Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 1H

Wednesday 22 May 2024 Morning 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 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.

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

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.

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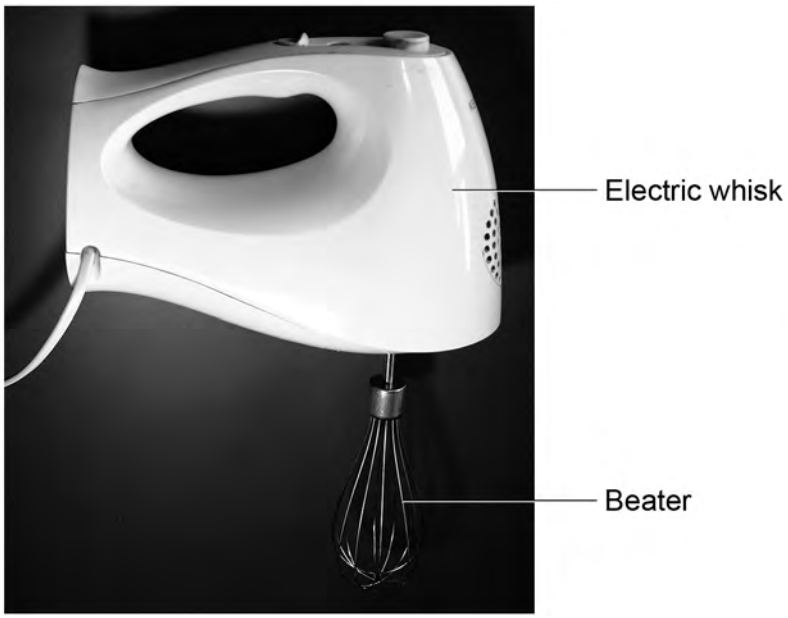
0 1 **Figure 1** shows an electric whisk that plugs into the mains electricity supply.

The whisk can mix food by spinning a beater.

Figure 1



0 1 . 1 Give **two** energy stores that increase when the whisk is switched on.

[2 marks]

1 _____

_____

2 _____

_____

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Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Work is done by the whisk when it is used to mix food.

Write down the equation that links power (*P*), time (*t*) and work done (*W*).

[1 mark]

0 1 . 3 The power output of the whisk is 92 W.

Calculate the time for the whisk to do 23 000 J of work.

[3 marks]

Time = _____ s

Question 1 continues on the next page

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Use the Physics Equations Sheet to answer questions **01.4** and **01.5**.

0 1 . 4 Which equation links current (I), power (P) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R^2}$ ☐

$P = I R^2$ ☐

$P = \frac{I^2}{R}$ ☐

$P = I^2 R$ ☐

0 1 . 5 The current in the whisk is 500 mA.

The resistance of the whisk is 640 Ω.

Calculate the power of the whisk.

[3 marks]

Power = _____ W

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The whisk has several settings that allow the beater to spin at different speeds.

A faster beater speed needs a greater power input from the mains electricity supply.

0 1 . 6 What is the potential difference between the live wire and neutral wire in the mains electricity supply?

[1 mark]

_____ V

0 1 . 7 Changing the beater speed does **not** change the potential difference between the live wire and neutral wire.

The power input to the whisk changes because the current in the whisk changes.

Complete the sentence.

[1 mark]

When the beater speed increases, the current in the whisk increases because the resistance of the whisk _____.

12

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 2 Last century, scientists used evidence from the alpha particle scattering experiment to develop a new model of the atom.

In the experiment, alpha particles were directed towards a piece of gold foil.

0 2 . 1 What does an alpha particle consist of?

[1 mark]

0 2 . 2 A gold atom has the symbol $^{197}_{79}Au$.

How many neutrons are there in this gold atom?

