OCR
Oxford Cambridge and RSA

Monday 16 June 2025 – Morning

GCSE (9–1) Physics B (Twenty First Century Science)

J259/02 Depth in physics (Foundation Tier)

Time allowed: 1 hour 45 minutes

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

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

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Please write clearly in black ink. **Do not write in the barcodes.**

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

First name(s) _____

Last name _____

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 **90**.
- 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.

1 Electromagnetic spectrum radiation ranges from a low to a high frequency.

(a) Complete the list to show all parts of the electromagnetic spectrum in order from lowest frequency to highest frequency.

Use these words.

Infrared	**Visible light**	**X-rays**

Lowest frequency ↓ **Highest frequency**

Radio waves

Microwaves

.....

.....

Ultraviolet

.....

Gamma

[2]

(b) Which statements about the electromagnetic spectrum are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	**False**
All parts of the electromagnetic spectrum travel at the speed of light.		
Gamma radiation has the longest wavelength.		
Radio waves carry the greatest energy.		
Visible light is a transverse wave.		

[3]

(c) When electromagnetic radiation hits a material, it can be **absorbed**, **reflected**, or **transmitted**.

What happens to the electromagnetic radiation in these situations?

Tick (✓) **one** box in each row.

	Absorbed	**Reflected**	**Transmitted**
Infrared radiation heats up a plastic block.			
Microwaves bounce off a metal sheet.			
Visible light passes through glass.			

[2]

2 A scientist has two pieces of equipment to send to the Moon.

They want to find the weight of both pieces of equipment.

(a) Which statement about mass and weight is **true**?

Tick (✓) **one** box.

Mass is a force. ☐

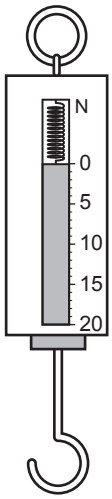
The weight is equal to the mass. ☐

Weight is the force on a mass due to gravity. ☐

[1]

(b) The diagram shows a spring balance.

A spring balance uses a spring to measure weight.



The scientist hangs a small piece of equipment on the spring balance. The spring extends. They then replace the equipment with a heavier piece of equipment.

Describe what happens to the extension of the spring when the small piece of equipment is replaced with the heavier piece.

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

(c) One piece of equipment is hung from the spring balance.

The spring extends by 0.08 m.
The spring has a spring constant of 250 N / m.

Calculate the force exerted by the spring.

Use the Equation Sheet.

Force exerted by the spring = ... N **[3]**

(d) The other piece of equipment has a mass of 12 kg.
The gravitational field strength on the Moon is 1.6 N / kg.

Calculate the weight of this piece of equipment on the Moon.

Use the equation: weight = mass × gravitational field strength

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

3 This question is about waves.

(a) Sound waves are longitudinal waves.

(i) Which statements about sound waves are **true**?

Tick (✓) **two** boxes.

Sound waves can only travel in air. ☐

Sound waves transfer energy. ☐

Sound waves travel at the same speed as the speed of light in air. ☐

The number of sound waves every second is the frequency. ☐

[2]

(ii) Which statements about longitudinal waves are **true**?

Tick (✓) **two** boxes.

Longitudinal waves are a series of compressions. ☐

Longitudinal waves can travel in space. ☐

The disturbance of particles is parallel to the direction of motion. ☐

The disturbance of particles is at right angles to the direction of motion. ☐

[2]

(b) A student does an experiment to calculate the speed of a water wave.

They fill a tray with water and take measurements of a wave travelling across the water.

The time for 1 wave to travel to the end of the tray and back is 18 seconds.

The length of the tray is 45 cm.

Calculate the speed of the wave.

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

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

Speed of water wave = ... m/s **[4]**

(c)* Describe a method for finding the speed of sound in **air**.

Include in your answer:
- the apparatus used
- possible sources of error.

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..... **[6]**

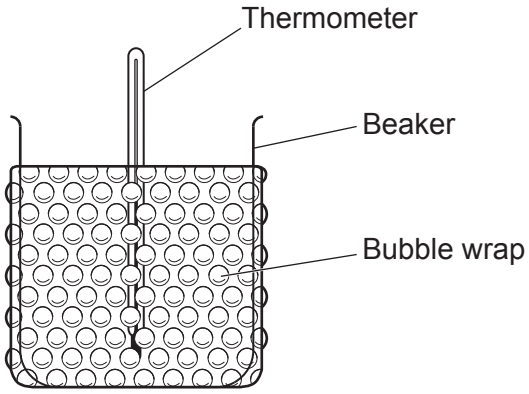
4 A student investigates how layers of bubble wrap can be used to insulate a beaker of hot water.

