



GCSE COMBINED SCIENCE: TRILOGY

F

Foundation Tier Paper 5: Physics 1F

Specimen 2018

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:

- a ruler
- a calculator
- the Physics Equation Sheet (enclosed).

Instructions

- 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.

Information

- There are 70 marks available on this paper.
- 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.
- When answering questions 05.1 and 07.5 you need to make sure that your answer:
 - is clear, logical, sensibly structured
 - fully meets the requirements of the question
 - shows that each separate point or step supports the overall answer.

Advice

- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature _____

0 1

Most electrical appliances are connected to the mains electricity using three-core cables.

0 1 . 1

What is the approximate value of the potential difference of the UK mains electricity supply?

Tick **one** box.

[1 mark]

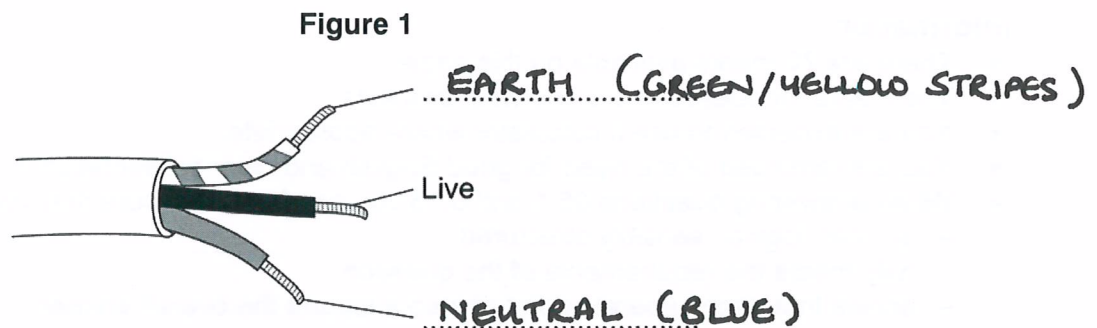
23 V

230 V

300 V

350 V

Figure 1 shows a three-core cable.



0 1 . 2

Use answers from the box to label the wires and complete Figure 1.

[2 marks]

Earth

Negative

Neutral

0 1 . 3 In the UK the three wires in a three-core cable are always the same colours.

Why are the wires always the same colours?

Tick **one** box

[1 mark]

Each wire is made by a different company.

It is easy to identify each wire.

They are cheaper to manufacture.

0 1 . 4 Touching the live wire is dangerous.

Use answers from the box to complete the sentences.

[2 marks]

current

resistance

shock

force

voltage

Touching the live wire causes a large potential difference to exist across the body.

This causes a CURRENT through the body,

which results in an electric SHOCK

0 1 . 5 What is the approximate frequency of the UK mains electricity supply?

Tick **one** answer.

[1 mark]

50 Hz

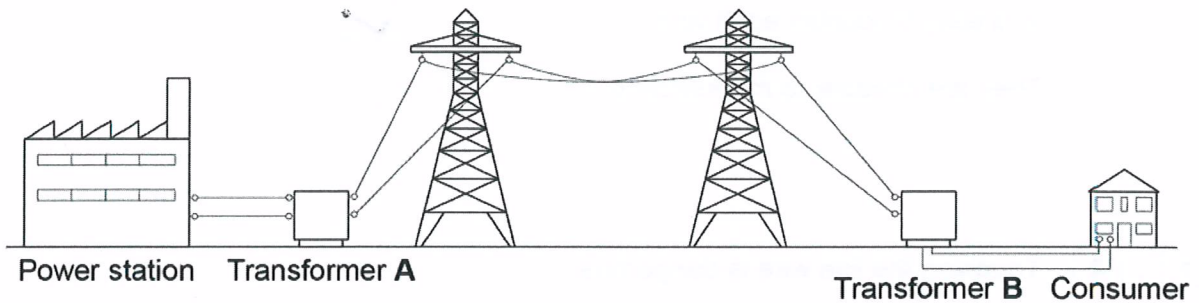
75 Hz

100 Hz

150 Hz

Figure 2 shows how power stations transfer electrical power to consumers using the National Grid.

Figure 2



0 1 . 6 The power station generates electricity at a voltage of 25 kV.

Transformer **A** increases the voltage by a factor of 16.

What is the voltage output of transformer **A**?

[2 marks]

OUTPUT = 25 x 16

Output voltage = 400 kV

0 1 . 7 Why is the voltage increased by transformer **A**?

Tick **one** box.

