Oxford Cambridge and RSA

Accredited

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

J259/04 Depth in physics (Higher Tier)

H

Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 45 minutes

You must have:
- the Data Sheet

You may use:
- a scientific or graphical calculator

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First name					
Last name					
Centre number					
Candidate number					

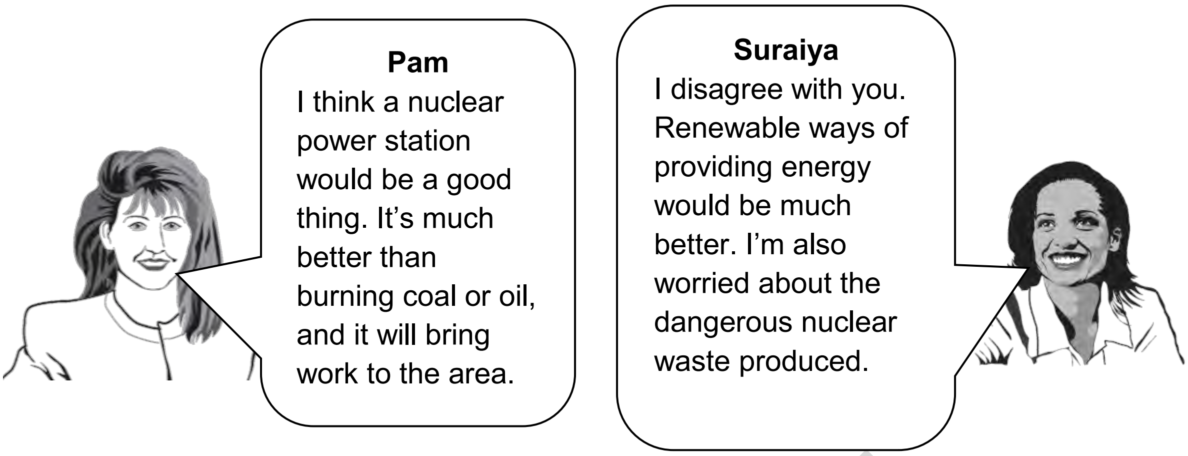
INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **20** pages.

QN: 601/8685/9

Answer **all** the questions.

1* Two people are discussing plans to build a nuclear power station near their town.



Explain the different points of view put forward by these two people, and state, with reasons, which of the two has the better argument.

