



General Certificate of Secondary Education
2023–2024

Centre Number

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Candidate Number

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Single Award Science: Physics

Unit 3
Higher Tier



[GSA32]

GSA32

WEDNESDAY 15 NOVEMBER 2023, MORNING

TIME

1 hour.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all ten** questions.

INFORMATION FOR CANDIDATES

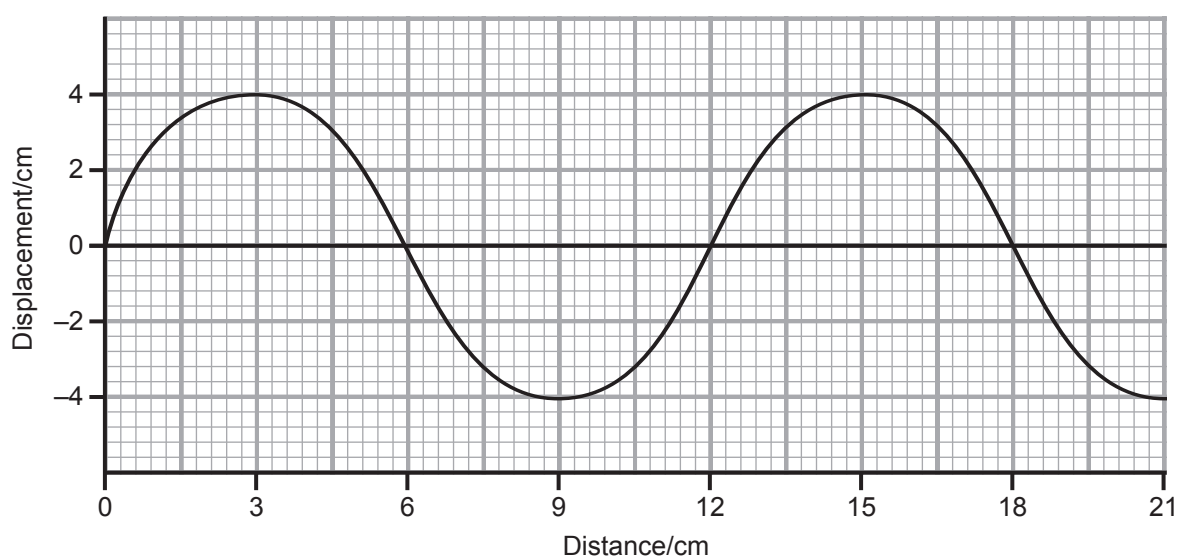
The total mark for this paper is 60.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Question 4.



- 1 (a) The graph below shows how the displacement of a wave changes with distance.



- (i) What is the amplitude of this wave?

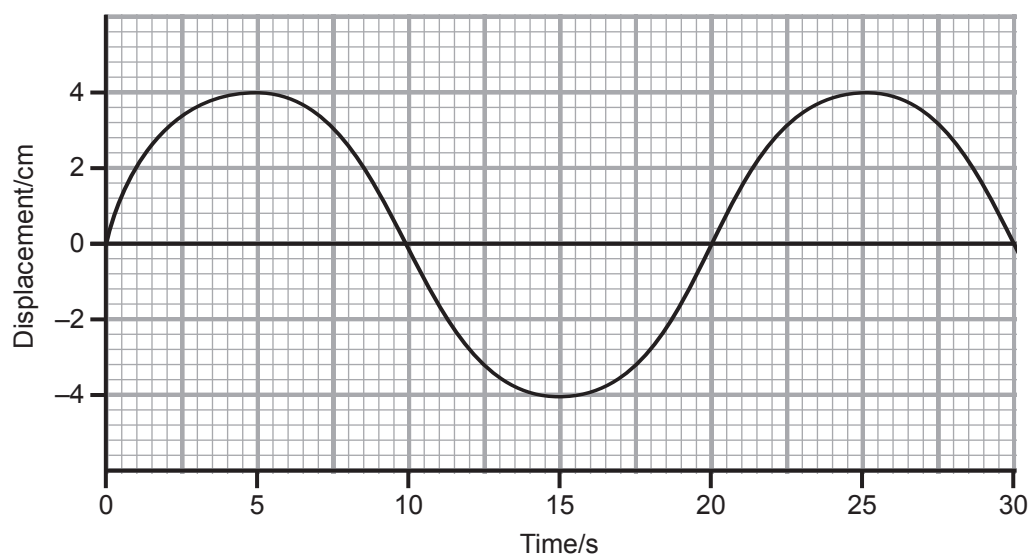
_____ cm [1]

- (ii) What is the wavelength of this wave?

