OCR
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# Tuesday 23 November 2021 – Morning

## GCSE (9–1) Combined Science (Physics) A (Gateway Science)

**J250/05** Paper 5 (Foundation Tier)

**Time allowed: 1 hour 10 minutes**

*8209788308*

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

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

*J250005*

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 **60**.
- 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 **24** pages.

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

## SECTION A

Answer **all** the questions.

You should spend a maximum of 20 minutes on this section.

**Write your answer to each question in the box provided.**

**1** This question is about forces.

Which diagram shows attraction?

**A**


**B**

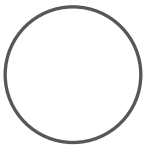

**C**

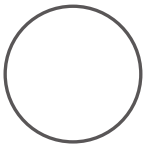

**D**

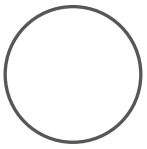

Your answer ☐ **[1]**

**2** Each planet, **A**–**D**, has the same diameter (width).

Which planet has the largest gravitational field strength?

**A**  Mass = $1 \times 10^{24}$ kg

**B**  Mass = $2 \times 10^{24}$ kg

**C**  Mass = $1 \times 10^{26}$ kg

**D**  Mass = $2 \times 10^{26}$ kg

Your answer ☐ **[1]**

**3** Which statement describes power?

**A** The rate of flow of charge.

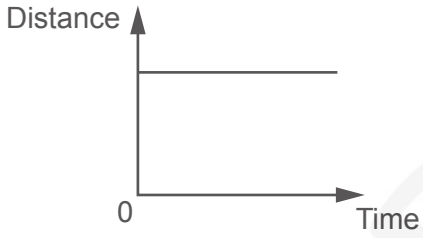
**B** The rate of flow of current.

**C** The rate of stretching of a spring.

**D** The rate of transfer of energy.

Your answer ☐ **[1]**

**4** This is a distance-time graph for a car.




Which is the correct description of the motion of the car?

**A** Accelerating

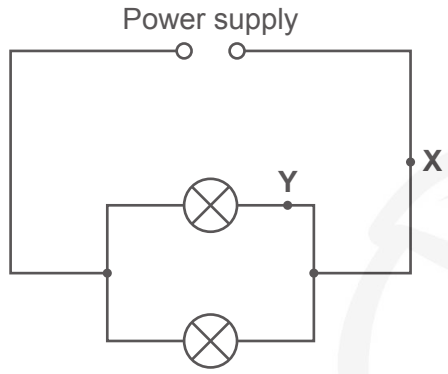
**B** Decelerating

**C** Moving at constant speed

**D** Staying still

Your answer ☐ **[1]**

**5** Both lamps in this circuit are identical.




The current at point **X** is 0.2 A.

What is the current at point **Y**?

**A** 0.1 A

**B** 0.2 A

**C** 0.4 A

**D** 0.6 A

Your answer ☐ **[1]**

**6** In an electrical circuit, a current of 1.2 A flows for 25 seconds.

How much charge is transferred?

**A** 0.048 C

**B** 20.8 C

**C** 30 C

**D** 1800 C

Your answer ☐ **[1]**

**7** A battery in a circuit has a potential difference of 6 V.

How much energy is transferred when 4 C of charge flows?

**A** 0.4 J

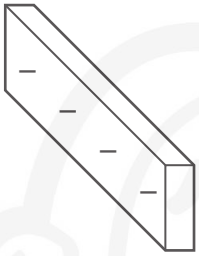
**B** 0.67 J

**C** 1.5 J

**D** 24 J

Your answer ☐ **[1]**

**8** A student uses friction to charge a piece of plastic.



Which statement explains why the plastic becomes **negatively** charged?

