(NO_3)_2$	soluble	yes
barium carbonate		insoluble	no
barium sulfate	$BaSO_4$	insoluble	no

(a) Complete the table by giving the formula of barium chloride and of barium carbonate.

(2)

(b) The human stomach contains hydrochloric acid.

Suggest why barium carbonate may cause poisoning when it enters the stomach.

(2)

.....

.....

.....

(c) Before patients have stomach X-rays they are given a barium salt to swallow.

Which salt in the table is safe to use?

(1)

.....

(d) A student accidentally swallowed a small amount of barium hydroxide solution, which is poisonous.

Suggest a reason why a solution of magnesium sulfate could be given to the student to swallow as a first aid treatment. Write a word equation for the reaction that takes place.

(3)

Reason.....

.....

.....

Word equation

.....

(e) The table gives information about the first five elements in Group 2 of the Periodic Table.

Element	Atomic number	Reaction with cold water	Reaction with air
beryllium	4	no reaction	burns when strongly heated
magnesium	12	reacts very slowly	burns when heated
calcium	20	reacts slowly	reacts slowly without heating
strontium	38	reacts quickly	reacts quickly without heating
barium	56		

Use the information in the table to help you answer the questions.

(i) Suggest how barium reacts with cold water and with air.

(2)

Reaction with cold water .....

.....

Reaction with air .....

.....

(ii) Use your answer to (e)(i) to suggest how barium should be stored.

(1)

.....

.....

(iii) Suggest a connection between the atomic number and the reactivity of the elements in Group 2.

(1)

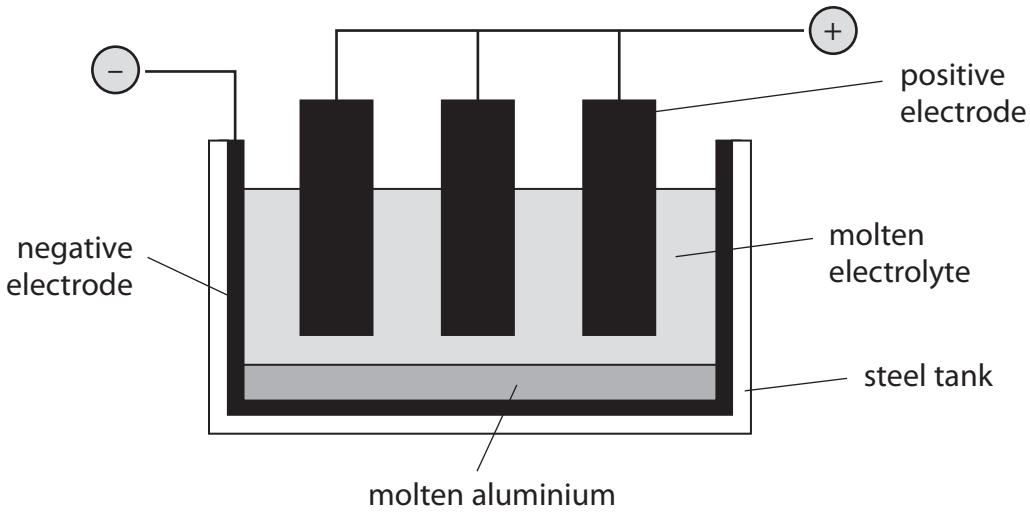
.....

.....

(Total for Question 3 = 12 marks)

4 This question is about the extraction and uses of aluminium.

(a) Aluminium is extracted from aluminium oxide by electrolysis.



What are the electrodes made of?

(2)

Negative electrode .....

Positive electrode .....

(b) (i) Explain why the operating temperature would need to be very high if pure aluminium oxide were used as the electrolyte.

(1)

.....

.....

(ii) Describe how the operating temperature is kept low.

(1)

.....

.....

.....

.....

(c) The ionic half-equation for the reaction at the negative electrode is

$$Al^{3+} + 3e^- \rightarrow Al$$

What type of reaction is occurring at the negative electrode?

Explain your answer.

(2)

.....

.....

.....

.....

(d) The waste gases escaping from the electrolysis cell contain carbon dioxide.

Describe how the carbon dioxide is formed.

(2)

.....

.....

.....

.....

(e) Aluminium is used to make cans for food and drinks.

State two properties of aluminium that make it suitable for this use.

You should not refer to cost in your answers.

(2)

1 .....

2 .....

(Total for Question 4 = 10 marks)

5 (a) Explain what is meant by the term **isomerism**.

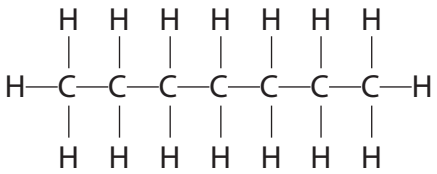
(2)

.....

.....

.....

