# OCR
## Oxford Cambridge and RSA

# Thursday 25 May 2023 – Morning

## GCSE (9–1) in Combined Science B
## (Twenty First Century Science)

**J260/03** Physics (Foundation Tier)

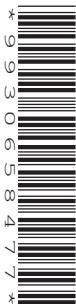**Time allowed: 1 hour 45 minutes**

**F**

**You must have:**
- a ruler (cm/mm)
- the Equation Sheet for GCSE (9–1) Combined Science Physics B (inside this document)

**You can use:**
- an HB pencil
- a scientific or graphical calculator

**INSTRUCTIONS**
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

**INFORMATION**
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

**ADVICE**
- Read each question carefully before you start your answer.

**Turn over**

**1** Ling has a torch with a filament lamp.

**(a)** What is the correct circuit symbol for a filament lamp?

Put a ring around the correct option.
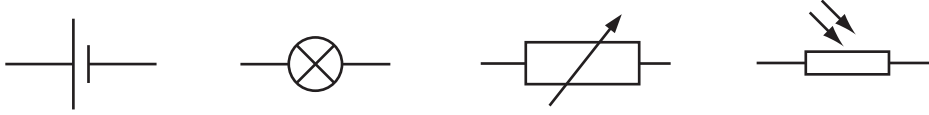


[1]

**(b)** The torch is not working. Ling makes this circuit to test components.
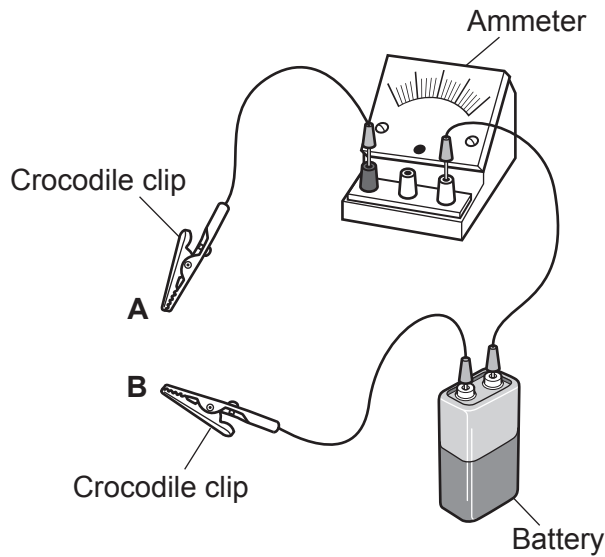


Complete the sentences to explain how the circuit works.

Put a ring around each correct option.

A component is connected to **A** and **B** using the **ammeter / battery / crocodile clips**.

If the ammeter measures a current it means that the circuit is **broken / complete / faulty**.

This shows that the component conducts **electricity / heat / light**.

[3]

**(c)** Which equation shows how to calculate the energy transferred to the filament lamp?

Tick (✓) **one** box.

energy transferred = charge ÷ potential difference ☐

energy transferred = potential difference ÷ charge ☐

energy transferred = potential difference × charge ☐

**[1]**

**(d)** The current through the filament lamp is 0.5A.

Calculate the charge that flows through the lamp in 30 s.

Use the equation: charge = current × time

Charge = .......................................................C **[2]**

2 Jack has a kidney scan. A radioactive tracer called technetium-99m is used in the scan.

(a) This radioactive decay graph shows how the percentage of technetium-99m remaining in the tracer changes with time.
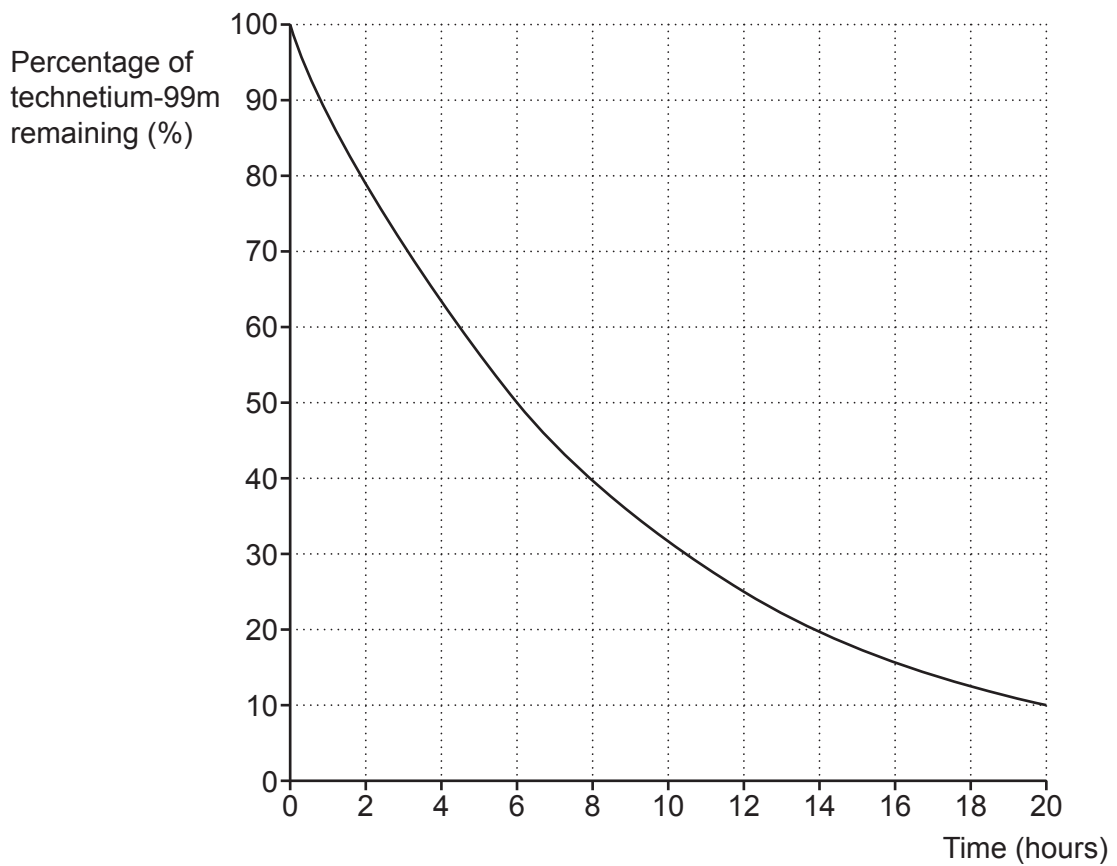