They cover the sides of two beakers in bubble wrap insulation.

- One beaker has **one** layer of bubble wrap.
- The other beaker has **two** layers of bubble wrap.

They also use a third beaker that has **no** bubble wrap.

The diagram shows how the beaker with one layer of bubble wrap is set up.



They follow this method:

- Fill each beaker with hot water.
- Record the initial temperature of the water in each beaker.
- Record the temperature of the water in each beaker every 5 minutes, as the water cools.

(a) Suggest **two** variables that the student needs to control.

1 .....

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2 .....

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[2]

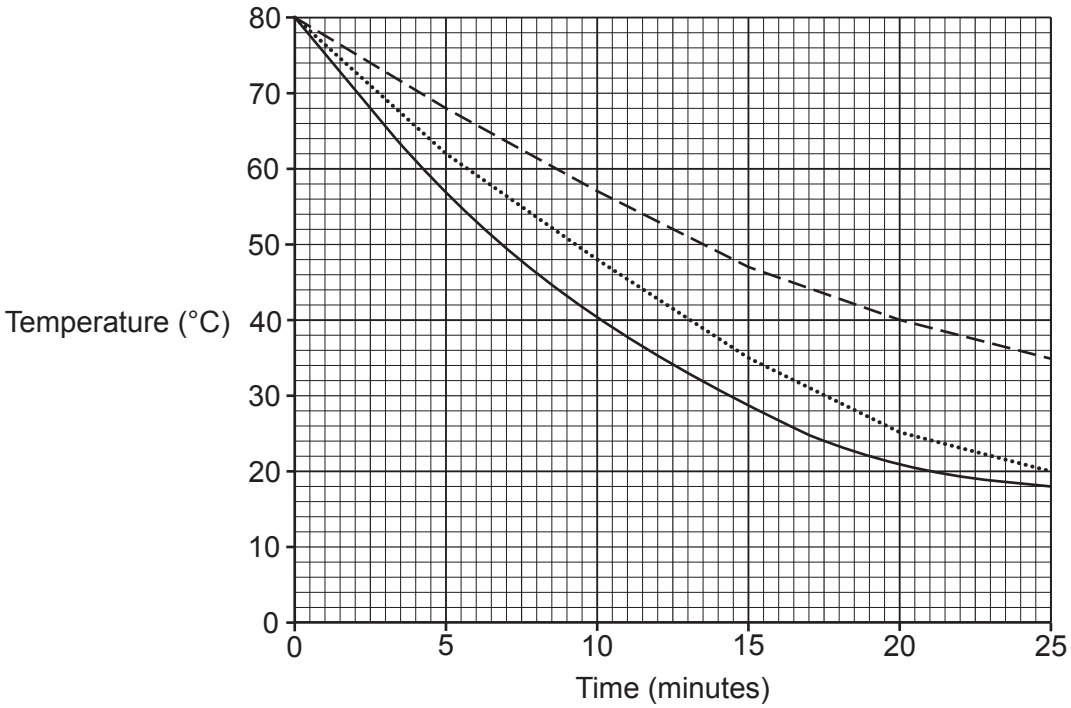
(b) The graph shows how the temperature changes with time for the three beakers.

Key:

– – – Beaker with **two** layers of bubble wrap

····· Beaker with **one** layer of bubble wrap

——— Beaker with **no** layers of bubble wrap



Which **two** of these conclusions can be made from this graph?

Tick (✓) **two** boxes.

After 10 minutes the temperature of the water is the same in all the beakers. ☐

The temperature in each beaker dropped more quickly when the water was hotter. ☐

The water cools more quickly with more layers of insulation. ☐

The water stays warmer for longer with more layers of insulation. ☐

[2]

(c) Suggest **one** improvement that the student can make to their investigation.

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

5 A radioactive isotope decays by emitting an alpha particle.

(a) An alpha particle is a helium-4 nucleus and can be written as:

$^{4}_{2}He$

How many protons and neutrons are contained in the nucleus of helium-4?