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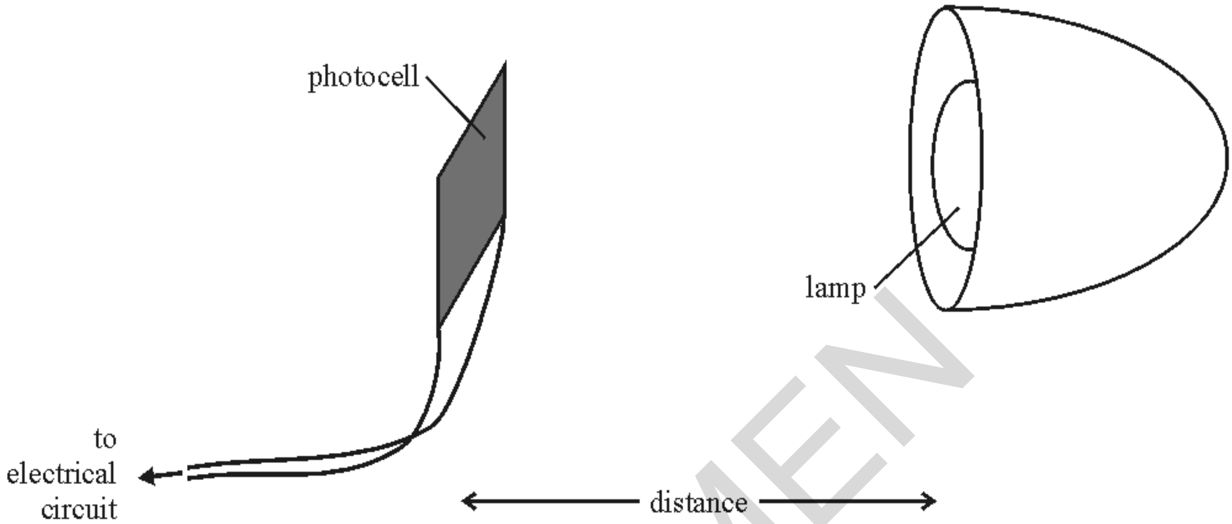
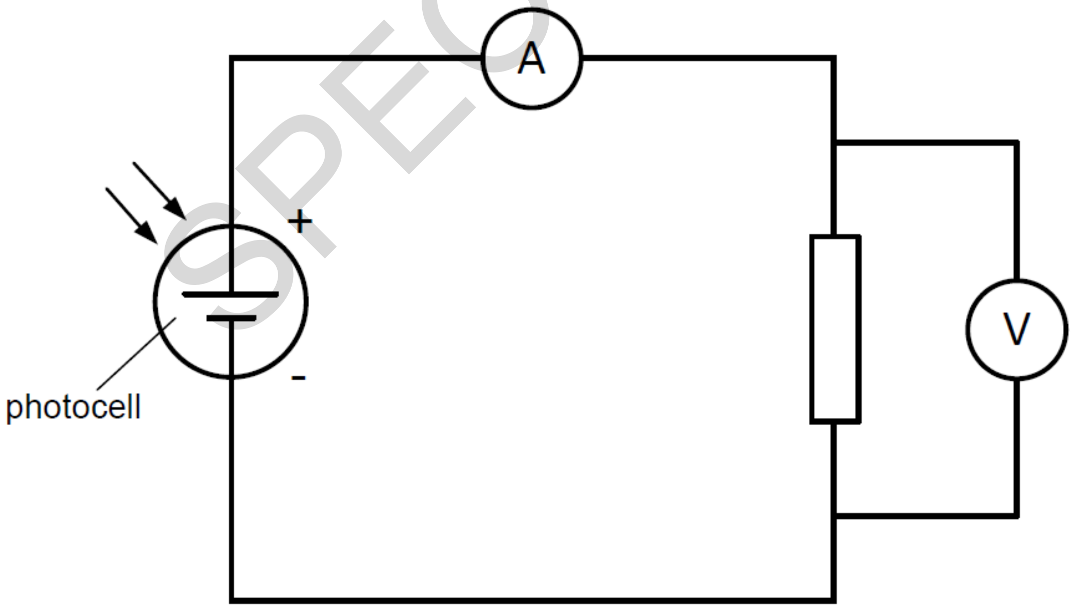
2 Sam is doing an experiment to investigate the output of a solar panel. She is using a small photocell to model the panel.

She is measuring the power output of the photocell when it is different distances from a lamp, as shown below.



