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GCSE (9–1) Chemistry A (Gateway Science)

F

J248/01 Paper 1 (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2

Time allowed: 1 hour 45 minutes

You must have:
- the Data Sheet

You may use:
- a scientific or graphical calculator
- a ruler

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document consists of **28** pages

SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

1 Which technique is the best for separating pure water from a solution of sodium chloride in water?

A Chromatography

B Crystallisation

C Distillation

D Filtration

Your answer ☐ **[1]**

2 Which statement shows that lead is a metal?

A It is a dull grey colour.

B It is in Group 4 of the periodic table.

C It is in Period 6 of the periodic table.

D It is malleable and can be easily shaped.

Your answer ☐ **[1]**

3 When 12 g of carbon (C) burns in oxygen (O_2), 44 g of carbon dioxide (CO_2) is formed.

What mass of C would burn to form 11 g of CO_2?

A 3 g

B 4 g

C 11 g

D 12 g

Your answer ☐ **[1]**

4 What is the relative formula mass of sodium carbonate, Na_2CO_3?

A 83.0

B 90.0

C 106.0

D 130.0

Your answer ☐ **[1]**

5 The size of a nanoparticle is similar to the size of a molecule.

What is the approximate size of a nanoparticle?

A 0.01 nm

B 50 nm

C 1000 nm

D 10,000 nm

Your answer ☐ **[1]**

6 Two isotopes of neon are

$^{22}_{10}Ne$ and $^{20}_{10}Ne$

The two isotopes of neon have different:

A Charges

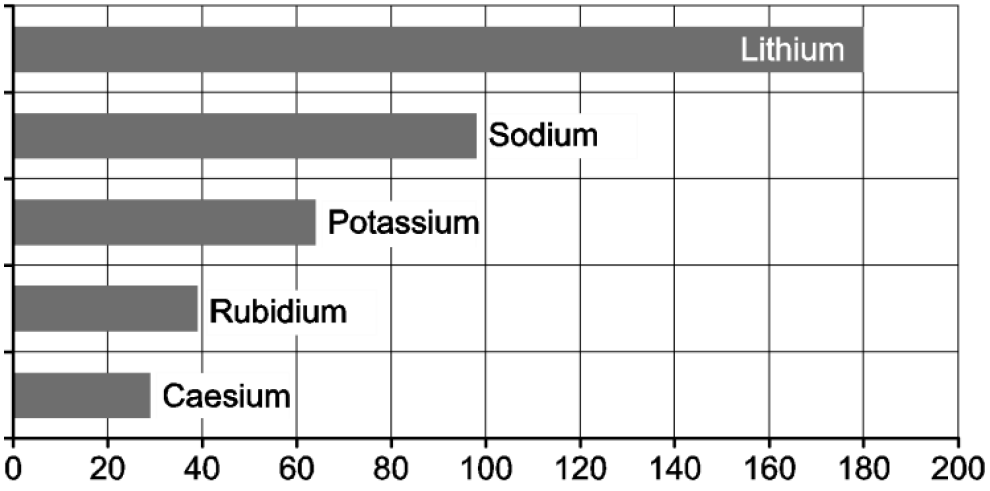
B Numbers of electrons

C Numbers of neutrons

D Numbers of protons

Your answer ☐ **[1]**

7 The bar chart shows the melting points of Group 1 elements.



What are the melting points of rubidium and caesium?

	Melting point of rubidium (°C)	Melting point of caesium (°C)
A	39	29
B	40	25
C	29	41
D	41	25

Your answer ☐ **[1]**

8 A student separates the colours of black ink using paper chromatography.

- He puts a spot of black ink onto a piece of filter paper.
- He dips the filter paper into ethanol in a beaker.

What phase describes **ethanol** in this experiment?

