Specimen Paper

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

AQA Level 1/2 Certificate in Physics
Specimen Paper

Physics

Paper 1

For this paper you must have:
- a pencil, ruler and protractor
- a calculator
- the Physics Equations Sheet (enclosed).

Time allowed
- 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

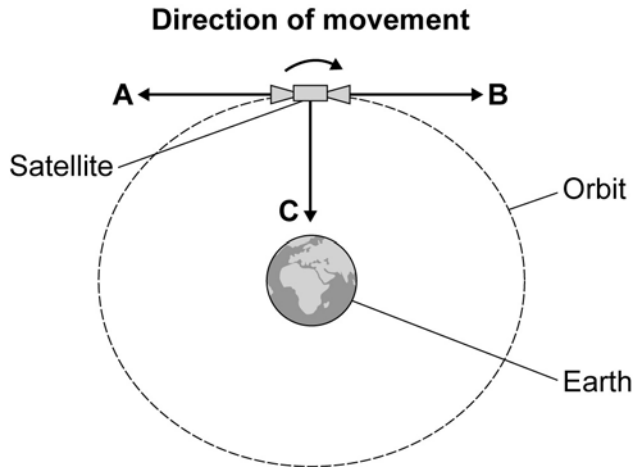
Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 4(b) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

1 (a) The diagram shows a satellite moving in a circular orbit above the Earth.

A centripetal force acts on the satellite, causing it to accelerate.



1 (a) (i) Use a word from the box to complete the sentence.

friction	**gravity**	**tension**

The centripetal force on the satellite is provided by ..... .

(1 mark)

1 (a) (ii) In what direction does the satellite accelerate, **A**, **B** or **C**?

.....

(1 mark)

1 (a) (iii) When the satellite accelerates in a circular orbit its speed does not change.

Draw a ring around the correct answer in the box to complete the sentence.

When the satellite accelerates there is a change in its

direction.
distance from the Earth.
kinetic energy.

(1 mark)

1 (b) The electrical systems on the satellite can be powered by rechargeable batteries.

One fully charged 4 volt battery stores 216 000 coulombs of charge.

Calculate the energy, in joules, available from one fully charged battery.

.....

.....

.....

Energy available = ... J

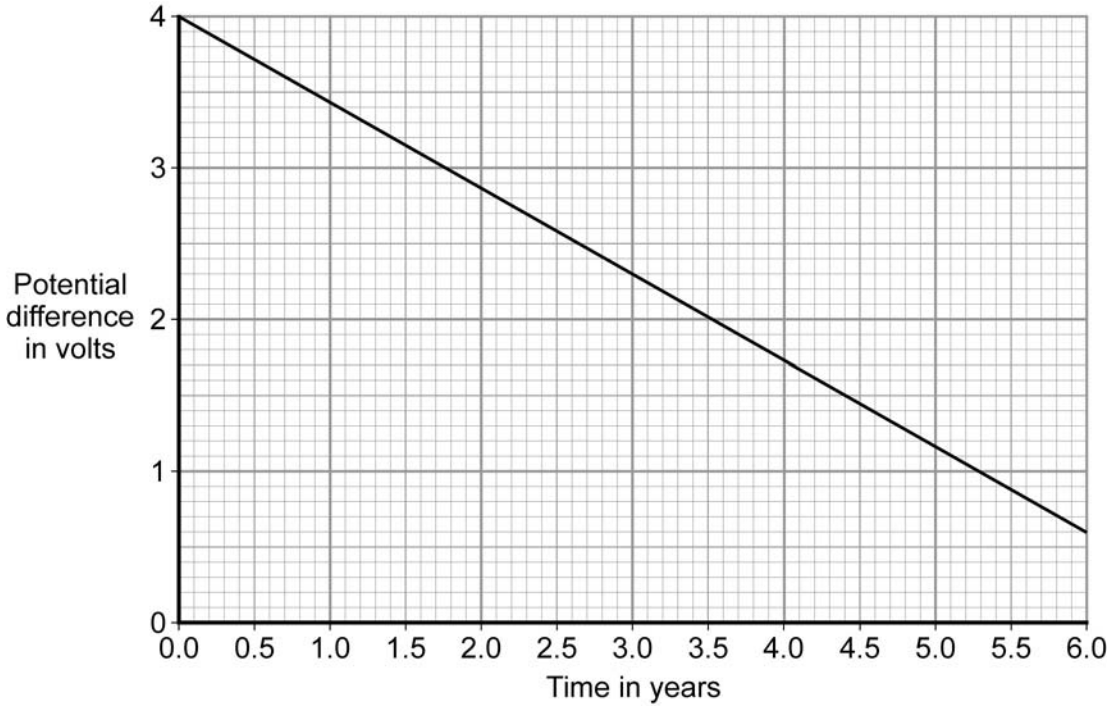
(2 marks)