**A** The plastic gains electrons.

**B** The plastic gains protons.

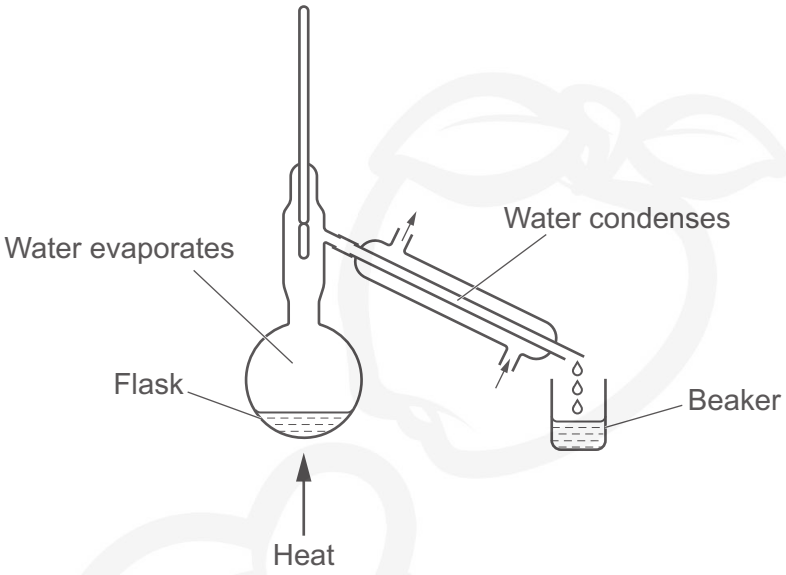
**C** The plastic loses electrons.

**D** The plastic loses protons.

Your answer ☐ **[1]**

**9** A teacher is distilling water using the equipment shown in the diagram.

Distillation involves evaporating and condensing the water.




When the teacher starts, there is 100 g of water in the flask, and the beaker is empty.

They stop when less than half of the water in the flask has been distilled.

Which statement is correct?

**A** Mass of water in flask + Mass of water in beaker = 100 g

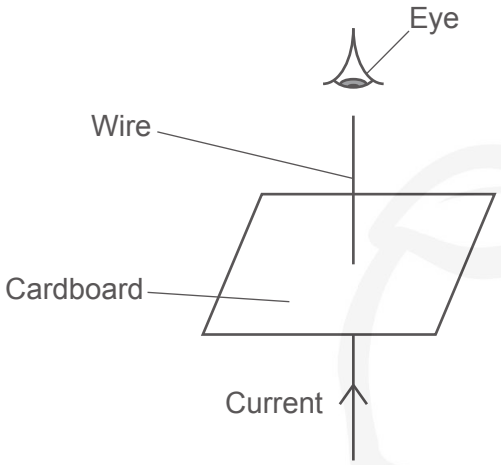
**B** Mass of water in flask – Mass of water in beaker = 100 g

**C** Mass of water in flask = Mass of water in beaker

**D** There is twice as much water in the beaker than in the flask

Your answer ☐ **[1]**

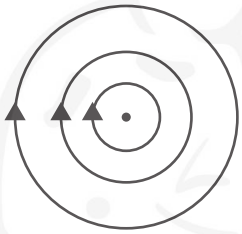
**10** A magnetic field is produced around a current-carrying wire.



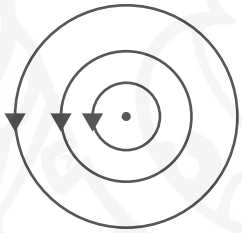

A student views the magnetic field from above, as shown by the eye in the diagram.

Which diagram shows the magnetic field around the wire?

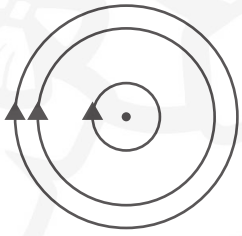
**A**



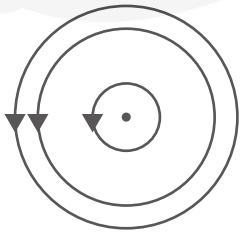
**B**



**C**



**D**



Your answer ☐ **[1]**

## SECTION B

Answer **all** the questions.

**11** **Fig. 11.1** shows the plan view of the corridor in a school building. The arrow shows the path students must take to get from **Room 1** to **Room 4**.