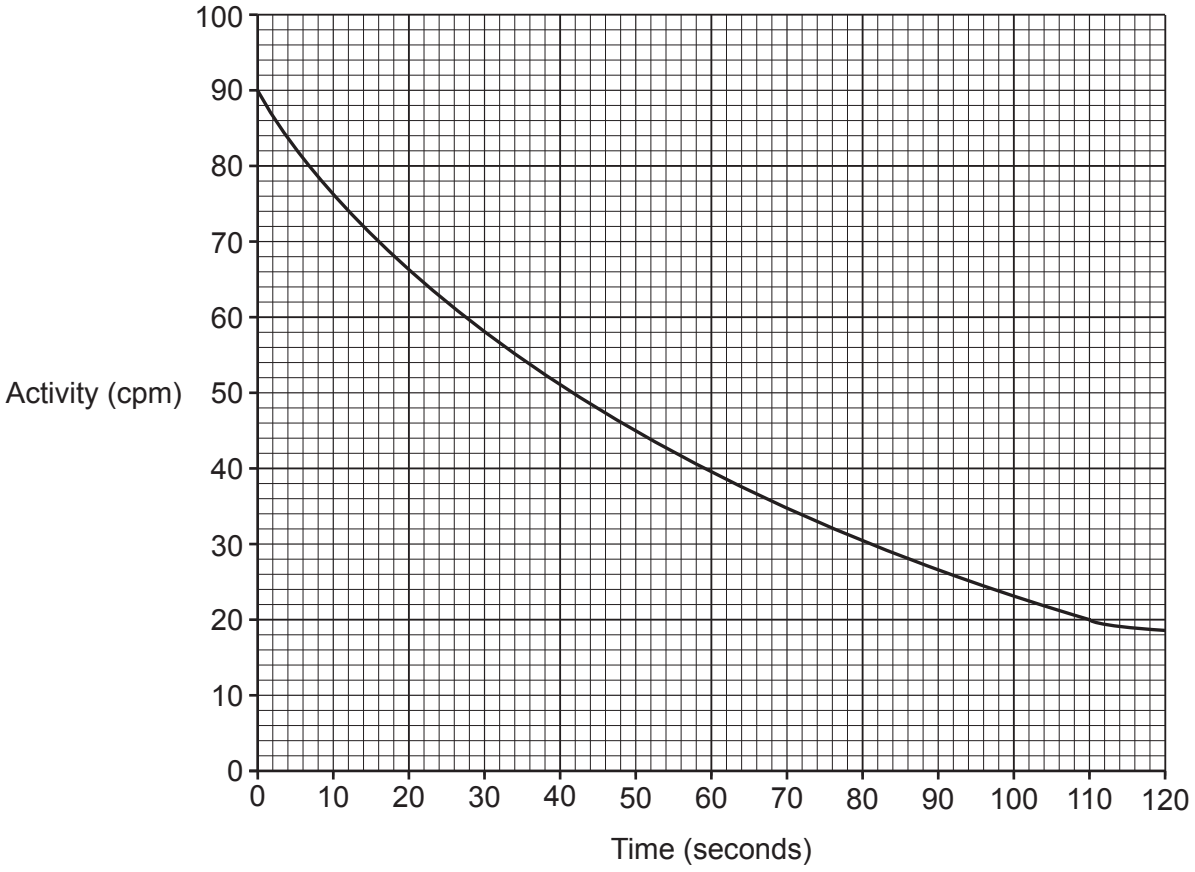
Number of protons = ...

Number of neutrons = ...

[2]

(b) The graph shows the activity-time graph for a radioactive isotope.

The activity is measured in counts per minute (cpm).



(i) What is the activity at 15 seconds?

Activity = ... cpm **[1]**

(ii) What is the change in the activity between 15 and 30 seconds?

Change in activity = ... cpm **[1]**

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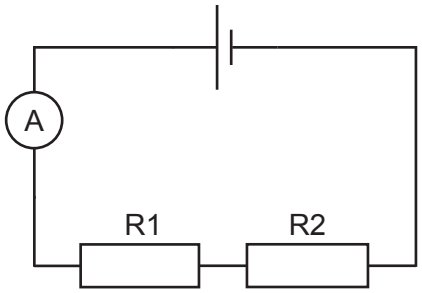
6 A student investigates how the current in series and parallel circuits changes with the number of cells.

(a) The student builds a circuit with two identical resistors, R1 and R2.

The resistors are connected in series with an ammeter.

Fig. 6.1 shows the circuit they build.