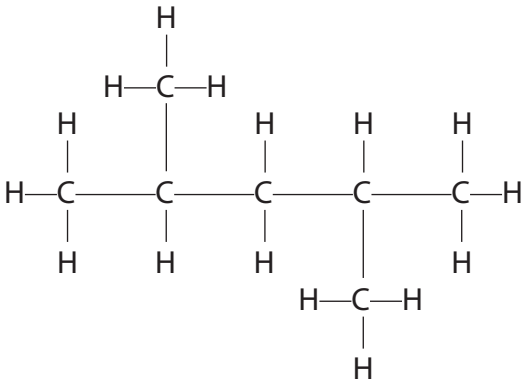
(b) The displayed formula of heptane (C_7H_{16}) is



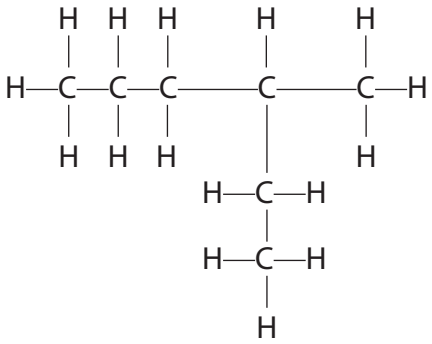
Which one of the displayed formulae below does **not** represent an isomer of heptane?

Place a cross (☒) in the box to indicate your answer.

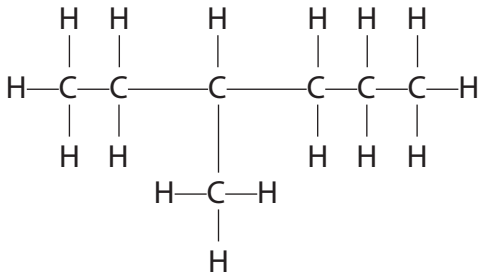
(1)



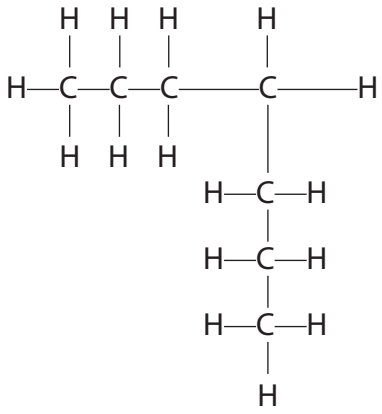
A ☒



B ☒



C ☒



D ☒

(c) Heptane belongs to a homologous series of compounds called alkanes.

The general formula of the alkanes is C_nH_{2n+2}

(i) Heptene belongs to a homologous series of compounds called alkenes.

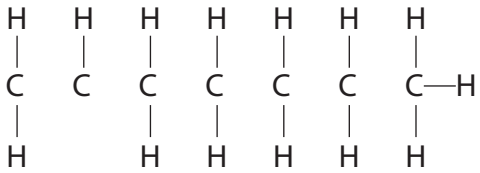
Give the general formula of the alkenes.

(1)

.....

(ii) Complete the following diagram to show the structural formula of heptene (C_7H_{14}) by inserting lines to represent the covalent bonds between the carbon atoms.

(2)



(d) When heptene is added to bromine water, and the mixture is shaken, a reaction occurs.

State the type of reaction and give the colour of the bromine water before and after the reaction with heptene.

(3)

Type of reaction .....

Colour before .....

Colour after .....

(e) Explain, in terms of the bonds present, why heptane is described as saturated and heptene as unsaturated.

(2)

.....

.....

.....

.....

(Total for Question 5 = 11 marks)

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6 The table gives information about the first four elements in Group 7 of the Periodic Table.

Element	Atomic number	Electronic configuration	Physical state at 20 °C	Colour at 20 °C
fluorine	9	2.7	gas	pale yellow
chlorine	17	2.8.7	gas	pale green
bromine	35	2.8.18.7	liquid	red-brown
iodine	53	2.8.18.18.7	solid	dark grey

(a) Astatine (At) has an atomic number of 85 and is the fifth element in Group 7.

It is possible to make predictions about astatine by comparison with the other elements in Group 7.

(i) How many electrons does an atom of astatine have in its outer shell?

(1)

.....

(ii) What physical state and colour would you expect for astatine at 20 °C?

(2)

Physical state .....

Colour .....

(iii) Predict the formula of the compound formed between astatine and hydrogen.

Suggest a name for this compound.

(2)

Formula .....

Name .....

(iv) Suggest how the reactivity of astatine compares to that of iodine.

Explain your answer.

