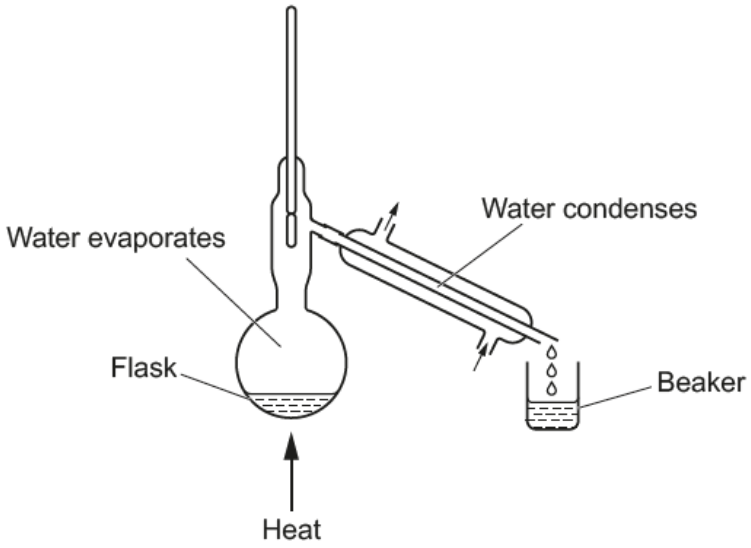
Matter – 2021/20 GCSE Gateway Physics Combined Science A

1. Nov/2021/Paper_J250/05/No.9

A teacher is distilling water using the equipment shown in the diagram.

Distillation involves evaporating and condensing the water.



When the teacher starts, there is 100 g of water in the flask, and the beaker is empty.

They stop when less than half of the water in the flask has been distilled.

Which statement is correct?

A Mass of water in flask + Mass of water in beaker = 100 g

B Mass of water in flask – Mass of water in beaker = 100 g

C Mass of water in flask = Mass of water in beaker

D There is twice as much water in the beaker than in the flask

Your answer ☐ **[1]**

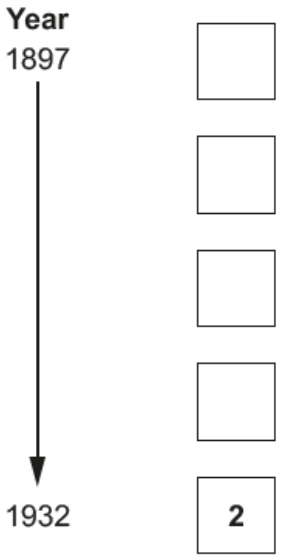
2. Nov/2021/Paper_J250/05/No.16

(a) Here are some events in atomic theory:

1	Thomson	Discovered the electron. Published findings in a scientific journal.
2	Chadwick	Discovered the neutron.
3	Bohr	Suggested electron shells after a science conference.
4	Rutherford	Did experiments showing the atom had a nucleus.
5	Thomson	Published the 'plum pudding' model in a scientific journal.

(i) Place the events in the order they occurred.

Write the numbers in the boxes below. One has been done for you.



[2]

(ii) The events were peer reviewed **and** communicated to others.

Suggest why **both** are important in science.

Peer review .....

.....

Communication .....

.....

[2]

(b) **Table 16.1** gives the density of different materials.

Material	State	Density (kg/m^3)
Argon	Gas	1.45
Copper	Solid	8960
Ethanol	Liquid	789
Iron	Solid	7870
Oxygen	Gas	1.31
Water	Liquid	998

Table 16.1

(i) Describe any trends in the data in **Table 16.1**.

.....

.....

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

(ii) Explain the difference in density between solids and liquids.

You may draw diagrams to help your answer.

.....