_____ cm [1]



The graph below shows the time taken for one and a half vibrations to occur.



(b) How long does it take for one complete vibration?

_____ s [1]

(c) Water waves are an example of transverse waves.

(i) Give **one** other example of a transverse wave.

_____ [1]

(ii) Which of the diagrams below shows how the particles vibrate as a transverse wave moves from left to right?

Circle your answer.

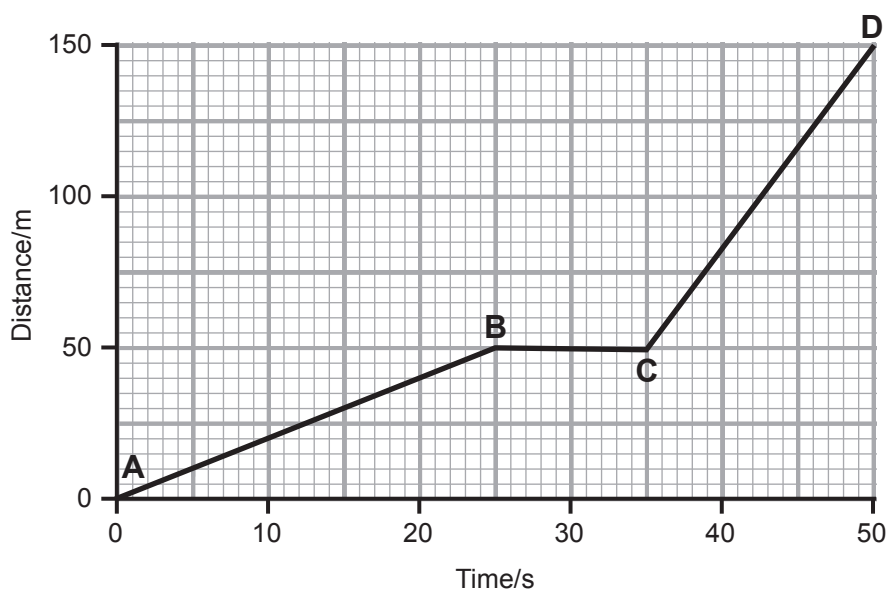


[1]

[Turn over



- 2 (a) Shown below is the distance–time graph for a short bicycle journey.



- (i) Describe fully the motion of this bicycle between **A** and **C**.

[2]

- (ii) Compare the motion of the bicycle between **A** and **B** to its motion between **C** and **D**.

[1]



(b) Use the equation:

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

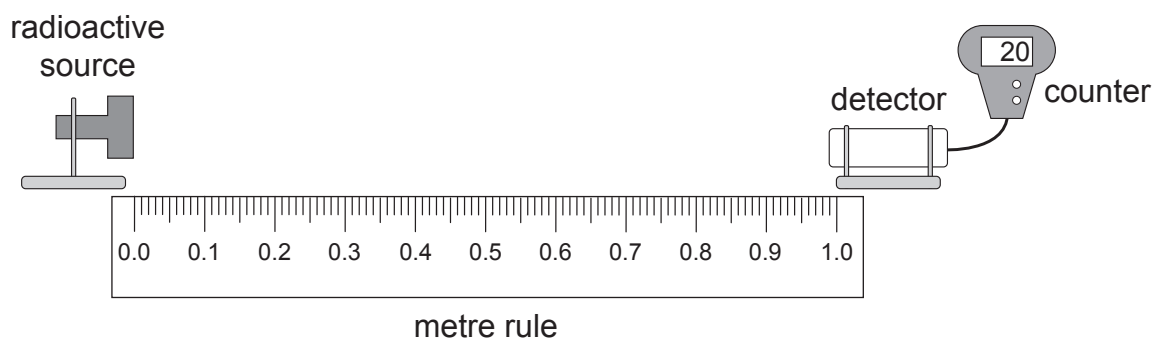
to calculate the average speed of the bicycle from **A** to **D**.