(2)

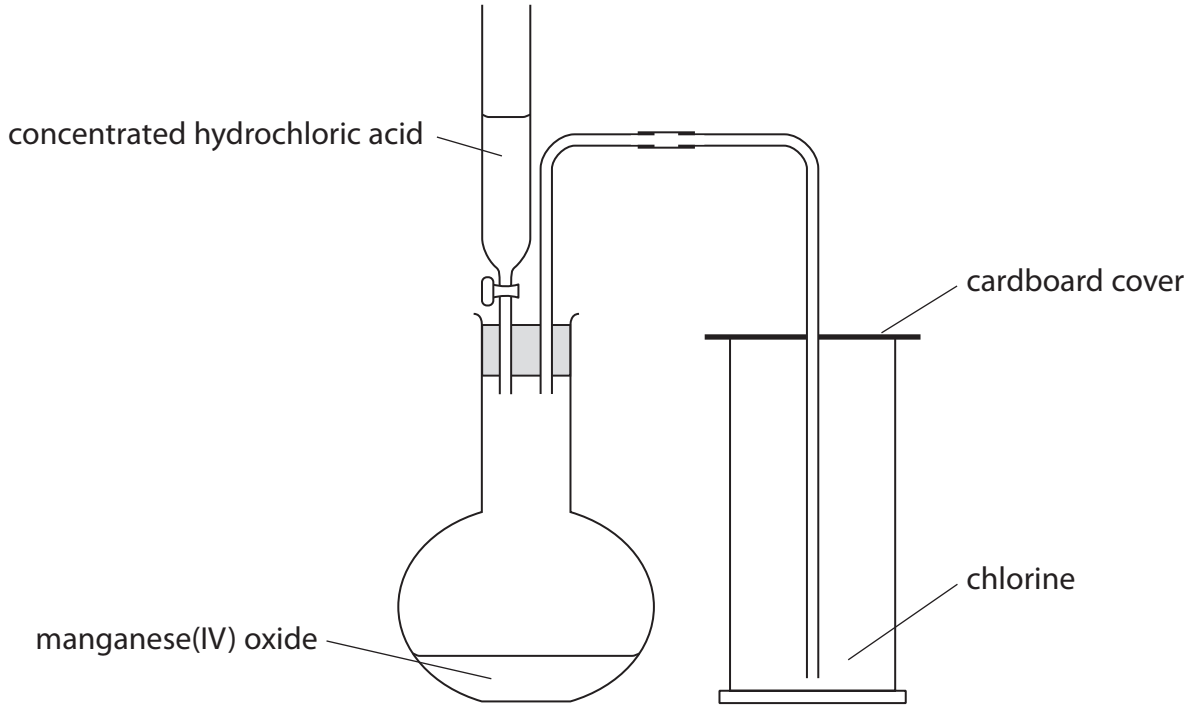
.....

.....

.....

.....

(b) Chlorine gas can be prepared by heating a mixture of concentrated hydrochloric acid and manganese(IV) oxide using this apparatus.



(i) Balance the equation for the reaction.

(1)

..... $HCl(aq)$ + ... $MnO_2(s)$ → ..... $MnCl_2(aq)$ + ... $H_2O(l)$ + ... $Cl_2(g)$

(ii) State what you would observe when a piece of damp litmus paper is placed into the gas jar containing chlorine.

(1)

.....

.....

(c) Chlorine can be used to obtain bromine (Br_2) from sea water.

Sea water contains bromide ions, Br^-

The pH of sea water is usually within the range of 7.5 to 8.4

The stages in the extraction of bromine from sea water are

Stage 1 The pH of the sea water is lowered to about 3.5

Stage 2 An excess of chlorine is bubbled through the sea water

Stage 3 The bromine (Br_2) is removed from the mixture and reacted with sulfur dioxide (SO_2) and water. This reaction converts the bromine to hydrogen bromide (HBr) and sulfuric acid (H_2SO_4)

Stage 4 The hydrogen bromide is reacted with chlorine to form bromine (Br_2)

(i) Suggest a substance that could be added to lower the pH of sea water in Stage 1.

(1)

.....

(ii) Why is an excess of chlorine added in Stage 2?

(1)

.....

(iii) Write a chemical equation for the reaction in Stage 3.

(2)

.....

(iv) Write a chemical equation for the reaction in Stage 4.

(1)

.....

(d) State the colour change observed when bromine is added to an aqueous solution of potassium iodide.

(2)

Colour of potassium iodide solution at start.....

Colour of final reaction mixture.....

(Total for Question 6 = 16 marks)

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7 Some students investigated the rate of the reaction between marble chips (calcium carbonate) and dilute hydrochloric acid.

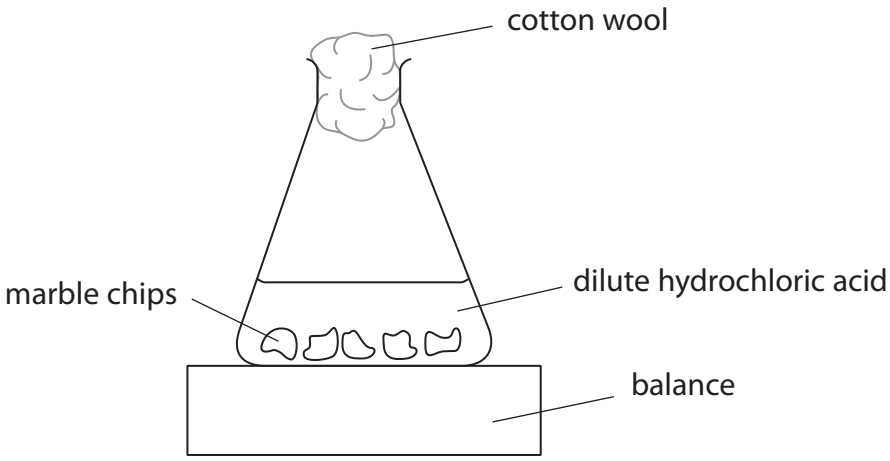
(a) The equation for the reaction is

$$CaCO_3 (.....) + 2HCl (.....) \rightarrow CaCl_2 (.....) + H_2O (.....) + CO_2 (.....)$$

Insert state symbols after each formula.