Fig. 6.1



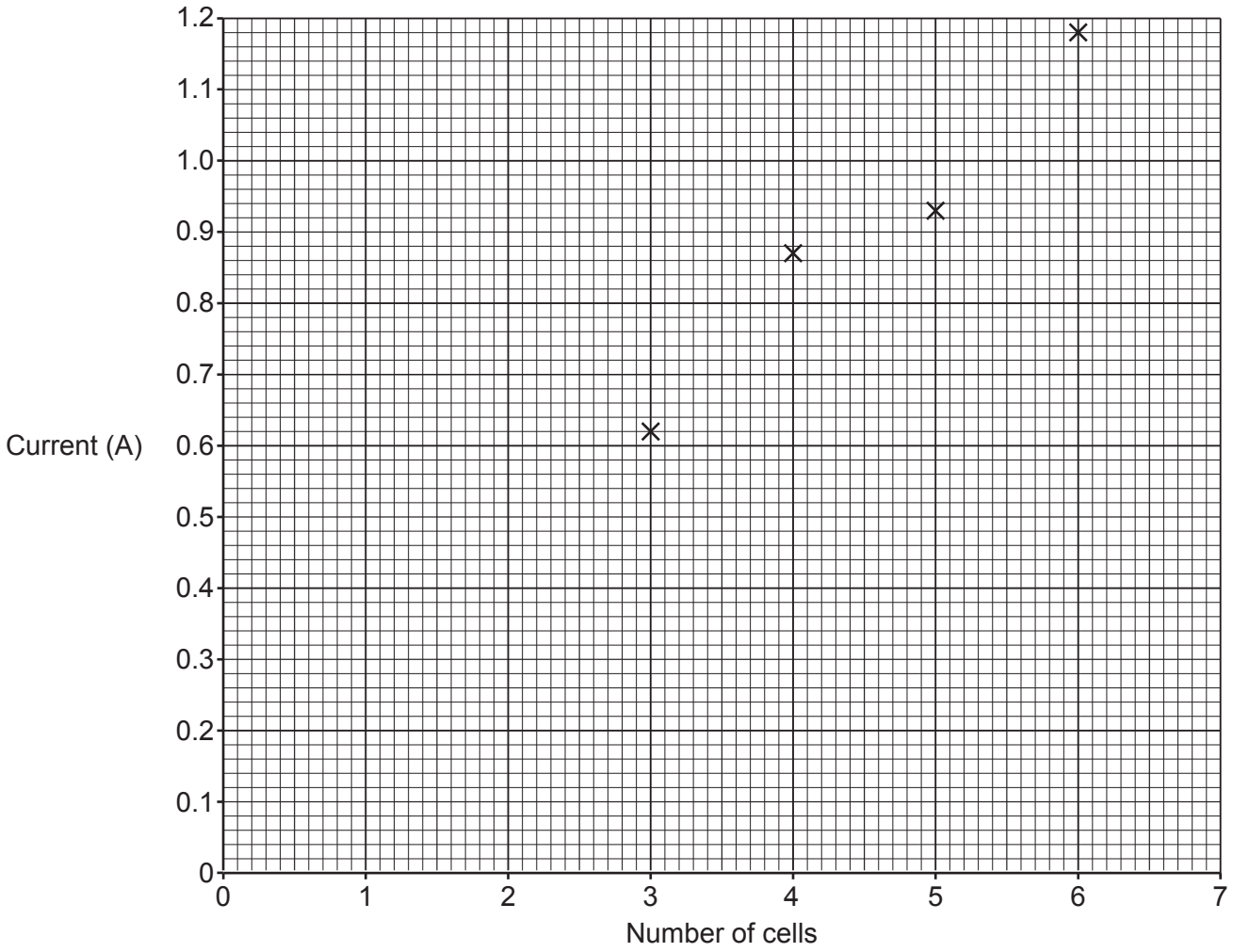
The student records the current in the circuit.

They add more cells in series, one at a time, and repeat the measurement of current.

The table shows their results.

Number of cells	Current (A)
1	**0.20**
2	**0.42**
3	0.62
4	0.87
5	0.93
6	1.18

The student plots their results on the graph.



(i) Complete the graph.

You need to plot the first **two** points. **[1]**

(ii) Draw a line of best fit on the graph. **[1]**

(iii) Describe how the current changes as the number of cells increases.

Use the graph.

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

(iv) Suggest why **not every** point lies on the line of best fit.