A Gas phase

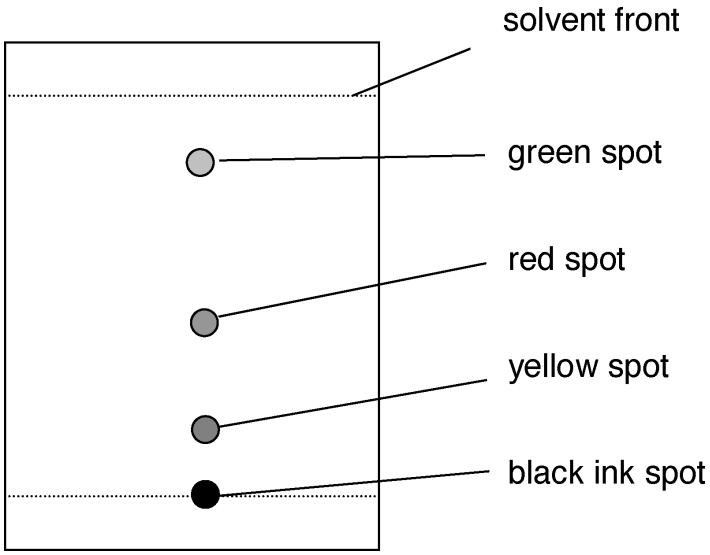
B Mobile phase

C Solid phase

D Stationary phase

Your answer ☐ **[1]**

9 Look at the chromatogram.



What is the R_f value of the **green** spot? Use a ruler to help you.

A 0.17

B 0.42

C 0.83

D 1.00

Your answer ☐ **[1]**

10 What is the best description of the particles in a liquid?

	Distance between particles	Movement of particles
A	Close together	in continuous random motion
B	Close together	vibrating about a fixed point
C	Far apart	in continuous random motion
D	Far apart	vibrating about a fixed point

Your answer ☐ **[1]**

11 Look at the table of fractions from the fractional distillation of crude oil.

Fraction	Boiling range (°C)
LPG	less than 25
petrol	85 – 105
diesel	150 – 290
fuel oil	290 – 380
bitumen	greater than 400

A hydrocarbon has a boiling point which is 3.5 times the boiling point of petrol.

Which fraction contains the hydrocarbon?

A Bitumen

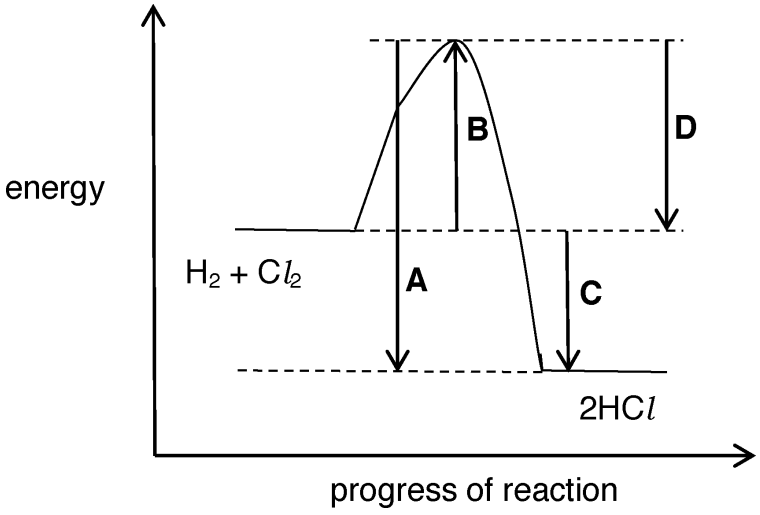
B Diesel

C Fuel oil

D LPG

Your answer ☐ **[1]**

12 Look at the energy changes in the reaction profile for the reaction between hydrogen and chlorine.



Which energy change shows the enthalpy change of reaction?

Your answer ☐ **[1]**

13 The **molecular** formula of decene is $C_{10}H_{20}$.

What is the **empirical** formula of decene?

A CH_2

B C_2H_4

C C_5H_{10}

D $C_{20}H_{40}$

Your answer ☐ **[1]**

14 A student measures the pH on an acid and an alkali.

He adds magnesium metal to the acid and to the alkali.

What results should he expect?

	Acid		**Alkali**	
	pH	**Reaction with magnesium**	**pH**	**Reaction with magnesium**
A	Below 7	No reaction	Above 7	Magnesium fizzes
B	Below 7	Magnesium fizzes	Above 7	No reaction
C	Above 7	Magnesium fizzes	Above 7	No reaction
D	Above 7	No reaction	Below 7	Magnesium fizzes

Your answer ☐ **[1]**

15 A student tests the conductivity of an ionic compound.

Which row in the table shows the correct results?

	Solid ionic compound	**Ionic compound dissolved in water**	**Molten ionic compound**
A	Conducts	Conducts	Does not conduct
B	Conducts	Conducts	Conducts
C	Does not conduct	Does not conduct	Conducts
D	Does not conduct	Conducts	Conducts

Your answer ☐ **[1]**

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TURN OVER FOR THE NEXT QUESTION

SECTION B

Answer **all** the questions.

16 A student investigates some exothermic and endothermic reactions.

(a) He measures the temperature changes during some chemical reactions.

Look at his table of results.

Reaction	Temperature at start (°C)	Temperature at end (°C)	Temperature change (°C)
1	15	25	+10
2	15	15	0
3	18	15	-3
4	15	20	+5

What can you conclude about the **type** of energy change in each reaction?

Explain your answer.

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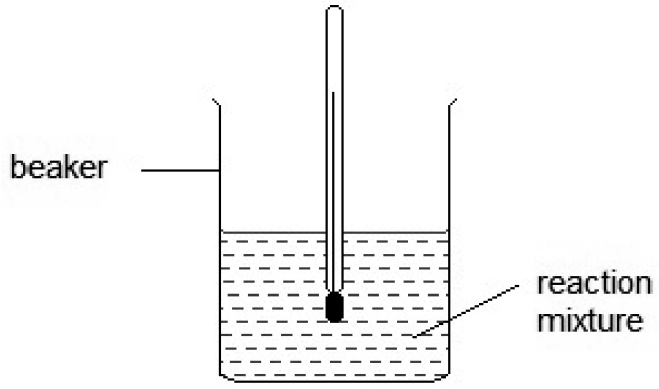
..... **[4]**

(b) A student does an experiment with an acid and an alkali.



1. He adds the acid to a beaker and measures its temperature.

2. He then adds the alkali to the beaker and stirs the mixture.

3. At the end of the reaction, he removes the thermometer from the beaker and measures the temperature.

How should he improve his method? Explain your answer.

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..... **[2]**

(c) A student adds water to calcium oxide. A vigorous exothermic reaction takes place forming calcium hydroxide.

Calcium hydroxide has the formula $Ca(OH)_2$.

Show that the relative formula mass (M_r) of calcium hydroxide is 74.1.

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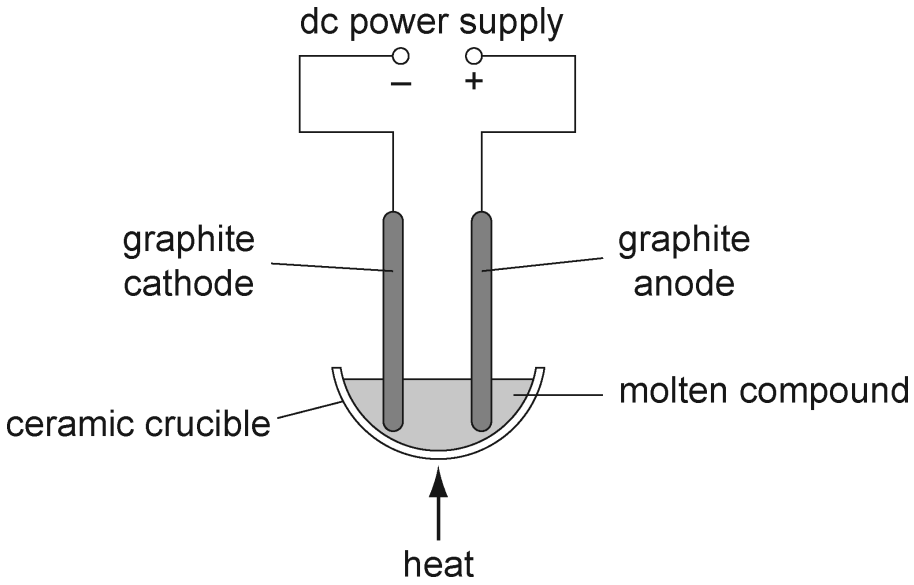
..... **[2]**

17 **(a)** Look at the diagram.

It shows the apparatus used for the electrolysis of some molten compounds.



The table shows the products at each electrode during the electrolysis of two molten compounds.

Complete the table.

Molten compound	**Formula**	**Product at negative electrode (cathode)**	**Product at positive electrode (anode)**
sodium chloride	$NaCl$	.....	chlorine
lead bromide	$PbBr_2$	lead	.....

[2]

(b) Copper sulfate solution can be electrolysed using non-inert copper electrodes.

Describe what happens at the negative copper electrode **and** the positive copper electrode.

Negative electrode: .....

Positive electrode: ..... **[2]**

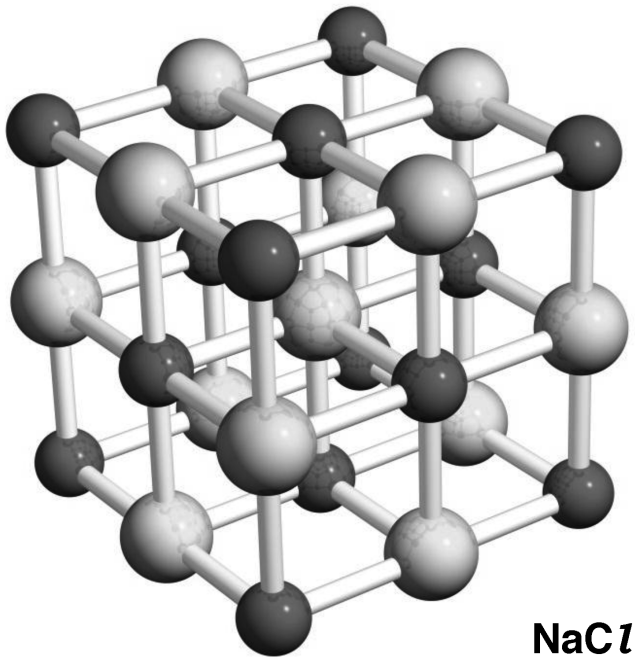
(c) A student is electrolysing a solution of sodium chloride, NaC*l*, in water, H_2O.

Complete the list of ions present in sodium chloride solution.

Positive ions (cations)	Negative ions (anions)
Na^+	.....
.....	OH^-

[2]

(d) Here is a diagram of a sodium chloride crystal.



Salt **NaC*l*** = sodium ion = chloride ion

- The C*l*–Na–C*l* length in a crystal of sodium chloride is 0.564 nm.

What is the volume of this cube in nm^3?

Give your answer to **3** significant figures.

Answer = ... nm^3 **[3]**

18* A student is separating a mixture of three solid substances, **A**, **B** and **C**.

Look at the table. It gives information about these substances.

Substance	Colour	Melting point (°C)	Is it magnetic?	Is it soluble in water?
A	grey	1535	yes	no
B	white	801	no	yes
C	yellow	1427	no	no

Suggest how the student can separate the mixture to get pure, dry samples of substances **A**, **B** and **C**.

Explain why your methods work.

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..... **[6]**

19 Magnesium burns in oxygen to make magnesium oxide.

The reaction involves both oxidation and reduction.

(a) Complete the equation by adding the state symbols for magnesium and oxygen at room temperature.

$2Mg(....) + O_2(....) \rightarrow 2MgO(s)$

magnesium + oxygen → magnesium oxide **[2]**

(b) Which element is oxidised and which element is reduced?

oxidised: .....

reduced: ..... **[1]**

(c) Magnesium oxide reacts with water to make an alkaline solution.

Describe how you would measure the pH of the magnesium hydroxide solution.

A pH meter is **not** available.

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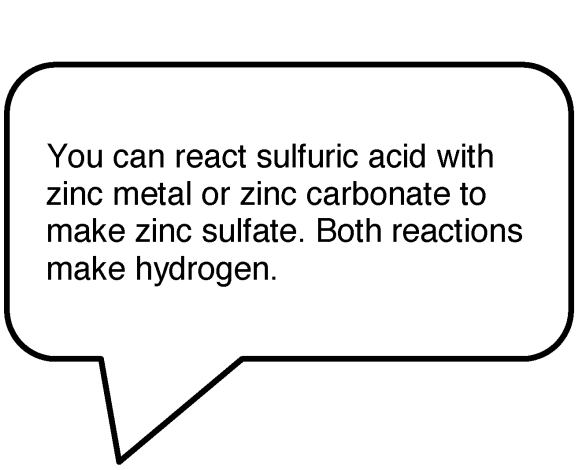
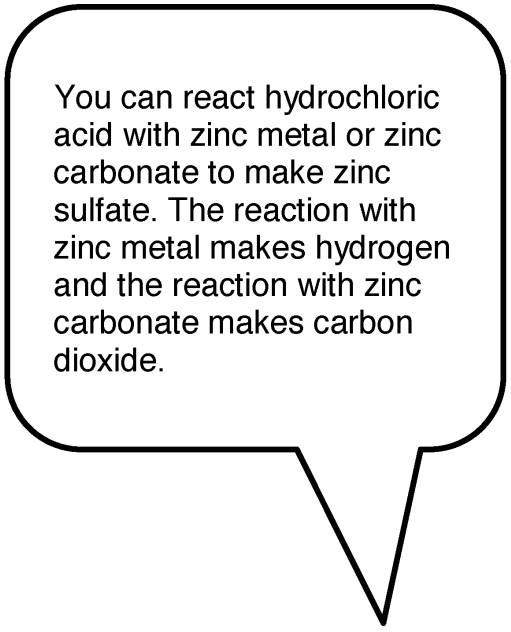
..... **[3]**

20 Two students, **A** and **B**, want to make some solid zinc sulfate.

They make some predictions.



Student **A** says



Student **B** says

(a) Comment on how correct **both** predictions are.

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..... **[4]**

(b) (i) Zinc oxide, ZnO, is reacted with nitric acid, HNO_3.

The reaction makes zinc nitrate, $Zn(NO_3)_2$, and water, H_2O.

Write a **balanced symbol** equation for this reaction.

..... **[2]**

(ii) A student suggests this method for preparing zinc nitrate.

1. Measure 50 cm^3 of dilute nitric acid into a beaker.
2. Add one spatula measure of zinc oxide.
3. Heat the mixture until crystals of zinc nitrate are made.

Her method will **not** make a pure dry sample of zinc nitrate.

What improvements should she make to the method to make sure that:

- the reaction is complete
- the zinc nitrate can be separated from the nitric acid and the zinc oxide?

Explain your answer.

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..... **[4]**

21 Look at the data about some hydrocarbons.

Hydrocarbon	Number of carbon atoms in molecule	Molecular formula	Boiling point (°C)
ethane	2	C_2H_6	–88
propane	3	C_3H_8	–42
pentane	5	C_5H_{12}	36
hexane	6	C_6H_{14}	69

(a) Butane contains 4 carbon atoms.