(2)

(b) One of the students used this apparatus.



(i) What is the purpose of the cotton wool?

(1)

.....

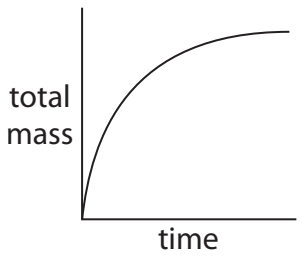
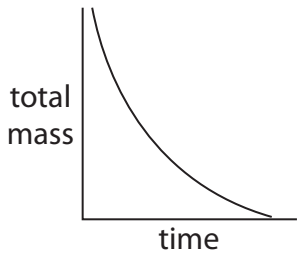
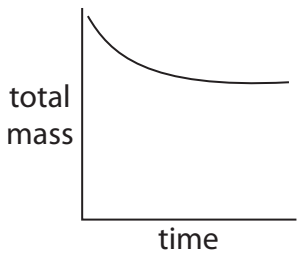
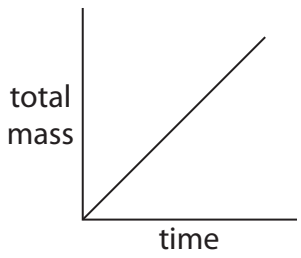
.....

(ii) He recorded the total mass of the conical flask and contents every 30 seconds for several minutes. He plotted the results as a graph of total mass (*y*-axis) against time.

Which of the graphs could represent his results?

Put a cross (☒) in a box to indicate your answer.

(1)

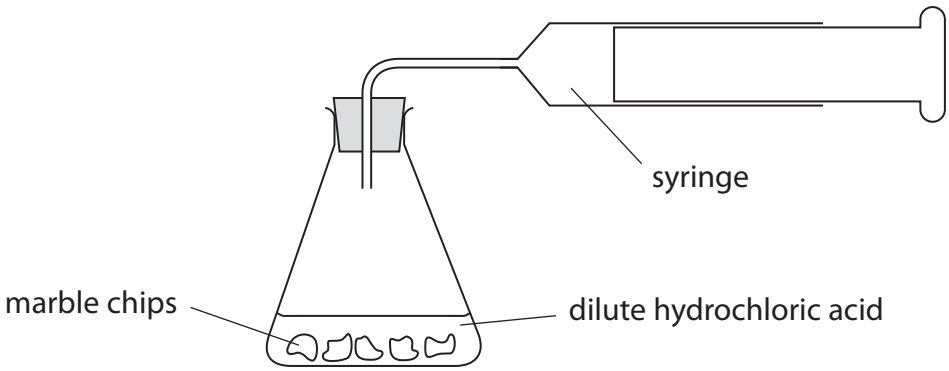
			
A ☒	**B** ☒	**C** ☒	**D** ☒

(c) Another student carried out three experiments to investigate the effect of changing the concentration and temperature of hydrochloric acid on the rate of reaction.