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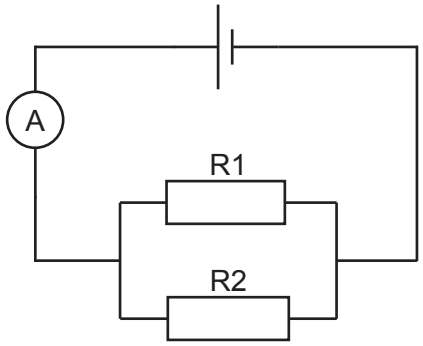
..... **[1]**

(b) **Fig. 6.2** shows a parallel circuit using the same components as the circuit in **Fig. 6.1**.

The resistors, R1 and R2, are identical to each other.

Fig. 6.2



(i) Which **two** statements about the parallel circuit in **Fig. 6.2** are **true**?

Tick (✓) **two** boxes.

The current in R1 is bigger than R2. ☐

The potential difference across R1 is greater than across R2. ☐

The total current equals the sum of the currents in R1 and R2. ☐

The total resistance is less than in the series circuit in **Fig. 6.1**. ☐

[2]

(ii) Calculate the total current in the circuit in **Fig. 6.2**.

- The potential difference across the cell is 3 V.
- The total resistance in the circuit is 1.5 Ω.

Use the Equation Sheet.

Current = ... A **[3]**

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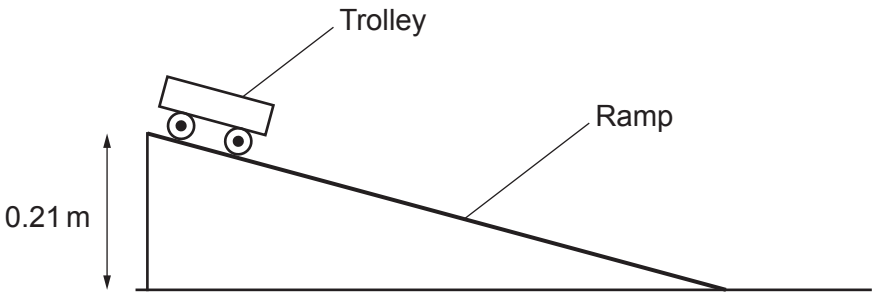
7 **Fig. 7.1** shows a trolley at the top of a ramp.

Fig. 7.1



When the trolley is released it accelerates down the ramp.

(a) Complete the table to show whether the gravitational potential energy and kinetic energy stores of the trolley **increase**, **decrease** or **stay the same** as the trolley accelerates down the ramp.

Tick (✓) **one** box in each row.

	Increases	**Decreases**	**Stays the same**
Gravitational potential energy store of the trolley			
Kinetic energy store of the trolley			

[2]

(b) The mass of the trolley is 0.6 kg.

(i) Calculate the gravitational potential energy store of the trolley when it is at a height of 0.21 m.

Use the Equation Sheet.

Gravitational field strength = 10 N / kg.

Gravitational potential energy store = ... J **[3]**

(ii) The trolley reaches a maximum velocity of 1.7 m / s when it travels down the ramp.

Calculate the maximum kinetic energy store of the trolley.

Use the Equation Sheet.

Give your answer to **1** decimal place.

Maximum kinetic energy store = ... J **[4]**

(c) A force of 0.8 N acts on the trolley in the same direction that the trolley is accelerating.

The trolley travels 1.5 m down the ramp.

Calculate the work done on the trolley by the force of 0.8 N.

Use the Equation Sheet.

State the units.

Work done = ... Unit ..... **[4]**

(d) Explain why energy is transferred to the surroundings as the trolley travels down the ramp.

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

(e) A student releases the trolley from rest at the top of the ramp and the trolley travels down the ramp with a constant acceleration.

Describe a method to find the average speed of the trolley as it travels down the ramp.

The student has this equipment:

- The trolley and the ramp shown in **Fig. 7.1**.
- A stopwatch.
- A tape measure.

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..... **[3]**

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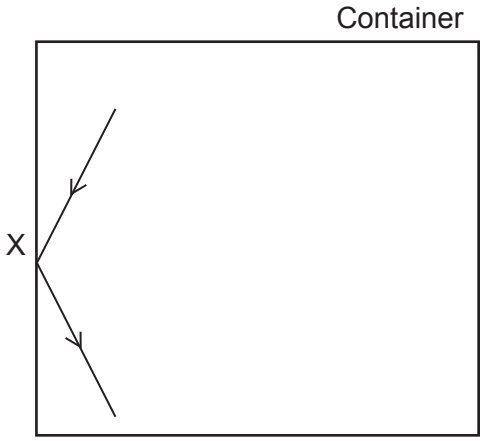
8 A sealed container is filled with air.