What is the half-life of technetium-99m?

Put a ring around the correct option.

**6 hours**      **10 hours**      **32%**      **50%**

[1]

**(b)** A gamma camera uses the radiation emitted by a radioactive tracer to form an image.

The statements describe how a kidney is scanned by a gamma camera.
They are **not** in the correct order.

**A**   This causes gamma rays to be emitted from the kidney.

**B**   There is radioactive decay of the tracer in the kidney.

**C**   The radioactive tracer is injected into Jack's blood.

**D**   The gamma rays are detected by the gamma camera.

**E**   The tracer travels around the body and collects in the kidney.

Write the letters in the boxes to show the correct order of how a kidney is scanned.

The first one has been done for you.

| C | | | | |
|---|---|---|---|---|

[2]

**(c)** Radioactive materials emit ionising radiation.

**(i)** Explain how ionising radiation can affect living things.

...........................................................................................................................................

.................................................................................................................................... [1]

**(ii)** Using a radioactive source can result in contamination or irradiation.

Which statement is an example of contamination?

Tick (✓) **one** box.

A person wearing gloves picks up a radioactive rock.  ☐

A radioactive isotope gets on the skin.  ☐

The body is irradiated by a source of gamma radiation.  ☐

[1]

**Turn over**

**3** Kai reads about an insect that has a large acceleration.

**(a)** The speed of the insect increases from $0\,m/s$ to $0.9\,m/s$ in a time of $0.006\,s$.

Calculate the acceleration of the insect.

Use the equation: $\text{acceleration} = \dfrac{\text{change in speed}}{\text{time taken}}$

Acceleration = ................................................ $m/s^2$ **[2]**

**(b)** The insect has a very small mass.

Kai investigates how changing the force on an object affects the acceleration of the object.
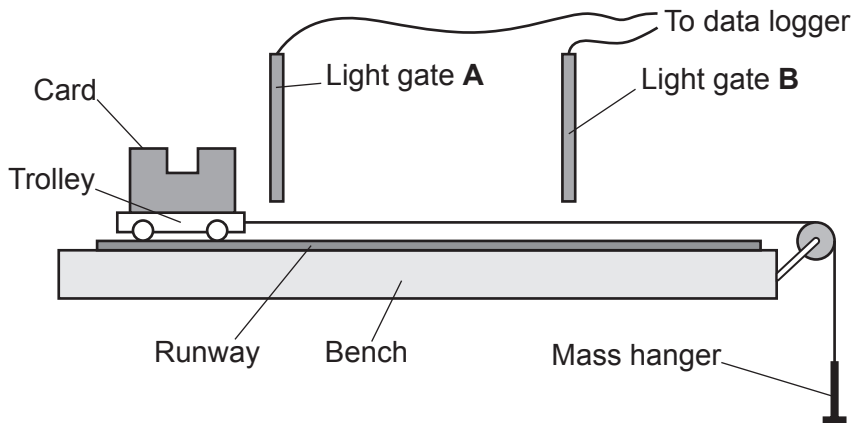


**(i)** Complete the sentences to explain how Kai does the experiment.

Put a ⬭ring around each correct option.

Kai adds a 100 g mass to the **bench / mass hanger / trolley**.

He releases the trolley and it travels along the runway.

The light gates detect the **card / trolley / mass hanger**.

Kai repeats the experiment adding another **100 g mass / trolley / light gate** each time.