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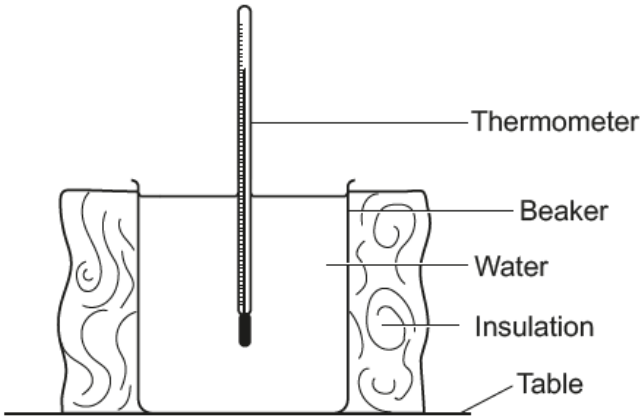
..... **[2]**

3. Nov/2021/Paper_J250/06/No.5

A student investigates how **hot** water in an insulated beaker cools.



They test how the thickness of insulation affects the rate of cooling.

Which row in the table describes a suitable method for this investigation?

	What the student changes	What the student measures
A	temperature drop of water	thickness of insulation
B	temperature rise of water	thickness of insulation
C	thickness of insulation	temperature drop of water
D	thickness of insulation	temperature rise of water

Your answer ☐ **[1]**

4. Nov/2021/Paper_J250/06/No.12(d)

(d) Equal amounts of isotope **Y** are placed in a plastic box and in a cardboard box.

Table 11.1 gives information about both boxes.

	Plastic box	Cardboard box
Waterproof	yes	no
Material breaks easily	no	yes
Secure lid	yes	no

Table 11.1

(i) Which box is best for storing isotope **Y**?

Give **one** reason for your answer using the information in **Table 11.1**.

.....

.....

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

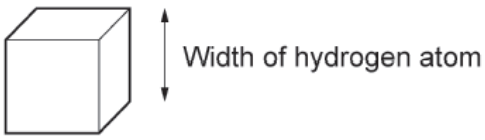
(ii) The plastic box does not let any of the radiation emitted by isotope **Y** pass through it.

Which type of radiation does isotope **Y** emit?

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

5. Nov/2020/Paper_J250/05/No.7

A physics student says a hydrogen atom is like a cube.



What is the **approximate** volume of this hydrogen atom?

A $1 \times 10^{-30}\,m^3$

B $1 \times 10^{-27}\,m^3$

C $1 \times 10^{-10}\,m^3$

D $1 \times 10^{-9}\,m^3$

Your answer ☐ **[1]**

6. Nov/2020/Paper_J250/05/No.9

Which statement describes an atom?

A The nucleus is smaller than the atom and contains no mass.

B The nucleus is smaller than the atom and contains most of the mass.

C The nucleus orbits the electrons and contains most of the mass.

D The nucleus orbits the protons and contains electrons.

Your answer ☐ **[1]**

7. Nov/2020/Paper_J250/05/No.10

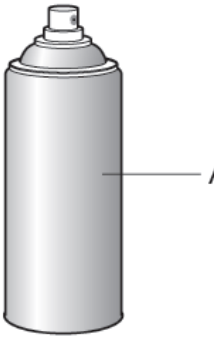
Which row of the table describes a physical change?

	Process	Material
A	Can be reversed	Keeps new properties when reversed.
B	Can be reversed	Returns to original properties when reversed.
C	Cannot be reversed	Has new properties after the change.
D	Cannot be reversed	Keeps its original properties after the change.

Your answer ☐ **[1]**

8. Nov/2020/Paper_J250/05/No.11

An aerosol canister contains a non-flammable gas at high pressure. The aerosol canister should **not** be exposed to high temperatures.



Complete the sentences using the words below.

You can use each word once, more than once, or not at all.

accelerate **collide** **faster** **pressure**

slower **temperature** **vibrate** **volume**

When the temperature of the gas in the aerosol canister increases, gas particles move

..... .

The gas particles ..... with the sides of the aerosol canister more often.

The ..... of the gas increases, so the aerosol canister may explode.