Question 1 continues on the next page

1 (c) Batteries to be used on a satellite must not discharge by more than 15 % when left unused for three years.

Scientists test new types of battery by charging them to 4 volts and then storing them at 37 °C for several years. The potential difference of the battery is measured every month.

The graph shows the data obtained for one type of battery.



1 (c) (i) Use the graph to calculate the time taken, in years, for the potential difference of this battery to drop by 15%.

.....

.....

.....

Time taken = ... years

(2 marks)

1 (c) (ii) Use your answer from **(c)(i)** to explain whether this battery is suitable for use on a satellite.

.....

.....

(1 mark)

1 (d) There are now thousands of satellites in orbit around the Earth. A student used the Internet to find information about three of them.

The table shows the information found by the student.

Satellite	Height of the orbit above the Earth in kilometres	Orbital speed in kilometres per hour
K	705	27 500
L	20 200	13 900
M	35 800	11 100

A student concluded that the greater the height of the satellite the slower the orbital speed.

Any conclusion drawn from the data in the table might not be valid for **all** satellites.

Suggest reasons why.

.....

.....

.....

.....

.....

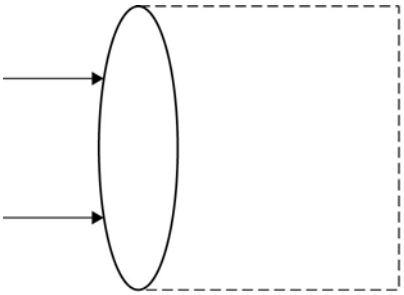
.....

(3 marks)

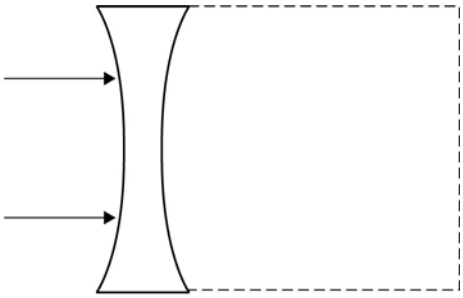
11

Turn over for the next question

2 The diagram shows two lenses, **A** and **B**. Two rays of light are shown incident on the left-hand surface of each lens.



Lens A



Lens B

2 (a) On the diagram, draw lines to show how the light passes through each lens into the region within the dotted lines.

(3 marks)

2 (b) A student has short sight because his eyeball is too long. This produces a blurred image.

To be able to see clearly, the student wears glasses.

Which lens, **A** or **B**, should be used in the student's glasses?

Write your answer in the box. ☐

Explain how your chosen lens corrects the student's short sight.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

2 (c) It is sometimes possible to correct short sight by having the cornea of the eye reshaped.

What device is used by a surgeon to reshape the cornea?

Draw a ring around **one** answer.