**[3]**

**(ii)** The data logger calculates the acceleration of the trolley.

What data does the data logger use to calculate the acceleration of the trolley?

Tick (✓) **three** boxes.

| Data | Used to calculate acceleration |
|---|---|
| Distance between light gates **A** and **B** | |
| Length of the runway | |
| Mass of the mass hanger | |
| Speed of the trolley when it passes light gate **A** | |
| Speed of the trolley when it passes light gate **B** | |
| Time to travel from light gate **A** to light gate **B** | |

**[2]**

**(iii)** The force accelerating the trolley is the weight of the mass hanger.

Calculate the weight of the mass hanger when its mass is 0.4 kg.

Use the equation: weight = mass × gravitational field strength

Gravitational field strength = 10 N/kg

Weight = .................................................... N **[2]**

**4** Alex uses some filament lamps to light the rooms of a model house.
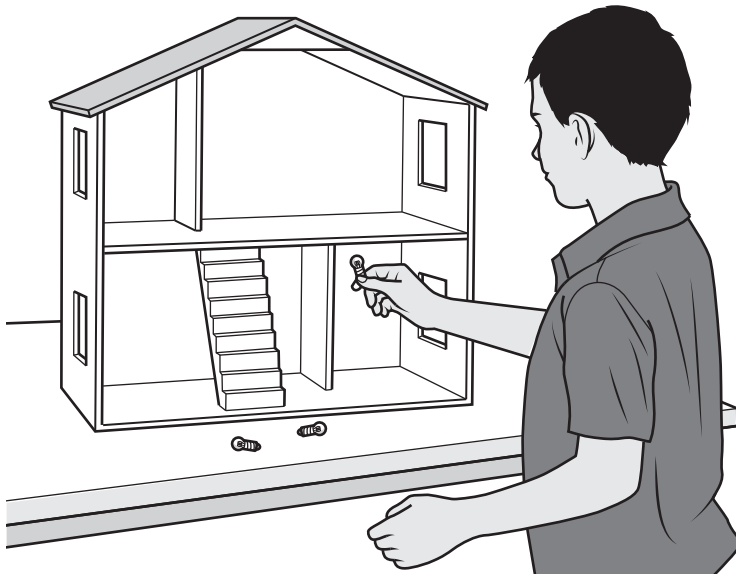


**(a)** Alex connects one filament lamp to a battery. The lamp has a resistance of 10 Ω and the current through it is 0.3A.

    **(i)** Calculate the potential difference across the lamp.

        Use the equation: potential difference = current × resistance

        Potential difference = ....................................................... V **[2]**

    **(ii)** Calculate the power transferred in the lamp.

        Use the Equation Sheet.

        Resistance of lamp = 10 Ω
        Current through lamp = 0.3A

        Power transferred = ...................................................... W **[3]**

**(b)** Alex learns about connecting resistors in series and parallel.

**(i)** Alex builds a circuit with one fixed resistor, as shown in **Fig. 4.1**.

Alex then adds a second resistor in series as shown in **Fig. 4.2**.
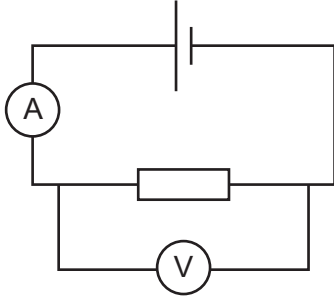
**Fig. 4.1**                                                        **Fig. 4.2**
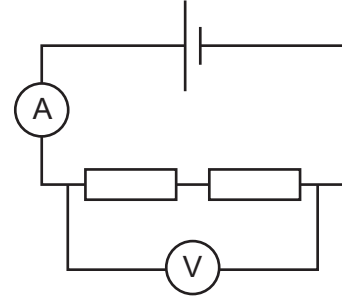


Complete the sentences to explain the increase in total resistance of the circuit when a second resistor is added in series.

Put a ring around each correct option.

The reading of the current on the ammeter **increases / decreases** because it has to pass through both resistors.

The reading of the potential difference on the voltmeter **stays the same / increases**.

[1]

**(ii)** Alex rebuilds his original circuit (**Fig. 4.1**).
Alex then adds a second resistor in **parallel** as shown in **Fig. 4.3**.
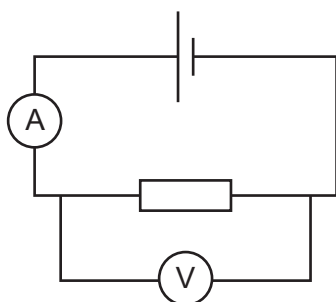
**Fig. 4.1**                                                    **Fig. 4.3**
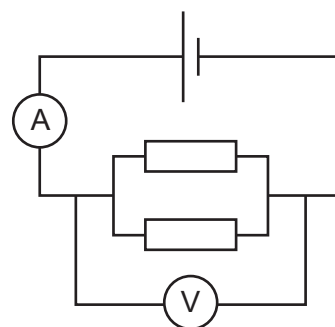


Complete the sentences to explain the decrease in total resistance of the circuit when a second resistor is added in parallel.