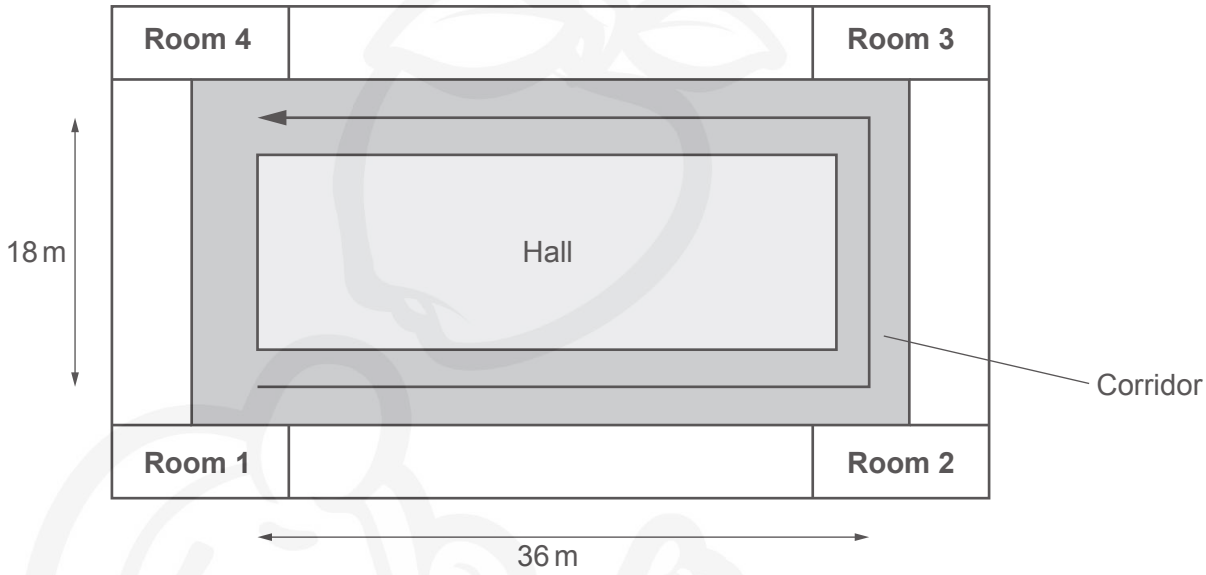



**Fig. 11.1**

**(a)** Student **A** says:

'The displacement from **Room 1** to **Room 4** is the same as the distance travelled from **Room 1** to **Room 4**.'

Use calculations to explain why student **A** is incorrect.

.....

.....

.....

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

**(b)** Draw **two** lines from each **word** to the correct **descriptions**.

| Word | Descriptions |
| --- | --- |
| | Displacement / Time |
| Speed | Distance / Time |
| Velocity | Scalar |
| | Vector |

**[2]**

**(c)** Student **B** runs along the corridor from **Room 1** to **Room 2**.

**Fig. 11.2** is a graph of their motion:

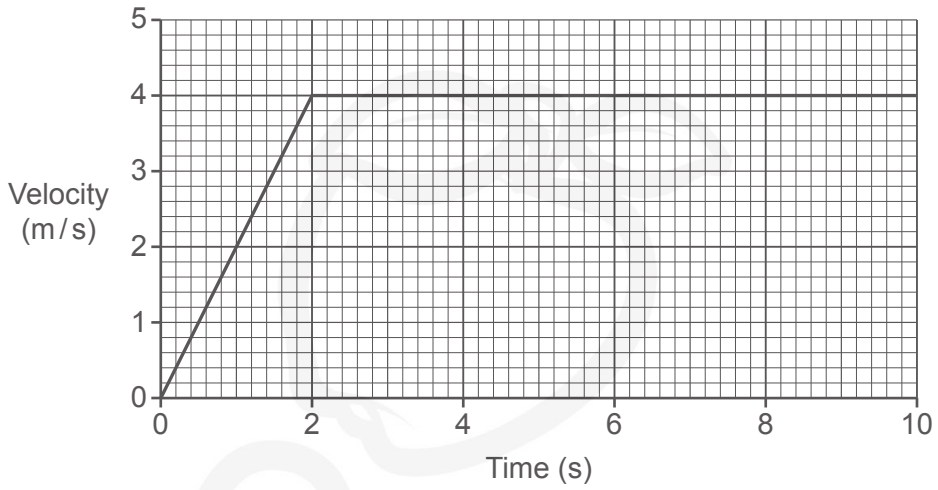



**Fig. 11.2**

**(i)** Calculate the acceleration of student **B** during the first 2 seconds.

Use the equation: acceleration = change in velocity / time

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

**(ii)** Describe the motion of the student between 2 and 10 seconds.

.....

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

**(iii)** Student **C** starts running along the corridor from **Room 1** to **Room 2** at the same time as student **B**.

Their acceleration is **less** than student **B**'s acceleration.

Add a line to **Fig. 11.2** to show the acceleration of student **C**. **[1]**

**12** **Fig. 12.1** shows a picture of a ball on a field. The ball is not moving.

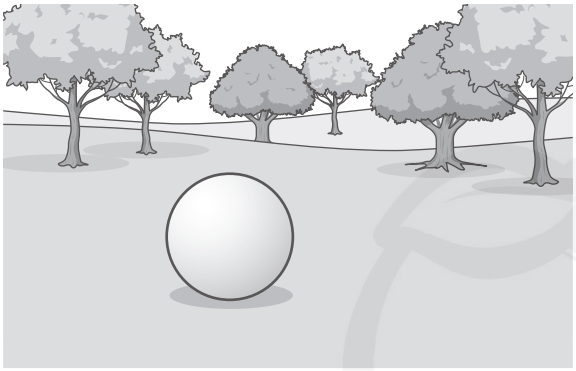


**Fig. 12.1**

**(a)** **Fig. 12.2** shows part of a free-body force diagram for the ball.

The force is drawn to scale. 1 cm = 1 N.

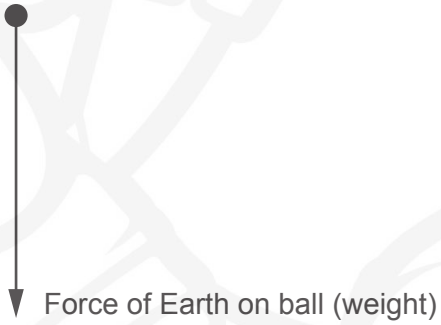



**Fig. 12.2**

**(i)** Complete the free-body force diagram by adding in the missing force. **[1]**

**(ii)** Which word describes this missing force?

Put a ring around the correct answer.

**Contact** **Electrostatic** **Gravity** **Magnetic**

**[1]**

**(b)** A person kicks the ball.

Complete the sentences explaining what happens to the ball.

Choose words from the list.

You may use each word once, more than once or not at all.

**balanced**

**forces**

**gravity**

**masses**

**speed**

**unbalanced**

The ..... on the ball are ..... .

Therefore the ..... of the ball changes.

**[2]**

**(c)** The mass of the ball is 0.4 kg.

How much force is needed to accelerate the ball at 400 m / $s^2$?

Use the equation: force = mass × acceleration

Force = ..... N **[2]**

**(d)** **Fig. 12.3** shows the person placing the ball so it touches a wall.

**Fig. 12.3**

He now kicks the ball directly at the wall.

The ball changes shape. Explain why.

.....

.....

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

**13** **(a)** A teacher lifts a weight of 45 N through a height of 1.8 m.

Calculate the work done by the teacher.

Use the equation: work done = force × distance

Work done = ..... J **[2]**

**(b)** Another teacher does 1500 J of work.

They take 5 seconds to do the work.

Calculate their power.

Give the unit in your answer.

Use the equation: power = work done / time

Power = ..... Unit ..... **[3]**

**14** A student carries out an experiment to calculate the spring constant of a spring.

Here are the student's results.

| Mass (g) | Force (N) | Extension (m) | Spring constant (N/m) |
|---|---|---|---|
| 100 | 0.98 | 0.05 | 20 |
| 200 | | 0.11 | 18 |
| 300 | 2.94 | 0.15 | 20 |
| 400 | 3.92 | 0.21 | 19 |
| 500 | 4.91 | 0.25 | |

**(a)** Calculate the force when the mass is 200 g.

Use the equation: gravitational force = mass × gravitational field strength

Assume gravitational field strength = 10 N/kg.

Force = ..... N **[3]**

**(b)** Calculate the spring constant when the mass is 500 g.

Use the equation: force exerted by a spring = extension × spring constant

Give your answer to the **nearest whole number**.

Spring constant = ..... N/m **[3]**

**(c)** Calculate the mean value of the spring constant.

Use the values in the table from 100 g to 400 g only.

Mean spring constant = ..... N / m **[1]**

**(d)** The teacher says that calculating the mean is a poor method to find the spring constant, even though the student's calculations are correct.

Describe a better way to find the spring constant using the student's measurements.

