OCR
Oxford Cambridge and RSA

Accredited

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

J259/04 Depth in physics (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2

Time allowed: 1 hour 45 minutes

You must have:
- the Data Sheet

You must use:
- a scientific or graphical calculator

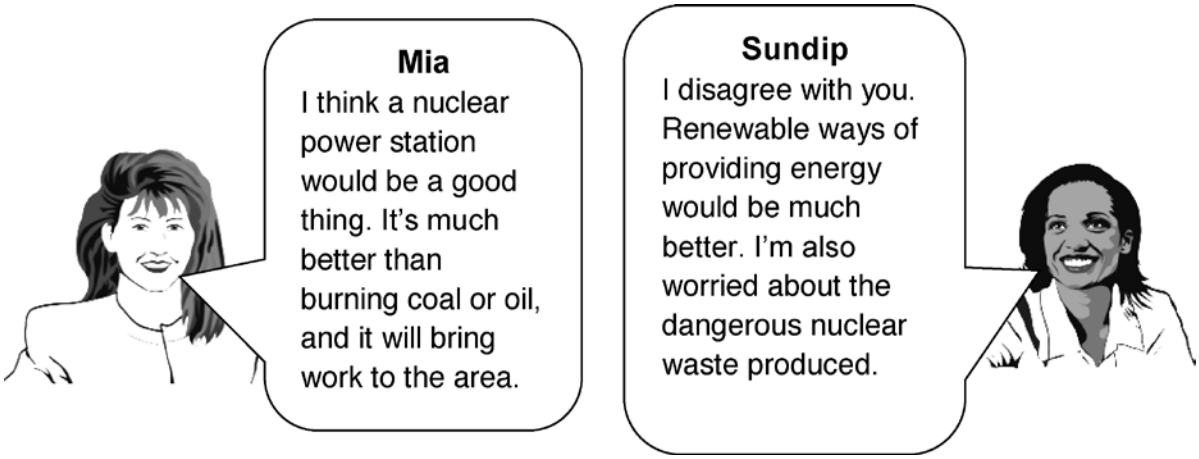
First name									
Last name									
Centre number						Candidate number				

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.

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 Mia and Sundip, and state, with reasons, which person you think has the better argument.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

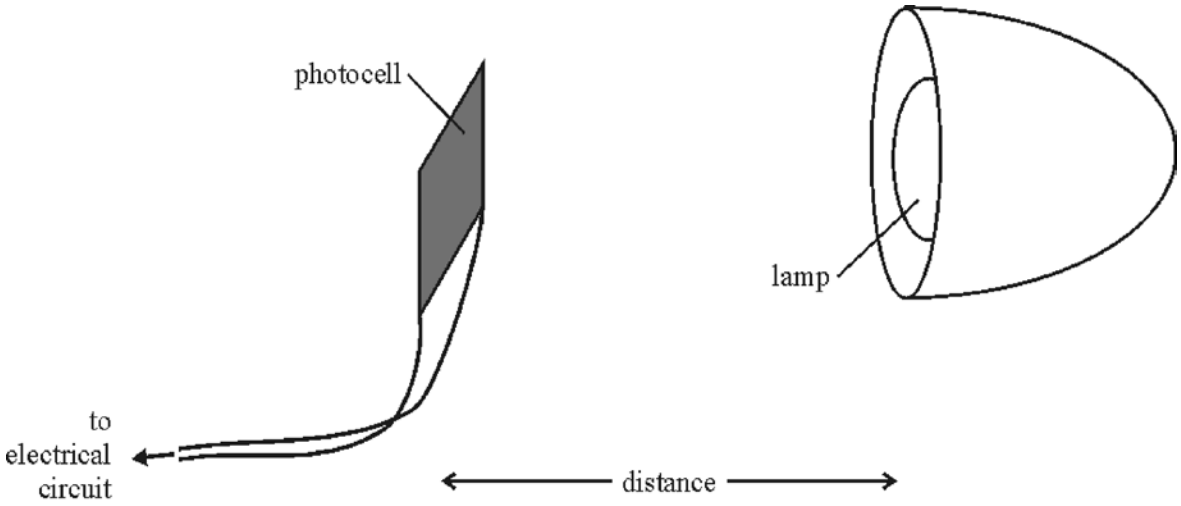
.....