Put a ring around each correct option.

The current passes through both branches of the circuit, so the reading on the ammeter **decreases / increases / stays the same**.

The potential difference reading on the voltmeter **decreases / increases / stays the same**.

[2]

**5** The diagram shows a spring key ring which can be stretched.
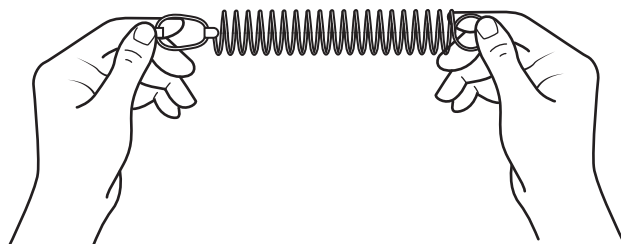
**(a)** The stretching forces deform the spring. The deformation can be plastic or elastic.

Complete the sentences to describe the difference between plastic deformation and elastic deformation.

**Plastic** deformation:

When the force is removed ......................................................................................................

..............................................................................................................................................

**Elastic** deformation:

When the force is removed ......................................................................................................

..............................................................................................................................................

**[2]**

**(b)** A force of 9N is used to stretch the spring.

Calculate the extension of the spring.

Use the equation: extension = $\dfrac{\text{force}}{\text{spring constant}}$

The spring constant = 2.5N/cm

Extension = ...................................................cm **[2]**

**6** Beth investigates the change in stored energy when an electrical appliance is used.

Her results are shown in the table.

| Electrical appliance | Power rating (W) | Time appliance is used for (h) | Change in stored energy (W h) |
|---|---|---|---|
| Fan heater | 3000 | 2 | 6000 |
| Television | 150 | 2 | 300 |
| Laptop computer | 100 | 4 | 400 |
| Refrigerator | 100 | 24 | 2400 |

**(a)** Explain how the power rating, and the time the appliance is used for, affects the change in stored energy.

Use data from the table.

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**(b)** Beth wants her home to be warm.

How can Beth reduce the energy losses from her home?

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.......................................................................................................................... **[1]**

**7** Ben is heating some soup on a gas hob.



**(a)** The temperature of the soup increases.

Which diagram describes the transfer between energy stores when the soup is heated?

| A Energy store of gas | Energy store of soup and surroundings | B Energy store of gas | Energy store of soup and surroundings |
|---|---|---|---|
| Chemical → transferred to → Elastic | | Chemical → transferred to → Thermal | |
| **C** Energy store of gas | Energy store of soup and surroundings | **D** Energy store of gas | Energy store of soup and surroundings |
| Thermal → transferred to → Chemical | | Thermal → transferred to → Elastic | |

Diagram = ....................................................... **[1]**

**(b)** Describe what happens to the liquid soup as its temperature increases.

Use ideas from the particle model.

.................................................................................................................................

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............................................................................................................................ **[2]**

**(c)** When energy is transferred to the soup, the internal energy of the soup increases.

Calculate the energy transferred to the soup when the temperature is increased from 20 °C to 90 °C.

The mass of the soup is 400 g
The specific heat capacity of the soup is 4100 J/kg °C

Use the Equation Sheet.

Energy transferred = ....................................................... J **[4]**
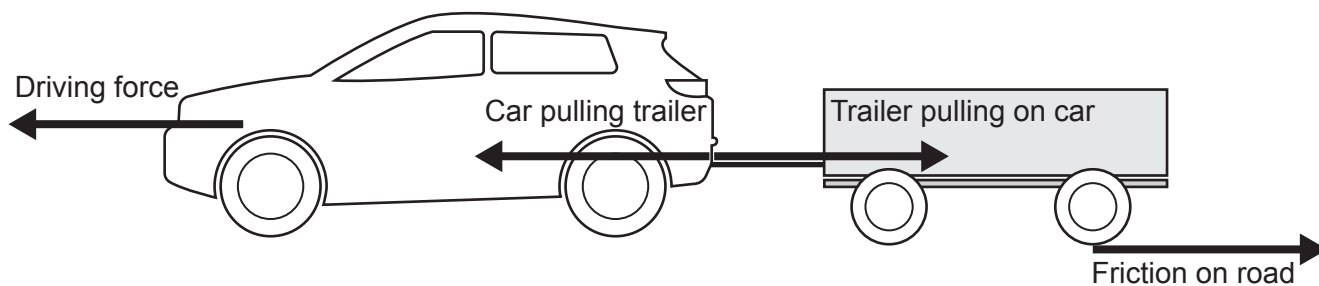
**8** A car is pulling a trailer. The diagram shows some of the forces on the car and the trailer.



**(a)** Newton's 3rd Law describes interaction pairs of forces.

  **(i)** Which **two** forces in the diagram form an interaction pair?

  Put rings around the **two** forces. **[1]**

  **(ii)** State **two** reasons why these forces are an interaction pair.

  1 ....................................................................................................................................