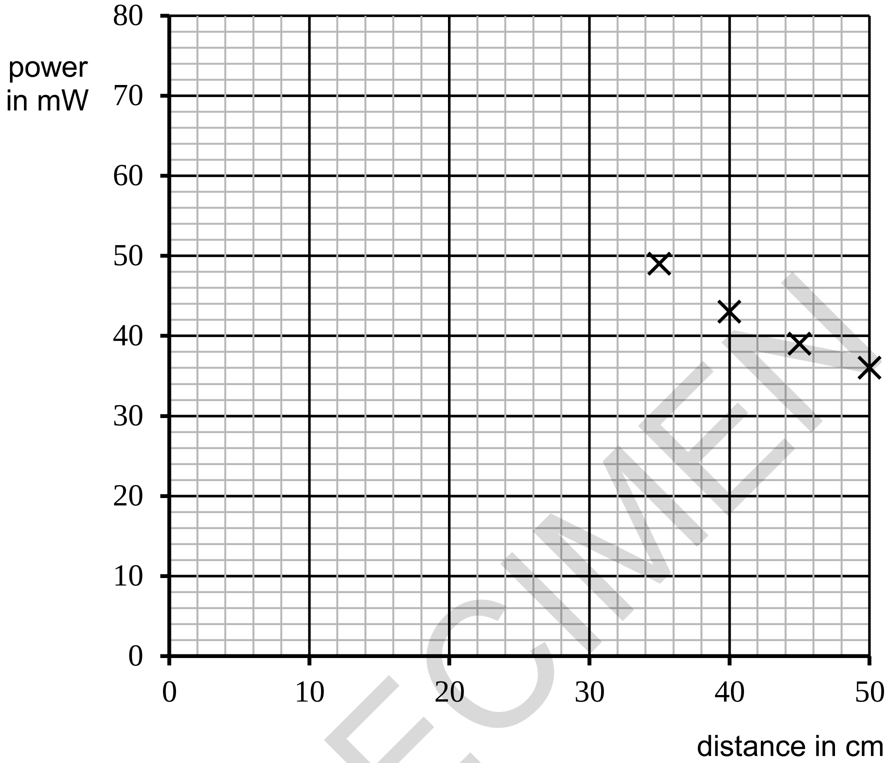


(a) Sam obtained a range of values of power at different distances, as shown in the table below:

distance (cm)	25	30	35	40	45	50
power (mW)	72	57	49	43	39	36

Four data points have been plotted on the graph axes below.

(i) Plot the remaining two data points and add a best-fit curve. **[2]**



(ii) What does the graph show?

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(iii) At a distance of 25 cm the power was 72mW. The voltage across the photocell was recorded as 12 V. Using the equation: power = potential difference x current, calculate the current through the photocell.

..........................A **[4]**

(iv) Calculate the resistance in Ohms of the photocell using the equation: potential difference = current x resistance.

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

(b) Describe how this experiment should be completed to get a good, reliable set of data.

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(c) Tom has done an identical experiment to Sam's in a **different part** of the same lab.

He used an identical lamp, photocell and resistor, but his values of power were much lower than Sam's for the same distances.

He thinks that his part of the lab must have been different from Sam's.

Suggest and explain a reason for the difference in their results.

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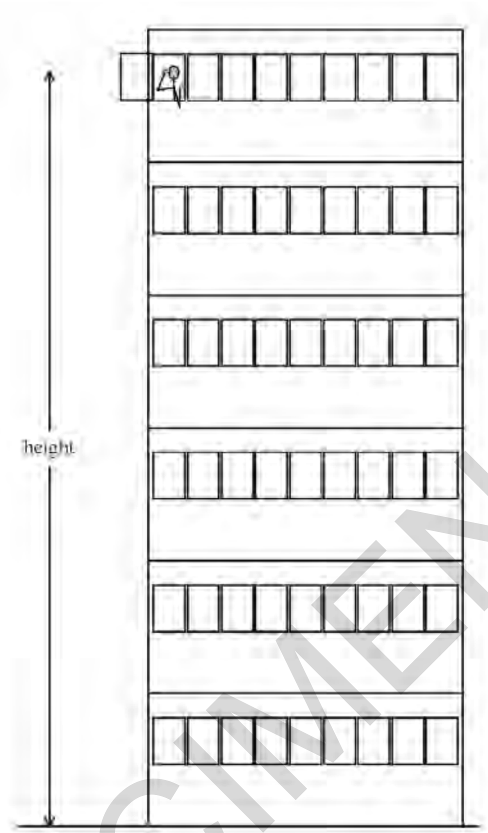
3 Tom is trying to measure the acceleration due to gravity (*g*) by dropping six tennis balls from a top floor window in a tall building. He starts a stopwatch as he lets go of each ball and stops it when he hears the ball hit the ground.



(a) Tom says that he knows that the height through which the ball is falling is 13.5 m.

Suggest and describe one way which Tom may have used to measure this height.