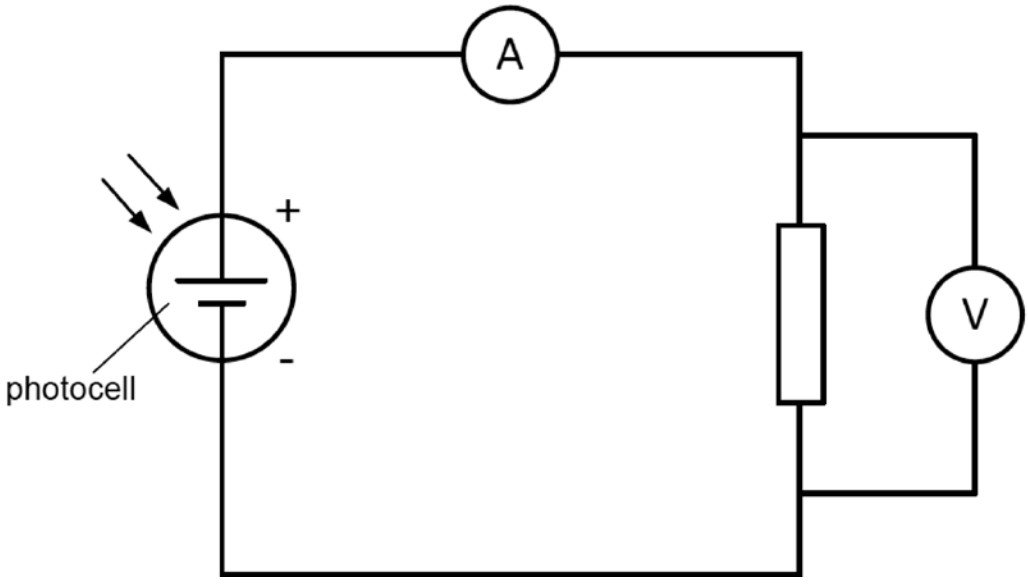
..... **[6]**

2 Beth is doing an experiment to investigate the output of a solar panel.

She is using a small photocell to model the panel.

She measures the power output of the photocell at different distances from a lamp, as shown below.