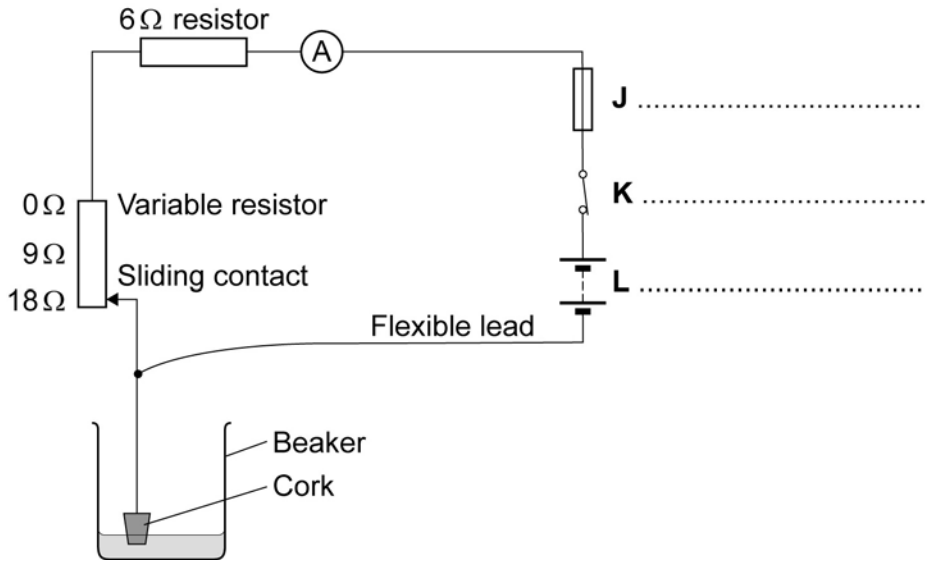
drill **laser** **scalpel**

(1 mark)

9

Turn over for the next question

3 A student has designed the circuit shown in the diagram to measure the water level in a beaker. The student is going to use the ammeter to indicate the water level.



3 (a) Use words from the box to label the three components, **J**, **K** and **L**, on the diagram.

battery	**cell**	**fuse**	**lamp**	**resistor**	**switch**

(3 marks)

3 (b) The resistance of the variable resistor changes as the cork moves up and down inside the beaker. This changes the *electric current* flowing in the circuit.

3 (b) (i) What is meant by the term *electric current*?

.....

.....

(1 mark)

3 (b) (ii) When a voltmeter was mistakenly added to the circuit in series, the reading on the ammeter was zero.

Suggest why.

.....

.....

(1 mark)

3 (c) The table gives the variable resistor value and the ammeter readings for different water levels. The table is not complete.

Water level	Variable resistor value in ohms	Ammeter reading in amps
Full	0	2.0
Half full	9	0.8
Empty	18	

Calculate the reading on the ammeter, in amps, when the beaker is empty.

Assume the ammeter, battery, fuse and wires have zero resistance.

.....

.....

.....

Ammeter reading = ... A

(3 marks)

3 (d) A second student copied the design using a 2A fuse, but he forgot to include the 6 Ω resistor.

What will happen to the fuse in this circuit as the water reaches the top of the beaker?

Explain your answer.

.....

.....

.....

.....

.....

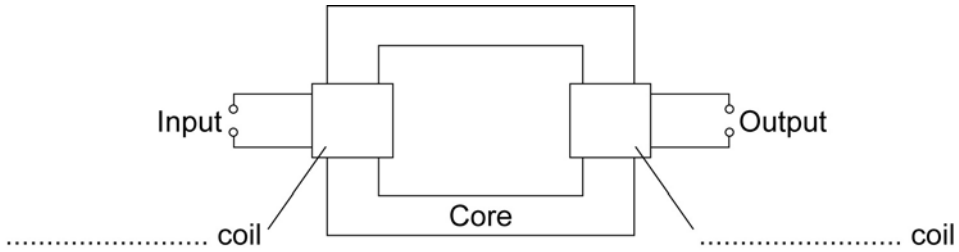
.....

.....

(5 marks)

13

4 (a) The diagram shows the basic structure of a mains-operated transformer.