[1 mark]

To reduce the energy lost due to heating

To increase the power

To increase the current

0 1 . **8** Why is it important that the voltage is decreased by transformer **B**?

Tick **one** box.

[1 mark]

Less energy is used by consumers

It is safer for consumers

It reduces consumers' electricity bills

Turn over for the next question

0 2 The nuclei of some isotopes are radioactive.

0 2 . **1** Which of the following statements could apply to a radioactive nucleus?

[1 mark]

Tick **one** box.

The nucleus will emit an atom.

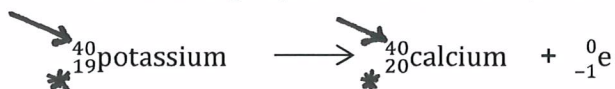
The nucleus will emit light.

The nucleus will emit a neutron.

The nucleus will emit sound.

0 2 . **2** Potassium-40 is a radioactive isotope present in food, such as bananas.

The following equation shows how potassium-40 will decay into calcium-40



Give one similarity and one difference between nuclei of potassium-40 and calcium-40

[2 marks]

Similarity \rightarrow SAME MASS NUMBER (PROTONS + NEUTRONS)

Difference \ast DIFFERENT ATOMIC NUMBER (PROTONS)

0 2 . **3** The activity of a sample of potassium-40 is measured 3 times.

The measurements are given below.

4906 Bq

4956 Bq

4889 Bq

Which of the following statements explains why the readings are different?

[1 mark]

Tick **one** box.

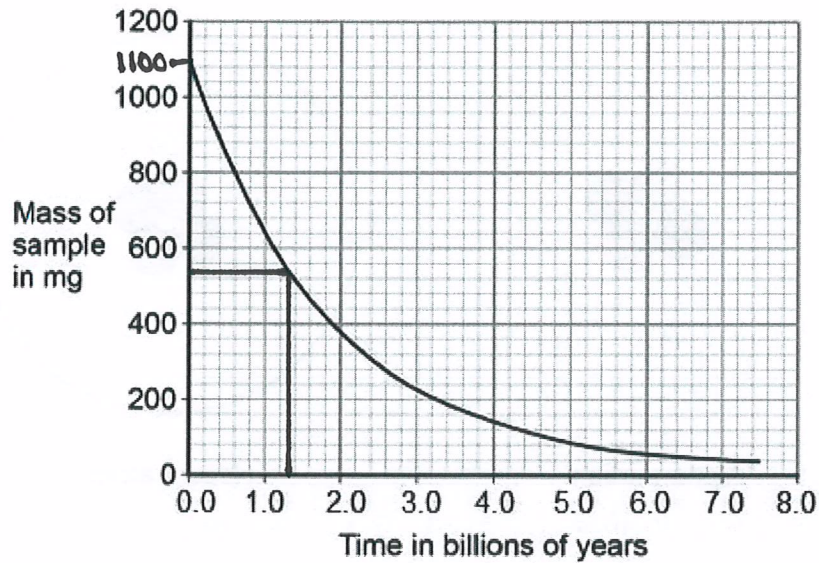
Radioactive decay is constant.

Radioactive decay is hazardous.

Radioactive decay is random.

0 2 . 4 Figure 3 shows how the activity of a sample of potassium-40 changes over time.

Figure 3



EXAM TIP:
ALWAYS USE A RULER TO DRAW LINES ON GRAPHS LIKE THIS.

Use Figure 3 to determine the half-life of potassium-40.

[2 marks]

at $t=0$, mass = 1100g. After 1 half life = $\frac{1100}{2} = 550$

Half-life = 1.3 billion years

0 2 . 5 When food is eaten, some of the radiation the food emits is detectable outside the body.

Which type of radiation would not be detectable outside the body?

Tick **one** box.

[1 mark]

alpha

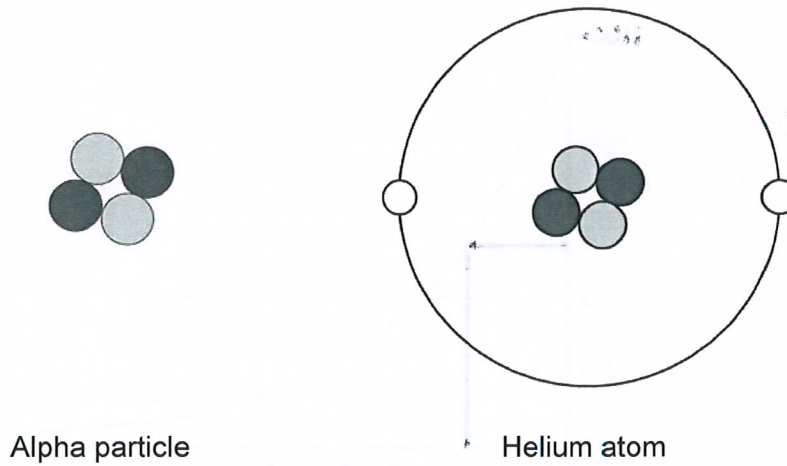
beta

gamma

0 3

Figure 4 is a diagram of an alpha particle and a helium atom.