  2 ....................................................................................................................................
  **[2]**

**(b)** The car and trailer are travelling at a speed of 12 m/s.

Calculate the kinetic energy of the car and trailer.

The mass of the car is 1100 kg and the mass of the trailer is 300 kg.

Use the equation: kinetic energy = $\frac{1}{2}$ × mass × (speed)$^2$

Kinetic energy = ...................................................... J **[2]**

**Turn over**

**9** Eve drops a pebble into a pond.

Fig. 9.1 shows how the water waves spread out.

**Fig. 9.1**
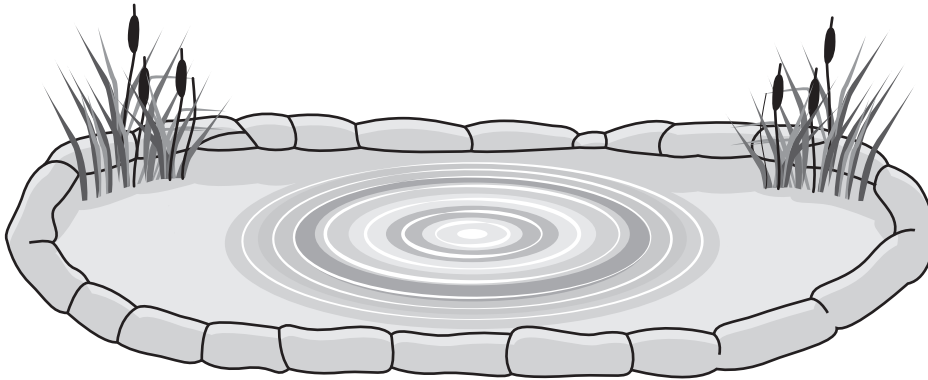


**(a) (i)** The graph shows a transverse wave.

Label an amplitude with a letter **A**, and a wavelength with a letter **W** on the transverse wave.
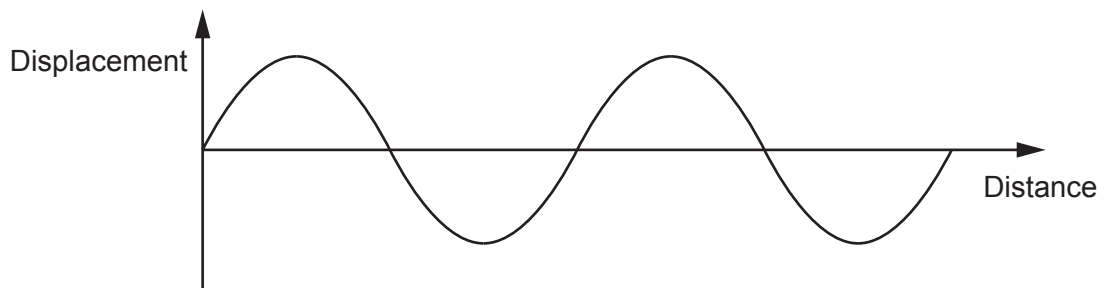


[2]

**(ii)** What is the **frequency** of the wave?

Tick (✓) **one** box.

The change in the wavelength of the waves in one second. ☐

The number of waves passing a point in one second. ☐

The time for the wavelength to change in seconds. ☐

[1]

**(iii)** A water wave has a wavelength of 0.3 cm and a frequency of 100 Hz.

Calculate the wave speed of the water wave.

Use the equation: wave speed = frequency × wavelength

Give your answer in **m/s**.

Wave speed =  ...................................................m/s **[3]**

**Turn over**

**(b)** Eve investigates waves using a ripple tank, as shown in **Fig. 9.2**.

**Fig. 9.2**



**(i)** Complete the sentences to describe how Eve can use the ripple tank to measure the wavelength of a water wave.

Use words from the list.

| distance | mass | ruler | speed | stopwatch | time |
|----------|------|-------|-------|-----------|------|

Make the waves low frequency waves by changing the ............................ of the motor.
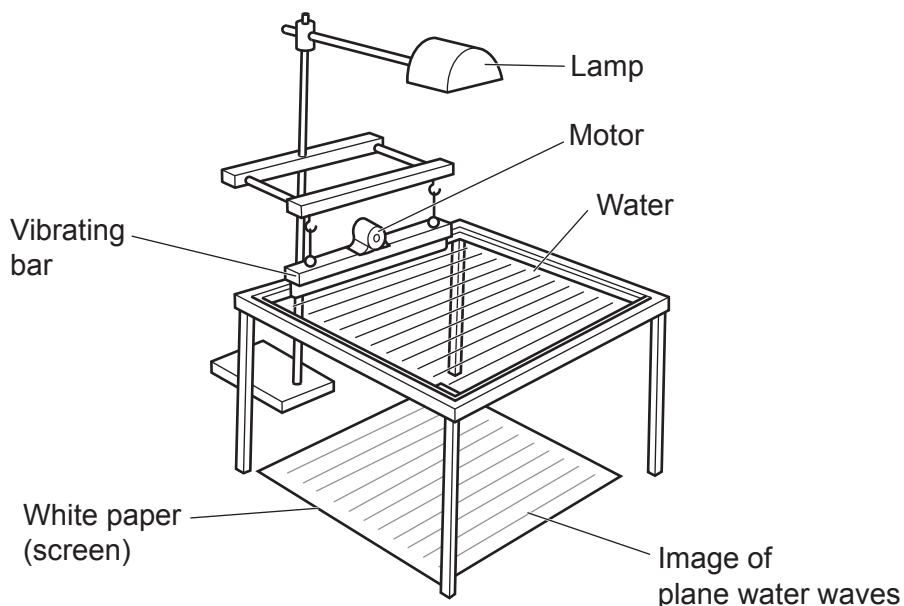
To measure the wavelength of the waves, place a ............................ on the paper.

Measure the ............................ between the waves to get the wavelength.

**[3]**

**(ii)** How can Eve get a stationary image of the waves on the paper?

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................................................................................................................................... **[1]**

**(iii)** The wavelength is very small.

How can Eve get a more accurate measurement of the wavelength?

.................................................................................................................................................

................................................................................................................................... **[1]**

**(iv)** How can Eve reduce the uncertainty of her result?

Tick (✓) **one** box.

Increase the frequency of the vibrating bar. ☐

Repeat the experiment 3 times and use the mean value. ☐

Use a magnifying lens to see the waves. ☐

**[1]**

**(v)** Eve wants to investigate circular waves with the ripple tank. Dropping a pebble into the ripple tank does not continually produce circular waves.

Suggest how she can **continually** produce **circular** waves in the ripple tank.

.......................................................................................................................................................

................................................................................................................................... **[1]**

**Turn over**

**10** When trains were invented, people were able to travel between places at 7 m/s. This is faster than the typical walking speed.

**(a)** What is a typical walking speed for an adult human?

Walking speed = ................................................ m/s **[1]**

**(b)** What is the difference between speed and velocity?

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............................................................................................................................... **[1]**

**(c)** The table and the graph show a train journey.

| Point on journey | Distance (km) | Time (h) |
|:---:|:---:|:---:|
| A | 0 | 0 |
| B | 100 | 1.0 |
| C | 250 | 3.0 |
| D | 250 | 3.5 |
| E | 300 | 4.0 |
| F | 350 | 5.0 |
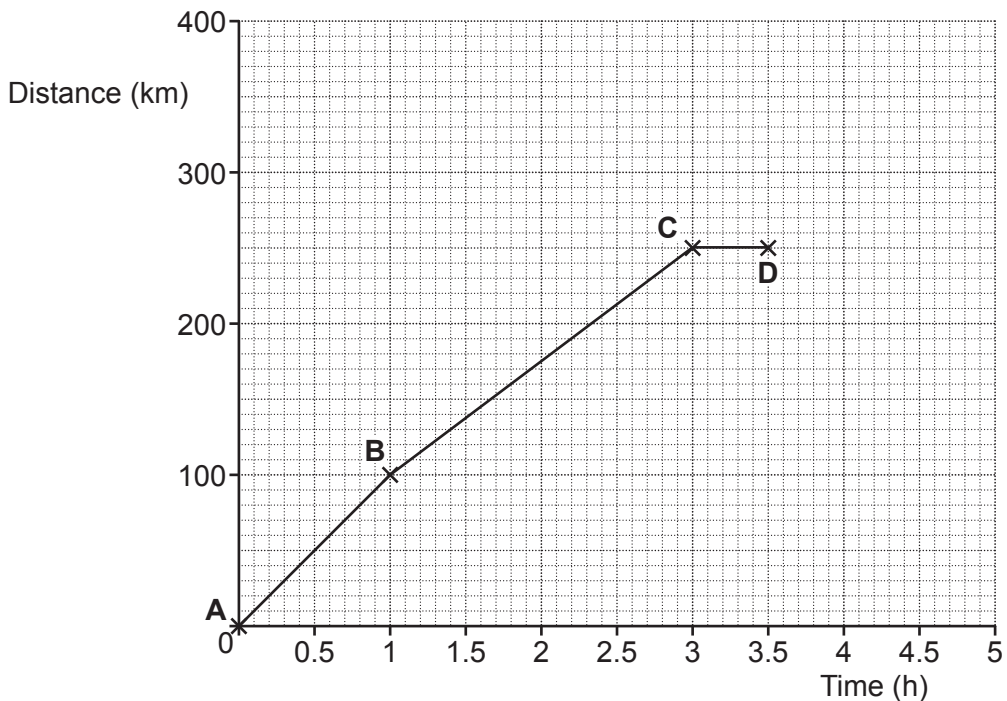


**(i)** Plot the results for point **E** and point **F** on the graph. **[1]**

**(ii)** Draw lines to complete the distance–time graph. **[1]**

(iii) Calculate the speed of the train between points **B** and **C**.

Use the equation: average speed = $\dfrac{\text{distance}}{\text{time}}$

Speed of train between points **B** and **C** = ................................................ km/h **[2]**

(iv) Describe how the speed of the train changes from point **A** to point **D**.

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.................................................................................................................................. **[2]**

**(d)** A stationary train accelerates steadily from an initial speed of 0 m/s to a final speed of 56 m/s.

Calculate the distance the train travels as it is accelerating.

The acceleration is 0.2 m/s².

Give your answer to **2** significant figures.

Use the Equation Sheet.

Distance = .................................................... m **[3]**

**(e)** In a collision a train comes to a stop quickly. This is a very large deceleration.

Explain why this is dangerous for the passengers.

In your answer, use the equation: force = mass × acceleration

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.................................................................................................................................. **[2]**

**11 (a)** Which **two** statements about electromagnetic radiation are true?

Tick (✓) **two** boxes.

All electromagnetic radiation is ionising. ☐

All electromagnetic radiation travels through space at the same speed. ☐

Only very hot bodies emit electromagnetic radiation. ☐

Our eyes can only detect a limited range of electromagnetic frequencies. ☐

Gamma rays are used for satellite communications. ☐

**[2]**

**(b) (i)** Complete the table by showing the main groups of the electromagnetic spectrum from long to short wavelengths.

Use words from the list.

| **Gamma rays** | **Microwave** | **Radio** | **Visible** | **X-rays** | **Ultraviolet** |
|---|---|---|---|---|---|

| Electromagnetic radiation spectrum | | | | | | |
|---|---|---|---|---|---|---|
| **Long wavelength** ⟶ | | | | | **Short wavelength** | |
| | | Infrared | | | | |

**[3]**

**(ii)** Complete the sentence about electromagnetic radiation.

Put a ⟨ring⟩ around each correct option.

When the wavelength of electromagnetic radiation gets shorter

the frequency **increases / decreases / stays the same**

and the energy **increases / decreases / stays the same**.

**[2]**

**(c)** A new telescope in space called the JWST uses electromagnetic radiation to produce images of very distant galaxies.

    **(i)** Suggest **one** benefit of seeing images of very distant galaxies.

        ...................................................................................................................................

        ............................................................................................................................. **[1]**

    **(ii)** Suggest **one** reason why scientists looking at images from the JWST should tell everyone about their discoveries.

        ...................................................................................................................................

        ............................................................................................................................. **[1]**

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　**Turn over**

**12** The UK uses a number of different energy resources including wind and nuclear fuel to generate electricity.

**(a)** Give **one other** example of a renewable energy resource and a non-renewable energy resource.
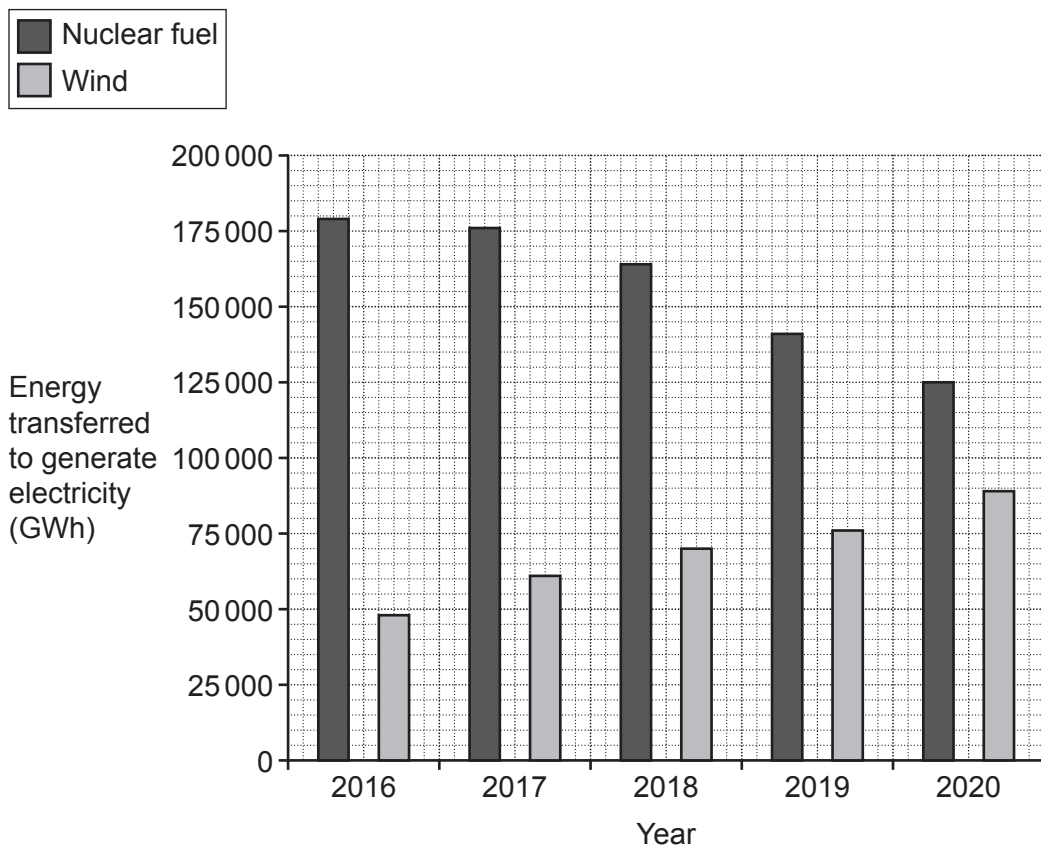
Renewable: ....................................................................................................................................