4 (a) (i) Complete the labelling of the coils by adding a word to each of the dotted lines.

(2 marks)

4 (a) (ii) In the transformer shown in the diagram, the potential difference across the input is 20 V, a.c. The potential difference across the output coil is 40 V, a.c.

What type of transformer is this?

.....

(1 mark)

4 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

A current flowing in a coil produces a magnetic field in the core.

Explain how an alternating input can produce an alternating output of a higher potential difference.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

4 (c) The transformer inside a USB adapter is a switch-mode transformer.

Apart from size, state **one** other difference between a switch-mode transformer and a traditional mains-operated transformer.

.....

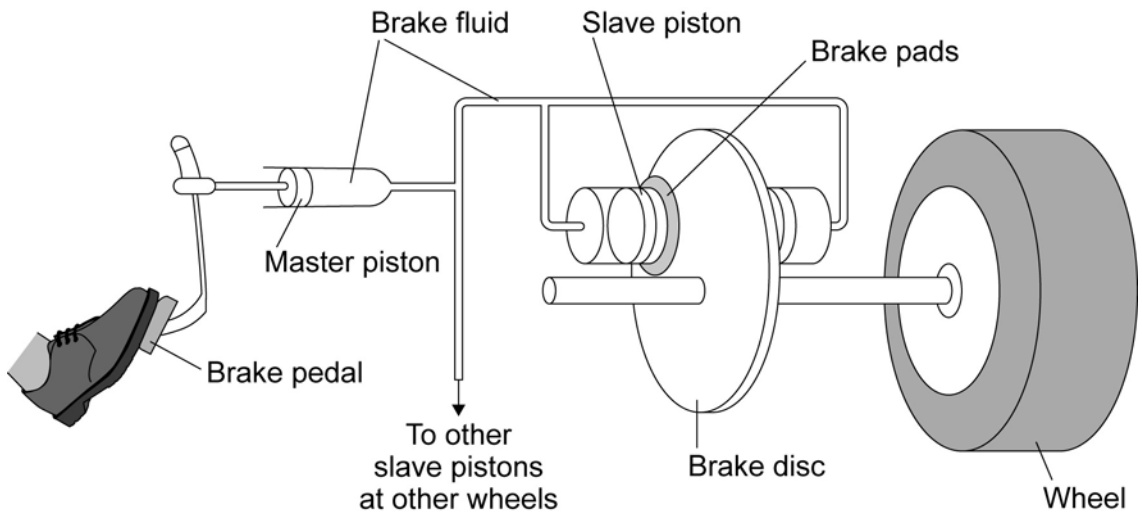
.....

(1 mark)

10

Turn over for the next question

5 (a) The diagram shows part of the hydraulic brake system for a car.



What property of a liquid is essential for a hydraulic brake system to work?

.....

(1 mark)

5 (b) Describe how a force exerted on the brake pedal leads to a force acting on each of the brake discs.

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

5 (c) Applying the brakes of a car leads to an increase in the temperature of the brakes.

Explain why.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

10

Turn over for the next question

6 (a) **Table 1** gives some properties of alpha, beta and gamma radiation.

Table 1

Radiation	Range in air	Effect of a magnetic field
Alpha particle	.....	deflected a small amount
Beta particle	about 1m	deflected a lot
Gamma ray	unlimited	.....

6 (a) (i) Which **one** of the following describes an alpha particle?

Tick (✓) **one** box.

It is the same as the nucleus of a helium atom. ☐

It is an electron. ☐

It is a negative ion. ☐

(1 mark)

6 (a) (ii) Complete **Table 1** by adding the missing information.

(2 marks)

6 (b) **Table 2** gives information about four radioactive isotopes.

Table 2

Isotope	Type of radiation emitted	Half-life
iridium-192	gamma ray	74 days
polonium-210	alpha particle	138 days
polonium-213	alpha particle	less than 1 second
technetium-99	gamma ray	6 hours

6 (b) Two isotopes of polonium are given in the table. In terms of particles in the nucleus:

6 (b) (i) how are these two isotopes the same

.....

