OCR
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GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/02 Chemistry (Foundation Tier)

Thursday 17 May 2018 – Morning

Time allowed: 1 hour 45 minutes

7032057160

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Chemistry B (Inserted))

You may use:
- a scientific or graphical calculator
- an HB pencil

J260002

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- 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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in the question marked with an asterisk (*****).
- This document consists of **24** pages.

Answer **all** the questions.

1 **(a)** Mendeleev developed the first Periodic Table. He looked for patterns in the properties of elements.

He discovered that by putting the elements in order of their atomic mass he could group together elements with similar properties.

The properties of some of the elements did not fit into the pattern.

What did Mendeleev do to make the pattern of properties fit?

Tick (✓) **two** boxes.

- He put the elements in alphabetical order. ☐
- He swapped the position of some elements to fit the pattern of properties. ☐
- He left out elements if their properties did not fit. ☐
- He left gaps for undiscovered elements. ☐
- He changed the properties of the elements to fit the pattern. ☐

[2]

(b) The modern Periodic Table puts elements in order of their atomic number.

Table 1.1 shows some information about fluorine and sodium.

Use the Periodic Table to help you to complete the missing information in **Table 1.1**.

Name of element	**Fluorine**	**Sodium**
Group number		1
Atomic number	9	11
Relative Atomic Mass	19	
Number of protons	9	
Number of electrons		11
Number of neutrons	10	

[5]

Table 1.1

2 Water is found naturally in very large amounts on Earth.

(a) **Table 2.1** shows some changes that produce water.

Place a tick (✓) in one box in each row to show whether each change is a **physical change** or **chemical change**.

	Physical change	**Chemical change**
Hydrogen and oxygen combine to form water.		
Ice melts to form water.		
Water vapour condenses to form water.		
Methane burns to form water and carbon dioxide.		

[3]

Table 2.1

(b) The different states of water can be explained by the particle model.

Complete **Table 2.2** to describe the particles in the three states of water.

Some have been done for you.

State	**Distance between particles**	**Movement of particles**
Solid	close together	
Liquid		slide over each other
Gas		

[3]

Table 2.2

(c) Methane and ammonia are compounds also found naturally on Earth.

Table 2.3 shows the boiling point of water, methane and ammonia.

Compound	Boiling point (°C)
Water	100
Methane	–164
Ammonia	–33

Table 2.3

Use ideas about forces between particles to explain why the compounds in **Table 2.3** have different boiling points.

.....

.....

.....

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

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3 Crude oil was formed from plants and animals which lived millions of years ago.

Crude oil contains a mixture of compounds called alkanes.

Alkanes contain only carbon and hydrogen atoms.

(a) What name is given to compounds that contain only carbon and hydrogen atoms?

Put a (ring) around the correct answer.

Acids **Crystals** **Hydrocarbons** **Salts** **Starch**

[1]

(b) The table gives information about some alkanes.

Alkane	Formula	Melting point (°C)	Boiling point (°C)
Methane	CH_4	–182	–164
Ethane	C_2H_6	–183	–89
Propane	C_3H_8	–188	–42
Butane	C_4H_{10}	–138	0
Pentane	C_5H_{12}	–130	36

(i) Describe how the formulae of the compounds change as the molecules of alkanes get larger.

.....

.....

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

(ii) Which compound is a liquid at 20 °C?
Use the data in the table to explain your answer.

.....

.....

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

(iii) What are the general trends in melting points and boiling points of alkanes as the molecules get larger?

.....

.....

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

(iv) Which alkane does not fit the general trend in melting and boiling points?

Explain your reasoning.

.....

.....

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

(c) All alkanes have the general formula C_nH_{2n+2}.

What is the formula for the alkane that has 8 carbon atoms?

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

(d) Chemists use a range of different separating techniques to separate mixtures.

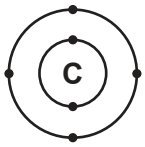
Which method is used to separate the alkanes in crude oil?

Put a (ring) around the correct answer.

