Please write clearly in block capitals.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 1F

Wednesday 22 May 2019 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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- 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	
7	
TOTAL	

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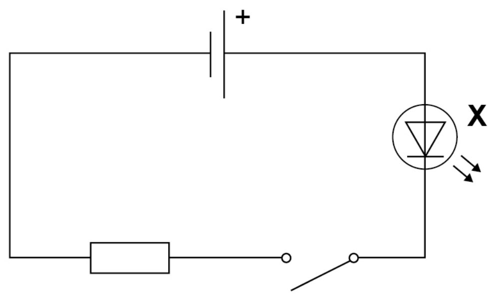
0 1 A designer made some shoes that have lights in them.

Each shoe has a switch which closes when a person puts their foot on the floor.

Figure 1 shows the circuit.

Figure 1



0 1 . 1 What is component **X**?

[1 mark]

Tick (✓) **one** box.

Lamp ☐

LDR ☐

LED ☐

0 1 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

greater than	**less than**	**the same as**

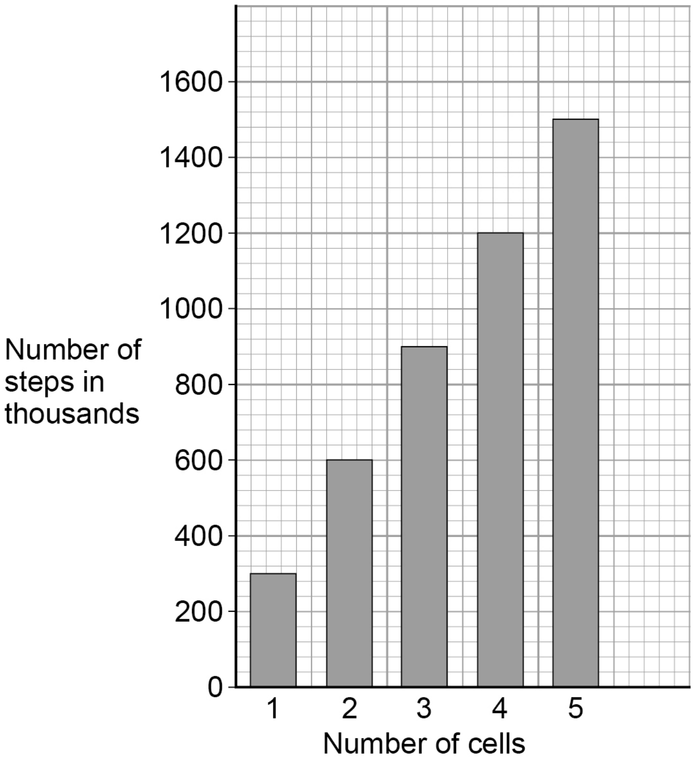
When the switch was closed, the current in component **X** was

______________________________ the current in the resistor.

The designer tested how the number of cells affected the number of steps that could be taken before the lights stopped working.

Figure 2 shows the results.

Figure 2



0 1 . 3 Determine how many more steps could be taken when the number of cells was increased from 3 to 5

[2 marks]

____

____

Number of steps = ______________________ thousand

Question 1 continues on the next page

Turn over ►

0 1 . 4 How could the designer check the repeatability of the results?

[1 mark]

Tick (✓) **one** box.

Repeat the experiment with a different resistor in the circuit. ☐

Repeat the experiment using exactly the same method. ☐

Repeat the experiment with different types of shoe. ☐

0 1 . 5 When the potential difference across the resistor was 0.80 V, the current in the resistor was 0.020 A

Calculate the power dissipated by the resistor.

Use the equation:

power = potential difference × current

[2 marks]

____

____

____

Power = ________________ W

0 1 . 6 Which other equation can be used to calculate the power dissipated by a resistor?

[1 mark]

Tick (✓) **one** box.

$\text{Power} = (\text{current})^2 \times \text{resistance}$ ☐

$\text{Power} = \dfrac{\text{current}}{(\text{resistance})^2}$ ☐

$\text{Power} = \text{current} \times (\text{resistance})^2$ ☐

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0 1 . 7 What happens to the temperature of the resistor when there is a current in it?

[1 mark]

____

____

0 1 . 8 There was a current of 0.020 A in the resistor for 180 seconds.

Calculate the charge flow through the resistor.

Use the equation:

charge flow = current × time

[2 marks]

____

____

____

Charge flow = ____________________ C

11

Turn over for the next question

Do not write outside the box

0 2 A student investigated how the area of a solar panel affected the output potential difference of the solar panel.

The student placed different sized solar panels under a lamp.

Figure 3 shows a solar panel under a lamp.

Figure 3

0 2 . 1 Which variable should be controlled?

[1 mark]

Tick (✓) **one** box.

The area of the solar panels ☐

The brightness of the lamp ☐

The output potential difference of the solar panels ☐

0 2 . 2 The student measured the output potential difference using a voltmeter.

When the voltmeter was **not** connected, the reading on the voltmeter was 0.7 V

What name is given to this type of error?

[1 mark]

Tick (✓) **one** box.

Zero error ☐

Random error ☐

Measurement error ☐

Question 2 continues on the next page

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Table 1 shows the results of the investigation.

Table 1

Solar panel	**Area of solar panel in cm^2**	**Output potential difference in volts**			
		Test 1	Test 2	Test 3	Mean
A	10	2.5	2.4	2.6	2.5
B	20	5.0	5.0	4.9	5.0
C	30	7.5	11.9	7.5	7.5
D	50	12.4	12.6	12.5	12.5

0 2 . 3 The readings for which solar panel show an anomalous result?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 4 The student did **not** have a solar panel with an area of 40 cm^2

Determine the most likely value for the mean output potential difference of a 40 cm^2 solar cell.

[1 mark]

____

____

Mean output potential difference = ____________________ V

0 2 . 5 The total input energy transfer to one of the solar panels was 8.0 joules.

The useful output energy transfer was 0.96 joules.

Calculate the efficiency of the solar panel.

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

Efficiency = ____________________

0 2 . 6 Solar power is a renewable energy resource.

Complete the sentence.

Choose the answer from the box.

[1 mark]

burned	**replenished**	**consumed**

A renewable energy resource is one that is ____________________ as it is used.

Question 2 continues on the next page

0 2 . 7 Some homes have solar panels which generate electricity.

On a sunny day the potential difference across a solar panel is 31 volts.

A charge of 490 coulombs flows through the solar panel.

Calculate the energy transferred by the solar panel.

Use the equation:

energy transferred = charge flow × potential difference

Give your answer to 2 significant figures.

[3 marks]

____

____

____

____

Energy transferred = ____________________ J

0 2 . 8 Why do solar panels on homes help reduce the environmental impact of using electrical devices?

[1 mark]

Tick (✓) **one** box.

Less electricity is used in the home. ☐

Less fossil fuel is burned. ☐

The electricity from the solar panels is cheaper. ☐

11

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0 3 In an experiment, a beam of alpha particles was directed at a thin sheet of gold foil.

0 3 . 1 Most of the alpha particles passed straight through the gold foil.

Alpha particles which passed close to the nucleus of a gold atom did **not** pass straight through.

What happened to the alpha particles which passed close to the nucleus of a gold atom?

[1 mark]

____

____

0 3 . 2 The results suggested that the diameter of the nucleus of a gold atom is $\frac{1}{6000}$ of the diameter of the atom.

The diameter of a gold atom is 0.18 nm

Calculate the diameter of a gold nucleus in nm

[2 marks]

____

____

____

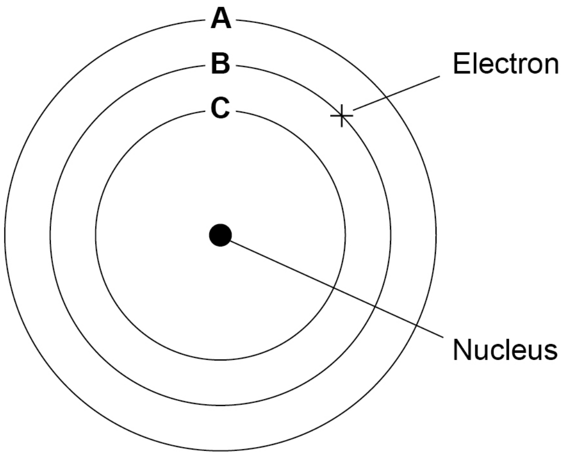
____

Diameter = ______________________ nm

0 3 . 3 Further experiments showed that gold nuclei are surrounded by electrons in different energy levels.

Figure 4 shows three of the energy levels around the nucleus of a gold atom.

Figure 4



The electron in energy level **B** absorbs electromagnetic radiation.

Which energy level will the electron be in after it has absorbed the electromagnetic radiation?

[1 mark]

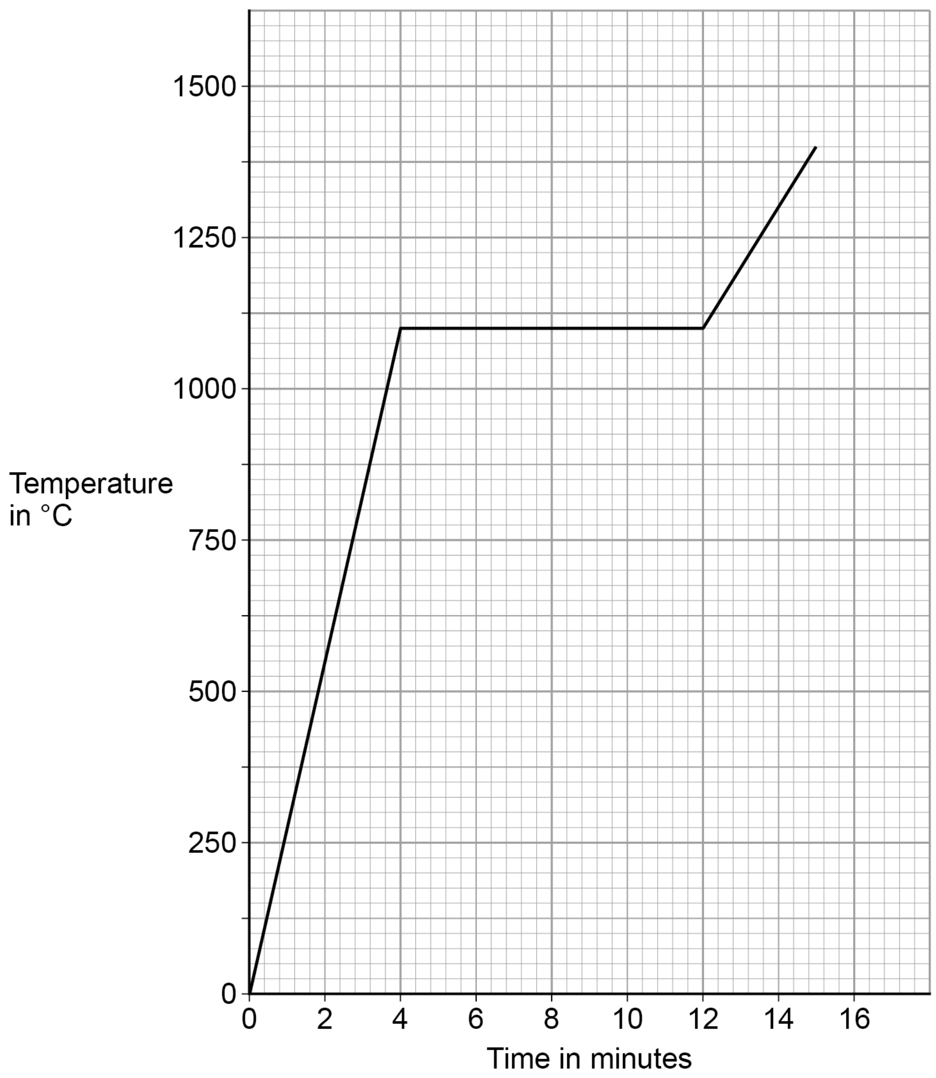
Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Question 3 continues on the next page

Figure 5 shows how the temperature of a small sample of gold changes as it is heated from a solid to a liquid.

Figure 5



0 3 . 4 What is the melting point of the gold?

[1 mark]

Melting point = ________________________ °C

0 3 . 5 How many minutes did it take for all of the gold in the sample to change from solid to liquid?

[1 mark]

Time taken = ________________________ minutes

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0 3 . 6 What does the gradient of the graph in **Figure 5** represent?

[1 mark]

Tick (✓) **one** box.

The internal energy of the gold ☐

The rate of change of temperature of the gold ☐

The specific heat capacity of the gold ☐

7

Turn over for the next question

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0 4 Protactinium (Pa) is radioactive.

0 4 . 1 An atom of one isotope of protactinium contains 91 protons and 143 neutrons.

What is the correct symbol for this atom?

[1 mark]

Tick (✓) **one** box.

$^{143}_{91}Pa$ ☐ $^{234}_{91}Pa$ ☐ $^{234}_{143}Pa$ ☐ $^{91}_{52}Pa$ ☐

A teacher investigated how the count rate from a sample of protactinium changed over time.

Table 2 shows the results.

Table 2

Time in seconds	Count rate in counts per second
0	200
50	122
100	74
150	45
200	27

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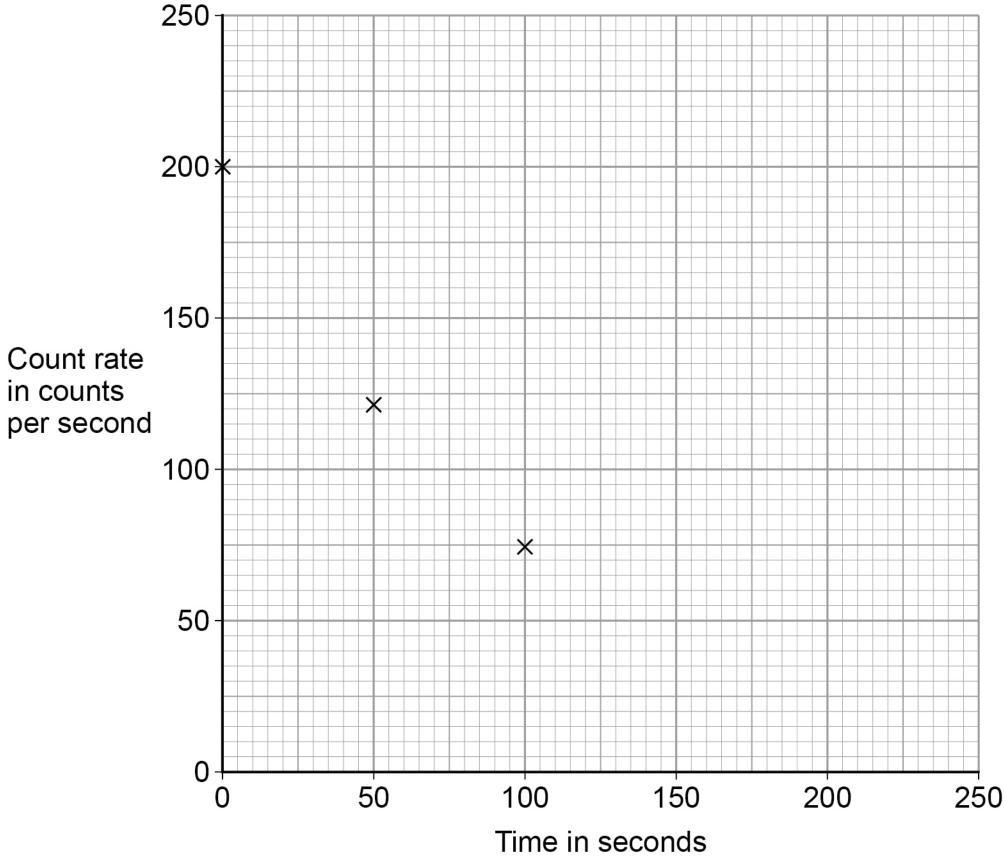
Figure 6 shows some of the teacher's results.

Figure 6



0 4 . 2 Complete the graph in **Figure 6**.

Use data from **Table 2**.

Draw the line of best fit.

[2 marks]

0 4 . 3 How much time did it take for the count rate to change from 200 counts per second to 100 counts per second?

[1 mark]

____

Time taken = ____________________ s

0 4 . 4 What is the half-life of protactinium?

[1 mark]

Half-life = ____________________ s

Turn over ►

Do not write outside the box

0 4 . 5 The nuclear radiation from the protactinium can pass through paper.

This radiation can only be detected up to 1 metre away from the protactinium.

What type of radiation is emitted by the protactinium?

[1 mark]

Tick (✓) **one** box.

Alpha ☐

Beta ☐

Gamma ☐

Neutron ☐

0 4 . 6 The teacher read an article about the effects of radiation on the human body.

Why are articles in scientific journals generally more trustworthy than articles in newspapers?

[1 mark]

____

____

7

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0 5 **Figure 7** shows a toaster.

Figure 7

The toaster is connected to the mains supply using a three-core cable.

0 5 . 1 What is the function of the earth wire inside the cable?

[1 mark]

Tick (✓) **one** box.

To carry the current from the supply to the toaster ☐

To complete the circuit in the toaster ☐

To melt if a fault occurs inside the toaster ☐

To stop the metal case of the toaster becoming live if a fault occurs ☐

0 5 . 2 Complete the sentences.

Choose answers from the box.

[3 marks]

blue	**brown**	**orange**	**white**	**yellow**

The insulation around the earth wire is green and ______________________ .

The insulation around the live wire is ______________________ .

The insulation around the neutral wire is ______________________ .

Do not write outside the box

0 5 . 3 The toaster is switched on for 120 seconds.

The power of the toaster is 850 watts.

Calculate the energy transferred by the toaster.

Use the equation:

energy transferred = power × time

[2 marks]

____

____

____

Energy transferred = ____________________ J

0 5 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**kinetic**	**thermal**

When bread is lowered into the toaster, a spring is stretched. The stretched spring stores ____________________ energy.

After the bread is toasted, the spring makes the toast move upwards. As the speed of the toast increases, the ____________________ energy of the toast increases.

Do not write outside the box

0 5 . 5 Write the equation which links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

____

____

0 5 . 6 The toast was moved upwards by the spring.

The change in gravitational potential energy of the toast was 0.049 J

The mass of the toast was 0.050 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the toast.

[3 marks]

____

____

____

____

____

____

Change in height = ____________________ m

12

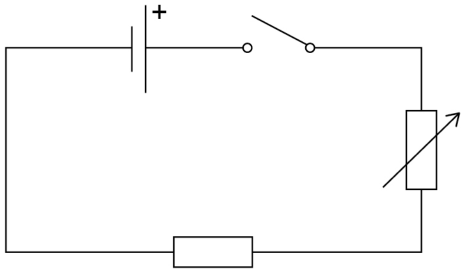
Turn over for the next question

Do not write outside the box

0 6 A student investigated how the current in a resistor varies with the potential difference across the resistor.

Figure 8 shows part of the circuit used.

Figure 8



0 6 . 1 The student connected an ammeter and a voltmeter into the circuit.

What is the correct way to connect the ammeter and the voltmeter into the circuit?

[1 mark]

Tick (✓) **one** box.

Ammeter	**Voltmeter**	
In parallel with the resistor	In series with the resistor	☐
In parallel with the cell	In series with the resistor	☐
In series with the resistor	In parallel with the resistor	☐
In series with the resistor	In parallel with the cell	☐

0 6 . 2 The student increased the resistance of the variable resistor.

How did increasing the resistance affect the current in the circuit?

[1 mark]

____

____

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0 6 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

0 6 . 4 Name the type of relationship between current and potential difference for a resistor at constant temperature.

[1 mark]

0 6 . 5 Write the equation which links current, potential difference and resistance.

[1 mark]

0 6 . 6 The current in the resistor was 0.12 A when the potential difference across the resistor was 3.0 V

Calculate the resistance of the resistor.

[3 marks]

Resistance = ______________________ Ω

8

Turn over ►

0 7 A scientist cooled the air inside a container.

0 7 . 1 The temperature of the air changed from 20 °C to 0 °C

The volume of the container of air stayed the same.

Explain how the motion of the air molecules caused the pressure in the container to change as the temperature decreased.

[3 marks]

0 7 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

Mass of ice = ____________________ kg

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0 7 . 3 The air also contained oxygen, nitrogen and carbon dioxide.

Oxygen boils at –183 °C and freezes at –218 °C
Nitrogen boils at –195 °C and freezes at –210 °C
Carbon dioxide sublimates at –78 °C

The scientist continued to cool the air to a temperature of –190 °C

What is the state of each substance at –190 °C?

[2 marks]

Tick (✓) **one** box for **each** row of the table.

Substance	**Solid**	**Liquid**	**Gas**
Oxygen			
Nitrogen			
Carbon dioxide			

Question 7 continues on the next page

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0 7 . 4 The air also contained a small amount of argon.

As the temperature of the air decreased from 20 °C to –190 °C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased.

[6 marks]

14

END OF QUESTIONS

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