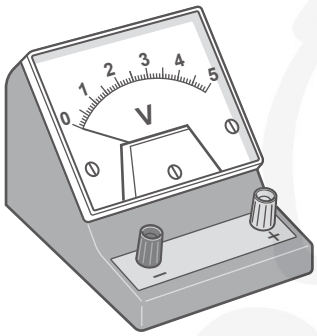
.....

.....

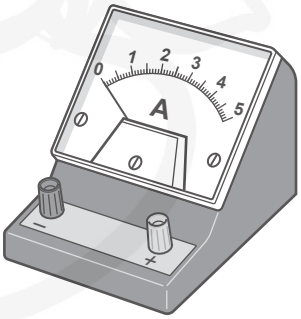
..... **[2]**

**15* (a)** A student investigates if resistance changes as current changes.

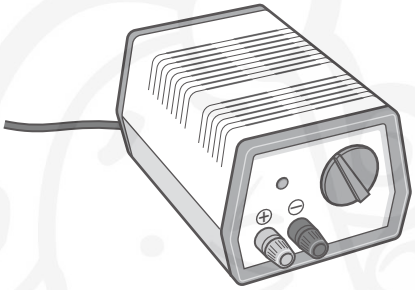
The student can use this equipment:

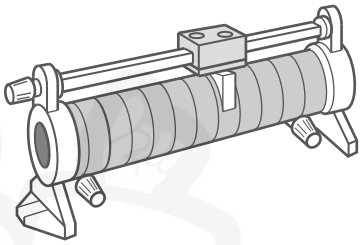

Voltmeter



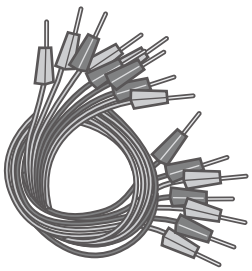

Ammeter



Power pack



Variable resistor



Connecting wires

Describe the method the student should follow to work out if the resistance of the 10 cm wire changes as current changes and describe how to use the results to calculate resistance.

You can include a diagram in your answer.

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

**(b)** The student writes a risk assessment for the investigation.

**(i)** Suggest a possible hazard for this investigation.

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

**(ii)** How can the student reduce the risk from the hazard?

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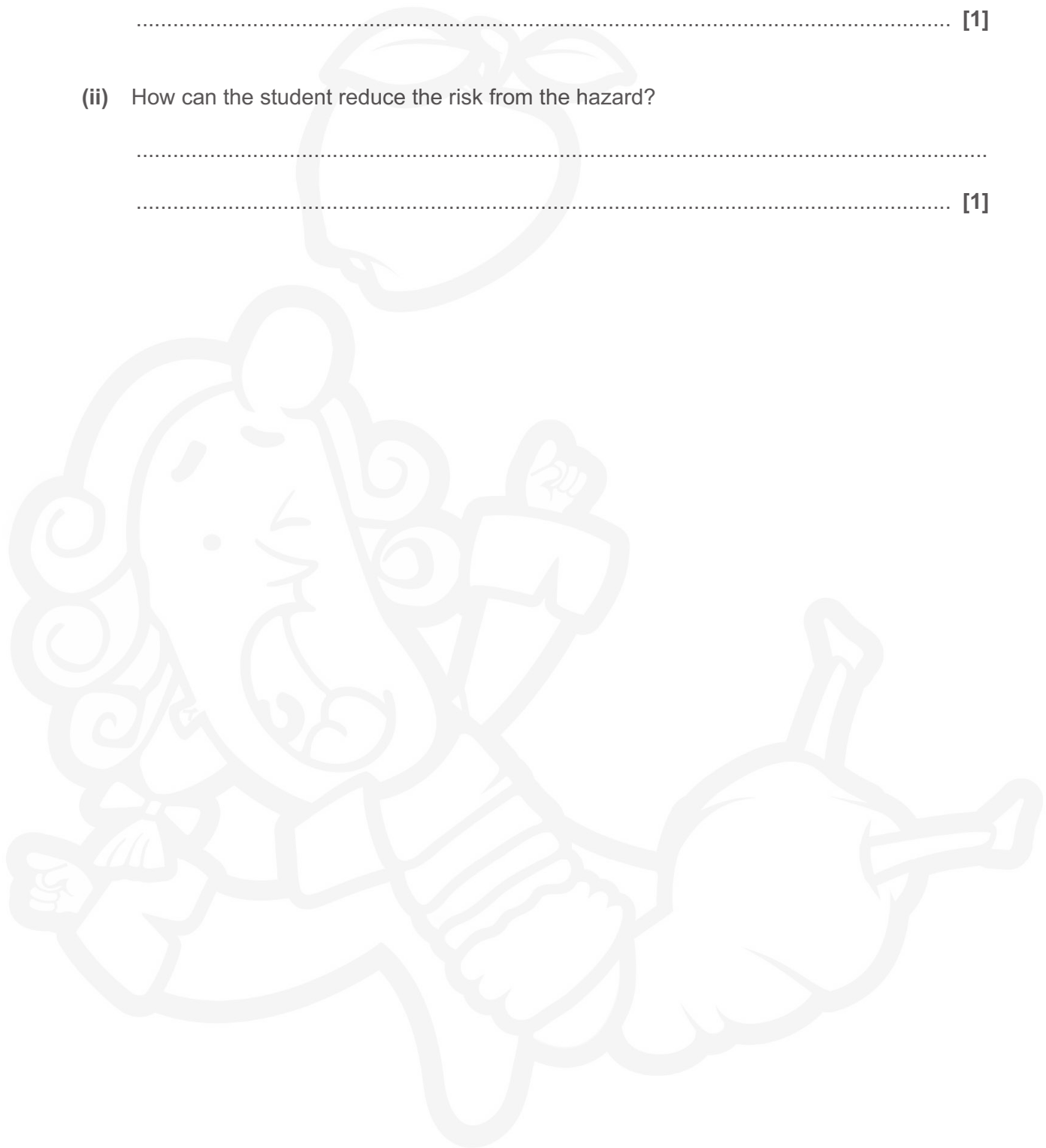
..... **[1]**

