# AQA

# GCSE
# COMBINED SCIENCE: TRILOGY

**F**

Foundation Tier
Physics Paper 1F

Wednesday 20 May 2020          Afternoon          Time allowed: 1 hour 15 minutes

## Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

## Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book.  Write the question number against your answer(s).
- Do all rough work in this book.  Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

## Information

- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

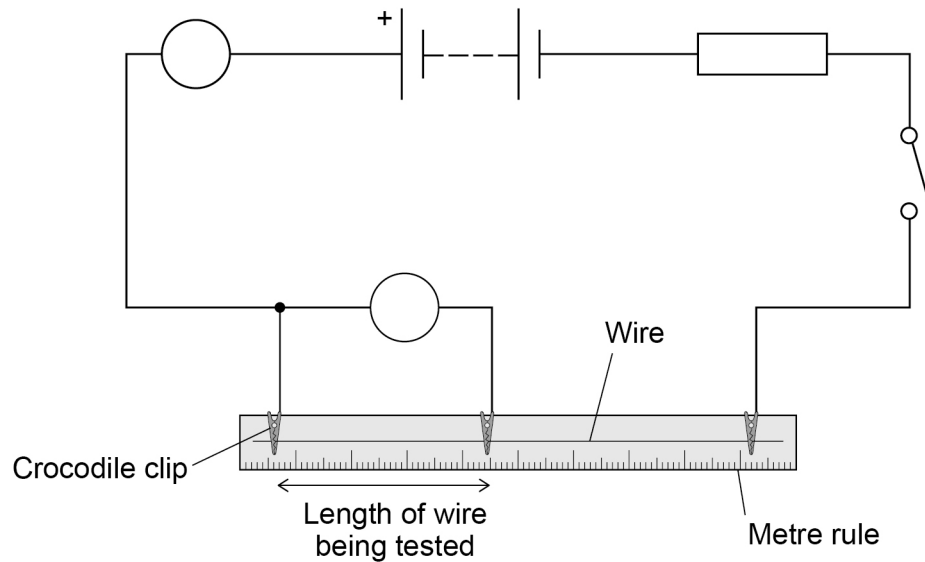| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| **TOTAL** | |

**0 1** A student investigated how the resistance of a wire varies with the length of the wire.

**Figure 1** shows the circuit used.

**Figure 1**



**0 1 . 1** The symbols for the voltmeter and ammeter in **Figure 1** are **not** complete.

Complete the symbols for the voltmeter and ammeter in **Figure 1**.

**[1 mark]**

**0 1 . 2** Which variable is the independent variable?

**[1 mark]**

Tick (✓) **one** box.

The current in the wire ☐

The length of the wire being tested ☐

The resistance of the wire ☐

The thickness of the wire ☐

| 0 | 1 | . | 3 | Which variable is the dependent variable?

**[1 mark]**

Tick (✓) **one** box.

The current in the wire

The length of the wire being tested

The resistance of the wire

The thickness of the wire

| 0 | 1 | . | 4 | The student took repeat readings of potential difference for a 30 cm length of the wire.

The readings were:

0.16 V          0.17 V          0.15 V

Calculate the mean potential difference.

**[2 marks]**

Mean potential difference = _____ V

**Question 1 continues on the next page**

**Turn over ▶**

The length of the wire was increased to 60 cm

The current in the wire was 0.50 A

The mean potential difference across the wire was 0.32 V

**0 1 . 5** Calculate the resistance of the 60 cm length of wire.

Use the equation:

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

**[2 marks]**

Resistance = _____ Ω

**0 1 . 6** Calculate the power dissipated in the 60 cm length of wire.

Use the equation:

$$\text{power} = \text{potential difference} \times \text{current}$$

**[2 marks]**

Power = _____ W

0 1 . 7   Calculate the charge flow when there is a current of 0.50 A in the wire for 17 s

Use the equation:

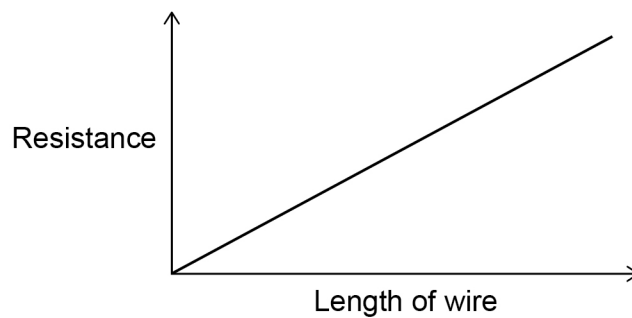$$\text{charge flow} = \text{current} \times \text{time}$$

**[2 marks]**

Charge flow = _____ C

0 1 . 8   **Figure 2** is a sketch graph of the results.