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(b) Tom finds that it takes an average of 1.8 seconds for the ball to fall. Use this time to calculate the average speed of a falling ball and use this value to find the acceleration due to gravity, *g*.

…………………………..m/s^2 **[5]**

(c) Toms' method gives a value for *g* which is too low.

Suggest and explain one experimental error which could account for this.

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4 Below is a distance-time graph for a short car journey along a straight road.

(a) Explain how the graph shows that that the car begins to decelerate at a time of 10 s.

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(b) Use the graph to calculate the mean deceleration between 10 and 16 seconds.

Show your working clearly.

...............m/s^2 **[4]**

(c) A second car starts from the same starting point as the first car at the same time. It has an initial velocity of 1.0 m/s and accelerates at a uniform rate.

(i) When the second car has travelled a distance of 66 m, its velocity is 7.0 m/s. Calculate the acceleration of this second car.

…………..m/s^2 **[3]**

(ii) Calculate the time taken to reach the velocity of 7.0 m/s and use this to **sketch a line** on the graph opposite showing the journey of the second car.

……………..s **[3]**

5 **(a)** The table below gives information about three planets in the solar system.

planet	**percentage of carbon dioxide in the atmosphere**	**density of the atmosphere at the planet's surface (kg/m^3)**	**distance from the Sun (millions of km)**	**mean surface temperature (°C)**
Venus	96 %	120	1.1	470
Earth	0.04 %	1.3	1.5	20
Mars	95 %	0.02	2.3	-60

One astronomer has described the temperatures of these three planets as follows:

Professor Rubin

The mean temperatures of the Earth, Venus and Mars all correlate with their distances from the Sun, but the temperature differences are not due to the difference in the distances.

Explain what Professor Rubin means and decide whether the data in the table supports her statement.

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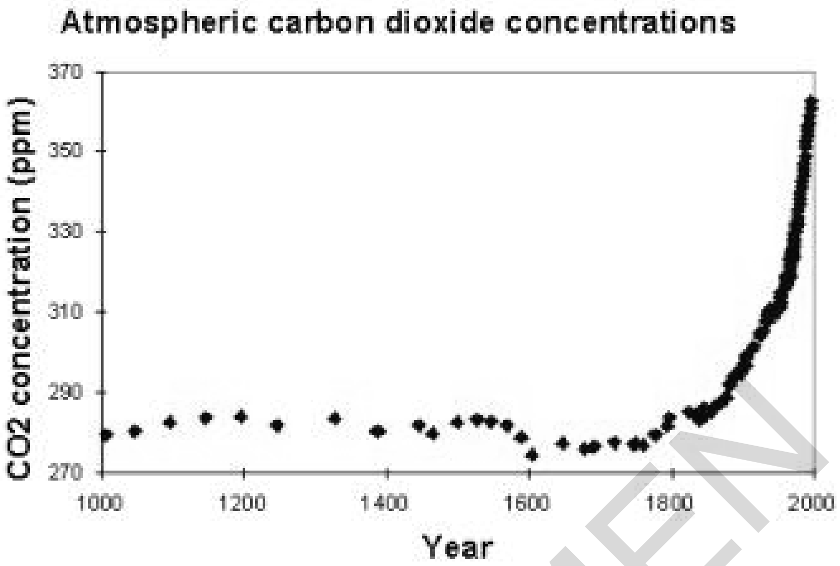
(b) Increased levels of carbon dioxide in the atmosphere have been linked to the greenhouse effect. The graph below shows the amount of carbon dioxide in the atmosphere over a 1000 year period.



Many scientists think this is evidence that human activity has had an effect on the amount of carbon dioxide in the atmosphere.

Explain how the graph supports this idea.