Non-renewable: .............................................................................................................................

**[2]**

**(b)\*** Nuclear fuel and wind are used to generate electricity in the UK.
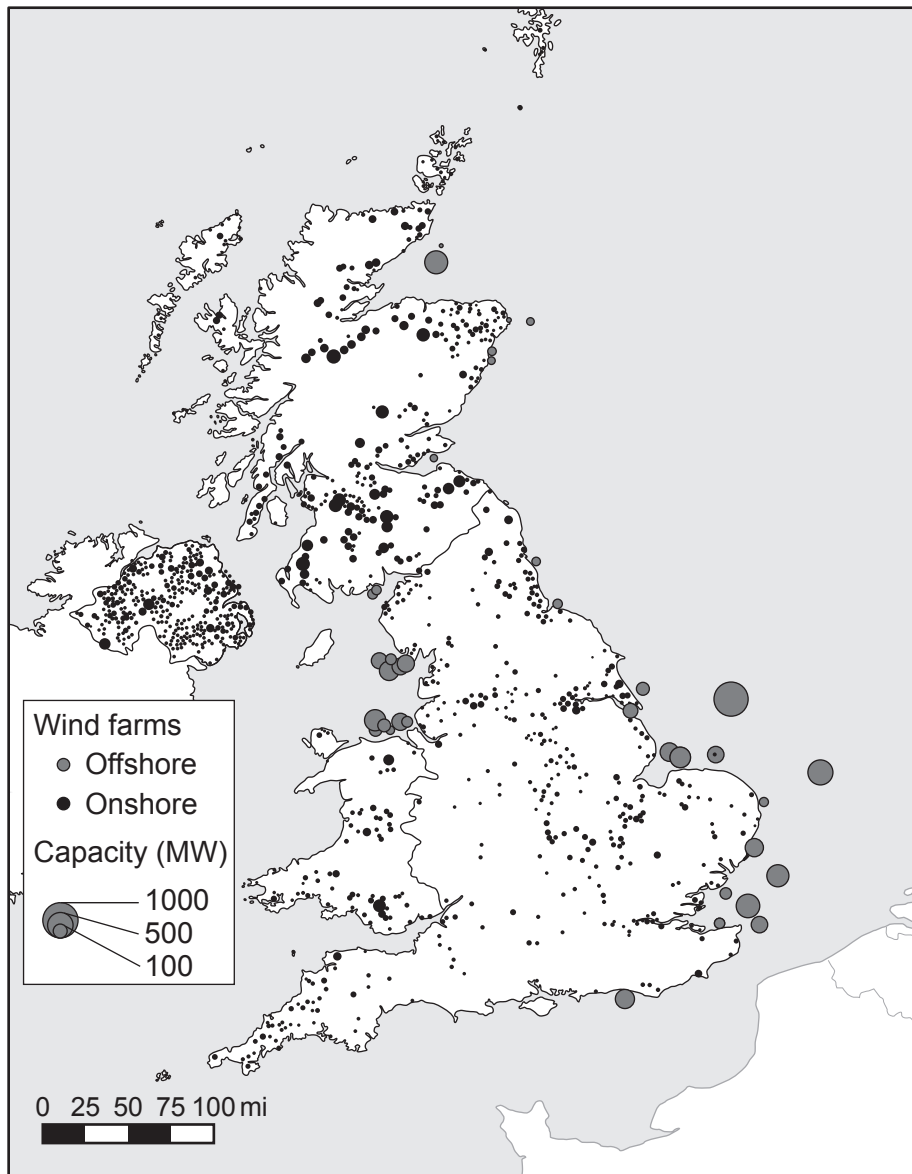
The graph shows the energy transferred to generate electricity from these resources between 2016 and 2020.

Describe how nuclear fuel and wind are used to generate electricity.

Include in your answer how the use of these energy resources has changed in the UK since 2016.

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**Turn over**

**(c)** This map shows wind farm sites in the UK in 2021.



Wind turbines can be built on land or in the sea.

Suggest **two** reasons why some land areas may **not** be suitable for wind turbines.

1 ...................................................................................................................................................

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2 ...................................................................................................................................................

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**[2]**

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).