(1 mark)

6 (b) (ii) how are these two isotopes different?

.....

(1 mark)

6 (c) To monitor the blood flow through a patient's heart, a doctor injects the patient with a very small dose of technetium-99. The gamma radiation detected outside of the patient's body allows the doctor to see if the heart is working correctly.

6 (c) (i) Explain why technetium-99 is more suitable for this use than polonium-210.

.....

.....

.....

.....

(2 marks)

6 (c) (ii) Explain why technetium-99 is more suitable for this use than iridium-192.

.....

.....

.....

.....

(2 marks)

6 (d) Technetium-99 (Tc) is produced by the beta decay (β) of an isotope of molybdenum (Mo).

The decay can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.

$$\square \quad \text{Mo} \longrightarrow {}^{99}_{43}\text{Tc} + {}^{0}_{-1}\beta$$

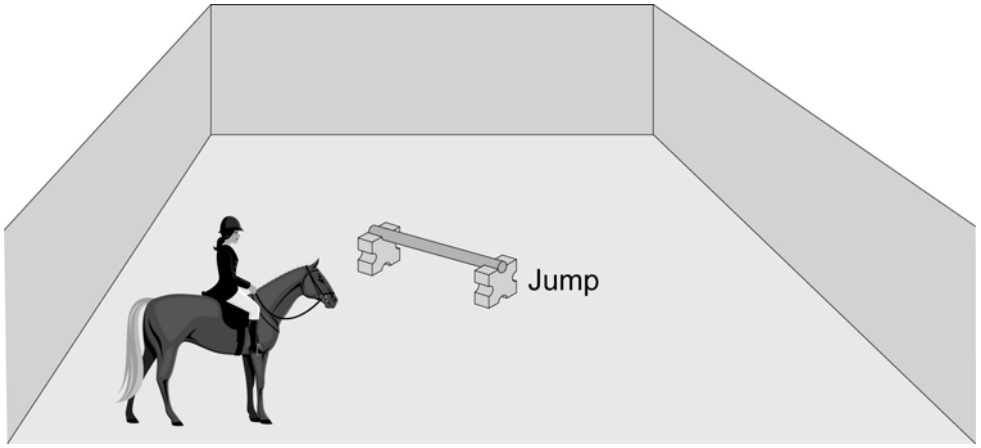
$$\square$$

(2 marks)

11

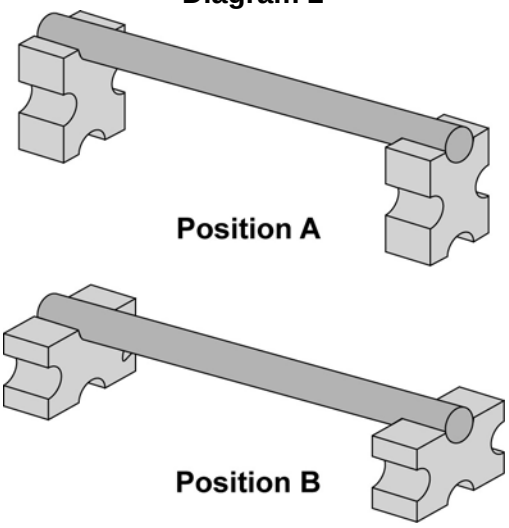
7 **Diagram 1** shows a horse rider in a jumping arena.

Diagram 1



The jump has a pole support that can be in either position **A** or position **B**, giving two different jumping heights, as shown in **Diagram 2**.

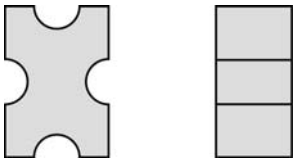
Diagram 2



7 (a) (i) **Diagram 3** shows a front and side view of the pole support in position **A**.