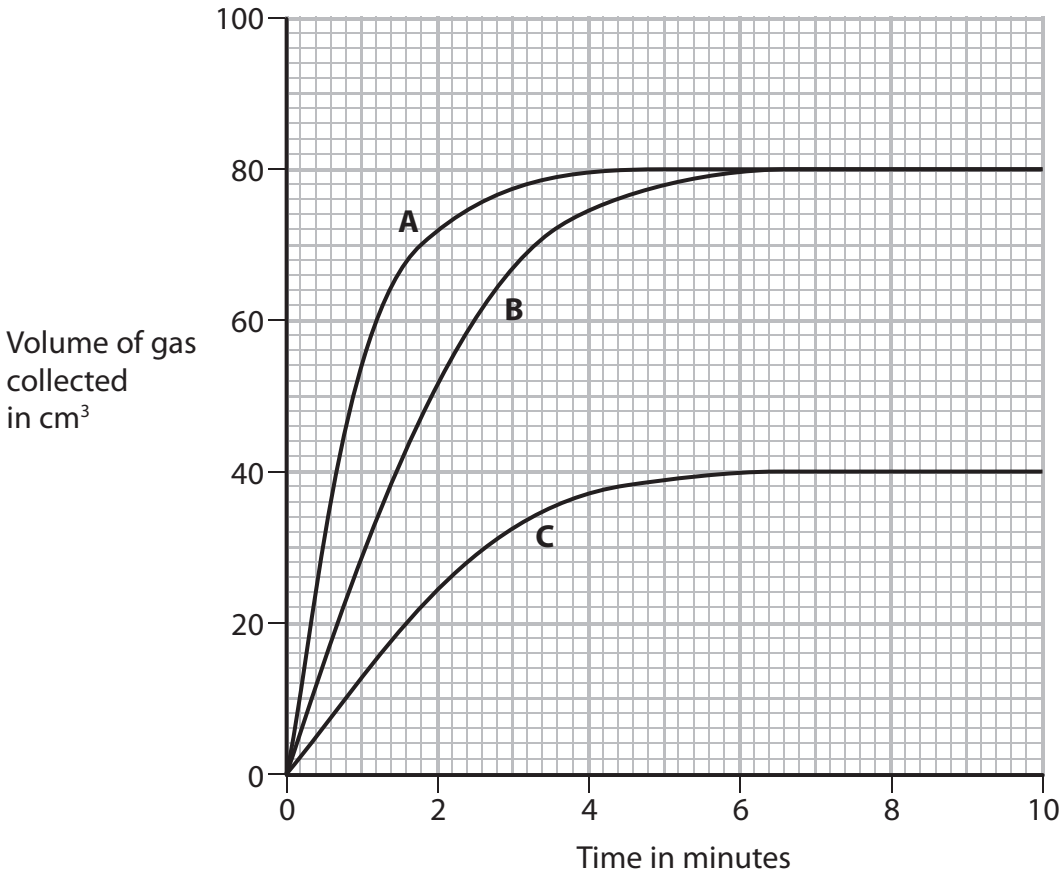
She kept the number and size of marble chips the same in each experiment.

The marble chips were in excess.

In each experiment she measured the volume of gas collected at different times, using this apparatus.



The graph shows the results of her experiments.



(i) Experiments **A** and **B** represent experiments using the same concentration of hydrochloric acid but at different temperatures.

Which letter represents the experiment at the higher temperature?

Give a reason for your choice.

(2)

Letter .....

Reason .....

.....

.....

(ii) Experiments **B** and **C** represent experiments at the same temperatures and using the same volumes of hydrochloric acid.

The concentration of hydrochloric acid used in experiment **B** is 0.20 mol/dm^3.

What is the concentration of hydrochloric acid used in experiment **C**?

Explain how you worked out your answer.

(2)

Concentration .....

Explanation .....

.....

.....

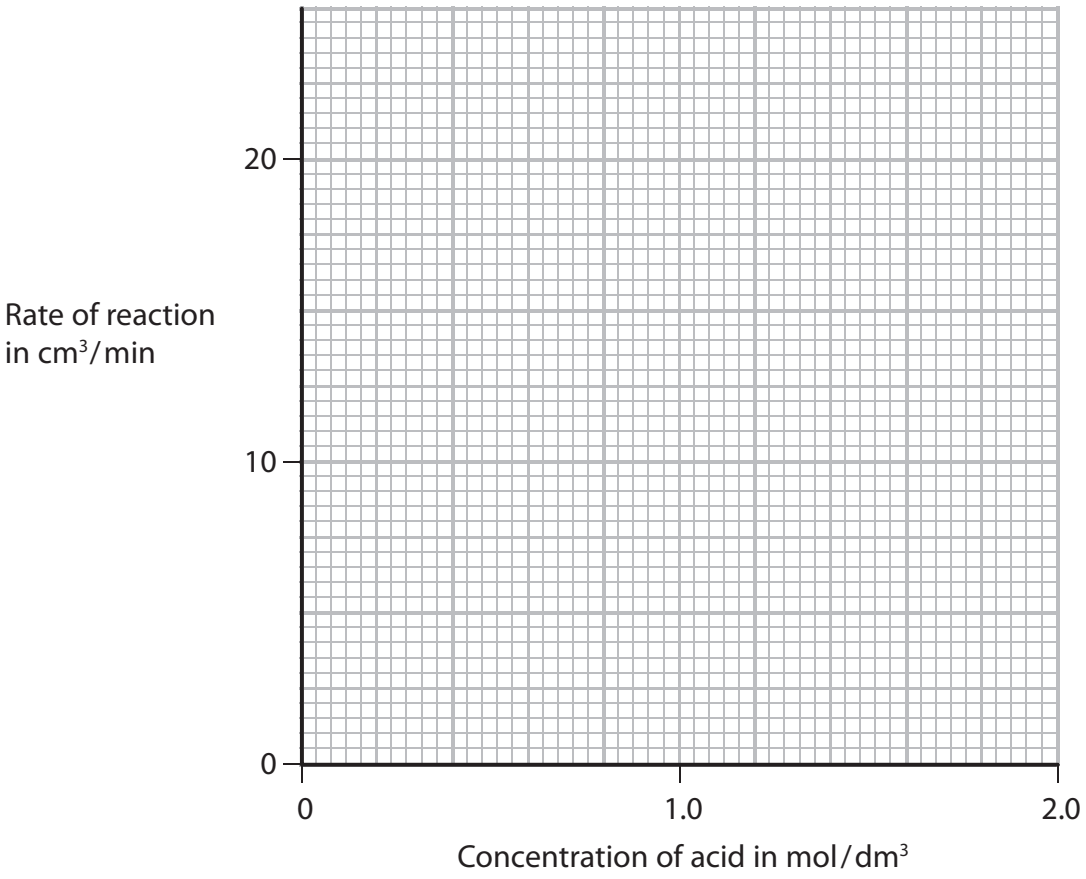
(d) (i) A third student calculated the rate of reaction in his experiments.