[3]

9. Nov/2020/Paper_J250/05/No.13

Salol is a solid at room temperature. A student heats some salol in a boiling tube, as shown in **Fig. 13.1**.

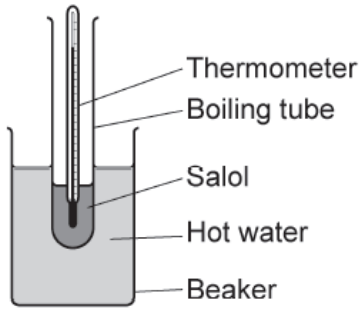


Fig. 13.1

She measures the temperature of the salol at different times. **Fig. 13.2** is a graph of her results.

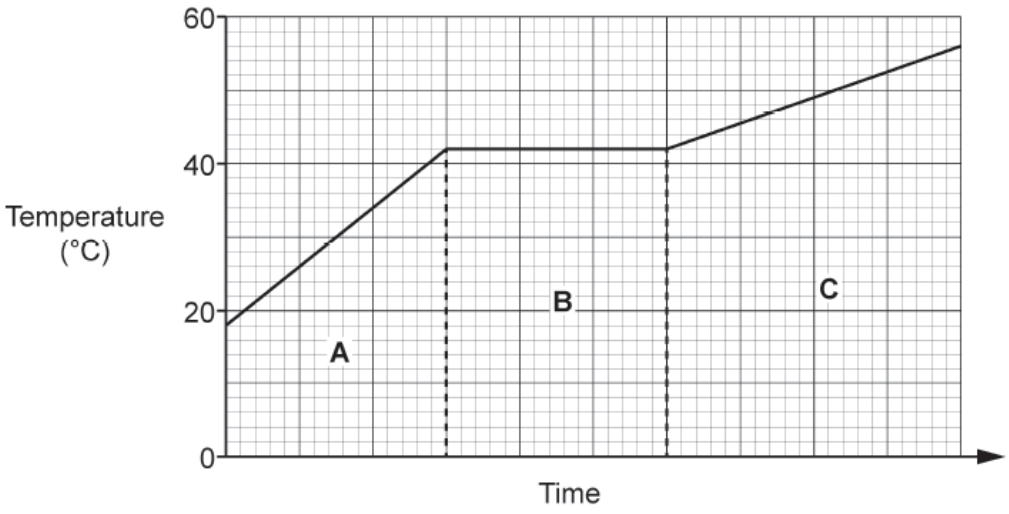


Fig. 13.2

(a) **Fig. 13.3** is a model of particles in salol.

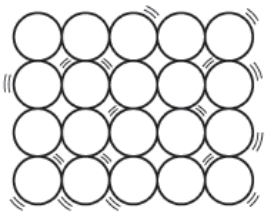


Fig. 13.3

In which part of the graph, **A**, **B** or **C**, would the particles look like those in **Fig. 13.3**?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

[1]

(b) What is the melting point of salol?

Melting point = ... °C **[1]**

(c) In which part of the graph, **A**, **B** or **C**, is salol a solid **and** a liquid?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

[1]

(d) Complete the sentences using the words or phrases below.

You can use each word or phrase once, more than once, or not at all.

break **decreases** **form** **increases** **stays the same**

In part **B** of the graph, bonds between salol particles ..... .

In part **B** of the graph, the temperature ..... .

In part **B** of the graph, the kinetic energy store of the salol ..... .

In part **B** of the graph, the mass of the salol ..... .

[4]

(e) **(i)** The student is given 20 grams (g) of salol.

What is the mass of salol in kilograms (kg)?

Mass = ... kg **[1]**

(ii) The specific latent heat of fusion of salol is 89 700 J/kg.

How much thermal energy is needed to completely melt 0.01 kg of salol?

Use an equation from the Data Sheet to help you.

Thermal energy = ... J **[2]**

10. Nov/2020/Paper_J250/06/No.16

A student measures the temperature of a beaker of water as it cools down.