Draw an **X** on both views in **Diagram 3** so that the centre of the **X** is at the *centre of mass* of the pole support.

Diagram 3



Front View Side View

(1 mark)

7 (a) (ii) Explain why the pole support is more stable in position **B** than in position **A**.

.....

.....

.....

.....

(2 marks)

Question 7 continues on the next page

7 (b) The combined mass of the horse and rider is 480 kg. As they approach the jump they are moving at 4 m/s.

7 (b) (i) Calculate the kinetic energy, in joules, of the horse and rider as they approach the jump.

.....

.....

.....

.....

Kinetic energy = ... J

(2 marks)

7 (b) (ii) Calculate the **maximum** height, in metres, that the centre of mass of the horse and rider can be lifted off the ground when the horse approaches the jump at 4 m/s.

acceleration of free fall = 10 m/s^2

.....

.....

.....

.....

.....

Maximum height = ... m

(3 marks)

8

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

8 (a) In 1929, the astronomer Edwin Hubble observed that the light from galaxies that are moving away from the Earth showed a *red-shift*. Red-shift provides evidence for the theory that the Universe began from a very small initial point.

What name is given to the theory that the Universe began from a very small initial point?

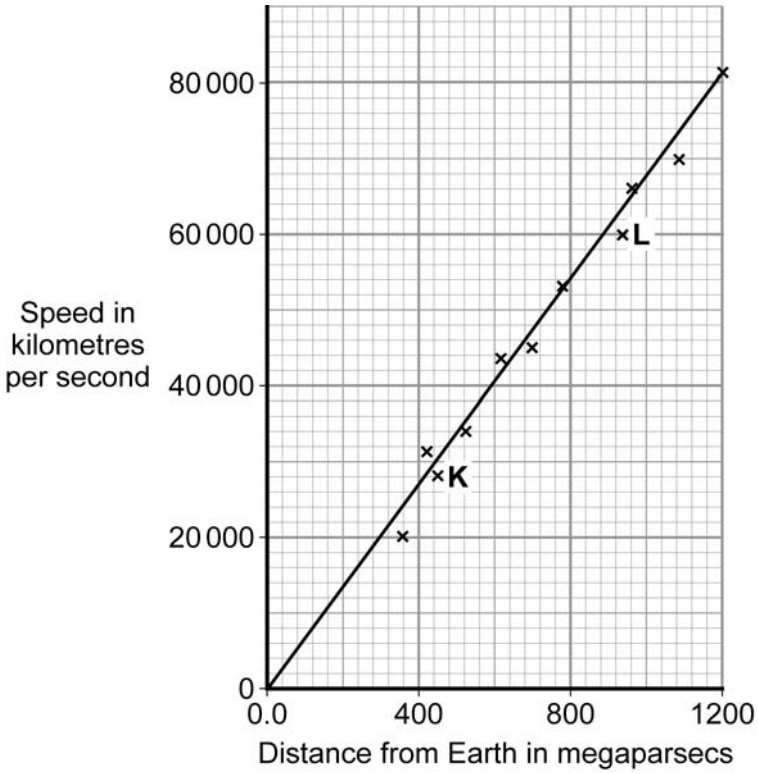
.....

(1 mark)

8 (b) By measuring the red-shift, astronomers are able to calculate the speeds at which galaxies are moving away from the Earth and the distances of these galaxies from the Earth.

The graph shows some of the data calculated by astronomers.

1 megaparsec = 3.09×10^{19} km



The data from two galaxies, **K** and **L**, is included in the graph.

What does the graph tell us about the two galaxies, **K** and **L**, and their red-shifts?

.....

.....

.....

.....

(3 marks)

8 (c) The Andromeda galaxy is not moving away from the Earth. It is actually moving towards the Earth. This means that the light from Andromeda shows a blue-shift.

How do the wavelength and frequency of the light from Andromeda seem to have changed when viewed from the Earth?

.....

.....

.....

.....