Figure 4



0 3

1

What is the approximate size of a helium atom?

Tick **one** box.

[1 mark]

1×10^{-5} m

1×10^{-10} m

1×10^{-15} m

1×10^{-20} m

0 3

2

A helium atom is much larger than an alpha particle.

Give **one** other difference between a helium atom and an alpha particle.

[1 mark]

A HELIUM ATOM HAS 2 ELECTRONS, AN
ALPHA PARTICLE DOES NOT.

NUMBER OF PROTONS - BOTTOM NUMBER ON
9
PERIODIC TABLE



0 3 . 3 What is the atomic number of the helium atom in Figure 4?

Tick **one** box.

[1 mark]

- 2
- 4
- 6
- 8

0 3 . 4 What is the charge on the helium atom in Figure 4?

Explain your answer.

[3 marks]

THE CHARGE IS NEUTRAL
BECAUSE THERE ARE 2 PROTONS WHICH ARE
POSITIVELY CHARGED AND 2 ELECTRONS WHICH
ARE NEGATIVELY CHARGED $\therefore +2 - 2 = 0$

0 3 . 5 Helium is a gas that occurs naturally.

There is very little helium on Earth.

Helium has important uses in medicine and is also used to inflate party balloons.

Some scientists believe that helium should **not** be used to inflate party balloons.

Why?

[2 marks]

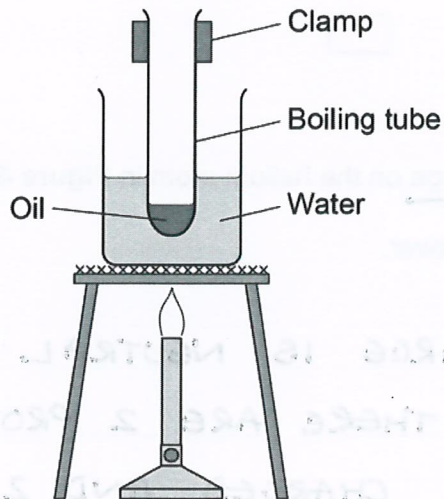
AS THERE IS VERY LITTLE HELIUM ON EARTH ONE
DAY IT WILL RUN OUT, THIS MEANS IT CAN
NO LONGER BE USED IN MEDICINE SO BALLOONS
WASTE THIS LIMITED RESOURCE.

0 4

A student investigated the change in temperature when oils of different specific heat capacities were heated.

She set up the apparatus shown in **Figure 5**.

Figure 5



This is the method used.

1. Put 25 g of oil into a boiling tube.
2. Pour 100 ml of water into a beaker and heat it with a Bunsen burner.
3. When the water is boiling, put the boiling tube into the beaker.
4. When the temperature of the oil reaches 30 °C, heat for a further 30 seconds and record the rise in temperature.
5. Repeat with different oils.
6. Repeat the whole investigation.

0 4

. 1

Name **two** pieces of apparatus the student used that are **not** shown in **Figure 5**.

[2 marks]

1 STOPWATCH (TO MEASURE TIME)

2 THERMOMETER (TO MEASURE TEMPERATURE)

0 4 . 2 What are the independent and dependent variables in the student's investigation? [2 marks]

'I' CHANGE ← Independent TYPE OF OIL

'DETERMINE' ← Dependent RISE IN TEMPERATURE

0 4 . 3 Give two safety precautions the student should have taken. [2 marks]

1 WEAR SAFETY GLASSES

2 DON'T HANDLE HOT APPERATUS -
LEAVE TO COOL

0 4 . 4 Suggest one improvement to the student's method. [2 marks]

REPEAT EACH OIL AT LEAST 3 TIMES
AND CALCULATE THE MEAN RISE IN
TEMPERATURE (THIS REDUCES THE EFFECT
OF RANDOM ERRORS)

Table 1 shows the student's results.