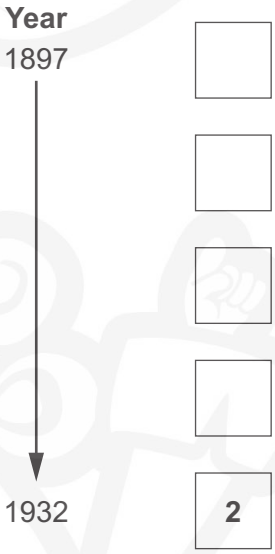


**16** **(a)** Here are some events in atomic theory:

| | | |
|---|---|---|
| **1** | Thomson | Discovered the electron. Published findings in a scientific journal. |
| **2** | Chadwick | Discovered the neutron. |
| **3** | Bohr | Suggested electron shells after a science conference. |
| **4** | Rutherford | Did experiments showing the atom had a nucleus. |
| **5** | Thomson | Published the 'plum pudding' model in a scientific journal. |

**(i)** Place the events in the order they occurred.

Write the numbers in the boxes below. One has been done for you.




**[2]**

**(ii)** The events were peer reviewed **and** communicated to others.

Suggest why **both** are important in science.

Peer review .....

.....

Communication .....

.....

**[2]**

**(b)** **Table 16.1** gives the density of different materials.

| Material | State | Density (kg / $m^3$) |
|---|---|---|
| Argon | Gas | 1.45 |
| Copper | Solid | 8960 |
| Ethanol | Liquid | 789 |
| Iron | Solid | 7870 |
| Oxygen | Gas | 1.31 |
| Water | Liquid | 998 |

**Table 16.1**

**(i)** Describe any trends in the data in **Table 16.1**.

.....

.....

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

**(ii)** Explain the difference in density between solids and liquids.

You may draw diagrams to help your answer.

.....

.....

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

**(c)** **Table 16.2** gives some information about ethanol and water.

| Liquid | Specific heat capacity (J / kg °C) | Specific latent heat of vaporisation (J / kg) |
|---|---|---|
| Ethanol | 2440 | 846 000 |
| Water | 4200 | 2 256 000 |

**Table 16.2**

**(i)** The specific latent heat of vaporisation is the energy transferred when 1 kg of a substance changes from liquid to gas.

Calculate the amount of energy needed to evaporate 0.2 kg of **ethanol**.

Use **Table 16.2** and an equation from the Data Sheet to help you.

Energy = ..... J **[2]**

**(ii)** The energy needed to heat 1 kg of water by 1 °C is 4200 J.

The energy needed to evaporate 1 kg of water is 2 256 000 J.

This is much **more** than 4200 J. Explain why.

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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).