The table shows his results.

Rate of reaction in cm^3/min	4.0	9.0	13.5	18.5	23.0
Concentration of acid in mol/dm^3	0.4	0.8	1.2	1.6	2.0

Plot these results on the grid. Draw a straight line of best fit through the points.

(3)



(ii) Describe the relationship between rate of reaction and concentration of acid shown by the graph.

(2)

.....

.....

.....

.....

(iii) Explain why increasing the concentration has this effect on the rate of reaction.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 7 = 16 marks)

8 A student was asked by his teacher to perform a flame test on a solid.

He used this method.

- dip the tip of a clean platinum wire into hydrochloric acid and then into the solid
- adjust the air hole of the Bunsen burner to obtain a non-roaring, non-luminous Bunsen flame
- place the tip of the platinum wire into the edge of the flame
- observe the colour in the flame

(a) (i) Why is it important that the platinum wire is clean?

(1)

.....

.....

(ii) Why is it important to use a non-luminous flame?

(1)

.....

.....

(iii) What colour would be observed in the flame if the solid contained sodium ions?

(1)

.....

(b) Another student was given a pale violet solid. He was told that it contained two cations (positive ions) from this list

Li^+ Ca^{2+} Fe^{2+} NH_4^+ Fe^{3+}

He performed a flame test on the solid.

He then dissolved a small sample of the solid in water. A yellow solution was formed.

He added sodium hydroxide solution and then warmed the mixture.

The table shows his observations.

Test	Observation
flame test	no positive result
add sodium hydroxide solution and warm	brown precipitate a pungent-smelling gas was evolved the gas turned damp red litmus paper blue

(i) The flame test gave no positive result.

State the two cations from the list that are **not** present in the solid.

(1)

..... and .....

(ii) Identify the pungent-smelling gas given off and explain why the red litmus paper must be damp before it is used.

(2)

.....

.....

.....

.....

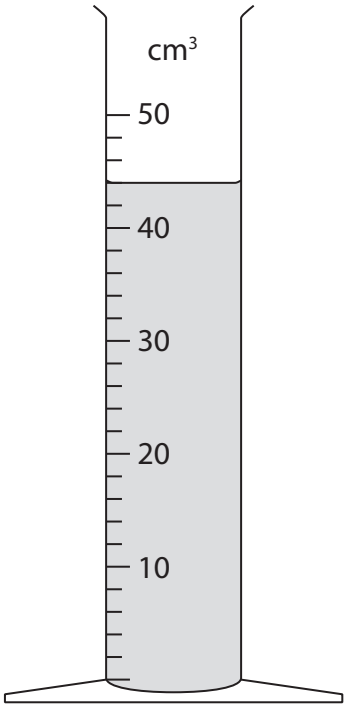
(iii) Identify the two cations present in the pale violet solid.

(2)

..... and .....

(Total for Question 8 = 8 marks)

9 The piece of apparatus shown contains 0.010 mol/dm^3 hydrochloric acid.



(a) (i) Give the name of this piece of apparatus.

(1)

.....

(ii) What volume of hydrochloric acid is in the apparatus?

(2)

.....

(iii) Use your answer in (a)(ii) to calculate the amount, in moles, of hydrochloric acid in the apparatus.

(2)

Amount = ... mol

(b) A student poured a solution containing 0.010 mol of hydrochloric acid into a beaker.

He then added 0.0075 mol of zinc powder and collected the hydrogen given off in a gas syringe.

The equation for the reaction is

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

Is the zinc or the hydrochloric acid in excess? Explain your answer.

(2)

.....

.....

.....

(c) The student repeated the experiment with 0.0075 mol of magnesium powder with the same total surface area as the zinc.

The equation for the reaction is

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

(i) What effect would this change have on the rate at which the hydrogen is given off?

(1)

.....

.....

.....

(ii) What effect would this change have on the volume of hydrogen produced?

(1)

.....

.....

.....