(Show your working out.)

_____ m/s [2]



- 3 The equipment shown below was used to measure the count rate at different distances from a radioactive source.

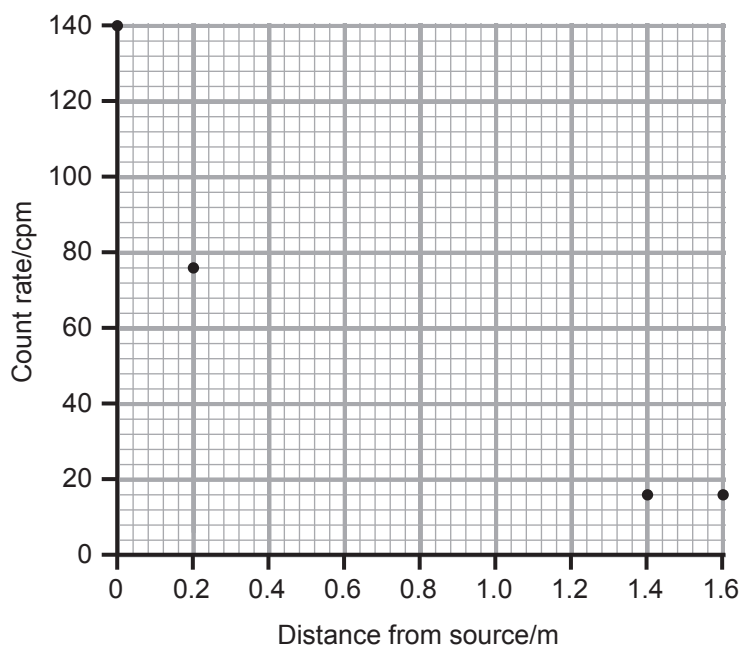


The results are shown below.

Distance from source/m	Count rate/cpm
0.0	140
0.2	76
0.4	50
0.6	40
0.8	30
1.0	20
1.2	16
1.4	16
1.6	16



- (a) On the grid below, plot and draw the line graph for these results.
Some of the points have been plotted for you.



[3]

- (b) State the trend shown by this information.

[2]

Background radiation is around us all the time.

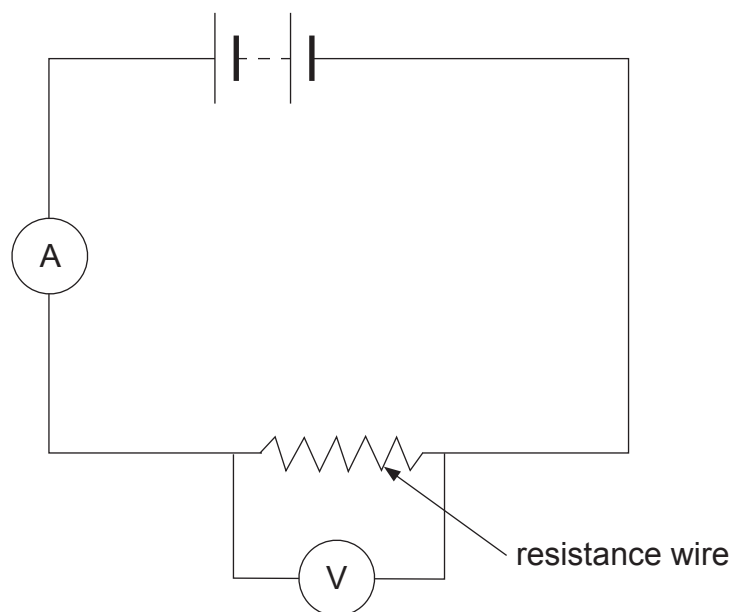
- (c) Use these results to suggest a value for background radiation.