Chromatography **Crystallisation** **Dissolving** **Filtration** **Fractional distillation**

[1]

(e) The diagrams show the arrangement of electrons in a carbon atom and a hydrogen atom.

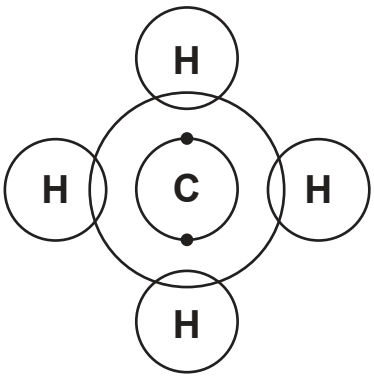


carbon atom

hydrogen atom

A methane molecule contains an atom of carbon joined to 4 atoms of hydrogen.

Complete the diagram to show the arrangement of electrons in a molecule of methane.



[2]

4 Jack works for a company that makes chemicals for farming. One of the chemicals is copper sulfate.

Jack is looking at ways to make copper sulfate.

(a) Jack adds copper metal to dilute sulfuric acid. There is no reaction.

Which statement explains why?

Tick (✓) **one** box.

- Copper is not a metal. ☐
- Copper is unreactive. ☐
- Sulfuric acid does not react with any metal. ☐
- Copper is more reactive than hydrogen. ☐

[1]

(b) Jack decides to make copper sulfate by reacting a compound of copper with dilute sulfuric acid.

Which copper compounds react with dilute sulfuric acid to make copper sulfate?

Put a (ring) around the **two** correct answers.

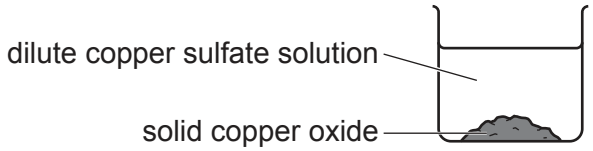
Copper carbonate **Copper chloride** **Copper hydroxide** **Copper nitrate**

[2]

(c) Jack finds out that copper oxide also reacts with dilute sulfuric acid to make copper sulfate.

He adds solid copper oxide to dilute sulfuric acid until no more solid reacts.

At the end of the experiment, Jack has a beaker of dilute copper sulfate solution with some unreacted solid copper oxide.



(i) Which method should Jack use to separate the dilute copper sulfate solution from the solid copper oxide?

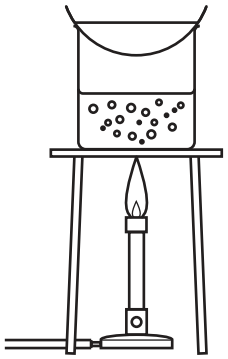
Put a (ring) around the correct answer.

Condensation **Crystallisation** **Distillation** **Evaporation** **Filtration**

[1]

(ii) Jack makes some crystals from the dilute copper sulfate.

He starts by setting up this apparatus.



Describe how Jack can use this apparatus to make crystals.

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.....

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

(d) Jack measures the mass of the copper oxide at the start of the experiment.
He measures the mass of the copper sulfate crystals at the end of the experiment.

The table shows his results.

Mass of copper oxide at start (g)	4.0
Mass of copper sulfate at end (g)	10.0

Calculate the mass of copper oxide Jack needs to use to make 5 kg of copper sulfate crystals.
Give your answer in kg.

Mass of copper oxide = ... kg
[2]

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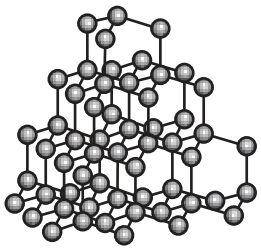
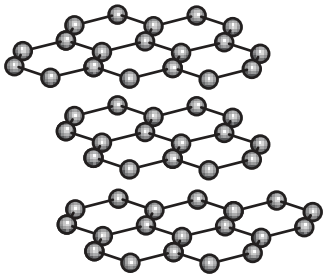
5 Diamond and graphite both consist of carbon atoms bonded together.

Their structures are shown below:



diamond



graphite

(a) The table contains some statements about diamond and graphite.