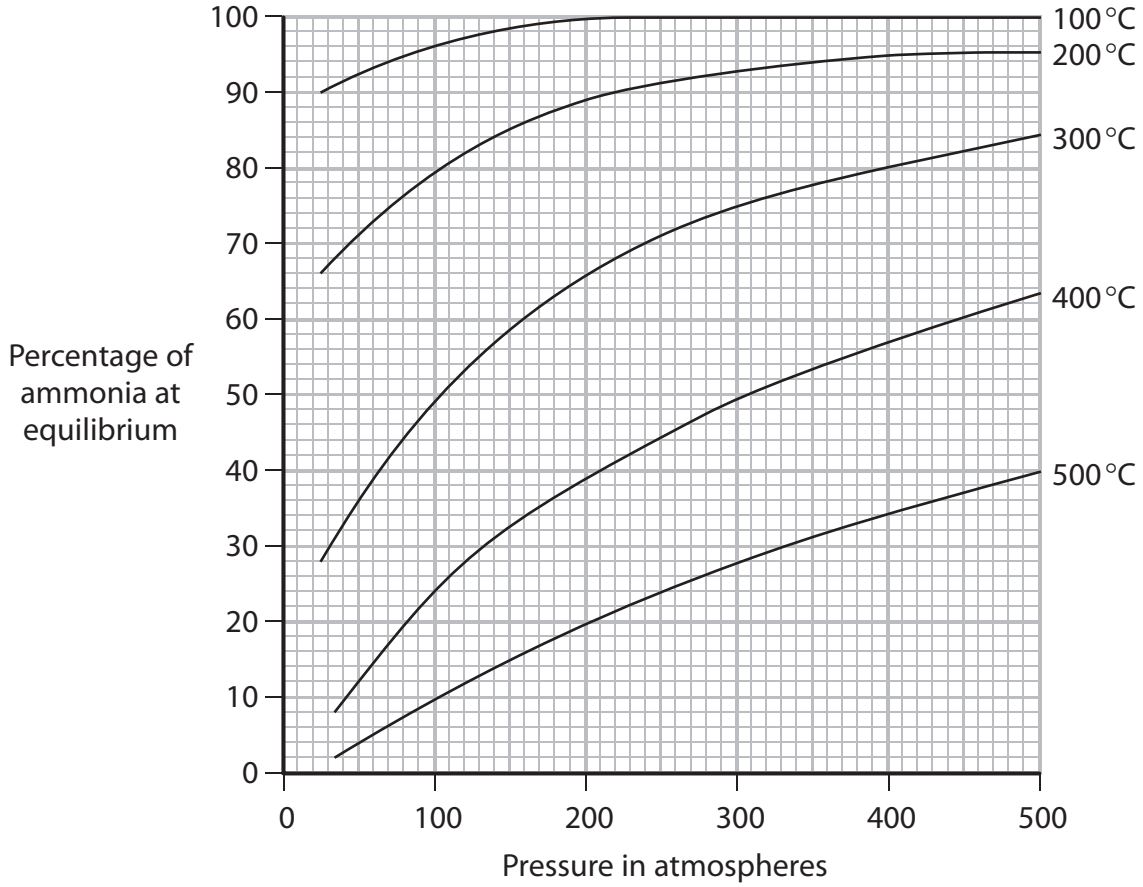
(Total for Question 9 = 9 marks)

10 Ammonia (NH_3) can be made by reacting nitrogen and hydrogen, in the presence of an iron catalyst, according to the equation

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92 \text{ kJ/mol}$$

The reaction is reversible and the reaction mixture can, if left for long enough, reach a position of dynamic equilibrium.

The graph shows how the percentage of ammonia at equilibrium depends on the temperature and pressure used.



(a) State two features of a reaction mixture that is in dynamic equilibrium.

(2)

1 .....

.....

2 .....

.....

(b) (i) Use the graph to state the effect on the percentage of ammonia at equilibrium of the following changes

- an increase in temperature at constant pressure
- an increase in pressure at constant temperature.

Write your answers in the table.

(2)

	Effect on percentage of ammonia at equilibrium
increase in temperature	
increase in pressure	

(ii) Explain why these changes have the effects you have given in (b)(i).

(2)

Increase in temperature.....

.....

Increase in pressure.....

.....

(c) The reaction between nitrogen and hydrogen is used to manufacture ammonia in the Haber process. This process operates at a pressure of 200 atmospheres and a temperature of 450 °C, with an iron catalyst.

If the reaction mixture reached a position of equilibrium, the expected yield of ammonia would be about 30%.

The actual yield of ammonia obtained in the Haber process is about 15%.

(i) Suggest why the actual yield of ammonia is lower than the expected yield.

(1)

.....

.....

.....

(ii) How is the ammonia separated from the unreacted nitrogen and hydrogen?

(2)

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(iii) What happens to the unreacted nitrogen and hydrogen?

(1)

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(d) The reaction would be faster if a higher temperature were used.

Suggest why a higher temperature is not used in the Haber process.

(1)

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(e) The equation for the formation of ammonia is

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(i) Calculate the amount, in moles, of ammonia, that could be formed in the Haber process from 112 kilograms of nitrogen, assuming all the nitrogen is converted into ammonia.

(3)

Amount of ammonia = ... mol

(ii) Only 15% of the nitrogen is converted into ammonia.

Calculate the actual amount, in moles, of ammonia that is formed from 112 kilograms of nitrogen.