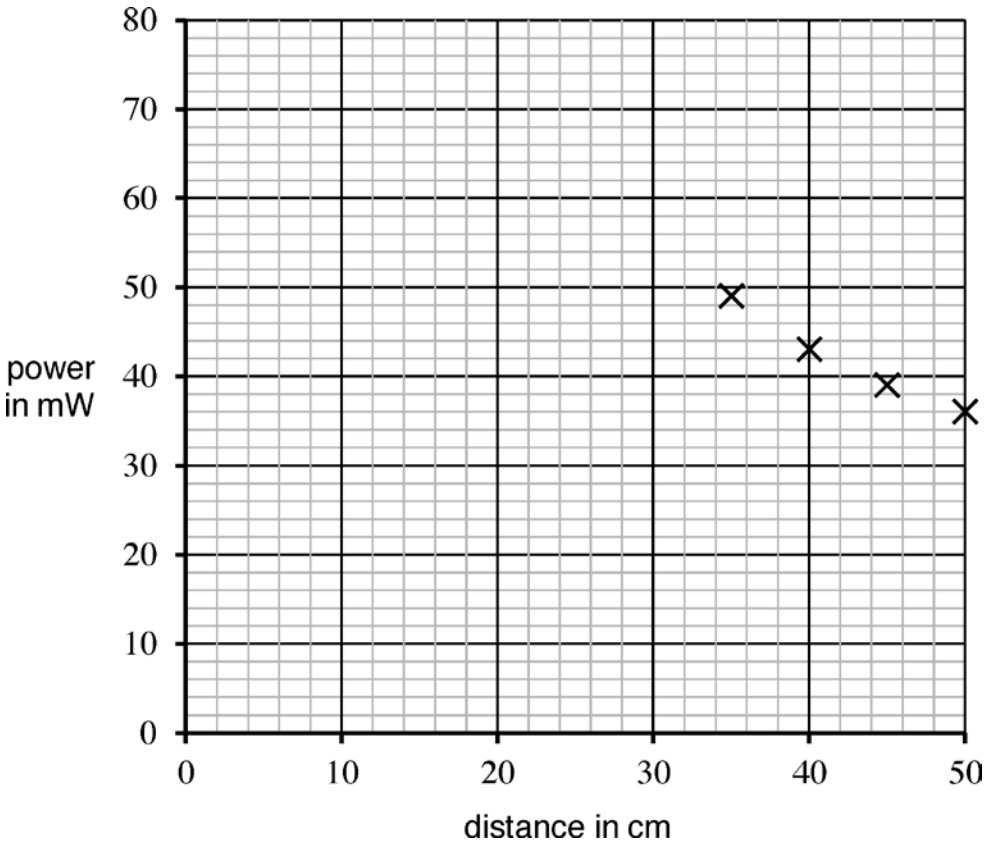


(a) Beth obtained values of power at different distances, as shown in the table.

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

(i) Four points have been plotted on the graph axes below.

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



(ii) What does the graph show?

.....

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

(iii) At a distance of 25cm the power was 72 mW. The voltage across the photocell was recorded as 12 V.

Calculate the current through the photocell.

Use the equation:

power = potential difference × current.

Current = ...A

(iv) Calculate the resistance in ohms of the resistor.

Use the information in **(iii)** and the equation:

potential difference = current × resistance.

Resistance = ... Ω **[3]**

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

.....

.....

.....

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

(c) James has done an identical experiment to Beth'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 Beth's for the same distances.

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

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

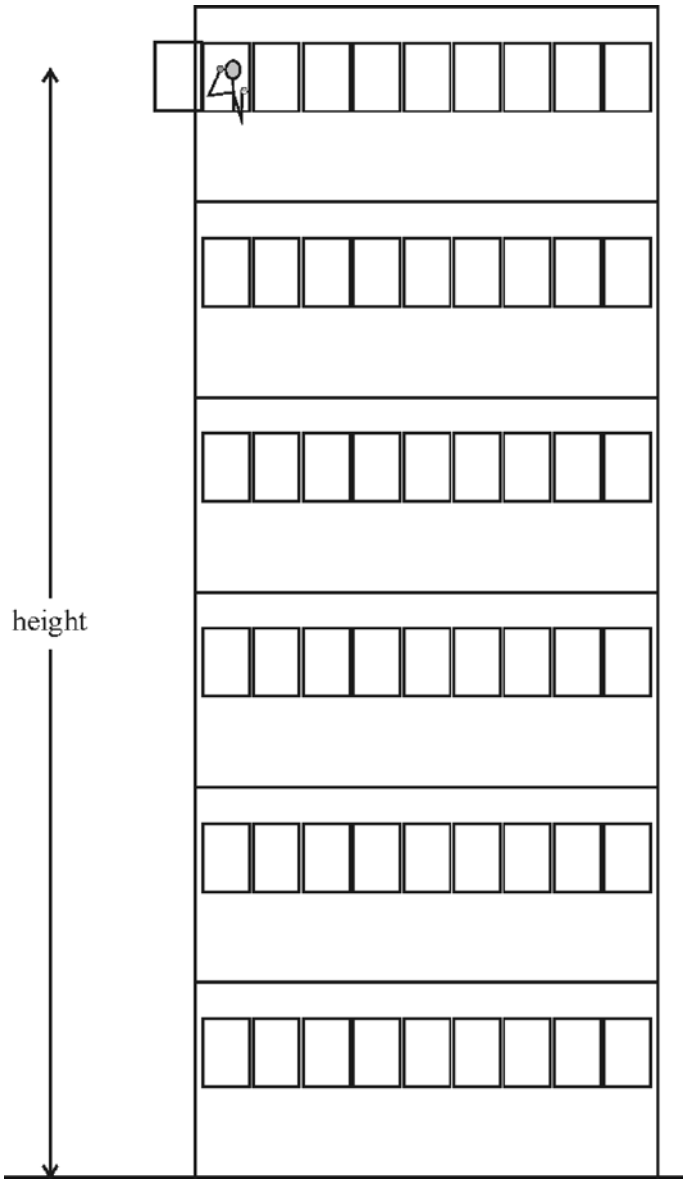
.....

.....

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

3 Jack is trying to measure the acceleration due to gravity (*g*).

- He drops 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) Jack says that he knows that the height through which the ball is falling is 13.5 m.

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

.....

.....

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

(b) Jack finds that it takes an average of 1.8 seconds for the ball to fall to the ground.

Calculate the average speed of the falling ball and use this value to find the acceleration due to gravity, *g*.

Acceleration = ... m/s^2 **[5]**

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

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

.....

.....

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

4 **Fig. 4.1** is a distance–time graph for a short car journey along a straight road.

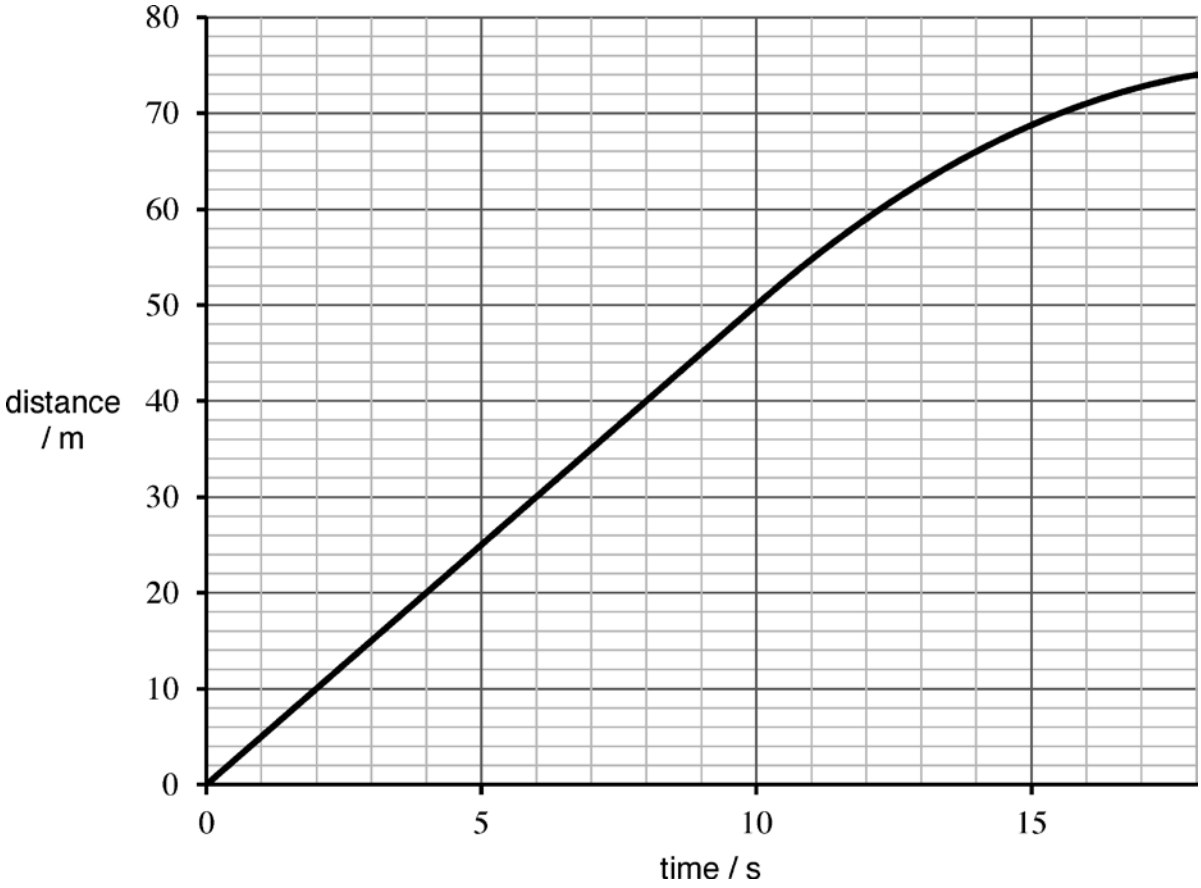


Fig. 4.1

(a) Explain how the graph in **Fig. 4.1** shows that the car begins to decelerate at a time of 10 s.

.....

.....