[1 mark]

Number of neutrons = _____

Question 2 continues on the next page

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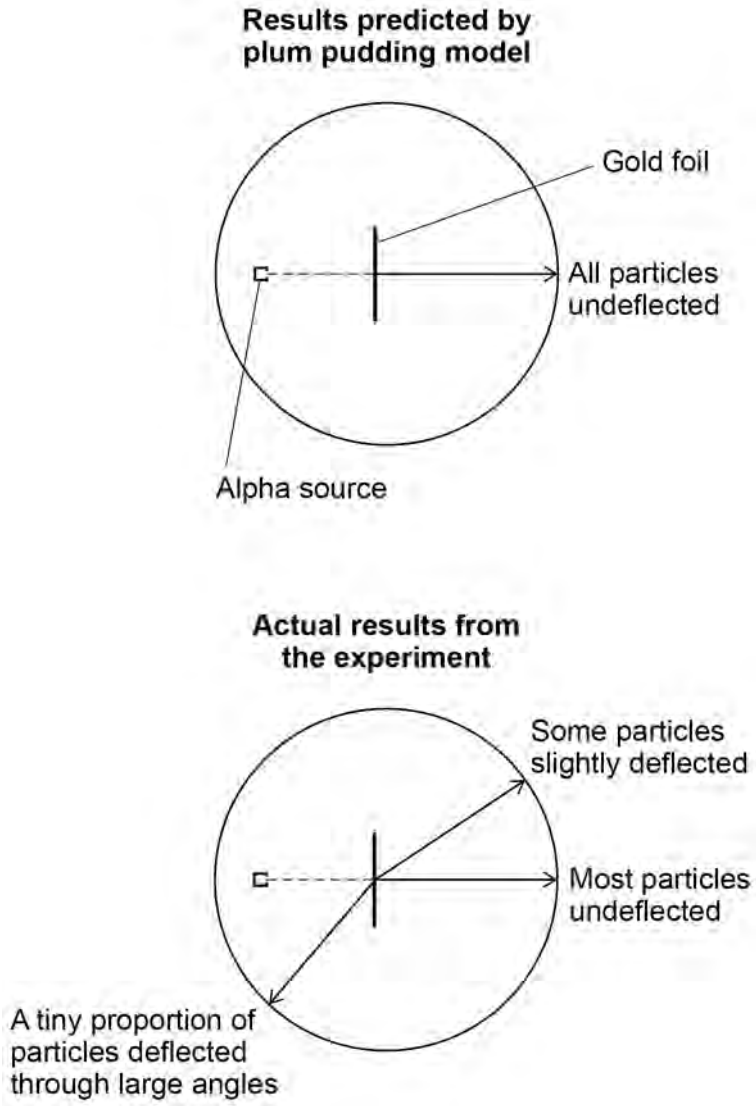
0 2 . 3 The alpha particle scattering experiment led to the plum pudding model of the atom being replaced by the nuclear model.

Figure 2 shows the results predicted by the plum pudding model and the actual results from the alpha particle scattering experiment.

Figure 2



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Describe how the actual results led to the plum pudding model of the atom being replaced by the nuclear model.

You should include details of the plum pudding model and the nuclear model of the atom.

[6 marks]

0 2 . 4 Scientists did not know that neutrons existed when they first did alpha particle scattering experiments.

Which scientist did the experiments that provided evidence that neutrons exist?

[1 mark]

Tick (✓) **one** box.

Isaac Newton ☐

James Chadwick ☐

Niels Bohr ☐

9

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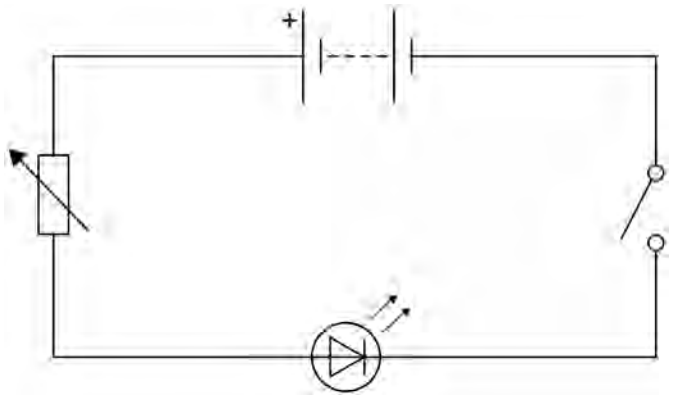
0 3 A student investigated how the current in a red LED varies with the potential difference across the LED.

Figure 3 shows an incomplete diagram of the circuit used.

Figure 3



0 3 . 1 Complete **Figure 3** to show how the student should have connected a voltmeter and an ammeter into the circuit.