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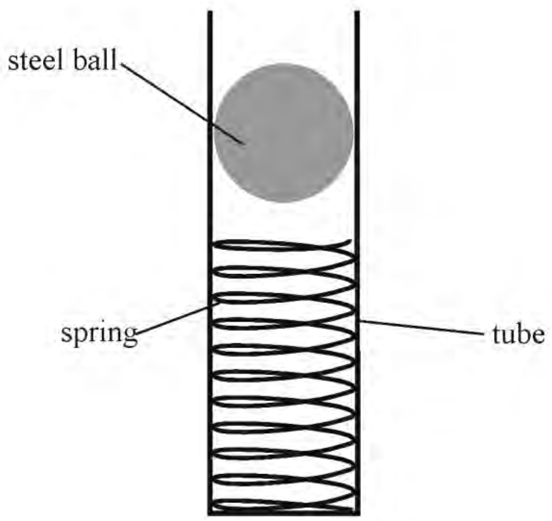
6 This question is about using a spring to fire a small steel ball from a 'cannon'.
The spring fits inside a tube, as shown below.



The spring is compressed, and the energy stored in the spring is used to fire the ball.

(a) The spring used has a spring constant of 32 N/m, and the steel ball has a weight of 0.14 N.

The ball is placed on top of the spring. Show that the weight of the ball compresses the spring by about 4 mm.

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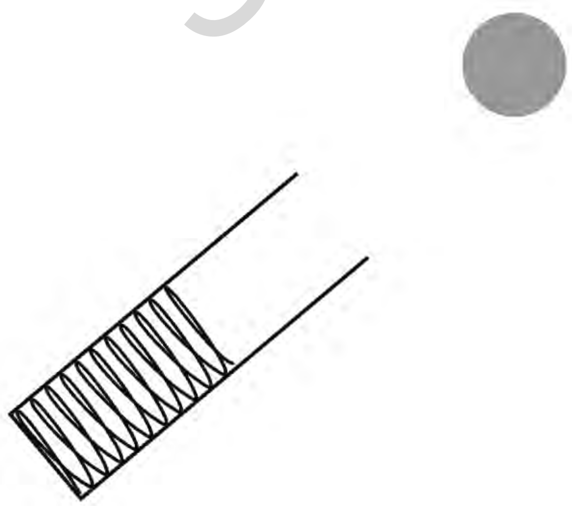
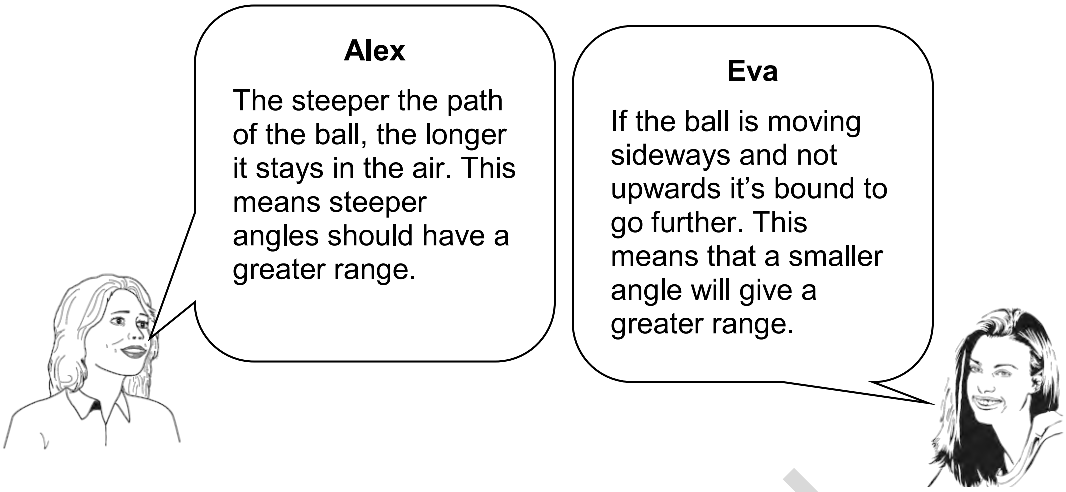
(b) Alex is going to use this apparatus to investigate the range of a projectile fired at an angle. The diagram below shows the steel ball just after it has left the tube.