(2 marks)

8 (d) Although the early universe contained only hydrogen, it now contains many different elements.

Describe how the different elements were formed.

.....

.....

.....

.....

(2 marks)

8

Turn over for the next question

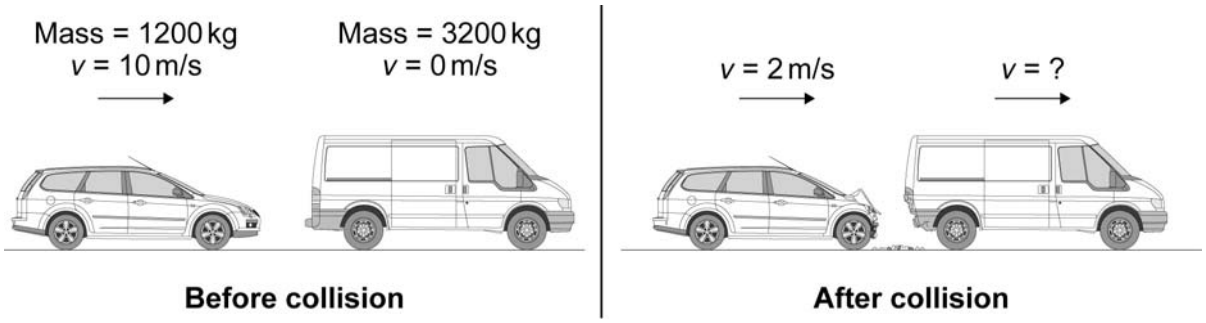
9 (a) Complete the sentence.

In a closed system, when two objects collide, the total momentum of the two objects before the collision is ..... the total momentum of the two objects after the collision.

(1 mark)

9 (b) The diagram shows a car before and after the car collides with a stationary van.

The handbrake of the van is not on.



Use the information in the diagram to calculate the velocity, *v*, in metres per second, with which the van moves forwards after the collision.

.....

.....

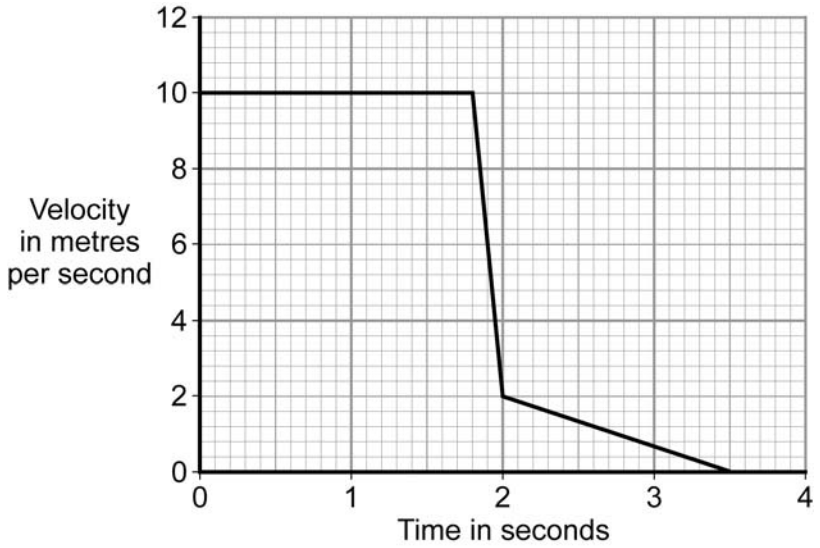
.....

.....

Velocity = ... m/s

(4 marks)

9 (c) The graph shows the velocity of the car before, during and after the collision.



Use the graph to calculate the distance travelled by the car, in metres, after the collision.

.....

.....

Distance = ... m

(2 marks)

9 (d) The collision causes the car driver to jerk forward.

Explain why wearing a seat belt reduces the risk of the driver being injured in the collision.

.....

.....

.....

.....

.....

.....

(3 marks)

10

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED