



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

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	



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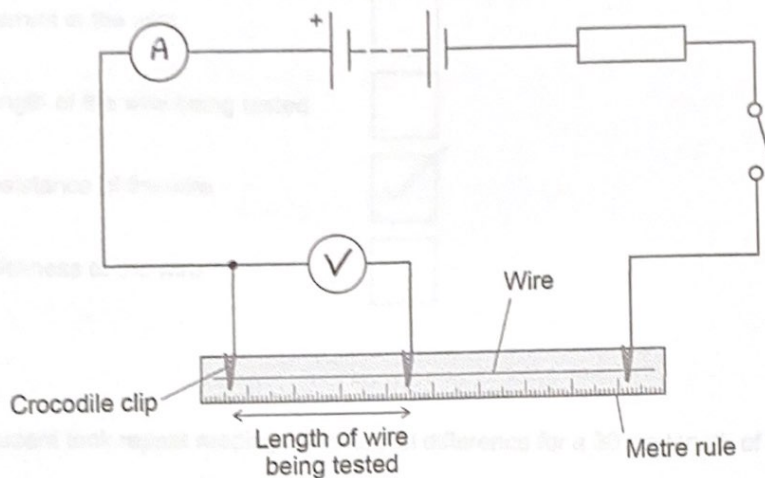
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0 1

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 . 4

The student took repeat measurements for a length of the wire.

The readings were:

0.16 V

0.17 V

0.18 V

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 2

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 p.d = $\frac{0.16 + 0.17 + 0.15}{3}$

mean p.d = 0.16

Mean potential difference = 0.16 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]

$$\text{resistance} = \frac{0.32}{0.5}$$

$$= 0.64$$

$$\text{Resistance} = 0.64 \, \Omega$$

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]

$$\text{power} = 0.32 \times 0.5$$

$$= 0.16$$

$$\text{Power} = 0.16 \, \text{W}$$

Turn over for the next question



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]

$$\text{Charge flow} = 0.5 \times 17$$

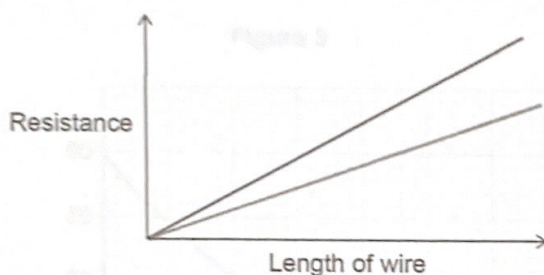
$$= 8.5$$

$$\text{Charge flow} = 8.5 \text{ C}$$

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

Figure 2 shows how the resistance of the wire varies with length.

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

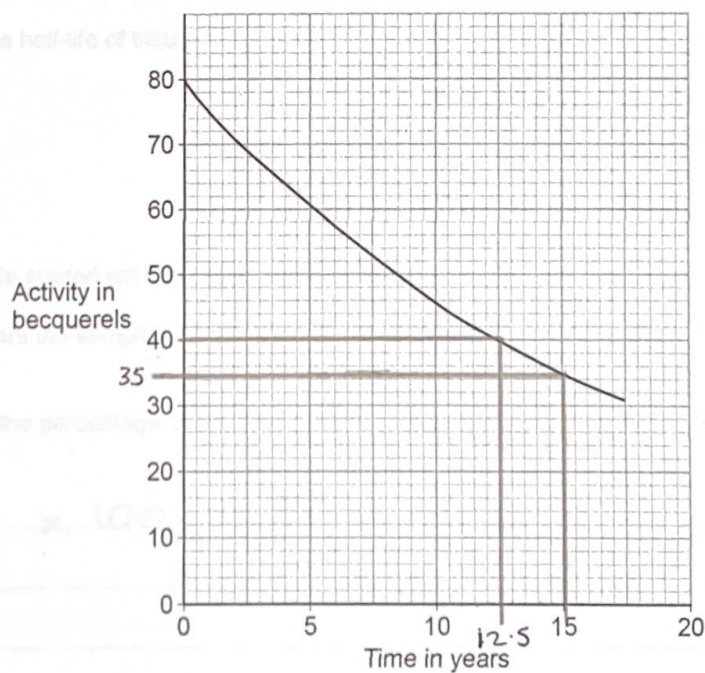
Radioactive dust from the nuclear weapons testing settled on the desert. This is called radioactive contamination

[1 mark]

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



[1 mark]



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]

$$2007 - 1992 = 15 \text{ years}$$

Activity = 35 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]

Why do the activity readings in Table 1 vary?

Tick (✓) one box.

Time = 12.5 years

Radioactive decay is a random process.

Temperature changes affect the radioactive decay.

0 2 . 4

What is the half-life of tritium?

[1 mark]

The number of radioactive nuclei keeps increasing as time goes on.

Half-life = 12.5 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]

$$\frac{36}{45} \times 100 = 80$$

Percentage of tritium remaining = 80 %

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

☐

10

0 3 . 1

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

Turn over for the next question

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.

☐

Turn over ►

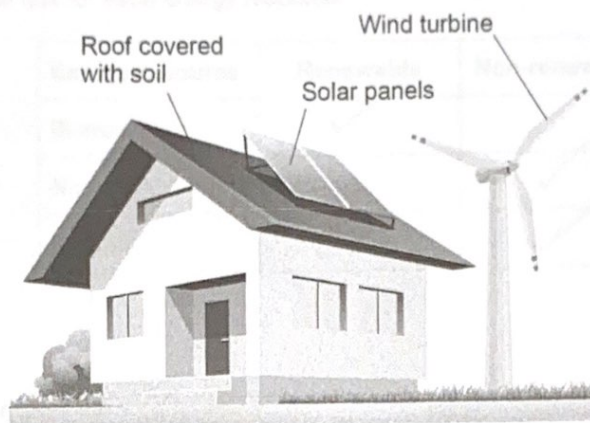


0 3

An eco-house is designed to be environmentally friendly.

Figure 4 shows a picture of an eco-house.

Figure 4



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.

☐

Question 3 continues on the next page



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 Kinetic energy.

Charging the battery increases the Chemical 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:

$$\text{energy transferred} = \text{power} \times \text{time}$$

[2 marks]

$$\begin{aligned} \text{energy transferred} &= 26000 \times 30 \\ &= 780\,000 \end{aligned}$$

$$\text{Average energy transferred to solar panels} = 780\,000 \text{ J}$$



03.6

Write down the equation that links efficiency, total power input and useful power output.

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}} \quad [1 \text{ mark}]$$

03.7

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]

$$0.15 = \frac{\text{useful power output}}{26000}$$

$$\text{useful power output} = 0.15 \times 26000$$

$$\text{useful power output} = 3900$$

04.2

Average useful power output = 3900 W

03.8

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

[2 marks]

Sometimes it's not sunny and sometimes it is not windy so there's a greater chance of electricity being generated at any time.

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

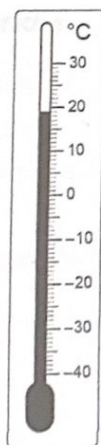
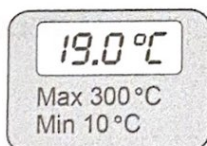
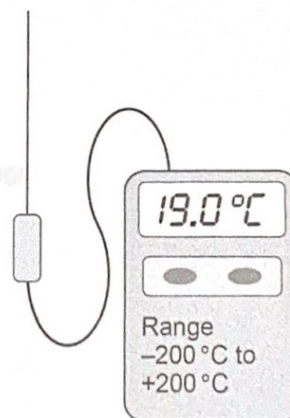
The scientist dipped the balloon into liquid nitrogen.

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.☐☐☒

0 4 . 3

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

Suggest why.

[1 mark]

To prevent getting cold / frost burns
from the cold nitrogen.

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

0 4 . 6

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

was decreased. This is because the kinetic energy of the

particles decreased.

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]

$$\frac{\text{change in thermal energy}}{\text{}} = \frac{\text{mass} \times \text{Specific heat capacity} \times \text{temperature change}}{\text{}}$$

$$860 = 0.00320 \times c \times 215$$

$$c = \frac{860}{0.00320 \times 215}$$

$$= 1250$$

$$\text{Specific heat capacity} = 1250 \text{ J/kg}^\circ\text{C}$$

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]

$$1440 = 0.0072 \times L$$

$$L = \frac{1440}{0.0072}$$

$$= 200\,000$$

Specific latent heat of vaporisation = 200 000 J/kg

13

Turn over for the next question

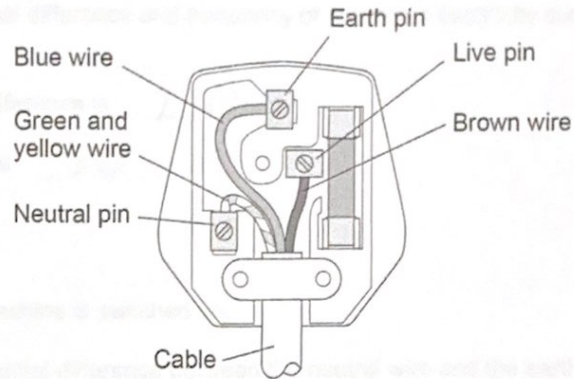
Turn over ►



0 5

Figure 5 shows the inside of a plug.

Figure 5



0 5 . 1

The plug is **not** wired correctly.

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

[1 mark]

Swap the blue wire with the
green and yellow wire



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 230 V

The frequency is 50 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 = 0 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]

The person would get an electric shock because there is a current in the person.

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]

Instead of flowing through the person the charge flows through the earth wire because the resistance of the earth wire is much less than that of the person.



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:



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 ►



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:



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

[2 marks]

A = 89

Z = 39

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

☐

END OF QUESTIONS



06.5

Explain the differences between the properties of alpha, beta and gamma radiations.

[6 marks]

An alpha particle is the same as a helium nucleus. It is the ^{least} ~~weakest~~ penetrating so can be stopped by paper or skin and will only travel a few cm in air. This is because alpha is the most ionising with a charge of +2. Beta particles are electrons emitted from the nucleus. They can penetrate more than alpha particles but less than gamma. And can be stopped by a thin sheet of aluminium. Beta particles can travel further in air than alpha particles but less than gamma, up to 1 m. This is because beta is more ionising than gamma but less than alpha with a charge of -1. Gamma is the most penetrating, ~~and~~ ^{only} stopped by several cm of thick ~~concrete~~ ^{concrete} or lead. Gamma is an electromagnetic wave and can travel very large distances in air. Gamma is the least ionising and is uncharged.

11

END OF QUESTIONS