Use the correct circuit symbols.

[2 marks]

Do not write outside the box

0 3 . 2 The potential difference across the battery was +2.6 V.

The student varied the potential difference across the LED between –2.6 V and +2.6 V.

Describe how the student should have adjusted the circuit to vary the potential difference across this range.

[2 marks]

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 **Table 1** shows the results when the potential difference across the LED had positive values.

Table 1

Potential difference in volts	0.0	1.0	1.8	2.0	2.2	2.4	2.6
Current in milliamps	0	0	0	5	19	41	69

Figure 4 shows a graph of current against potential difference.

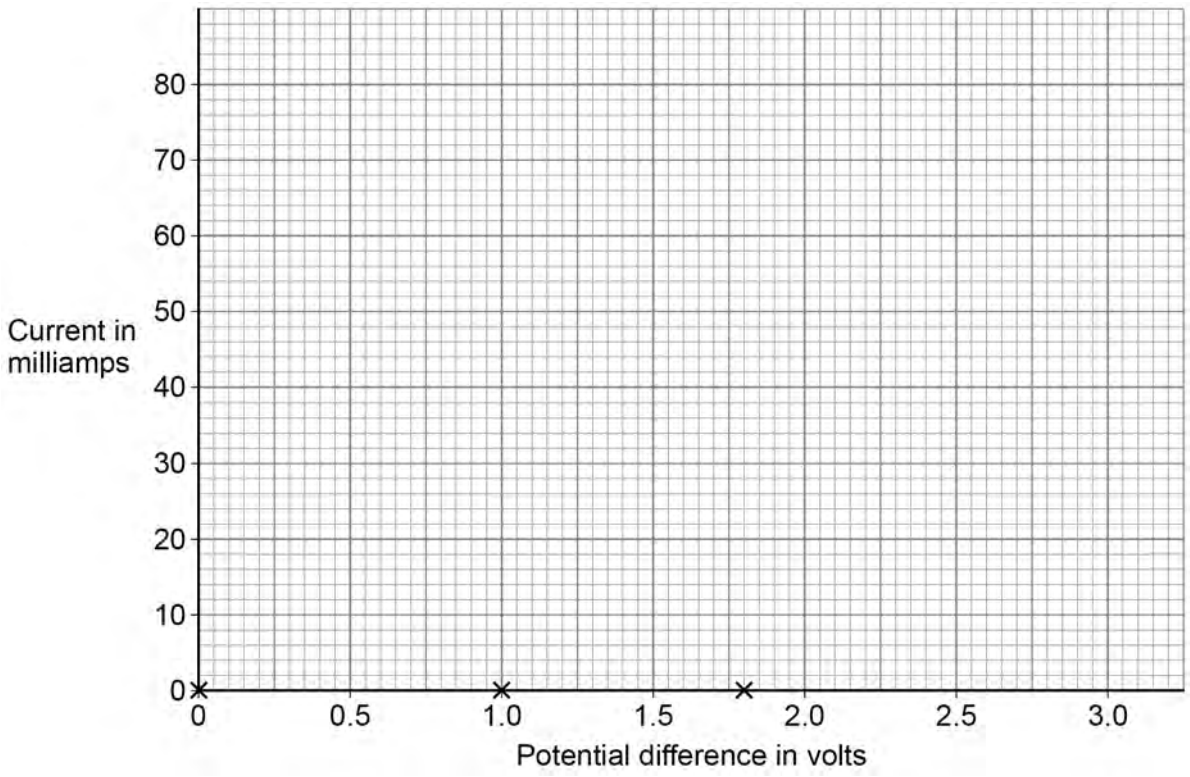
Complete **Figure 4**.

You should:

- plot the remaining points from **Table 1**
- draw a line of best fit.

[3 marks]

Figure 4



Do not write outside the box

0 3 . 4 Explain what happens to the current in the LED when the potential difference across the LED is negative.

[2 marks]

0 3 . 5 A second student did the investigation using a blue LED.

The results for both the red LED and the blue LED showed the same pattern.

What conclusion can be made about the investigation?

[1 mark]

Tick (✓) **one** box.