Table 1

Type of oil	Temperature rise in °C			Mean
	1	2	3	
Castor oil	20	19	21	20
Linseed oil	19	18	19	19
Mineral oil	21	21	21	21
Olive oil *	17	17	18	
Sesame oil	23	23	20	22

0 4 . 5 Calculate the mean temperature rise for olive oil.*

Give your answer to two significant figures.

[2 marks]

$$\text{MEAN RISE} = \frac{\text{SUM OF EACH RISE}}{\text{NUMBER OF TRIES}}$$

$$= \frac{17 + 17 + 18}{3} = \frac{52}{3} = 17.33$$

$$\text{Mean temperature rise} = 17 \text{ } ^\circ\text{C}$$

EXAM TIP:

WHEN CALCULATING A MEAN CHECK FOR ANOMALIES (ODD RESULTS) FIRST AND IGNORE THEM IN YOUR CALCULATION

0 4 . 6 The mean change in temperature of the castor oil is 20 °C

The specific heat capacity of castor oil is 1 800 J/kg °C

The mass of oil used is 0.025 kg

Calculate the change in thermal energy of the castor oil the student used.

Use the correct equation from the Physics Equations Sheet.

Select the correct unit from the box.

joule	newton	volt
-------	--------	------

[3 marks]

$$\Delta\theta = 20 \quad c = 1800 \quad m = 0.025 \text{ Kg} \quad E = ?$$

$$E = mc\Delta\theta = 0.025 \times 1800 \times 20 = 900$$

Change in thermal energy = 900

Unit Joules

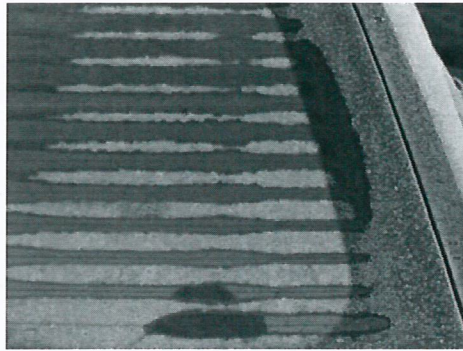
Turn over for the next question

IN A SOLID THE PARTICLES ARE IN A REGULAR ARRANGEMENT, THE PARTICLES CAN ONLY MOVE UP AND DOWN. THEY VIBRATE ABOUT A FIXED POSITION. THE HEATER WARMED THE PARTICLES GAINED AS THE PARTICLES GAINED MORE ENERGY AND STARTED TO VIBRATE. THE BOND HELD THE PARTICLES IN PLACE. AT THE POINT THE ARRANGEMENT IS DISRUPTED AND THE PARTICLES CAN MOVE UP AND DOWN.

0 5

Figure 6 shows solid ice on a car's rear window.

Figure 6



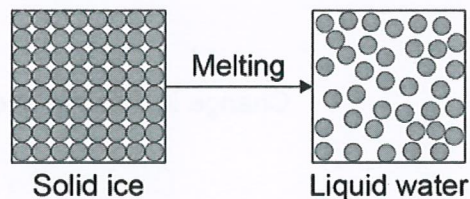
The glass window contains an electrical heating element.

0 5

1

Use the particle model in Figure 7 to describe how the heating element causes the arrangement of the ice particles to change as the ice melts.

Figure 7



You should include a description of how the particles are arranged in the solid ice and in the water.

[6 marks]

IN A SOLID THE PARTICLES ARE IN A REGULAR ARRANGEMENT, THE PARTICLES CANNOT MOVE PAST EACH OTHER; THEY VIBRATE ABOUT A FIXED POSITION. THE HEATER INCREASES THE INTERNAL ENERGY OF THE PARTICLES CAUSING THEM TO VIBRATE FASTER AND EVENTUALLY BREAKING THE BONDS HOLDING THE PARTICLES IN PLACE. AT THIS POINT THE ARRANGEMENT IS IRREGULAR AND THE PARTICLES CAN MOVE PAST EACH OTHER.

- 0 5** . **2** A car manufacturer tests different heating elements by measuring how long it takes ice to melt.

During the test some variables must be controlled.

Identify **two** control variables in the car manufacturer's test.

[2 marks]

Tick **two** boxes.

The colour of the car

The current in the heating element

The mass of ice

The size of the car

The time taken for the ice to melt

Question 5 continues on the next page

Some of the energy supplied by the heater causes the ice to melt without the temperature of the ice increasing.

0 5 . 3 What is the name given to this energy supplied by the heater?

[1 mark]

Tick **one** box.

Latent heat of freezing

Latent heat of fusion

Latent heat of vaporisation

0 5 . 4 When the heater is supplied with 120 J of energy each second, the internal energy of the ice increases by 45 J each second.

