Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3430U60-1

S19-3430U60-1

SCIENCE (Double Award)

Unit 6 – PHYSICS 2
FOUNDATION TIER

WEDNESDAY, 22 MAY 2019 – AFTERNOON

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**8**	
3.	**12**	
4.	**10**	
5.	**7**	
6.	**15**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question ***2(b)***.

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Equations

speed = $\frac{\text{distance}}{\text{time}}$	
acceleration [or deceleration] = $\frac{\text{change in velocity}}{\text{time}}$	$a = \frac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
resultant force = mass × acceleration	$F = ma$
weight = mass × gravitational field strength	$W = mg$
work = force × distance	$W = Fd$
force = spring constant × extension	$F = kx$

SI multipliers

Prefix	Multiplier
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

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Answer **all** *questions.*

1. *(a)* The following diagrams show the life cycle of two different mass stars.
Diagram 1 shows how a star that is similar in mass to our Sun changes with time.
Diagram 2 shows the changes for a star that is 8 times more massive than our Sun.

Complete the labelling on diagrams **1** and **2**, using words or phrases from the box below.
Words or phrases can be used once, more than once or not at all. [4]

asteroid	neutron star	red giant	supergiant	white dwarf

Diagram 1 – Star of mass similar to our Sun

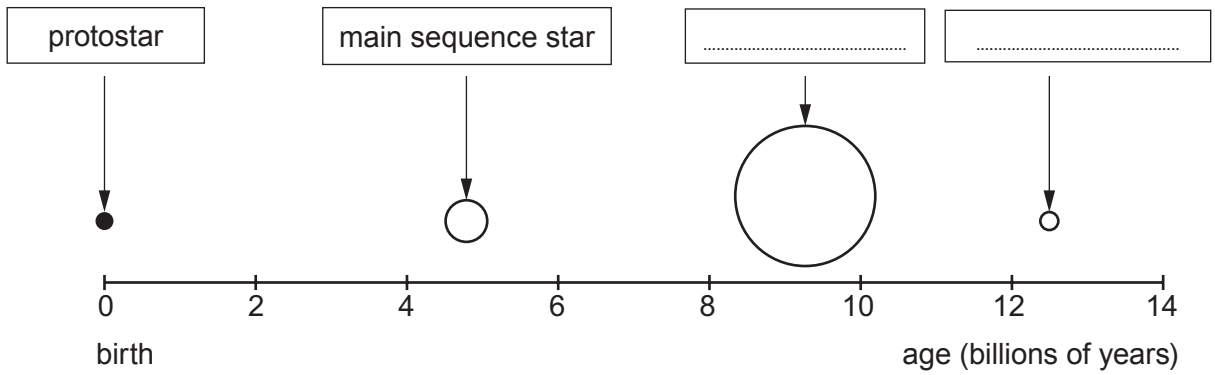
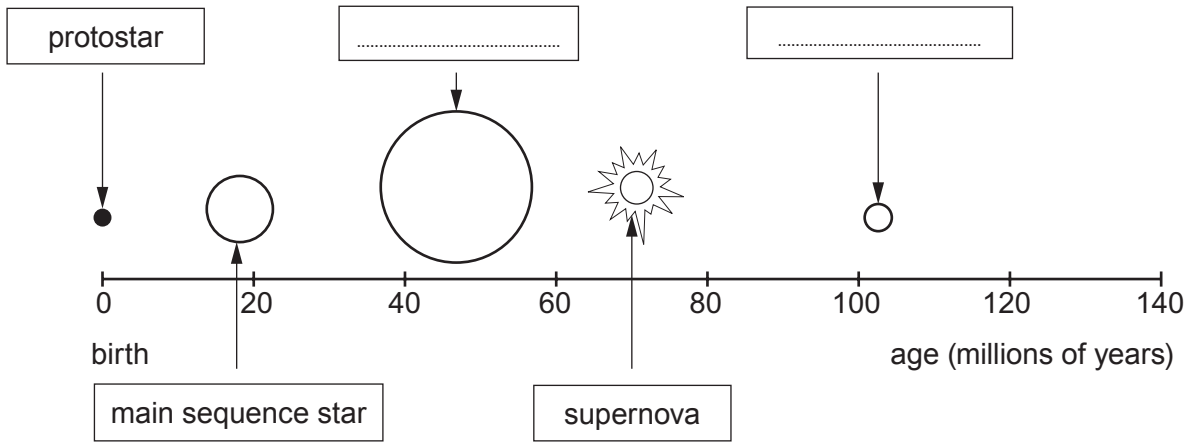


Diagram 2 – Star that is 8 times more massive than our Sun



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(b) **Underline** the word or phrase in the brackets which correctly completes each sentence. [4]

(i) A main sequence star is stable because its gravitational force is (**less than** / **equal to** / **greater than**) the force caused by its radiation pressure.