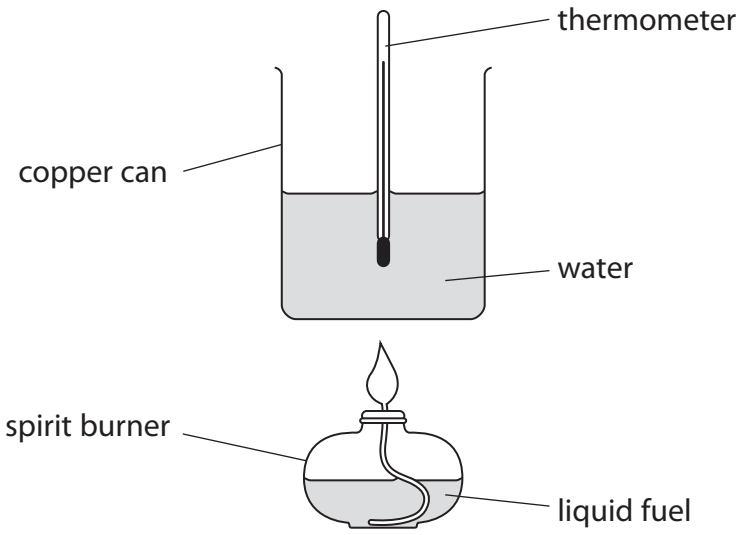
(1)

Amount of ammonia = ... mol

(Total for Question 10 = 15 marks)

11 A student burned four liquid fuels in order to compare the amount of energy they released, in the form of heat.

She used this apparatus.



The energy released when each fuel was burned was used to raise the temperature of 100 g of water. For each fuel, the student recorded the mass of fuel burned and the increase in temperature of the water.

Her results are shown in the table.

Fuel	Average relative formula mass	Mass of fuel burned in g	Amount of fuel burned in mol	Increase in temperature in °C
diesel	170	4	0.024	15
ethanol	46	3	0.065	10
methanol	32	2	0.063	5
petrol	114	1	0.009	4

The best fuel is the one that releases the most energy.

(a) The student suggested that petrol was the best fuel.

Explain why, using the information in the table.

(1)

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(b) Another student suggested that diesel was the best fuel.

Explain why, using the information in the table.

(1)

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(c) In another experiment, a student burned propanol and then used his results to calculate the energy released when one mole of propanol was burned.

He then compared his result with a value from a data book.

The values are shown in the table.

	Energy released per mole of propanol burned in kJ
Student's result	1020
Data book value	2010

Suggest two reasons why the student's result is lower than the data book value.

(2)

1 .....

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2 .....

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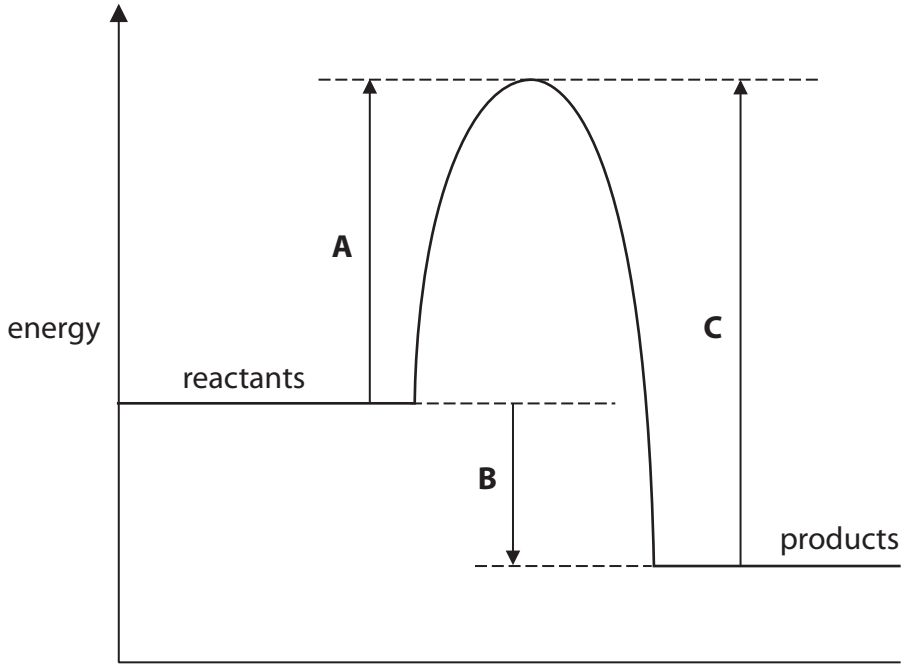
(d) The diagram shows the energy profile for burning a fuel.



Which of the energy changes A, B or C represents

- the activation energy for the reaction
- the amount of energy given out during the reaction?

(2)

Activation energy = ...

Energy released = ...

(e) Explain, in terms of bond breaking and bond making, why this reaction gives out energy.

(3)

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(Total for Question 11 = 9 marks)

TOTAL FOR PAPER = 120 MARKS

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