On the diagram, draw an arrow on the steel ball to show the direction of the resultant force acting on it. You should ignore any effects due to the presence of air. **[1]**

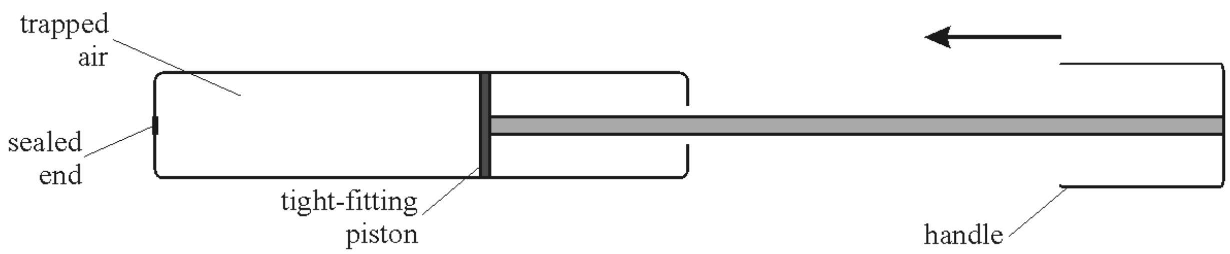
(c) In analysing her results, Alex found that the ball travelled furthest when it was fired at an angle of 45°. She and Eva are trying to explain this finding.



Discuss their ideas and decide whether their ideas help to explain the results.

[5]

7 This question is about compressing a gas inside a cylinder. The cylinder is the pump used for inflating a bicycle tyre. In this case, it is sealed at the end so no air can escape.



(a) The trapped air has a volume of 120 cm^3 and a pressure of 100 kPa.

(i) The handle is slowly pushed in until the volume of trapped air is 50 cm^3.

Calculate the new pressure of the air on the walls of the pump.

Show your working clearly.

………………kPa **[3]**

(ii) Explain the pressure change in terms of the behaviour of the particles of trapped air.

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(iii) In doing the calculation, you have to assume that no gas leaked out when the handle was moved.

State one other assumption which must be made for the calculation, and explain why this assumption would be correct if the volume change were slow but incorrect if the volume change were rapid.

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(b)* The physics described in part **(a)** help to explain how our Solar System formed.

Describe the main features of our Solar System and explain how it evolved from a cloud of dust and gas to its present state.

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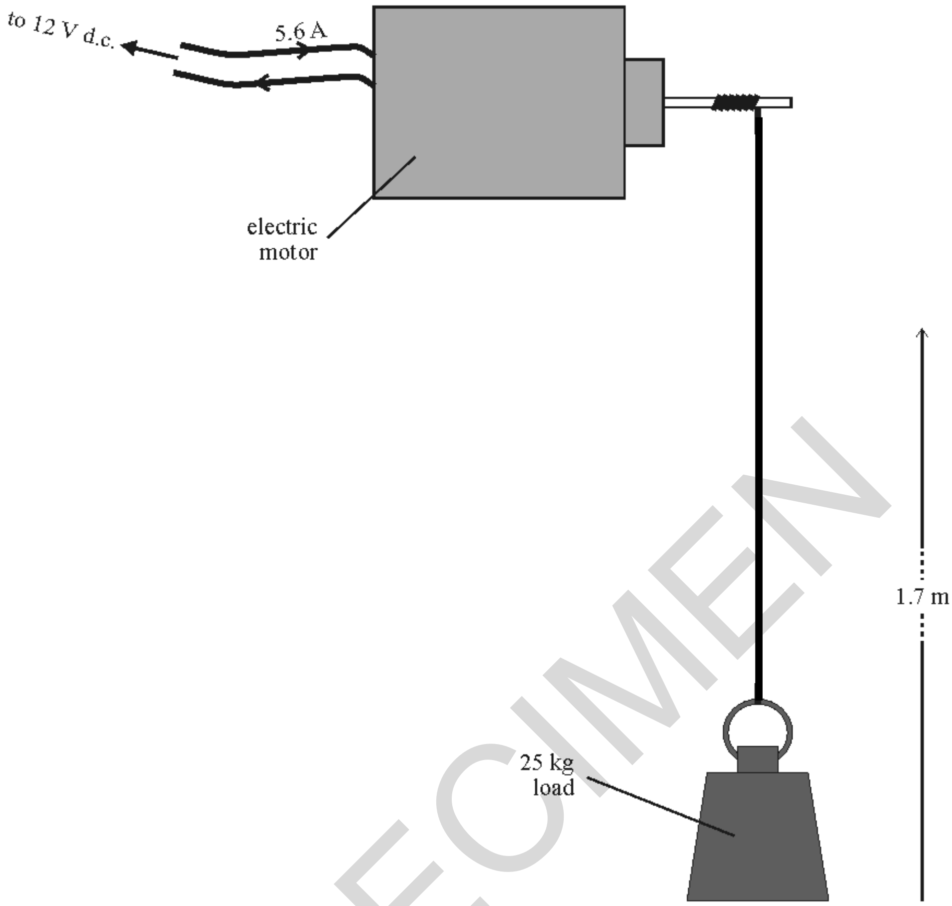
8 This question is about an electric motor.