**Figure 2**

The student repeated the investigation using a thicker wire made from the same metal. For the same length, the thicker wire has a lower resistance.

Draw a line on **Figure 2** to show how the resistance of the thicker wire varies with length.

**[1 mark]**

12

**Turn over for the next question**

**Turn over ▶**

**0 2**    Between 1951 and 1992 the USA tested nuclear weapons in a desert.

**0 2 . 1**    Complete the sentence.

Choose the answer from the box.

**[1 mark]**

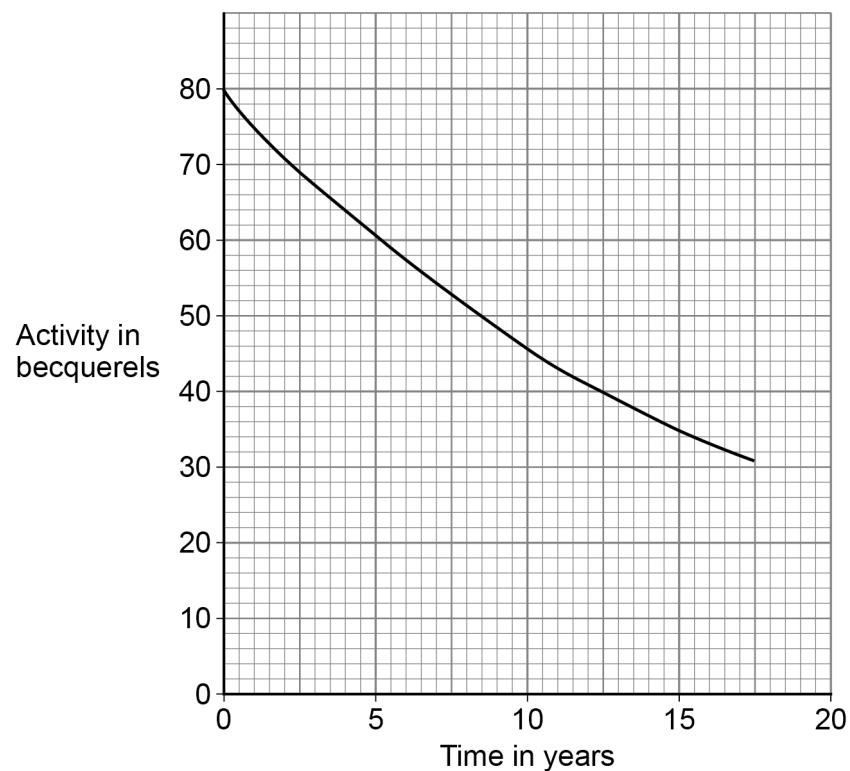| | | | |
|---|---|---|---|
| **contamination** | **irradiation** | **ionisation** | **decay** |

Radioactive dust from the nuclear weapons testing settled on the desert. This is

called radioactive _____ .

The desert now contains radioactive tritium.

**Figure 3** shows how the activity of the tritium in a sample taken from the desert changed with time.

**Figure 3**

**0 2 . 2** The sample was collected from the desert in 1992.

Determine the activity of the tritium in the sample in 2007.

**[2 marks]**

Activity = _____ Bq

**0 2 . 3** How much time did it take for the activity of the tritium in the sample to decrease from 80 Bq to 40 Bq?

**[1 mark]**

Time = _____ years

**0 2 . 4** What is the half-life of tritium?

**[1 mark]**

Half-life = _____ years

**0 2 . 5** The sample started with 45 billion atoms of tritium.

After 4 years the sample had 36 billion atoms of tritium.

Calculate the percentage of the tritium in the sample that remained after 4 years.

**[2 marks]**

Percentage of tritium remaining = _____ %

**Turn over ▶**

**0 2 . 6** A scientist determined the activity of a sample of tritium every minute for 3 minutes.

**Table 1** shows the results.

**Table 1**

| Time in minutes | Activity in Bq |
|---|---|
| 0 | 149 |
| 1 | 151 |
| 2 | 148 |
| 3 | 152 |

Why do the activity readings in **Table 1** vary?

**[1 mark]**

Tick (✓) **one** box.

Radioactive decay is a random process. ☐

Temperature changes affect the radioactive decay. ☐

The number of radioactive nuclei keeps increasing and decreasing. ☐

**0 2 . 7** What safety precaution should scientists take when working with radioactive materials in a laboratory?

**[1 mark]**

Tick (✓) **one** box.

Tie long hair back before handling the materials. ☐

Use long tongs to handle the materials. ☐

Wear safety goggles when handling the materials. ☐

**0 2 . 8** Studies show that children born near the area of the desert containing tritium were more likely to develop cancer.

It is important that the results from these studies are checked by other scientists.

What is this process called?

**[1 mark]**

Tick (✓) **one** box.

Experiment review ☐

Peer review ☐

Results review ☐

Test review ☐

**Turn over for the next question**
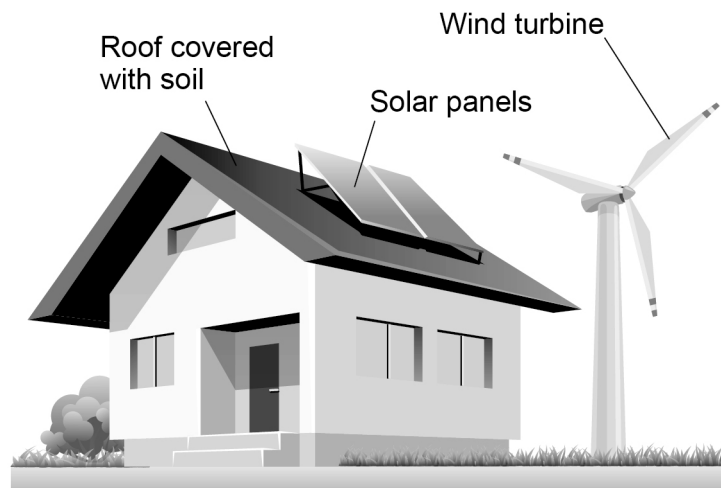
10

**Turn over ▶**

**0 3** An eco-house is designed to be environmentally friendly.

**Figure 4** shows a picture of an eco-house.

**Figure 4**



Roof covered with soil

Wind turbine

Solar panels

**0 3 . 1** The solar panels and a wind turbine are used to generate electricity for the eco-house.

Solar and wind are both renewable energy resources.

What does renewable energy resource mean?

**[1 mark]**

Tick (✓) **one** box.

It can be replenished as it is used. ☐

It is unreliable. ☐

It has no fuel costs. ☐

It produces no greenhouse gases. ☐

**0 3 . 2** Biomass, nuclear and natural gas are three other energy resources.

Complete the table to show whether each energy resource is renewable or non-renewable.

**[2 marks]**

Tick (✓) **one** box for **each** energy resource.

| Energy resource | Renewable | Non-renewable |
|---|---|---|
| Biomass | | |
| Nuclear | | |
| Natural gas | | |

**0 3 . 3** Moving air makes the wind turbine spin.

The wind turbine generates electricity which is used to charge a battery.

Complete the sentences.

Choose answers from the box.

**[2 marks]**

| | | | |
|---|---|---|---|
| **chemical** | **electrical** | **gravitational** | **kinetic** |

When the wind turbine spins faster there is an increase in its _____

energy.

Charging the battery increases the _____ store of energy of the

battery.

**Question 3 continues on the next page**

**Turn over ▶**

**0 3 . 4** The roof of the eco-house is covered with soil.

Covering the roof with soil decreases the thermal conductivity of the roof.

What are the advantages of having a roof with a lower thermal conductivity?

**[2 marks]**

Tick (✓) **two** boxes.

Less energy is needed to heat the house. ☐

The rate of energy transfer by conduction is greater. ☐

The roof is a better insulator. ☐

The roof is less likely to leak. ☐

Weather will have a greater effect on the temperature of the house. ☐

**0 3 . 5** The average power transferred to the solar panels by sunlight is 26 000 W

Calculate the average energy transferred to the solar panels in 30 seconds.

Use the equation:

energy transferred = power × time

**[2 marks]**

Average energy transferred to solar panels = _____ J

**0 3 . 6** Write down the equation that links efficiency, total power input and useful power output.

**[1 mark]**

_____

_____

**0 3 . 7** The solar panels on the roof of the eco-house have an efficiency of 0.15

The average power input to the solar panels is 26 000 W

Calculate the average useful power output from the solar panels.

**[3 marks]**

_____

_____

_____

_____

_____

Average useful power output = _____ W

**0 3 . 8** Explain why it is a good idea for the eco-house to have both a wind turbine and solar panels.

**[2 marks]**

_____

_____

_____

_____

**15**

**Turn over ▶**

**0 4** A scientist had a balloon which was filled with air.

**0 4 . 1** Which statement describes how air particles move?

[1 mark]

Tick (✓) **one** box.

At random speeds in random directions ☐

At random speeds in the same direction ☐

At the same speed in random directions ☐

At the same speed in the same direction ☐
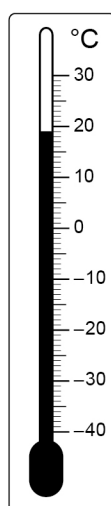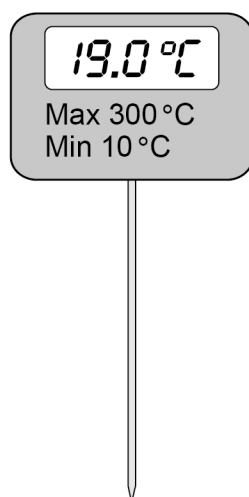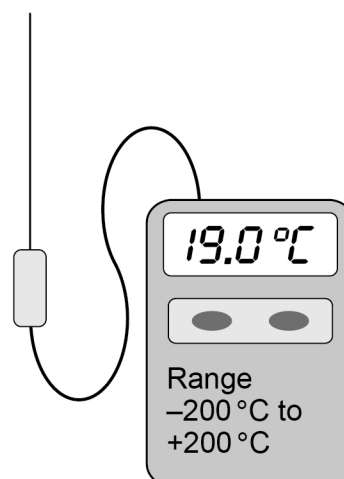
The temperature of the air was 19 °C

The scientist dipped the balloon into liquid nitrogen.

The temperature of the liquid nitrogen was −196 °C

**0 4 . 2** Which thermometer could be used to measure the temperature of the liquid nitrogen?

[1 mark]

Tick (✓) **one** box.

°C
30
20
10
0
−10
−20
−30
−40

19.0 °C
Max 300 °C
Min 10 °C

19.0 °C
Range
−200 °C to
+200 °C

☐          ☐          ☐

0 4 . 3 The scientist wore special insulating gloves when putting the balloon into the liquid nitrogen.

Suggest why.

**[1 mark]**

0 4 . 4 When the balloon was put into liquid nitrogen the temperature of the air in the balloon decreased.

Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

**[2 marks]**

| decreased | stayed the same | increased |
|---|---|---|

As the air in the balloon cooled down, the speed of the particles

_____ .  This is because the kinetic energy of the

particles _____ .

**Question 4 continues on the next page**

**Turn over ▶**

**0 4 . 5** The air in the balloon had a mass of 0.00320 kg

The temperature of the air in the balloon decreased by 215 °C

The change in thermal energy of the air in the balloon was 860 J

Calculate the specific heat capacity of the air in the balloon.

Use the Physics Equations Sheet.

**[3 marks]**

Specific heat capacity = _____ J/kg°C

**0 4 . 6** The liquid nitrogen boiled.

What happens to the temperature of nitrogen as it boils?

**[1 mark]**

Tick (✓) **one** box.

Temperature decreases ☐

Temperature increases ☐

Temperature stays the same ☐

The scientist recorded measurements to calculate the specific latent heat of vaporisation of nitrogen.

**0 4 . 7** What is meant by vaporisation?

**[1 mark]**

Tick (✓) **one** box.

A change of state from liquid to gas ☐

A change of state from solid to gas ☐

A change of state from solid to liquid ☐

**0 4 . 8** The mass of nitrogen that vaporised was 0.0072 kg

1440 J of energy was transferred to the nitrogen as it vaporised.

Calculate the specific latent heat of vaporisation of nitrogen.

Use the Physics Equations Sheet.

**[3 marks]**

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_____
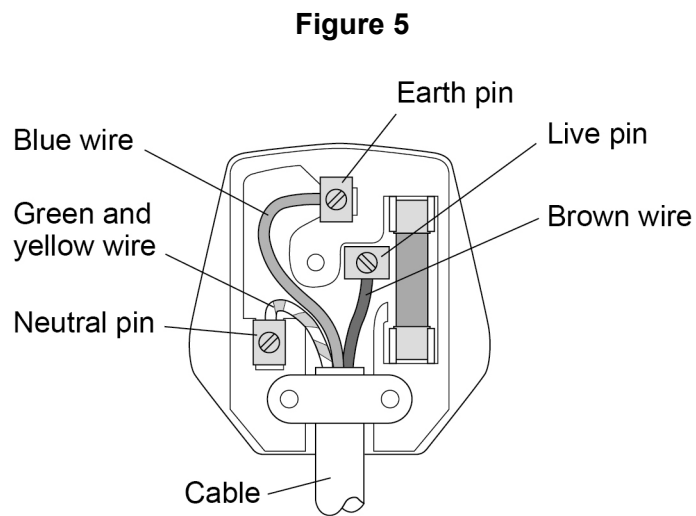
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Specific latent heat of vaporisation = _____ J/kg

**13**

**Turn over for the next question**

**Turn over ▶**

**0 5** **Figure 5** shows the inside of a plug.

**Figure 5**



Earth pin

Blue wire

Live pin

Green and
yellow wire

Brown wire

Neutral pin

Cable

**0 5 . 1** The plug is **not** wired correctly.

What should be done to connect the wires in the plug correctly?

**[1 mark]**

_____

_____

The correctly wired plug and cable connects a washing machine to the mains electricity supply.

| 0 | 5 | . | 2 | Give the potential difference and frequency of the mains electricity supply in the UK.

**[2 marks]**

The potential difference is _____ V

The frequency is _____ Hz

| 0 | 5 | . | 3 | The washing machine is switched on.

What is the potential difference between the neutral wire and the earth wire?

**[1 mark]**

Potential difference = _____ V

| 0 | 5 | . | 4 | The plug has a fuse.

Draw the circuit symbol for a fuse in the space below.

**[1 mark]**

**Question 5 continues on the next page**

**Turn over ▶**

The washing machine has a metal case.

A fault causes the live wire to make an electrical connection with the metal case of the washing machine.

**0 5 . 5** The earth wire is **not** connected to the metal case of the washing machine.

Explain why it would not be safe for a person to touch the metal case.

**[2 marks]**

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**0 5 . 6** The earth wire is now connected to the metal case of the washing machine.

Explain why it would now be safe for a person to touch the metal case, even if the live wire touches the metal case.

**[2 marks]**

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9

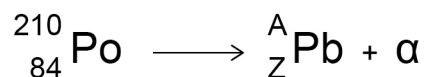**0 6** Different radioactive isotopes emit different types of nuclear radiation.

A polonium-210 (Po) nucleus emits an alpha particle (α) and turns into a lead (Pb) nucleus.

This can be represented by the equation:

$$^{210}_{84}\text{Po} \longrightarrow {}^{A}_{Z}\text{Pb} + \alpha$$

**0 6 . 1** What is the value of A in the equation?

**[1 mark]**

Tick (✓) **one** box.

A = 206 ☐      A = 208 ☐      A = 210 ☐      A = 211 ☐

**0 6 . 2** What is the value of Z in the equation?

**[1 mark]**

Tick (✓) **one** box.

Z = 80 ☐      Z = 82 ☐      Z = 85 ☐      Z = 86 ☐
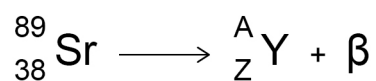
**Question 6 continues on the next page**

**Turn over ▶**

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**0 6 . 3** A strontium-89 nucleus (Sr) emits a beta particle (β) and turns into an yttrium nucleus (Y).

This can be represented by the equation:

$$^{89}_{38}\text{Sr} \longrightarrow ^{A}_{Z}\text{Y} + \beta$$

What are the values of A and Z in the equation?

**[2 marks]**

A = _____

Z = _____

**0 6 . 4** Gamma radiation is another type of nuclear radiation.

What does gamma radiation consist of?

**[1 mark]**

Tick (✓) **one** box.

High energy neutrons ☐

Electromagnetic waves ☐

Particles with no charge ☐

Positively charged ions ☐

**0 6 . 5** Explain the differences between the properties of alpha, beta and gamma radiations.

**[6 marks]**

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**11**

**END  OF  QUESTIONS**

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**ANSWER IN THE SPACES PROVIDED**

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**ANSWER IN THE SPACES PROVIDED**

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