(ii) Stars generate their energy by the (**burning** / **fusion** / **fission**) of increasingly heavier elements.

(iii) During the final stages in the life cycle of some stars heavy elements are ejected when the star becomes a (**gaseous giant planet** / **supernova** / **supergiant**). The collapse of a cloud of gas and dust combined with these heavy elements can eventually form a (**Solar System** / **galaxy** / **Universe**).

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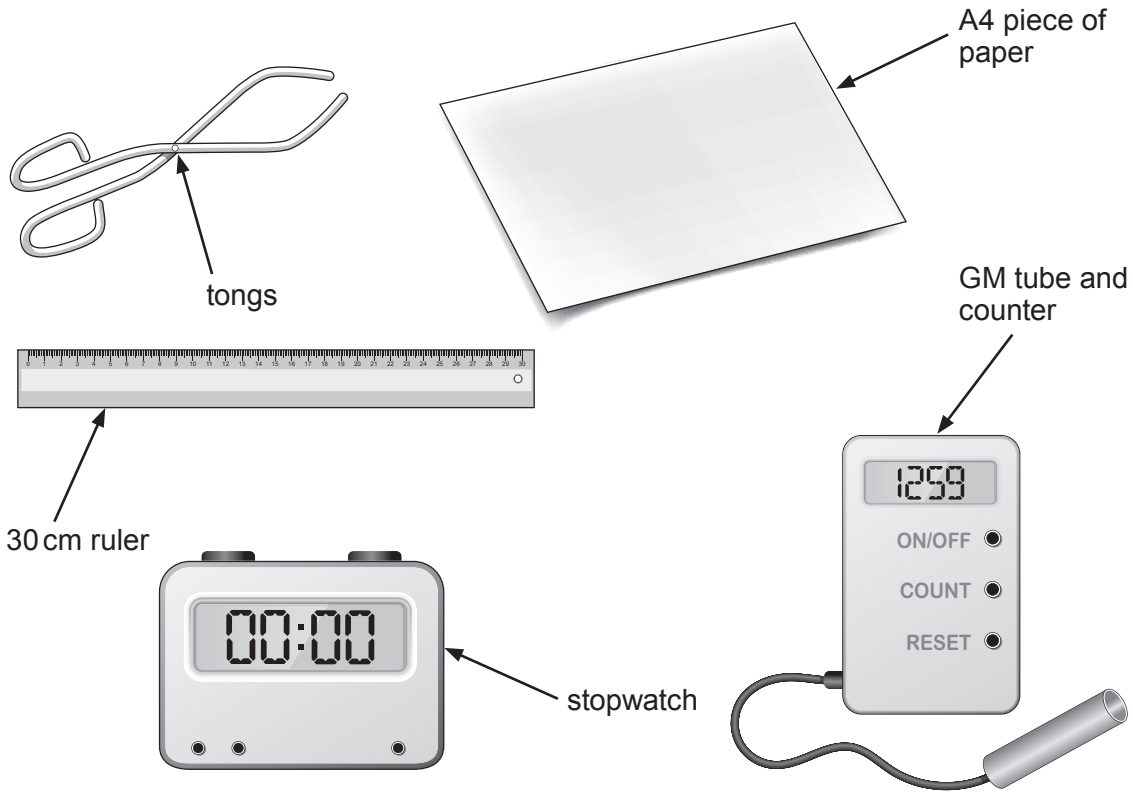
2. *(a)* Draw **one** line from each of the named radiations to the correct description. [2]

Named radiation	Description
alpha radiation	electromagnetic waves
beta radiation	helium nuclei
gamma radiation	high energy electrons

(b) A laboratory has 3 different radioactive sources that are not labelled.
It is known that one of the sources emits **only alpha** radiation. Another of the sources emits **only beta** radiation. The third source emits **both beta and alpha** radiation.

Only the following apparatus is available.



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Explain how the apparatus can be used to collect data **and** how the data can be analysed to identify the 3 sources. [6 QER]

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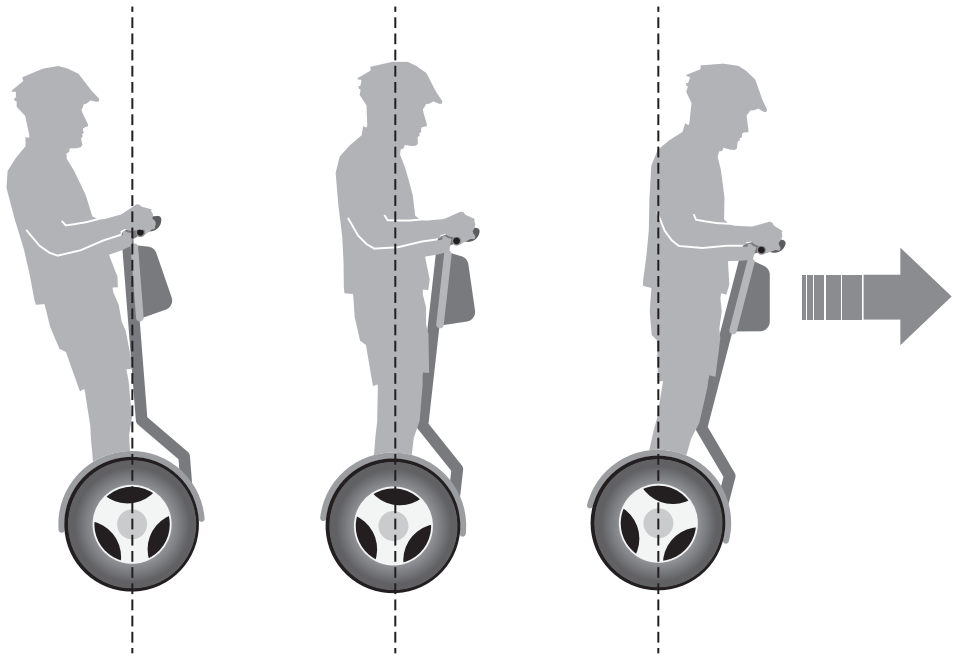
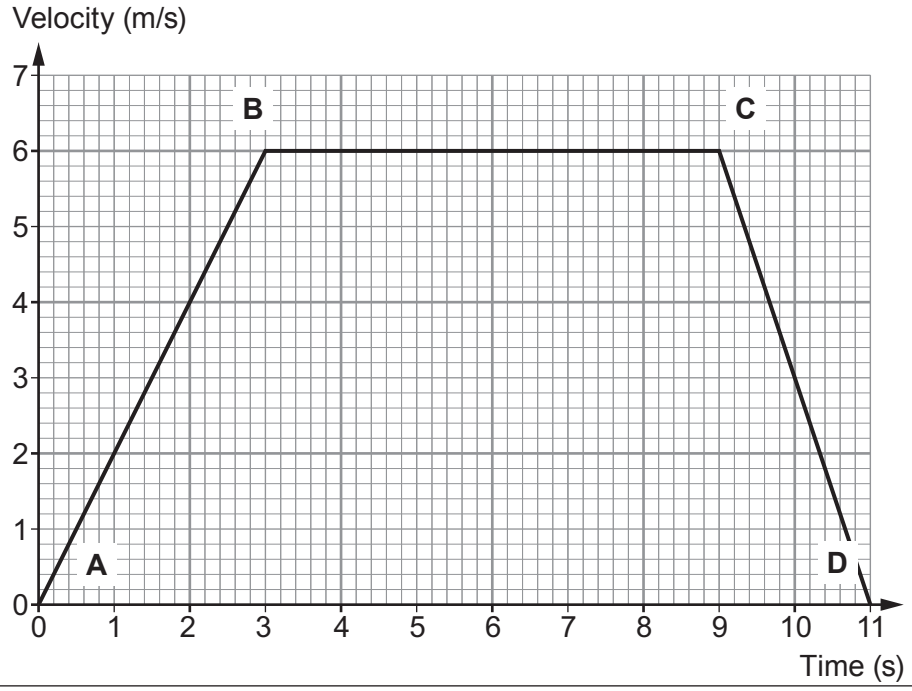
Turn over.

3. A Segway vehicle can be used as a method of transport for a person.
The person leans forwards to make the Segway accelerate and leans backwards to slow it down. It is recommended that short training sessions are carried out before using the Segway on a busy pavement.



The velocity-time graph below relates to a short Segway training session that is carried out on a **dry** pavement. The person riding the Segway is instructed to carry out an emergency stop during the training.



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Use information on the graph opposite to answer the following questions.

(a) Between which points, **A** to **B**, **B** to **C** or **C** to **D**, is the person leaning forward on the Segway? [1]

.....

(b) Use the equation:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

to calculate the acceleration during the first 3 seconds and state its unit. [3]

Acceleration = ...

Unit = ...

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(c) The combined mass of the person and the Segway is 110 kg.
Use the equation:

$$\text{resultant force} = \text{mass} \times \text{acceleration}$$

to calculate the resultant force during the first 3 seconds. [2]

Resultant force = ... N

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(d) The reaction time of the person riding the Segway is 0.6 seconds.
Use the graph on page 8 to determine the time, during the training session, at which the rider is asked to carry out the emergency stop. [2]

Time = ... s

(e) Newton's first law of motion states "An object will remain at rest, or move at constant velocity, if the forces acting on it are balanced".

A student states that during the Segway training session balanced forces act on it for 11.0 s. Explain whether you agree with the student. [2]

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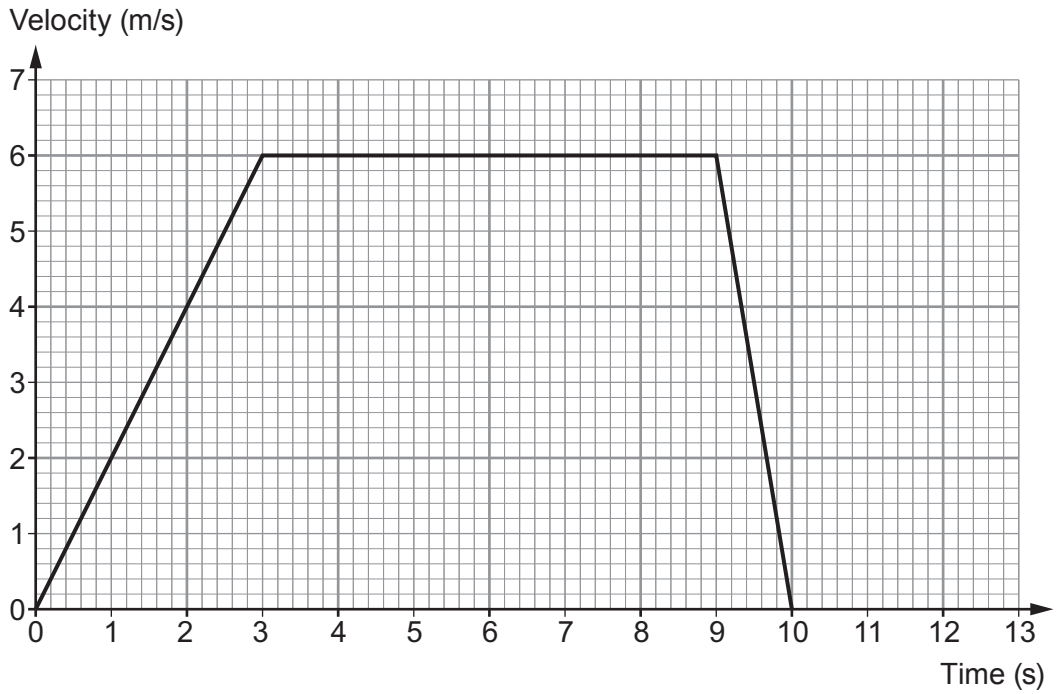
(f) The graphs below and opposite show 3 possible training sessions carried out by the same Segway rider. Lucy says that **Graph C** would represent the emergency stop carried out on an **icy** pavement. Explain whether you agree with Lucy. [2]

Graph A



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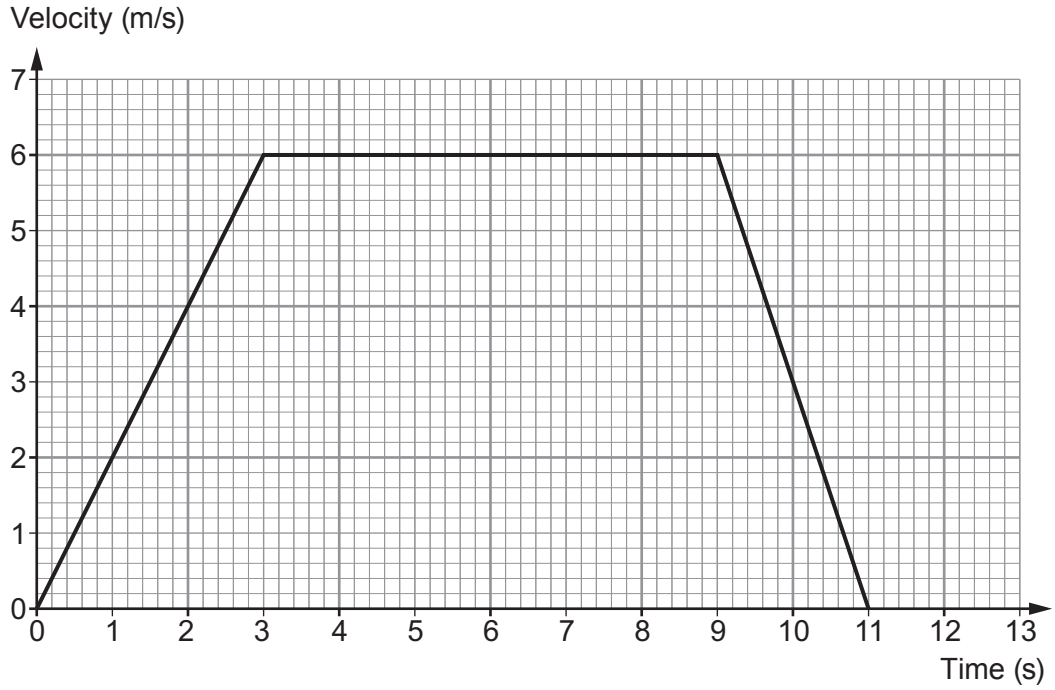
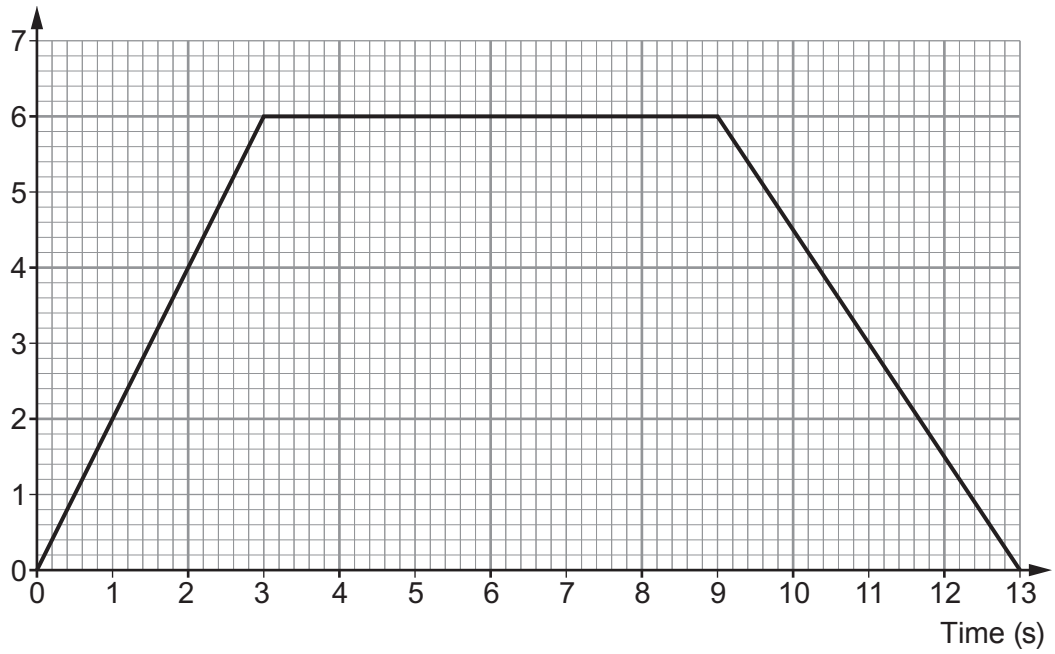
Graph B



Graph C



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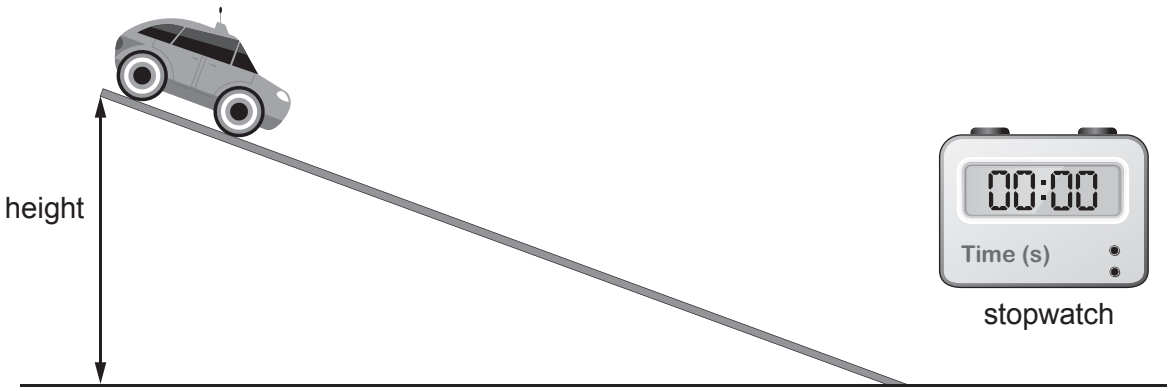
4. Two students carry out an experiment with a toy car and a 2.50 m long piece of track.



They investigate how changing the height at one end of the track affects the time taken for the toy car to travel down 2.50 m of the track. One student releases the car and the other uses a stopwatch to measure the time. They do this 3 times for each height.
Their results are shown in the table.

Height (cm)	Distance travelled (m)	Time (s)			
		Result 1	Result 2	Result 3	Mean
10	2.50	4.0	4.1	4.0	4.0
20	2.50	2.9	3.3	3.1	3.1
30	2.50	2.5	2.7	2.4	2.5
40	2.50	2.1	2.0	2.3	2.1
50	2.50	2.0	1.8	1.9	1.9

(a) Identify a controlled variable in the table. [1]

.....

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(b) (i) Use the equation:

$$\text{mean speed} = \frac{\text{distance travelled}}{\text{mean time}}$$

to calculate the mean speed of the toy car when the slope is set at a height of 10 cm. [2]

Mean speed = ... m/s

(ii) I. Describe how the mean time changes as the height increases by 10 cm steps. [2]

.....

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II. Describe how the mean speed changes as the height increases. [1]

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(c) (i) One student says, "The most repeatable data is for a height of 50 cm".
Explain why this statement is **incorrect** and write a similar correct statement. [2]

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(ii) Explain why using a timer connected to light gates positioned at the start and end of the 2.50 m track will improve the results. [2]

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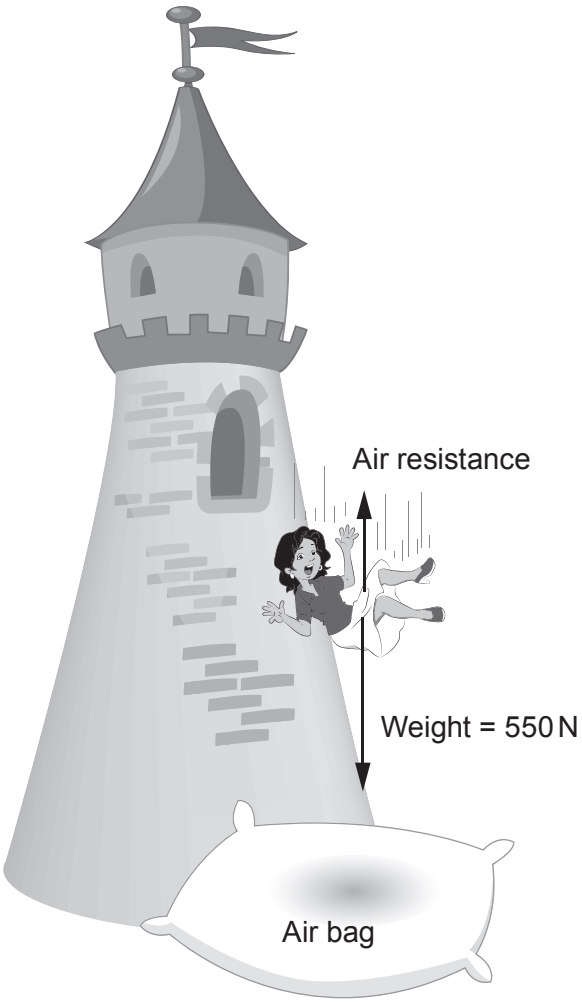
5. As part of a charity event a woman jumps from a tall tower and she safely lands on a large air bag that is beneath.



(a) On Earth, an object of 1 kg has a weight of 10 N. [1]
Calculate the mass of the woman.

Mass = ... kg

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(b) The woman hits the air bag with 5.60 kJ of kinetic energy.
The airbag stops her in a distance of 2.8 m.

(i) Convert 5.60 kJ into joules. [1]

Kinetic energy = ... J

(ii) Use the equation:

$$\text{mean force} = \frac{\text{work done}}{\text{distance}}$$

to calculate the mean force bringing the woman to rest. [2]

Mean force = ... N

(iii) It is suggested that it would be safer if the air bag were filled with water. The distance to stop the same woman falling from the same tower would be 0.8 m instead of 2.8 m. Without further calculation explain whether you agree with the suggestion. [3]

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6. *(a)* Pupils in a class were given 200 coins to use in an experiment to simulate radioactive decay.
They were asked to shake the coins in a bag, throw them out on the table then remove those showing "heads". The number removed were counted and recorded in a table.
The remainder of the coins were put back in the bag and the process was repeated again and again.
Their results are shown in the table below.

Throw number	Total number of coins removed	Number of coins remaining
0	0	200
1	104	96
2	149	51
3	.....	26
4	.....	20
5	.....	6
6	.....	4

(i) **Complete the table.** [1]

(ii) After two throws, the number of coins remaining was 51. How many coins would you have **expected** to remain? [1]

.....

(iii) After how many throws would the number of remaining coins fall to about **one eighth** of the original number? [1]

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(b) Carbon-14 is a radioactive form of carbon that is present in all living material. Each nucleus of carbon-14 undergoes radioactive decay by emitting a beta particle to form nitrogen-14 according to the following decay equation, which is incomplete.

$$^{14}_{6}\mathrm{C} \longrightarrow \overset{.....}{\underset{.....}{\mathrm{N}}} + {}^{0}_{-1}\mathrm{e}$$

Complete the nuclear equation above. [2]