(a) An electric motor, attached to a 12 V d.c. source, draws a current of 5.6 A while lifting a load of 25 kg. It takes the motor 45 seconds to lift the load through a height of 1.7 m.



(i) Assuming that all energy losses occur in the motor, and that the motor is well-insulated, calculate the increase in the internal energy of the motor.

………………..J **[6]**

(ii) A force of 250 N is needed to lift the load a distance of 1.7 m. Calculate the work done.

………………..J **[3]**

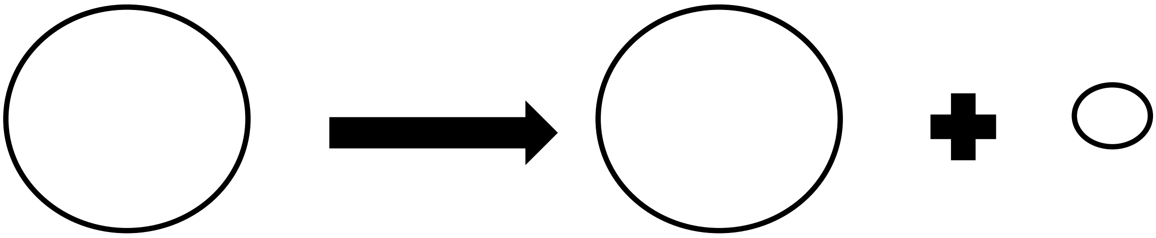
(b) When an electric motor is switched on, it has a very large current through it, but this rapidly drops to a much smaller value.

Which **two** of the following statements can explain this observation?
Put ticks (✓) in the boxes after the **two** correct statements.

The turning motor acts as a generator which produces a p.d. opposing the battery p.d.	☐
As the motor speeds up, the friction in the turning parts becomes smaller.	☐
Friction in the motor dissipates energy resulting in more energy taken from the supply.	☐
Current heats the coils in the motor which makes their resistance increase.	☐
As the motor turns faster, the force needed to turn it decreases	☐

[2]

9 Radon–222 is a dense radioactive gas. The diagram below shows the alpha decay of Radon–222.



$$^{222}_{86}Rn \qquad\qquad ^{\_\_}_{84}Po \qquad ^{\_\_}_{2}He$$

(a) Complete the above equation by adding the **two missing numbers** to the products produced. **[1]**

(b) Radon is found in many minerals. People working in deep mines where these minerals are extracted have long been known to have a high rate of lung cancer.

Explain this in terms of the properties of radon and alpha radiation.

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END OF QUESTION PAPER

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