_____ cpm [1]

[Turn over]



- 4 The circuit shown below can be used to prove Ohm's Law.



Describe fully how this circuit can be used to prove Ohm's Law.

Your answer should include:

- the names of the meters used and how they are connected in the circuit;
- a description of the method used to collect results; and
- how the results can be used to prove Ohm's Law.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.



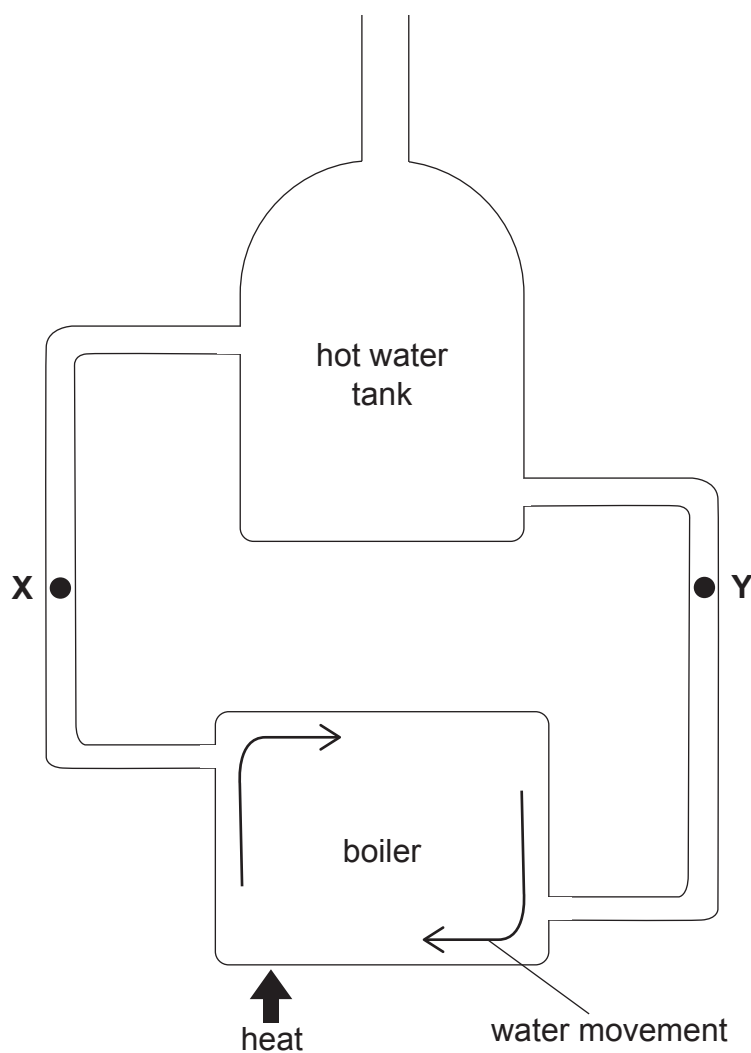


[6]

[Turn over



- 5 (a) The diagram below shows part of the hot water system in a house. Water is heated in the boiler and then stored in the hot water tank.



- (i) Name the method of heat transfer in water.

_____ [1]

- (ii) On the diagram above, draw arrows to show the direction that water moves at points X and Y. [1]





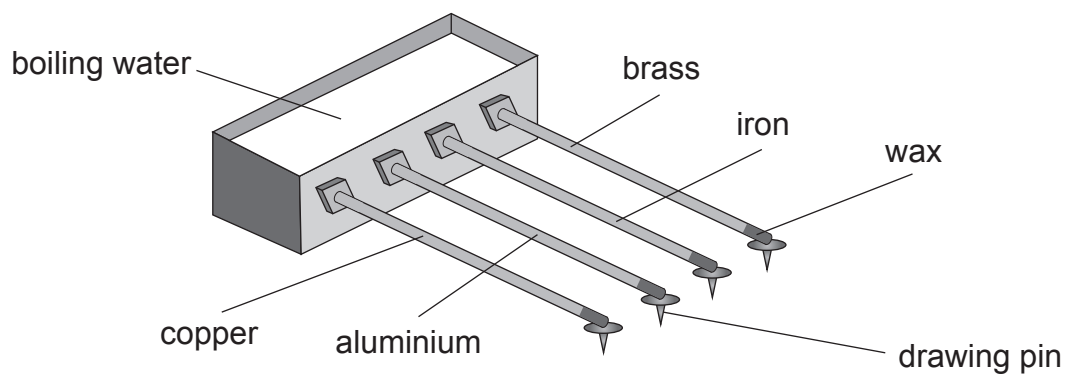
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(Questions continue overleaf)