Place **one** tick (✓) in a box for each statement to show whether it is **true for diamond only**, **true for graphite only** or **true for both diamond and graphite**.

Statement	True for diamond only	True for graphite only	True for both diamond and graphite
Every bond in the structure is the same.			
Solid conducts electricity.			
Atoms are joined in a giant structure.			

[3]

(b) Graphite is used in pencils.

Use ideas from the structures to explain why graphite can make marks on paper.

Tick (✓) **two** boxes next to the best explanations.

All the bonds in graphite are weak. ☐

Atoms in graphite are in layers. ☐

Forces between layers in graphite are weak. ☐

Every atom in graphite is strongly bonded to four others. ☐

[2]

6* Ropes can be made from different types of fibres.

Some ropes are made using natural fibres made from plants. Some ropes are made using synthetic fibres made from crude oil.

Information about some fibres is shown in the table.

Fibre	Manila	Nylon	Kevlar
Source	plants	crude oil	crude oil
Density (g/cm^3)	1.62	1.09	1.44
Range of tensile strength (N/mm^2)	49–75	62–79	210–350
Stretch before breaking (%)	7	22	3
Water absorbency (%)	33	4	5

Mia wants to buy a rope for climbing.

The best ropes for climbing are made from fibres which are strong and able to stretch. They need to be light in weight, even when wet.

Use the information in the table to choose the best fibre for making a rope for climbing. Justify your answer.

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

7 Indigestion may be caused by excess acid. Jane investigates indigestion tablets.

The active compound in each tablet is calcium carbonate which reacts with excess acid. Each tablet also contains other ingredients.

(a) The tablets are a formulation and not a pure substance.

Put ticks (✓) in one box in each row to show which statements about formulations and pure substances are **true** and which are **false**.

Statement	True	False
A formulation is a fixed mixture of pure substances.		
A formulation contains all the same type of atoms.		
A pure substance contains only one compound or element.		
All pure substances are safe to eat.		

[2]

(b) The acid in the stomach is mainly hydrochloric acid.

(i) The calcium carbonate reacts with the hydrochloric acid to form calcium chloride, carbon dioxide gas and water.

Complete the **word** equation for the reaction by filling in the missing words.

calcium carbonate + ... → ..... + ... + ...

....

[1]

(ii) Jane adds some indigestion tablets to some hydrochloric acid in a beaker.

Jane sees bubbles of carbon dioxide form when she adds the tablets to the acid.

Describe one **other** observation that Jane would see.

.....

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

(iii) Jane tests the carbon dioxide that is made.

What is the correct test for carbon dioxide?

Tick (✓) **one** box.

Relights a glowing splint.	☐
Pops a lighted splint.	☐
Bleaches damp litmus paper.	☐
Turns limewater cloudy.	☐

[1]

(c) Jane adds five indigestion tablets to some acid in a beaker.

When the tablets react with the acid, the mass decreases because carbon dioxide gas leaves the beaker.

Jane uses a balance to work out the mass change during the reaction.

These are her results:

Mass of 5 tablets = 7.55 g
Mass of beaker with acid before adding tablets = 200.49 g
Mass of beaker and contents at the end of reaction = 206.24 g

(i) Jane adds the five tablets to the beaker of acid.

Calculate the total mass of the beaker and all of its contents at the start of the reaction.

Total mass of beaker and contents = ... g

[1]

(ii) The mass of the beaker and its contents decreases during the experiment because carbon dioxide is made.

Calculate the mass of carbon dioxide made in Jane's experiment.

Mass = ... g

[1]

(d) Jane finds that the reaction takes a long time.

Give **two** changes she could make to her experiment to make the reaction faster.