(a) The diagram below shows the path of a particle of air in the container.

When the particle of air hits the wall of the container at X, a force acts on the wall.



Draw **one** arrow on the diagram at X to show this force. **[1]**

(b) The volume of the container is decreased.

The temperature and amount of air remain the same.

The table shows information for three different volumes.

Volume (m^2)	Pressure (N/m^2)	Pressure × Volume
0.8	100 000	80 000
0.4	200 000	.....
0.2	.....	80 000

Complete the table.

You can use the space below to show any calculations you use.

[4]

(c) Explain why the particles in the air hit the wall of the container more often when the volume of the container decreases.

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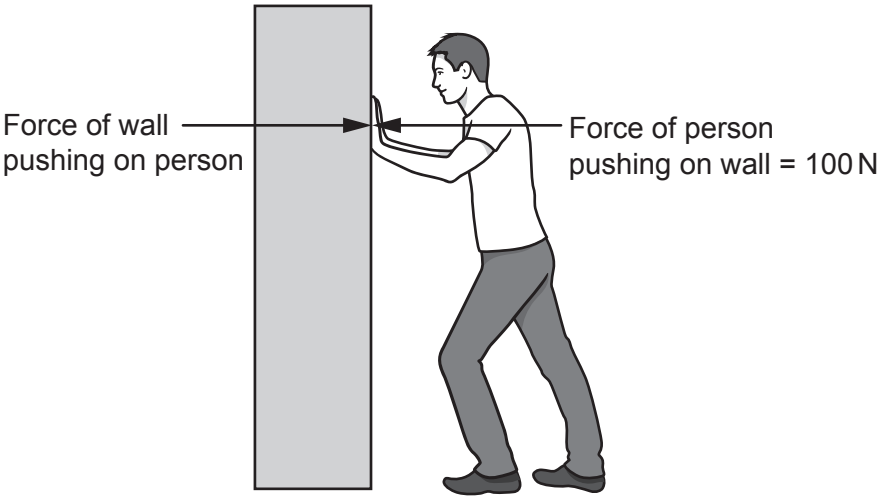
..... **[2]**

9 According to Newton's third law, when two objects interact, they apply forces on each other.

(a) A person pushes on a wall with a force of 100 N.

The diagram shows two forces that form an interaction pair between the person and the wall.



Which statements about this pair of forces are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
Both forces are acting on the person.		
The forces are the same kind of force.		
The forces are opposite in direction.		
The force of the wall on the person equals 100 N.		

[3]

(b) Which of these forces is a **contact** force?

Tick (✓) **one** box.

Electrostatic ☐

Friction ☐

Gravitational ☐

Magnetic ☐

[1]

(c) Complete the sentences in the table to describe each interaction pair of forces.

Use words from the list.

attracting	**Earth**	**Moon**	**negatively**
positively	**repelling**	**Sun**	

A magnet attracting an iron bar.	The iron bar ..... the magnet.
A positively charged rod attracting a piece of paper.	The piece of paper attracting the ..... charged rod.
The gravitational force of the Earth on the Moon.	The gravitational force of the ..... on the ..... .

[4]

10 Scientists advise people to use sunscreen when they are outside on a sunny day.

Sunscreen absorbs the UV radiation from the Sun.

(a)* Explain:
- how exposure to UV radiation can cause damage to human tissue
- why it is important to use sunscreen when outside on a sunny day.

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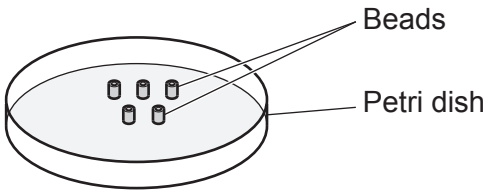
..... **[6]**

(b) The sun protection factor (SPF) is a measure of the strength of sunscreen.

A student investigates the SPF of different suncreens.

They use beads that change colour when they are exposed to UV radiation.



They use this method:

- Dip five beads in sunscreen with a SPF of 10.
- Spread the beads out in a petri dish and place them outside in the sun.
- Record the time taken for all the beads to change colour.
- Repeat the steps using different sunscreens with SPFs of 20, 30 and 40.

(i) Describe **two** improvements the student can make to their method.

1 .....

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2 .....

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[2]

(ii) The table shows the student's results.

SPF	Time taken for all beads to change colour
10	3.25
20	6
30	10
40	14

The table of results contains mistakes.

State **two** mistakes made by the student.

1 .....

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2 .....

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[2]

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.