The graph in **Fig. 16.1** shows how the temperature changes with time.

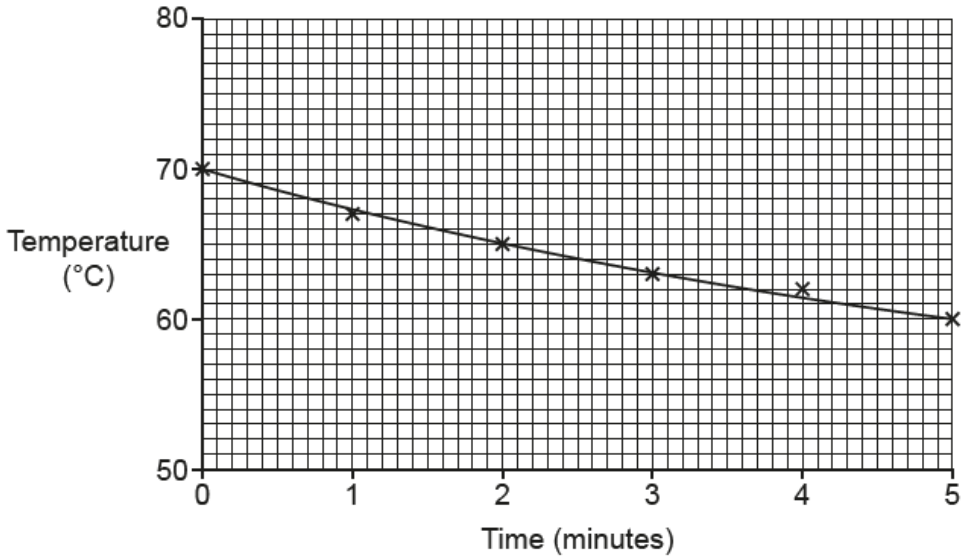


Fig. 16.1

(a) Calculate the rate of temperature change over the 5 minutes.

Rate of temperature change = ... °C / minute **[3]**

(b) **(i)** Describe, in detail, how the temperature changes over the 5 minutes.

.....

.....

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

(ii) The beaker contains 0.2 kg of water.

The specific heat capacity of water is 4200 J/kg °C.

Calculate the change in thermal energy in the water after 5 minutes.

Give your answer to **1** significant figure.

Use an equation from the Data Sheet to help you.

Change in thermal energy = ... J **[3]**

(c) Describe the change in energy stores as the water cools down.

.....

.....

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

(d) The student is given some insulation. She wraps the insulation around the sides of the beaker and repeats the experiment.

(i) Add **another line** to the graph in **Fig. 16.1** to show how the temperature may change when the beaker is wrapped with insulation. **[1]**

(ii) State **one** thing the student can do to reduce the rate of cooling further.

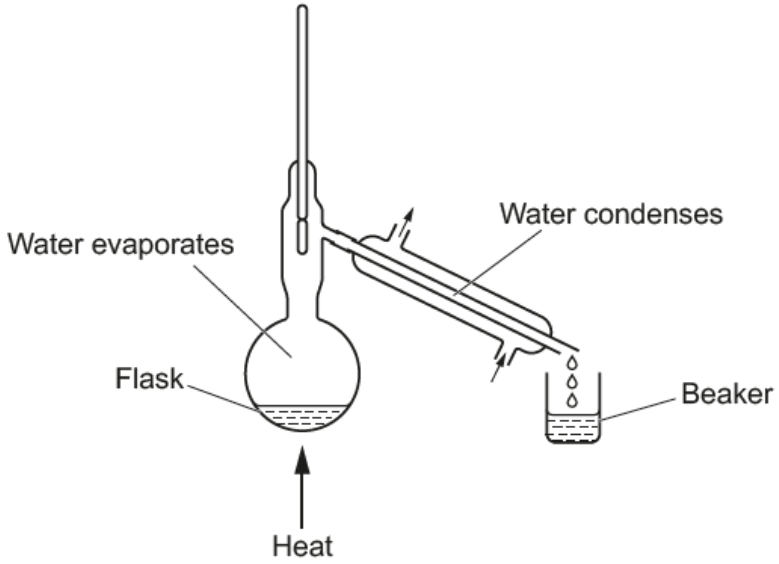
.....