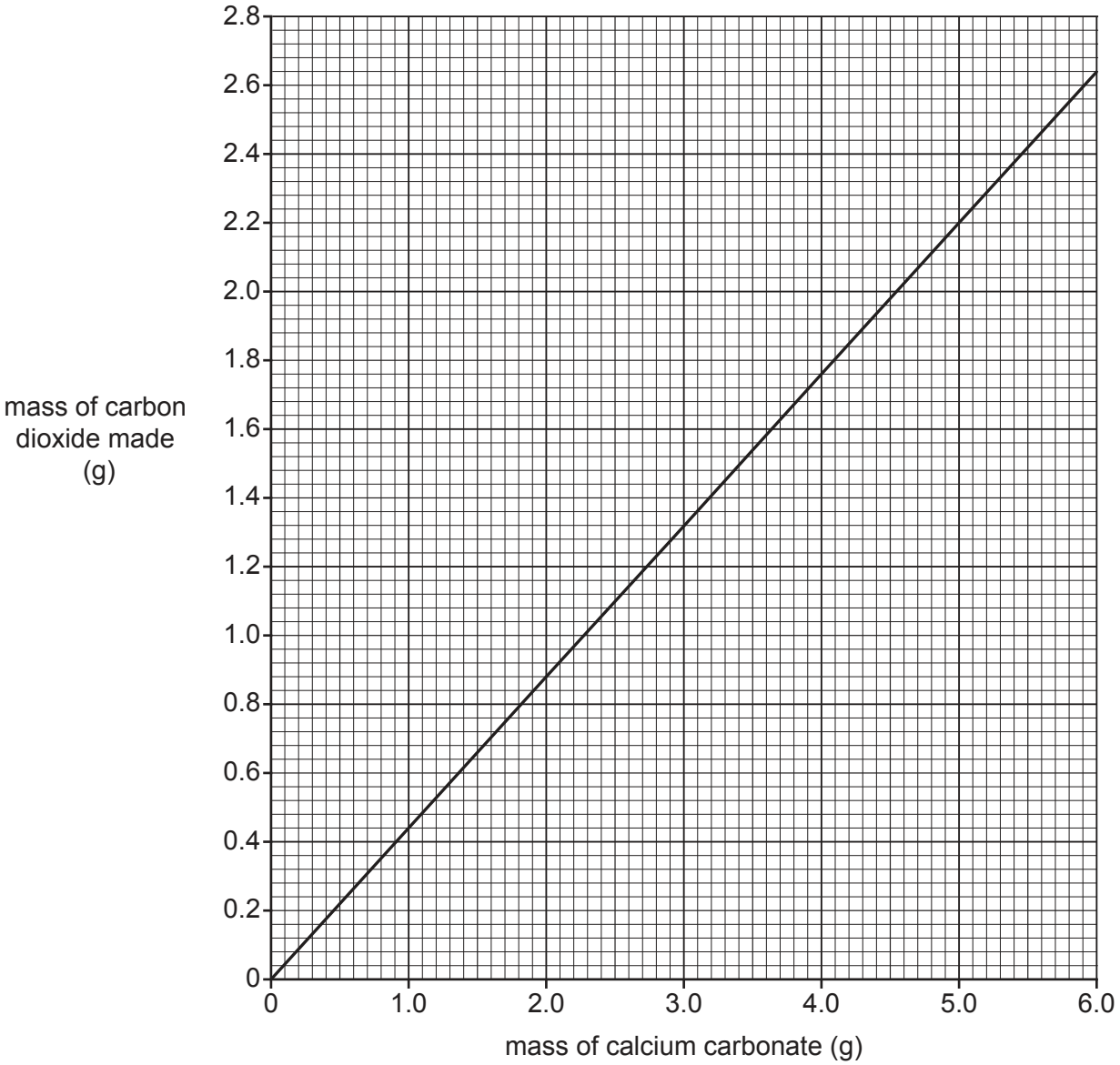
1 .....

2 .....

[2]

(e) The tablets contain calcium carbonate with other ingredients.

Jane looks at a graph which shows the mass of carbon dioxide that is made when different masses of calcium carbonate react with acid.



The label on the tablets says that **each** tablet contains 0.5 g of calcium carbonate.

(i) Calculate the mass of calcium carbonate in **5** tablets.

Mass of calcium carbonate = ... g

[1]

(ii) Use the graph to predict how much carbon dioxide is made from five tablets.
Show how you used the graph to find your answer.

Mass of carbon dioxide = ... g

[2]

8 Jamal does a titration to find the concentration of some acid.
He measures the volume of acid needed to react with 25.0 cm^3 of alkali.

(a) What type of reaction happens when the acid reacts with the alkali?

Put a (ring) around the correct answer.

Crystallisation **Neutralisation** **Oxidation** **Precipitation**

[1]

(b) Here are some statements about the steps needed to do a titration.

They are not in the correct order.

A Add an indicator.

B Measure out exactly 25.0 cm^3 of alkali into a conical flask.

C Repeat the experiment until the results closely agree.

D Write down the volume of acid used.

E Add acid to the alkali slowly until the indicator changes colour.

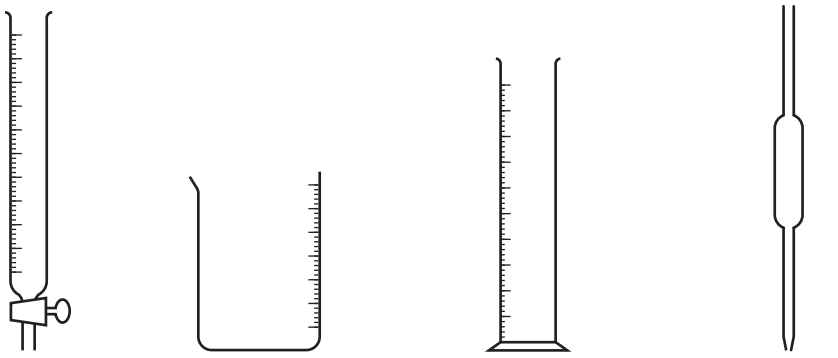
Fill in the boxes to show the **correct order** for the steps in a titration.

One has been done for you.

				C

[2]

(c) Here are some pieces of apparatus that are used to measure out volumes of liquids.



burette **graduated beaker** **measuring cylinder** **pipette**

(i) Which is the best apparatus to use to measure out exactly 25.0 cm^3 of alkali into a conical flask?

Put a (ring) around the correct answer.

Burette **Graduated beaker** **Measuring cylinder** **Pipette** **[1]**

(ii) Which is the best apparatus to use to accurately measure out the amount of acid needed to react with the alkali?

Put a (ring) around the correct answer.

Burette **Graduated beaker** **Measuring cylinder** **Pipette** **[1]**

(d) Here are Jamal's results.

	Rough trial	**Repeat titrations**			
		1	**2**	**3**	**4**
Volume of acid added (cm^3)	25.2	23.4	23.5	22.1	23.5

(i) Jamal does a rough trial before he does his repeat titrations.

Explain how he uses the result of his rough trial to help him to do his repeat titrations.

.....

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

(ii) Jamal ignores his rough trial when he processes his results.

What is the range of the results of Jamal's **repeat titrations**?

Range = ... **[1]**

(iii) Identify the outlier in the results of Jamal's **repeat titrations**.

Explain your choice.

.....

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

(iv) Use the repeat titration results to calculate the mean value for the volume of acid added.

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

Mean value = ... cm^3 **[3]**

9 The elements in Group 7 (Group 17) of the Periodic Table are called the halogens.

(a) Each element has a different state and colour at room temperature.

Draw lines to connect each **element** with its correct **state** and **colour** at room temperature.

State	Element	Colour
Solid	Chlorine	Green
Liquid	Bromine	Dark grey
Gas	Iodine	Pink
		Red/brown

[3]

(b) **Table 9.1** shows what happens when some halogens react with hydrogen.

Element	Reaction with hydrogen
Bromine	Reacts steadily when heated.
Fluorine	Explodes at room temperature.
Iodine	Reacts slowly when heated.

Table 9.1

(i) Describe the trend in reactivity of the Group 7 elements with hydrogen.

.....

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

(ii) A mixture of chlorine and hydrogen explodes when a small spark is added.

Does this fit the trend of the reactivity of the other Group 7 elements with hydrogen?

Explain your reasoning.

.....

.....

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

(c) The halogens also react with reactive metals.

(i) Potassium reacts with bromine to form potassium bromide.

Balance the symbol equation for this reaction.

.....K + Br_2 → .....KBr

[1]

(ii) Other metals also react with bromine to form metal bromides.

The formula of the metal bromide depends on the number of electrons in the outer shell of an atom of the metal.

Complete **Table 9.2** which shows the products formed when different metals react with bromine.

Metal	Periodic Table Group	Number of electrons in outer shell of atom of metal	Ion formed by metal	Formula of metal bromide
Potassium	1	1	K^+	KBr
Magnesium	2			
Aluminium	3			

Table 9.2

[3]

10 Most cars are fitted with catalytic converters.

Harmful gases from the car engine react together in the converter to form less harmful gases.

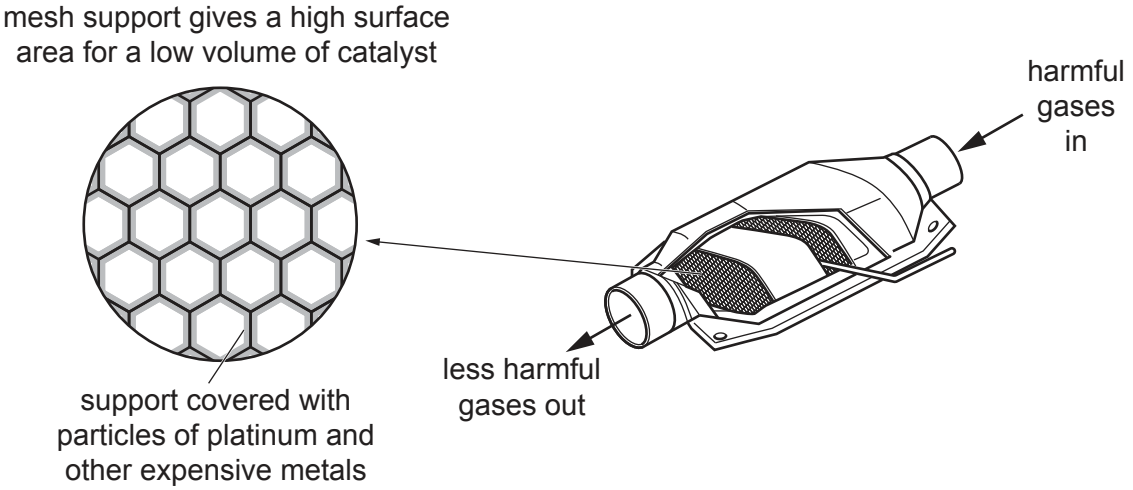
(a) The catalyst in the converter increases the rate of the reactions between the gases.

Use ideas about energy to explain how catalysts increase the rate of a reaction.

.....

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

(b) Platinum and other very expensive metals are used as catalysts in the converter.
Very small particles of the metals are spread in a thin layer over a support.
This means that a very low volume of metals is needed to give a very high surface area.



Suggest the advantages of using a low volume of catalyst with a high surface area.

Low volume .....

.....

High surface area .....

.....

[2]

(c) (i) The surface area to volume ratio of a particle of a catalyst can be calculated by using this formula:
surface area to volume ratio = surface area of particle ÷ volume of particle

The table shows the particle size and surface area to volume ratio for fine and coarse powders.

Particle	Fine powder	Coarse powder
Size (nm)	500	5000
Surface area to volume ratio (nm^{-1})	0.012	0.0012

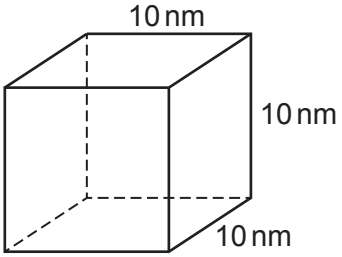
How is the surface area to volume ratio of a particle related to its size?

.....

.....

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

(ii) Catalysts are now made from nanoparticles. A nanoparticle in a catalyst is shown in the diagram.



Calculate the surface area to volume ratio of the nanoparticle.
Assume that it is a cube with sides of 10 nm.

Surface area to volume ratio of the particle = ... nm^{-1}

[4]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).