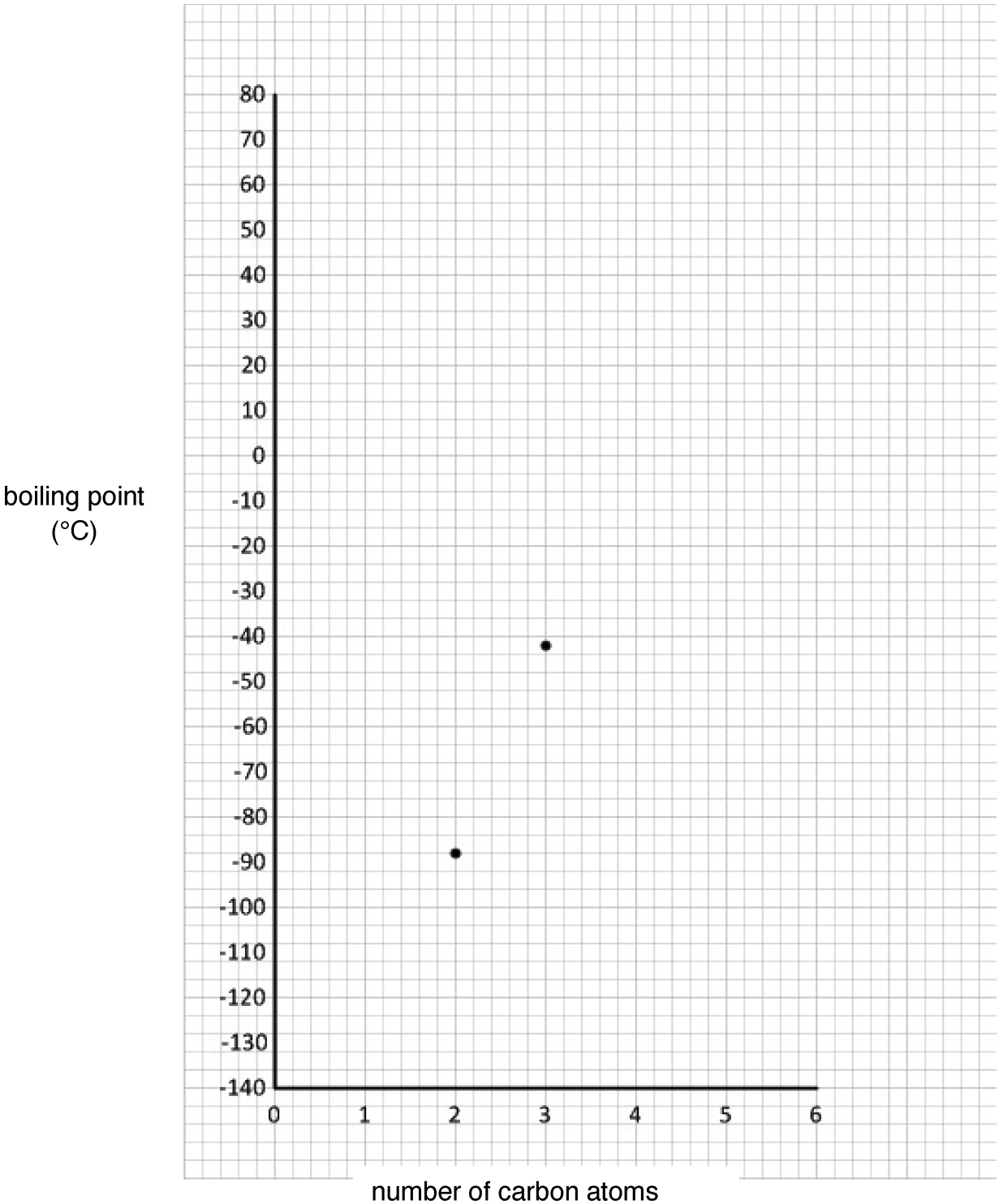
Use the table to suggest the molecular formula of butane.

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

(b) The boiling points of ethane and propane have been plotted on the graph.

(i) Plot the boiling points for pentane and hexane on the graph.

Draw the line of best fit. **[2]**



(ii) Use your graph to estimate the boiling point of butane.

Answer: ..... °C **[1]**

(iii) Describe the relationship between the number of carbon atoms in a molecule and its boiling point.

Use ideas about forces between molecules to explain your answer.

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..... **[2]**

(c) Propane burns in oxygen, O_2.

Carbon dioxide and water are made.

Write a **balanced symbol** equation for this reaction.

..... **[2]**

(d) Propane gives out 50 000 J/g when it reacts with oxygen.

- A propane burner is used to boil water to make a cup of tea.
- 63 000 J of energy are needed to boil the water.
- There is only 3 g of propane in the burner.