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

11. Nov/2021/Paper_J250/11/No.1

A teacher is distilling water using the equipment shown in the diagram.

Distillation involves evaporating and condensing the water.



When the teacher starts, there is 100 g of water in the flask, and the beaker is empty.

They stop when less than half of the water in the flask has been distilled.

Which statement is correct?

A Mass of water in flask + Mass of water in beaker = 100 g

B Mass of water in flask – Mass of water in beaker = 100 g

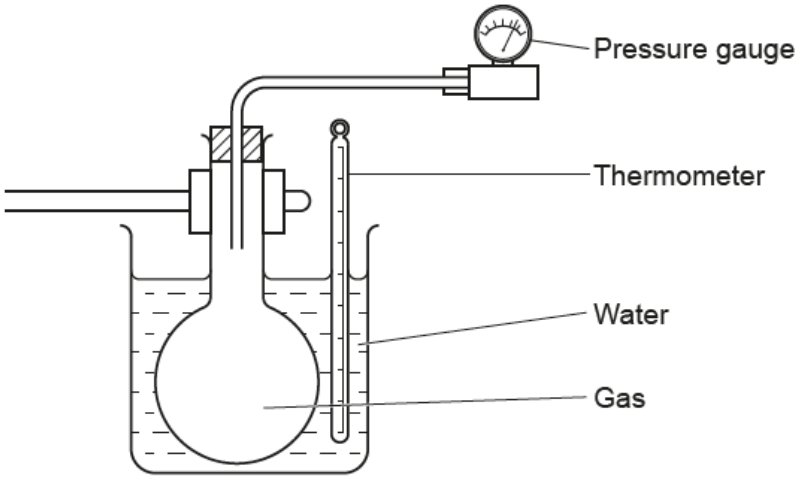
C Mass of water in flask = Mass of water in beaker

D There is twice as much water in the beaker than in the flask

Your answer ☐ **[1]**

12. Nov/2021/Paper_J250/11/No.7

This apparatus is used to measure the pressure of a fixed volume of gas.



When the temperature of water increases what happens to the pressure and the speed of the gas particles?

	Pressure	Speed of gas particles
A	Decreases	Decreases
B	Decreases	Increases
C	Increases	Decreases
D	Increases	Increases

Your answer ☐ **[1]**

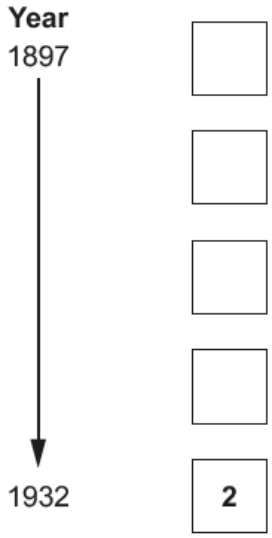
13. Nov/2021/Paper_J250/11/No.11

(a) Here are some events in atomic theory:

1	Thomson	Discovered the electron. Published findings in a scientific journal.
2	Chadwick	Discovered the neutron.
3	Bohr	Suggested electron shells after a science conference.
4	Rutherford	Did experiments showing the atom had a nucleus.
5	Thomson	Published the 'plum pudding' model in a scientific journal.

(i) Place the events in the order they occurred.

Write the numbers in the boxes below. One has been done for you.



[2]

(ii) The events were peer reviewed **and** communicated to others.

Suggest why **both** are important in science.

Peer review .....

.....

Communication .....

.....

[2]

(b) **Table 11.1** gives the density of different materials.

Material	State	Density (kg/m^3)
Argon	Gas	1.45
Copper	Solid	8960
Ethanol	Liquid	789
Iron	Solid	7870
Oxygen	Gas	1.31
Water	Liquid	998

Table 11.1

(i) Describe any trends in the data in **Table 11.1**.

.....

.....

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

(ii) Explain the difference in density between solids and liquids.

You may draw diagrams to help your answer.

.....

.....

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

(c) **Table 11.2** gives some information about ethanol and water.

Liquid	Specific heat capacity (J/kg °C)	Specific latent heat of vaporisation (J/kg)
Ethanol	2440	846 000
Water	4200	2 256 000

Table 11.2

(i) The specific latent heat of vaporisation is the energy transferred when 1 kg of a substance changes from liquid to gas.

Calculate the amount of energy needed to evaporate 0.2 kg of **ethanol**.

Use **Table 11.2** and an equation from the Data Sheet to help you.

Energy = ... J **[2]**

(ii) The energy needed to heat 1 kg of water by 1 °C is 4200 J.

The energy needed to evaporate 1 kg of water is 2 256 000 J.

This is much **more** than 4200 J. Explain why.

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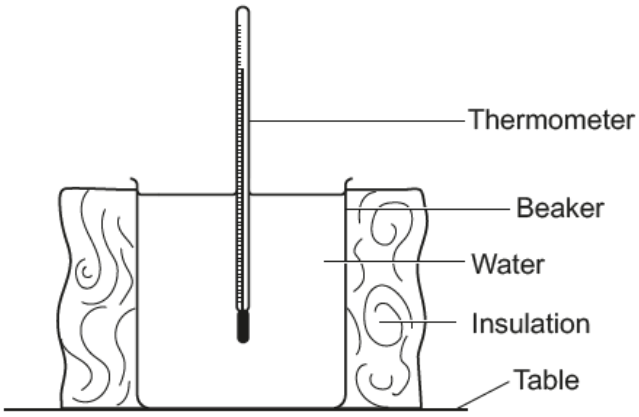
..... **[2]**

14. Nov/2021/Paper_J250/12/No.5

A student investigates how hot water in an insulated beaker cools. They test how the thickness of insulation affects the rate of cooling.



Which row in the table describes a valid procedure?

	What the student keeps the same	What the student changes	What the student measures
A	starting temperature	thickness of insulation	temperature rise of water
B	starting temperature	thickness of insulation	temperature drop of water
C	volume of water	starting temperature	thickness of insulation
D	volume of water	temperature of water	thickness of insulation

Your answer ☐ **[1]**

15. Nov/2020/Paper_J250/11/No.1

Which statement describes an atom?

A The nucleus is smaller than the atom and contains no mass.

B The nucleus is smaller than the atom and contains most of the mass.

C The nucleus orbits the electrons and contains most of the mass.

D The nucleus orbits the protons and contains electrons.

Your answer ☐ **[1]**

16. Nov/2020/Paper_J250/11/No.2

Which row of the table describes a physical change?

	Process	Material
A	Can be reversed	Keeps new properties when reversed.
B	Can be reversed	Returns to original properties when reversed.
C	Cannot be reversed	Has new properties after the change.
D	Cannot be reversed	Keeps its original properties after the change.

Your answer ☐ **[1]**

17. Nov/2020/Paper_J250/11/No.7

In an experiment, it takes 3006 J of energy to melt an ice cube.

The ice cube has a mass of 0.009 kg.

Calculate the specific latent heat of melting for ice.

Use an equation from the Data Sheet to help you.

A 27.1 J/kg

B 334 J/kg

C 27 100 J/kg

D 334 000 J/kg

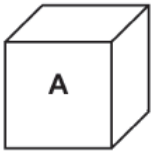
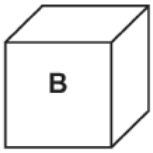
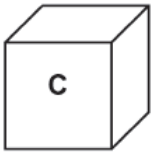
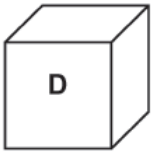
Your answer ☐ **[1]**

18. Nov/2020/Paper_J250/11/No.8

A student heats 4 blocks using the same heater for the same amount of time.

Each block has the same **mass** but a different **specific heat capacity**.

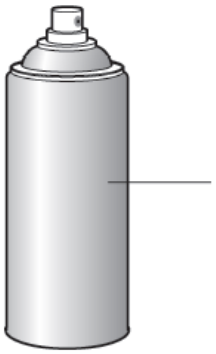
Which block will have the greatest temperature rise?

Block	Specific heat capacity (J/kg °C)
	130
	390
	460
	490

Your answer ☐ **[1]**

19. Nov/2020/Paper_J250/12/No.12

An aerosol canister may contain a non-flammable gas at high pressure.



Aerosol canister containing a non-flammable gas

The aerosol canister should **not** be exposed to high temperatures.

Explain why.

Include ideas about gas particles in your answer.

.....

.....

.....

.....

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

20. Nov/2020/Paper_J250/12/No.11

A student measures the temperature of a beaker of water as it cools down.

The graph in **Fig. 11.1** shows how the temperature changes with time.

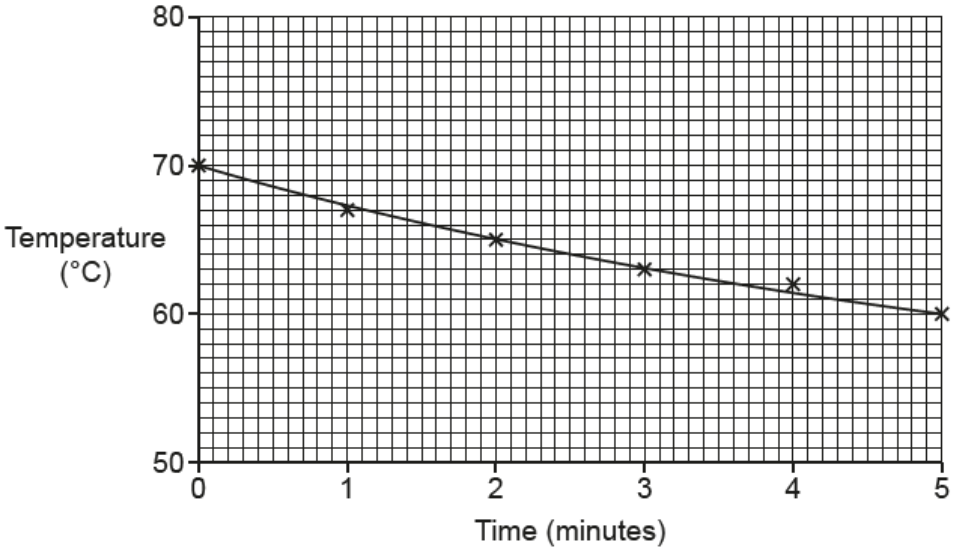


Fig. 11.1

(a) Calculate the rate of temperature change over the 5 minutes.

Rate of temperature change = ... °C/minute **[3]**

(b) **(i)** Describe, in detail, how the temperature changes over the 5 minutes.

.....

.....

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

(ii) The beaker contains 0.2 kg of water.

The specific heat capacity of water is 4200 J/kg °C.

Calculate the change in thermal energy in the water after 5 minutes.

Give your answer to **1** significant figure.

Use an equation from the Data Sheet to help you.

Change in thermal energy = ... J **[3]**

(c) Describe the change in energy stores as the water cools down.

.....

.....

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

(d) The student is given some insulation. She wraps the insulation around the sides of the beaker and repeats the experiment.

(i) Add **another line** to the graph in **Fig. 11.1** to show how the temperature may change when the beaker is wrapped with insulation. **[1]**

(ii) State **one** thing the student can do to reduce the rate of cooling further.

.....

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