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

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

Show your working clearly.

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

(c) A second car starts from the same starting point as the first car shown on the graph in **Fig. 4.1** at the same time.

The car 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.

Acceleration = ... m/s^2 **[3]**

(ii) The car reaches a velocity of 7.0 m/s.

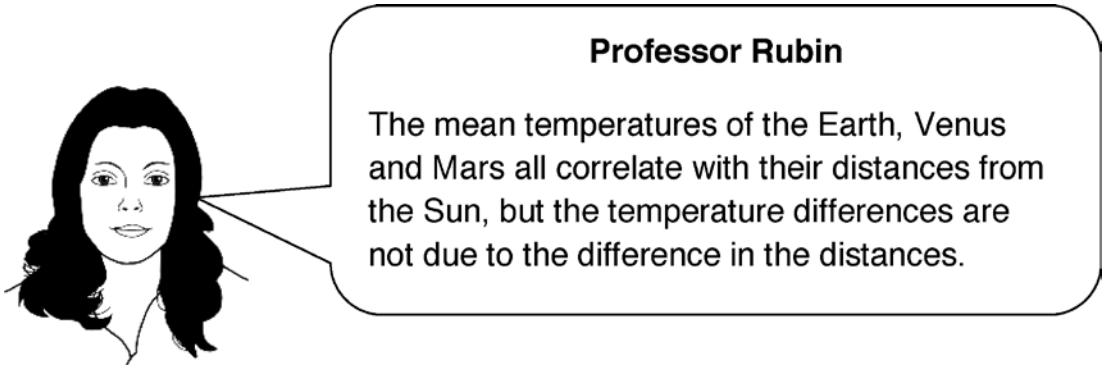
- Calculate the time for the car to reach this velocity.
- Using this value, **sketch a line** on the graph in **Fig. 4.1** to show the journey of the second car.

Time = ... s **[3]**

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

Planet	Percentage of carbon dioxide in atmosphere	Density of atmosphere at planet's surface (kg/m^3)	Distance from Sun (millions of km)	Mean surface temperature (ºC)
Venus	96 %	120	1.1	470
Earth	0.04 %	1.3	1.5	20
Mars	95 %	0.02	2.3	-60

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



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

.....

.....

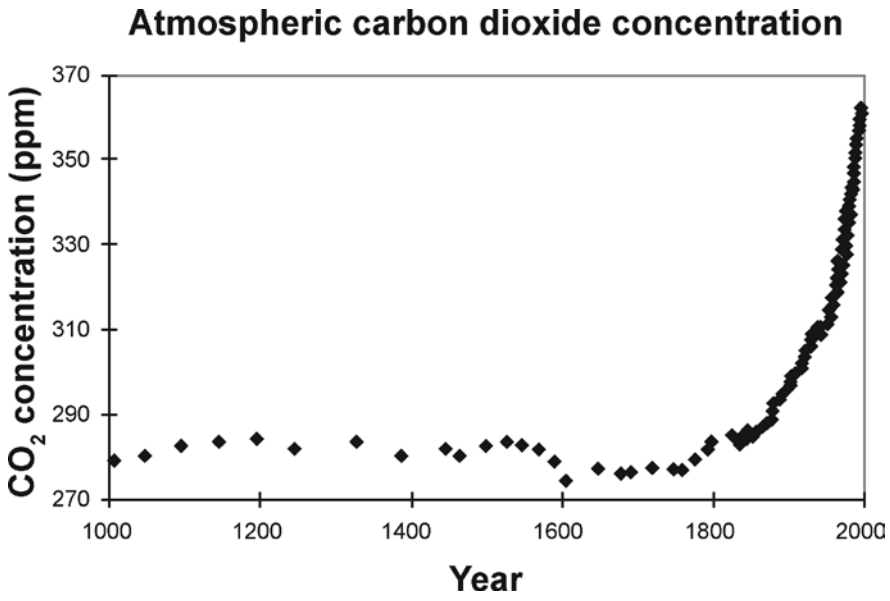
.....

.....

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

(b) Increased levels of carbon dioxide in the atmosphere have been linked to the greenhouse effect.

The graph 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.

.....

.....

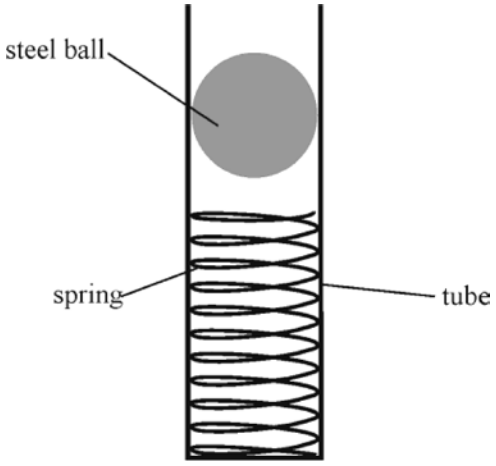
.....

.....

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

6 This question is about using a spring to fire a small steel ball from a 'cannon'.

The 'cannon' is made out of a spring that 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 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.

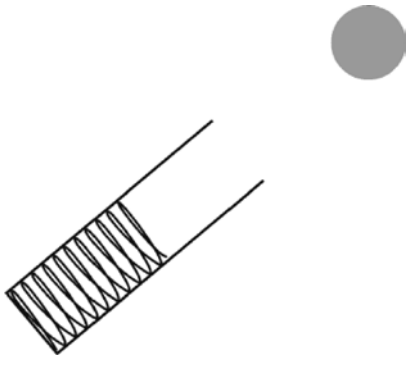
.....

.....

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

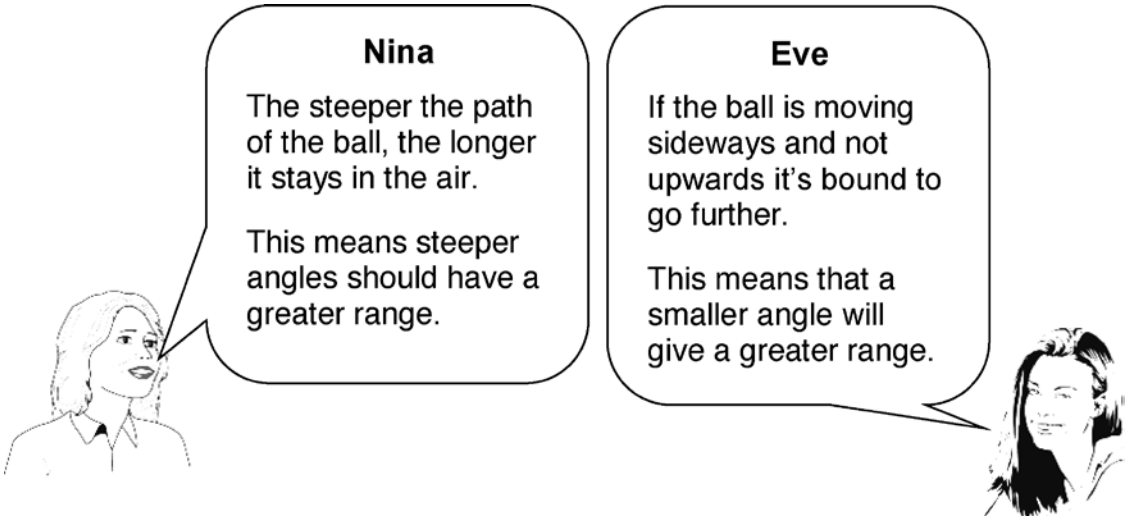
(b) Nina uses this apparatus to investigate the range of a projectile fired at an angle.

The diagram 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, Nina found that the ball travelled furthest when it was fired at an angle of 45°. She and Eve are trying to explain this finding.



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

.....

.....

.....

.....

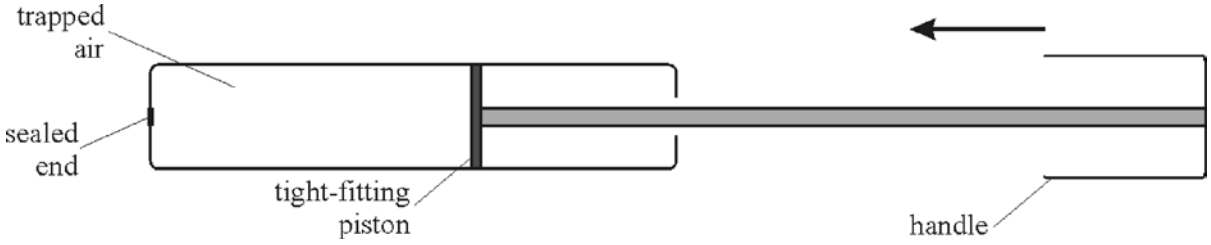
.....

.....

.....

..... **[5]**

7 This question is about compressing a gas inside a cylinder. The cylinder is a pump used for inflating a bicycle tyre. The cylinder is sealed at the end so that 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.

Pressure = ... kPa **[3]**

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

.....

.....

.....

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

(iii) In doing the calculation in **(i)**, 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 in **(i)**
- Explain why this assumption would be correct if the volume changes were slow but incorrect if the volume change were rapid.

.....

.....

.....

.....

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

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

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

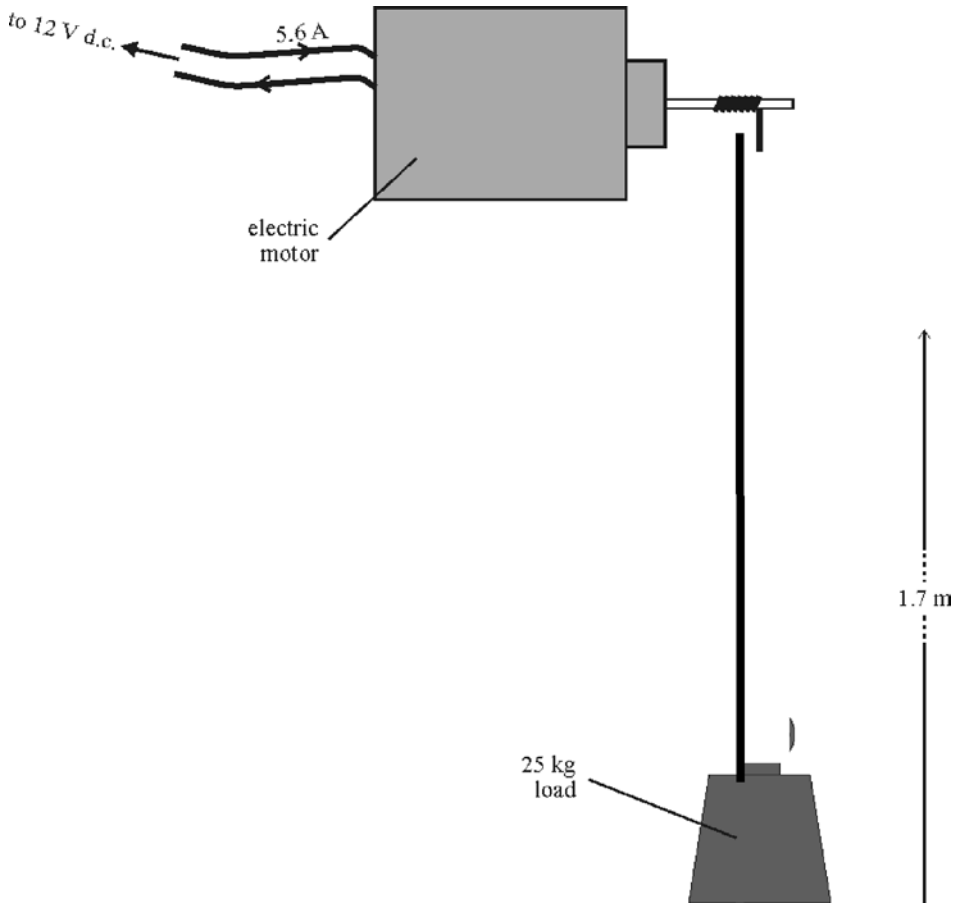
.....

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

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) Calculate the increase in internal energy of the motor.

Assume that all energy losses occur in the motor, and that the motor is well-insulated.

Energy = ... J **[6]**

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

Calculate the work done.

Work done = ... J **[3]**

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

Which **two** of the following statements can explain this observation?

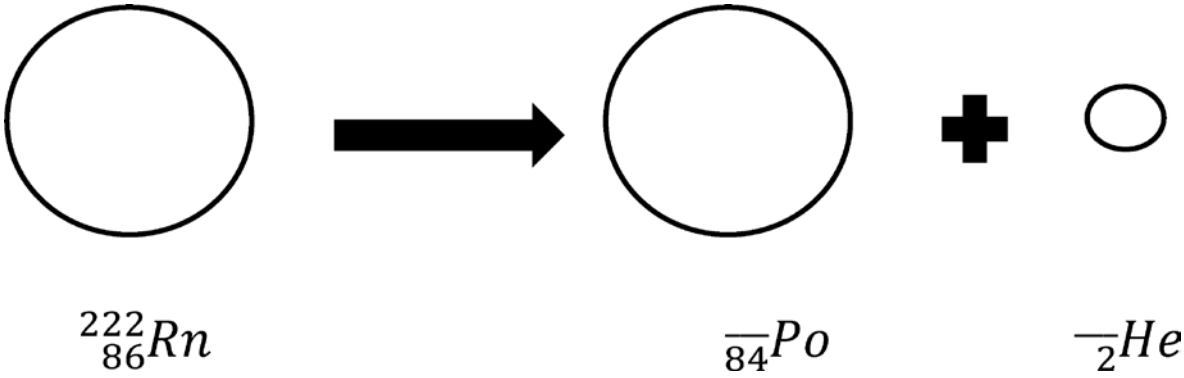
Put ticks (✓) in the boxes after the **two** correct statements.

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

[2]

9 Radon-222 is a dense radioactive gas.

The diagram below shows the alpha decay of Radon-222.



(a) Complete the above equation by adding the **two missing numbers** to the products. **[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 statement in terms of the properties of radon and alpha radiation.

.....

.....

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

END OF QUESTION PAPER