Do a calculation to find out if there is enough propane in the burner to boil the water.

[3]

22 **(a)** Nanoparticles are used as catalysts.

Describe a property of nanoparticles that make them useful as catalysts.

.....

..... **[2]**

(b) A student is synthesising a new titanium dioxide (TiO_2) nanoparticle for use as a catalyst.

One TiO_2 nanoparticle has a mass of 5.0×10^{-3} mg.

Calculate how many TiO_2 nanoparticles are in 80.0 mg of TiO_2.

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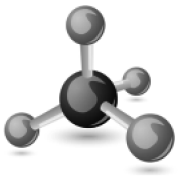
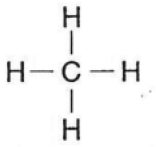
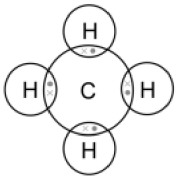
..... **[2]**

23 Methane has the formula, CH_4.

Look at the representations of methane.







ball and stick model **displayed formula** **dot and cross diagram**

Describe the limitations of a **displayed** formula.

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..... **[2]**

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24 Look at **Table 24.1**.

It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	.....	11	2.8.1
B	9	19	9	10	9	.....
C	.....	37	17	.....	17	2.8.7
D	13	27	.....	.....	10	2.8

Table 24.1

(a) **Complete** the missing information in **Table 24.1**. **[4]**

(b) Particle **A** is a **metal atom**, particle **D** is an **ion**.

Explain why.

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..... **[2]**

(c) Element **C** has the electronic structure 2.8.7.

What does this electronic structure tell you about the position of element **C** in the periodic table?

Explain your answer.

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..... **[4]**

(d) Complete the table below to give information about protons, neutrons and electrons.

	Charge	**Mass in atomic mass units**
proton	.....	1
neutron	.....	.....
electron	negative	.....

[2]

(e) Rutherford was a scientist who helped to develop the atomic model.

State how Rutherford's work contributed to the development of the atomic model.

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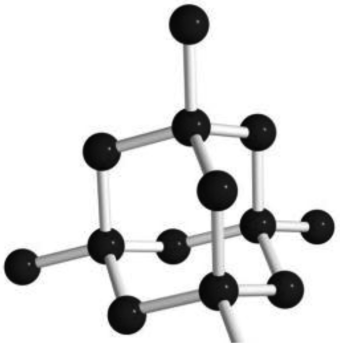
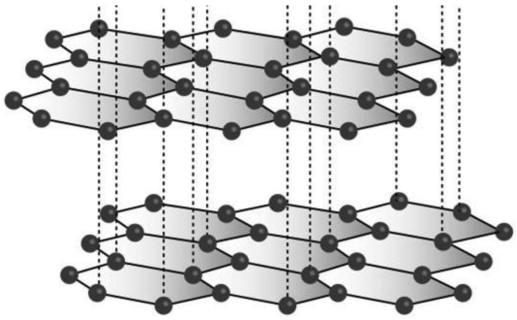
..... **[1]**

25 **(a)** The diagrams show the structures of two forms of carbon.



diamond



graphite

- Graphite is a good conductor of electricity.
- Diamond does **not** conduct electricity.

Use ideas about structure and bonding in diamond and graphite to explain these observations.

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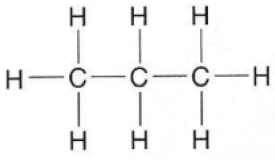
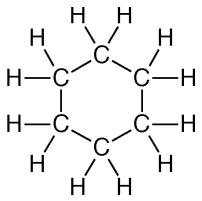
..... **[3]**

(b) Carbon can form many thousands of different compounds.

Two examples are shown below.



propane



cyclohexane

Why can carbon form many thousands of different compounds?

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

(c) Ethanol contains carbon.

Look at some information about ethanol.

- Melting point = –114 °C
- Boiling point = 78 °C

Predict the state of ethanol at 25 °C. How can you tell?

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..... **[2]**

END OF QUESTION PAPER