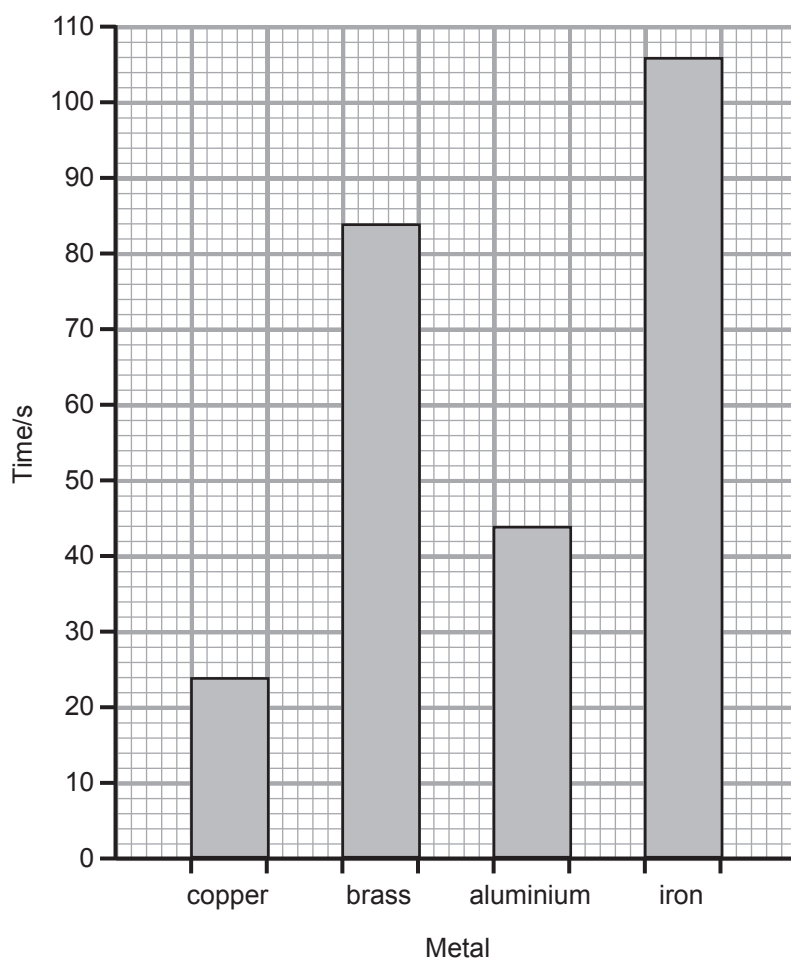


(b) The apparatus below was used to investigate heat transfer through four metal rods.



The time it took for the drawing pin to fall off each rod was measured.

The results are shown in the bar chart below.



- (i) Use the bar chart to calculate the time interval between the first and last pins to fall off the rods.

(Show your working out.)

_____ s [2]

- (ii) If a glass rod was used in this investigation, suggest how long it would take for the pin to fall off.

_____ s [1]

- (iii) Suggest **one** thing that was done to make this investigation valid (a fair test).

_____ [1]

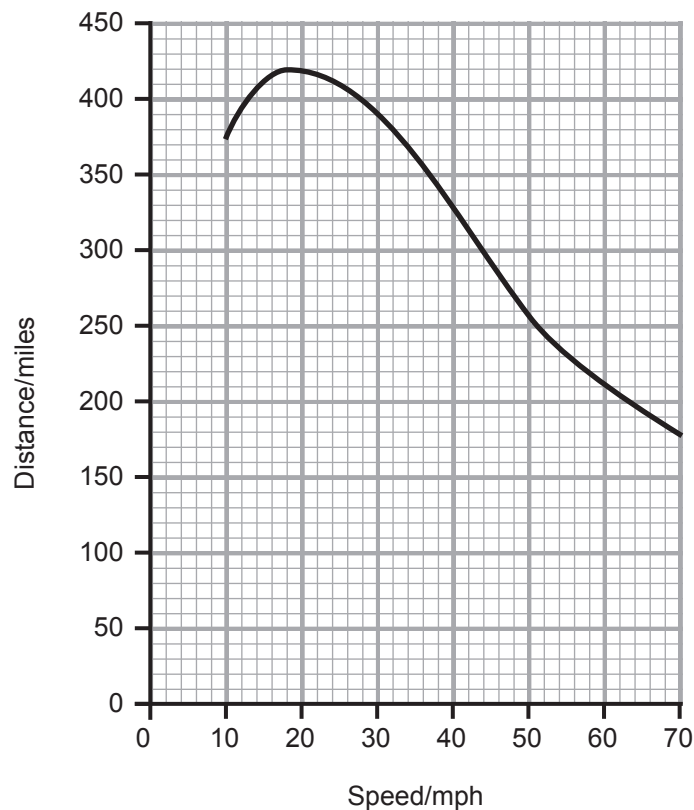
- (c) Explain fully, in terms of particle movement, how heat travels through **metals**.

_____ [3]

[Turn over



- 6 The graph below shows the distance that a battery powered car can travel, when it is driven at different speeds, before needing recharged.



- (a) Describe fully the trend shown by this information.

[2]

- (b) Regenerative braking is a common feature in many modern cars. Describe what is meant by the term **regenerative braking**.

[2]



- (c) Give **one** reason why governments have been encouraging car manufacturers to reduce our reliance on fossil fuels.

[1]

[Turn over



- 7 (a) The table below gives the wavelength and frequency of waves in the electromagnetic spectrum.

Wave type	Wavelength/m	Frequency/Hz
gamma	1×10^{-12}	3×10^{20}
X-ray	1×10^{-10}	3×10^{18}
	1×10^{-8}	3×10^{16}
visible light	1×10^{-7}	3×10^{15}
infrared	1×10^{-5}	3×10^{13}
microwave	1×10^{-2}	3×10^{10}
radio	1×10^2	3×10^6

- (i) Name the wave type missing from the table.

_____ [1]

- (ii) State the trend shown by this information.

_____ [1]



(b) Use information from the table and the equation:

$$\text{wave speed} = \text{wavelength} \times \text{frequency}$$

to calculate the speed of electromagnetic waves.

(Show your working out.)

_____ m/s [2]

(c) Microwave ovens are used to heat food.



(i) Explain fully how the microwaves in the oven can be used to heat food.

_____ [3]

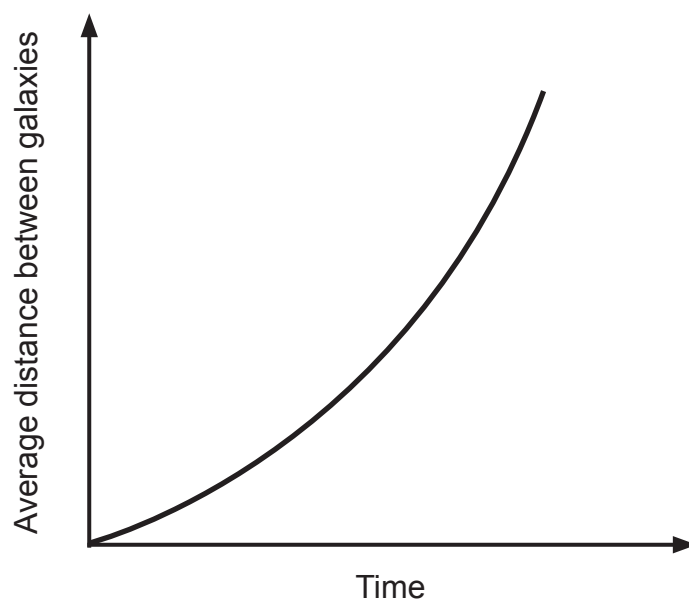
(ii) Apart from their use in microwave ovens, give **one** other use of microwaves.