Use the following equation to calculate the efficiency of the heater.

$$\text{Efficiency} = \frac{\text{output energy transfer}}{\text{input energy transfer}}$$

Give your answer to two decimal places.

[2 marks]

$$\text{EFFICIENCY} = \frac{\text{OUTPUT}}{\text{INPUT}} = \frac{45}{120} = 0.375$$

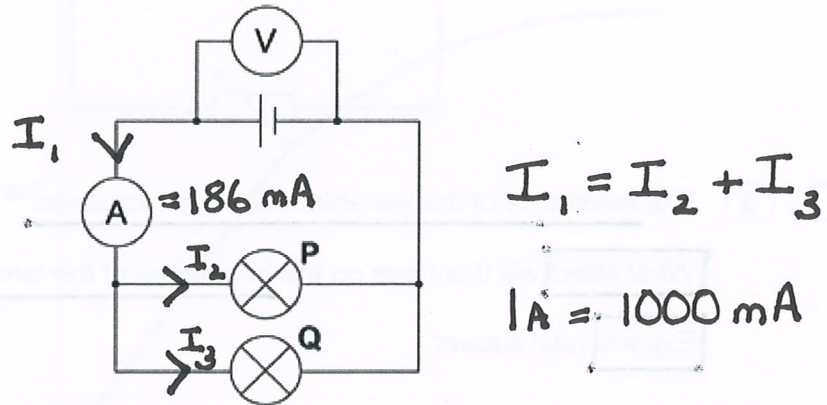
$$\text{Efficiency} = \underline{0.38}$$

0 6

Figure 8 shows a circuit diagram containing two identical lamps arranged in parallel.

The reading on the ammeter is 186 mA.

Figure 8



0 6

1

Which statement about the current through the lamps is true?

[1 mark]

Tick **one** box.

The current through both lamp P and lamp Q is **0.093 A**

The current through both lamp P and lamp Q is **0.186 A**

The current through both lamp P and lamp Q is **0.93 A**

The current through both lamp P and lamp Q is **1.86 A**

0 6

2

One of the lamps breaks and is not replaced.

Which statement about the current in the other lamp is true?

Tick **one** box.

[1 mark]

The current through the lamp is **0.093 A**

The current through the lamp is **0.186 A**

The current through the lamp is **0.93 A**

The current through the lamp is **1.86 A**

07

Figure 10 shows a battery operated remote control car.

Figure 10



07

1

The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

[2 marks]

THE CHEMICAL ENERGY STORED IN THE BATTERY DECREASES AS IT IS TURNED INTO THE KINETIC ENERGY OF THE CAR. THE INTERNAL ENERGY OF THE SURROUNDINGS INCREASES.

The car has a top speed of 12 m/s and a mass of 800 g. ← CONVERT TO Kg

07

2

Write down the equation that links kinetic energy, mass and speed.

[1 mark]

Equation $E_k = \frac{1}{2}mv^2$

07

3

Calculate the maximum kinetic energy of the car.

[2 marks]

$$E_k = \frac{1}{2}mv^2 = \frac{1}{2} \times \left(\frac{800}{1000}\right) \times 12^2 = \frac{1}{2} \times 0.8 \times 144$$

Maximum kinetic energy = 57.6 J

07 . 4 Explain why having a more efficient motor increases the top speed of the car.

[2 marks]

A MORE EFFICIENT MOTOR WASTES LESS ENERGY AS HEAT AND SOUND SO MORE OF THE CHEMICAL ENERGY IN THE BATTERY IS TRANSFERRED USEFULLY INTO KINETIC ENERGY.

Question 7 continues on the next page

Figure 11 shows an electric car being charged.

Figure 11



0 7 . 5 A driver wishes to buy a new car.

Table 2 gives some data about an electric car and one with a petrol engine.

Table 2

	Electric car	Petrol engine car
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from Table 2 to support your answer.

You should include the difference in cost in your answer.

[4 marks]

TOTAL COST FOR 12 YEARS;
 ELECTRIC CAR = $27,000 + (250 \times 12) = 30,000$
 PETROL CAR = $15,000 + (2000 \times 12) = 39,000$
 \therefore MEAN COST PER YEAR; ELECTRIC = 2500
 PETROL = 3250

ALTHOUGH THE ELECTRIC CAR COSTS £12,000 MORE TO BUY IT IS £1750 PER YEAR CHEAPER TO RUN
 THE MEAN COST PER YEAR IS LOWER \therefore MOST ECONOMIC

END OF QUESTIONS

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