The investigation is repeatable. ☐

The investigation is reproducible. ☐

The results were accurate. ☐

Question 3 continues on the next page

Do not write outside the box

0 3 . 6 The relationship between current and potential difference for an LED is non-linear.

Which of the following always shows a linear relationship between current and potential difference?

[1 mark]

Tick (✓) **one** box.

Filament lamp ☐

LDR ☐

Resistor at constant temperature ☐

Thermistor ☐

11

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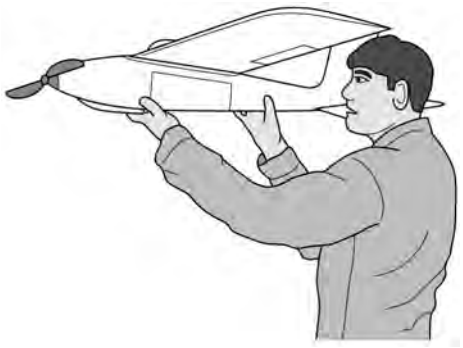
0 4 A drone is a miniature aircraft that has a remote control.

An inventor designed a battery powered drone.

The inventor tested what would happen if the battery runs out of charge during a flight.

Figure 5 shows the inventor about to launch the drone.

Figure 5



0 4 . 1 After the drone was launched, it moved at a constant speed and gained height.

The thermal stores of energy of the drone increased.

Describe **two** other changes to the energy stores of the drone as it moved at a constant speed and gained height.

[2 marks]

1 _____

_____

2 _____

_____

Question 4 continues on the next page

Do not write outside the box

When the drone reached a height of 840 m the motor was switched off.

The motor was switched back on after a short time, when the drone had fallen to a lower height above the ground.

The change in gravitational potential energy of the drone during the fall to this lower height was 3920 J.

The mass of the drone is 2.5 kg.

gravitational field strength = 9.8 N/kg

0 4 . 2 Calculate the height above the ground of the drone when the motor was switched back on.

Use the Physics Equations Sheet.

[4 marks]

Height above ground = _____ m

Do not write outside the box

0 4 . 3 When the motor was switched off, the kinetic energy of the drone was 150 J.

Calculate the maximum possible speed of the drone when the motor was switched back on.

Use the Physics Equations Sheet.

Give your answer in km/s.

[5 marks]

Maximum possible speed of drone = _____ km/s

11

Turn over for the next question

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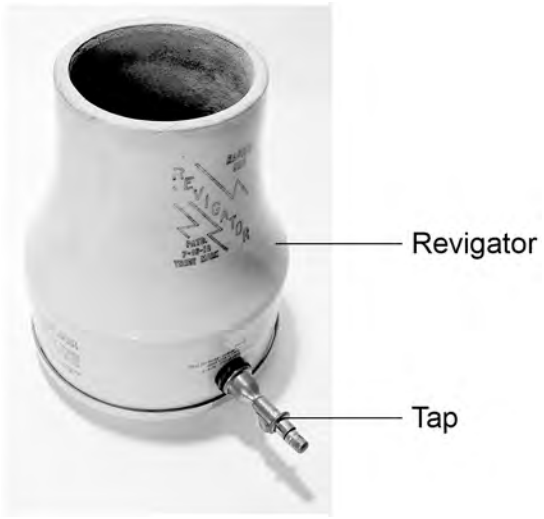
0 5 Some people used to think that radioactive substances had health benefits.

In the 1920s, a water container called a revigator was sold.

The walls of a revigator contain radioactive isotopes.

Figure 6 shows a revigator.

Figure 6



The revigator was filled with water and left overnight.

People then drank the water from the revigator.

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0 5 . 1 The water was irradiated and contaminated by the radioactive isotopes in the walls of the revigator.

Explain how irradiating and contaminating the water affected the hazard caused by drinking the water.

[4 marks]

Irradiating _____

_____

_____

_____

Contaminating _____

_____

_____

_____

Question 5 continues on the next page

Do not write outside the box

A scientist tested some water that had been left in a revigator.

The water contained radon-222 and vanadium-52.

0 5 . 2 Vanadium-52 (V) decays by emitting beta particles.

What is the correct nuclear equation for this process?

[1 mark]

Tick (✓) **one** box.

$^{52}_{23}V - {}^{0}_{-1}\beta \rightarrow {}^{52}_{22}Ti$ ☐

$^{52}_{23}V - {}^{0}_{-1}\beta \rightarrow {}^{52}_{24}Cr$ ☐

$^{52}_{23}V \rightarrow {}^{52}_{22}Ti + {}^{0}_{-1}\beta$ ☐

$^{52}_{23}V \rightarrow {}^{52}_{24}Cr + {}^{0}_{-1}\beta$ ☐

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0 5 . 3 **Table 2** shows the half-lives of radon-222 and vanadium-52.

Table 2

Isotope	Half-life
Radon-222	3.8 days
Vanadium-52	3.7 minutes

The scientist measured the radiation emitted by a sample of radon-222 and the radiation emitted by a sample of vanadium-52.

The scientist repeated the measurements 7.4 minutes later.

Explain how the activity of the radon-222 and vanadium-52 had changed after 7.4 minutes.

[4 marks]

Radon-222 _____

_____

_____

_____

Vanadium-52 _____

_____

_____

_____

0 5 . 4 Scientists monitored the effects of drinking the water from a revigator.

Their methods and results were checked by other scientists.

What name is given to the process of other scientists checking work before it is published?

[1 mark]

_____

10

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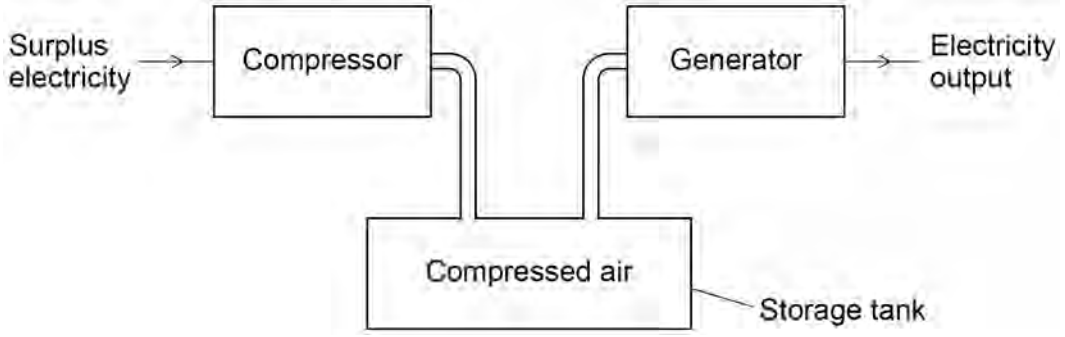
0 6 Energy can be stored using a Compressed Air Energy Storage (CAES) system.

When more electricity is generated than is needed, a CAES system uses the surplus electricity to compress air in a storage tank.

When there is a greater demand for electricity, the CAES system releases the compressed air to generate electricity.

Figure 7 shows a diagram of the CAES system.

Figure 7



0 6 . 1 The CAES system has two processes:

- compressing air to store energy. This process has an efficiency of 0.72
- releasing the air to generate electricity. This process has an efficiency of 0.86

Calculate the efficiency of the CAES system.

Give your answer to 2 significant figures.

[3 marks]

Efficiency of the CAES system (2 significant figures) = _____

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The generator works when forces from the compressed air cause a turbine to rotate.

When particles of air collide with the turbine they transfer energy to the turbine.

In warm weather the temperature of the compressed air increases, increasing the pressure inside the storage tank.

0 6 . 2 Explain how the motion of the particles in warmer air causes an increase in the power transferred to the turbine.

[4 marks]

Question 6 continues on the next page

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0 6 . 3 The volume of the storage tank is 5.0×10^5 m^3.

The density of the compressed air is 48 kg/m^3.

specific heat capacity of air = 1100 J/kg °C

The temperature of the compressed air increases from 12 °C to 27 °C.

Calculate the energy transferred to the compressed air in the storage tank.

Use the Physics Equations Sheet.

Give your answer in standard form.

[6 marks]

Energy transferred (in standard form) = _____ J

Do not write outside the box

0 6 . 4 The UK government wants the amount of carbon dioxide released into the atmosphere to be reduced.

Explain why efficient energy storage is important in reducing the amount of carbon dioxide released when generating electricity.

[4 marks]

17

END OF QUESTIONS

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