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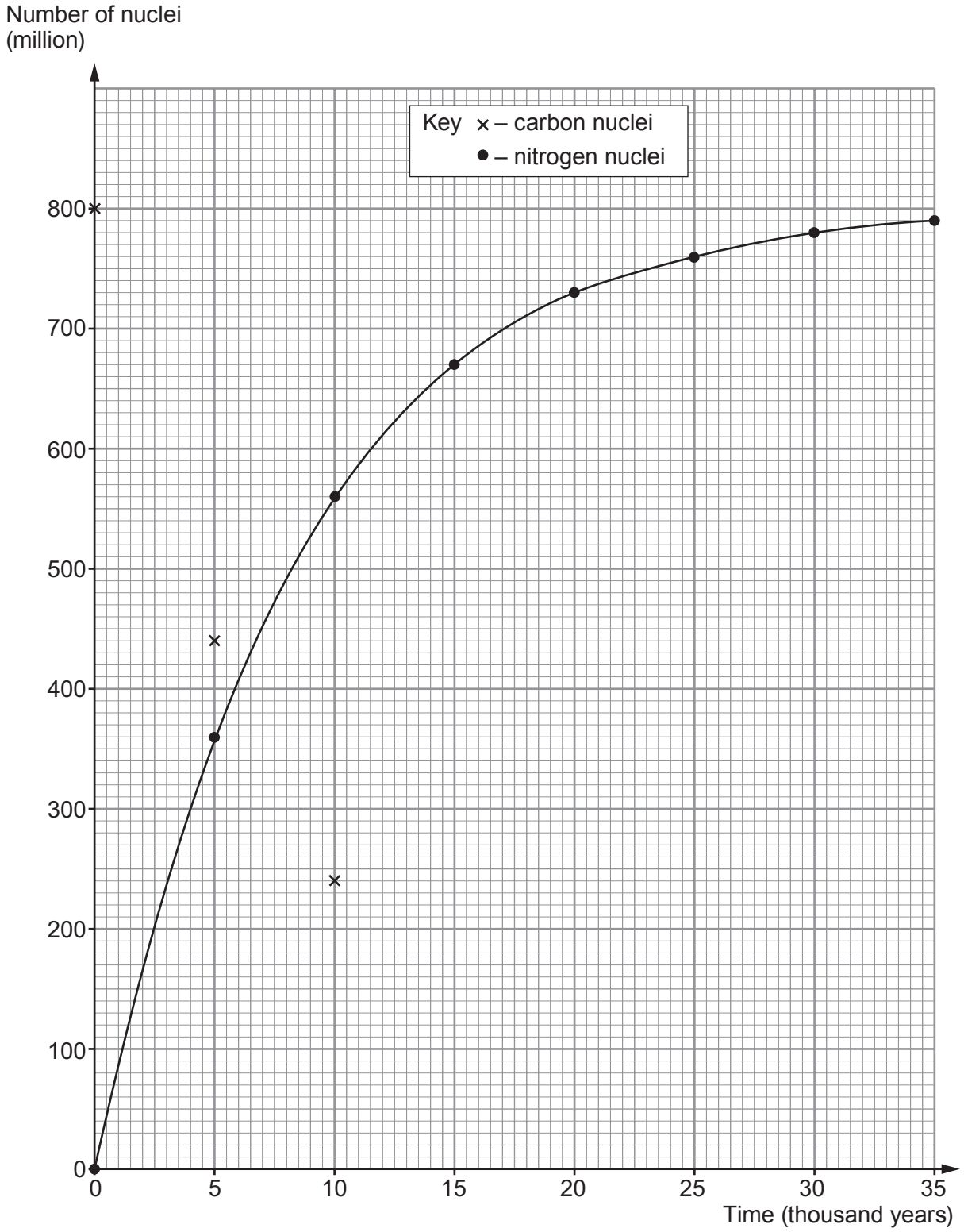
(c) A sample of 800 million carbon nuclei decays to create nuclei of nitrogen.
The decrease in the sample creates an **increase** in the number of nuclei of nitrogen according to the following graph.



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(i) **Complete the following table.** [2]

Time (thousand years)	Total number of nuclei (million)	Number of nitrogen nuclei (million)	Number of carbon nuclei (million)
0	800	0	800
5	.....	360	440
10	.....	560	240
15	.....	670	.....
20	.....	730	.....
25	.....	760	.....
30	.....	780	.....
35	.....	790	.....

(ii) On the grid opposite, plot points showing the **decay** of the carbon-14 nuclei. The first three crosses showing the numbers of carbon nuclei have been plotted for you.
Draw a suitable line. [3]

(d) (i) State the meaning of "the half-life" of a radioactive substance. [2]

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(ii) Use the graph to determine the half-life of carbon-14. [1]

Half-life = ... thousand years

THIS QUESTION CONTINUES ON PAGE 20

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(e) Carbon dating is used to find the age of some ancient objects because carbon-14 is present in all once-living material. The process has been used to identify the age of the Turin shroud. This is a sheet of cloth that was claimed to be about 2000 years old. Three independent radiocarbon dating tests, carried out recently, attempted to identify the age of the cloth.

Out of **80 million** carbon-14 nuclei which were present in each sample of the original cloth, around 6 million have decayed into nitrogen. Use this information to explain whether the claim about its age is correct. [2]

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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