_____ [1]

[Turn over



- 8 (a) The graph below shows how the average distance between galaxies has changed over time.



- (i) Explain fully how this graph supports the Big Bang theory.

[2]

- (ii) State **one** other piece of evidence that supports the Big Bang theory.

[1]

- (iii) Name **one** other scientific theory for the creation of the Universe.

[1]

- (b) Name our galaxy.

[1]



- (c) Distances are usually measured in kilometres.
Suggest why scientists find it more useful to use light years as a measure of the distances between galaxies.

[1]

[Turn over]



- 9 (a) Shown below is a football player about to kick a ball of mass 400 g.



Use the equation:

$$\text{kinetic energy} = \frac{1}{2} mv^2$$

to calculate the kinetic energy of the ball when it is travelling at 20 m/s.

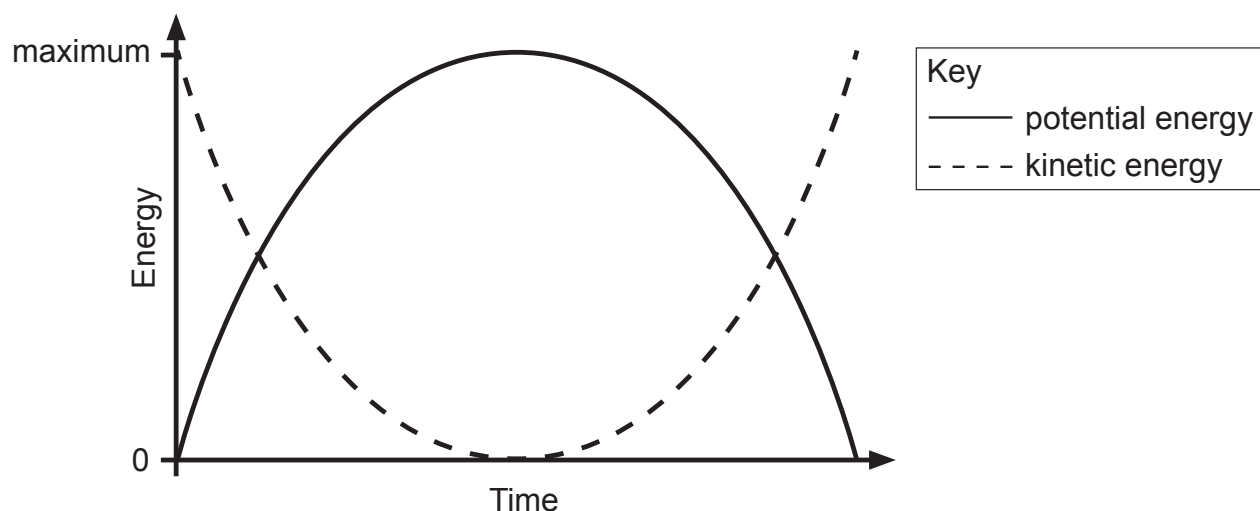
(Show your working out.)

_____ J [3]



Another footballer throws the ball straight up into the air and then catches it again as it falls.

- (b) The diagram below shows how the kinetic and potential energy of the ball changed during this motion.



- (i) Describe fully how the energy changes as the ball moves upwards.

[2]

- (ii) Complete the following sentence.

Energy can be changed from one type to another but the total amount of energy does not change, this is called the Principle of _____ . [1]

[Turn over



- 10 The diagrams (**A**, **B** and **C**) below show the forces acting on identical toy cars that are moving forward.



A



B



C

- (a) In terms of forces, describe the motion of car **A**.

[2]

- (b) (i) Look at the forces acting on cars **A**, **B** and **C**.
What is the size and direction of the largest resultant force?

[1]

- (ii) What effect, if any, will a resultant force have on a moving car?

[1]

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Question Number	Marks
1	
2	
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Total Marks	

Examiner Number

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