

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**A215/02**

Unit 2: Modules B4 C4 P4  
(Higher Tier)

Candidates answer on the question paper  
Calculators may be used

**OCR Supplied Materials:**  
None

**Other Materials Required:**

- Pencil
- Ruler (cm/mm)

**Wednesday 20 May 2009  
Afternoon**

**Duration: 40 minutes**



Candidate Forename		Candidate Surname	
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Centre Number							Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- A list of physics equations is printed on page 2.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

## TWENTY FIRST CENTURY SCIENCE EQUATIONS

### Useful Relationships

#### Explaining Motion

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved by the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

#### Electric Circuits

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

#### The Wave Model of Radiation

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

**BLANK PAGE**

**Question 1 starts on page 4.**

**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

- 1 Ben is on holiday. The weather is very hot and dry.



If Ben sits in the sun for too long he could develop heat stroke.

- (a) These statements describe how heat stroke may develop.

They are in the wrong order.

Put the letters **A**, **B**, **C**, **D** and **E** in the boxes in the right order.

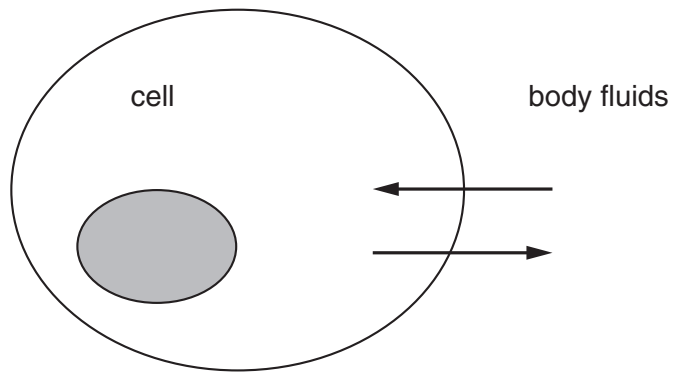
One has been done for you.

- A** sweating is reduced
- B** sweating increases
- C** the body is exposed to high temperatures
- D** dehydration develops
- E** body temperature increases above normal

				<b>E</b>
--	--	--	--	----------

[2]

(b) The diagram shows a cell surrounded by body fluids.



The arrows show movement of chemicals between cells and body fluids.

(i) Name one **gas** that moves into or out of cells by diffusion.

..... [1]

(ii) What is the name of the process that describes the overall diffusion of **water** through a cell membrane?

..... [1]

(c) The kidneys balance the water level in Ben's body.

A hormone called ADH controls the concentration of the urine he produces.

(i) Where is ADH produced?

Put a (ring) around the correct answer.

**adrenal glands      bone marrow      kidneys      pituitary gland** [1]

(ii) Increased production of ADH reduces the volume of urine he produces.

How does each of these changes affect the production of ADH?

Put a tick (✓) in the correct column for each change.

change	more ADH produced	less ADH produced	no change in ADH
ecstasy taken			
decrease in fluid intake			
increase in blood alcohol level			
increase in blood plasma salt concentration			

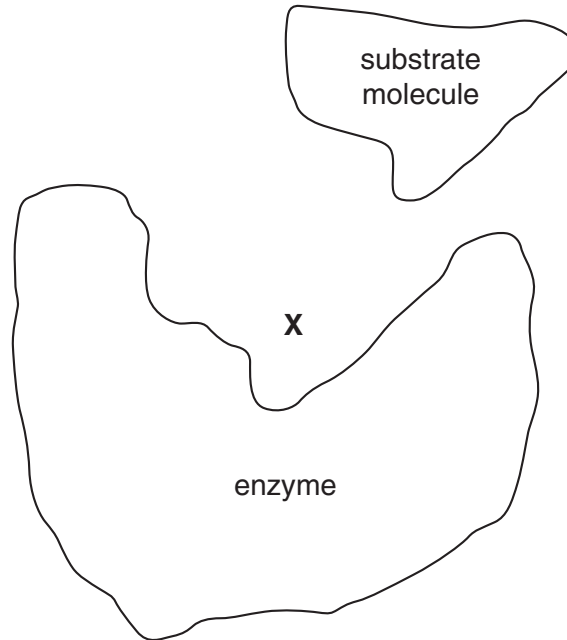
[3]

[Total: 8]  
Turn over

2 Enzymes are molecules that speed up reactions in cells.

Enzymes break down substrate molecules.

The diagram represents the 'lock and key' model of an enzyme.



(a) (i) Complete the sentence.

The area marked **X** on the diagram is called the ..... site.

[1]

(ii) Increases in temperature can **stop** enzyme reactions happening.

Which of these statements explains why?

Put a tick (✓) in the box next to the **best** answer.

The enzymes move closer together.

The enzyme changes shape.

The substrate molecules move too quickly.

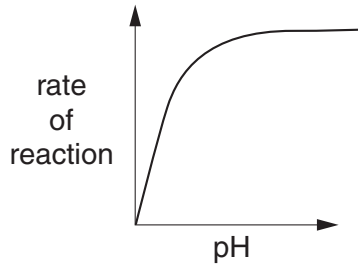
The substrate molecules move further apart.

[1]

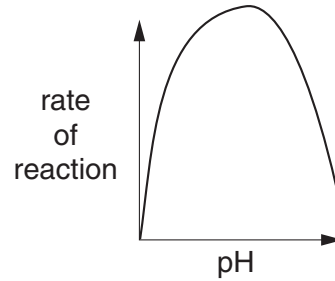
(b) The rate of an enzyme reaction can be shown on a graph.

(i) Which graph, **A**, **B**, **C** or **D**, shows how **pH** affects enzyme activity?

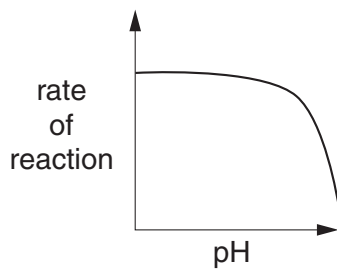
Put a tick (✓) in the correct box.



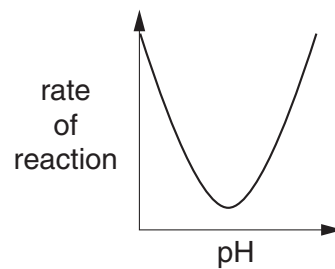
Graph **A**



Graph **B**



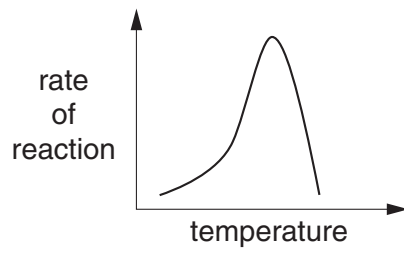
Graph **C**



Graph **D**

[1]

(ii) The graph below shows how the rate of an enzyme reaction varies with temperature.



Which **two** statements, taken together, **explain** why the graph has this shape?

- A** Enzymes speed up reactions.
- B** Increasing temperature increases the collisions between enzyme and substrate.
- C** At high temperatures the enzyme is denatured.
- D** The optimum temperature is the only temperature at which the enzyme works.
- E** Enzymes only work with one substrate.
- F** At high temperatures the rate of reaction falls sharply.

statements ..... and ..... [2]

[Total: 5]



- 3 Sam's sunglasses go darker when sunlight gets brighter.

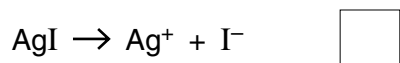
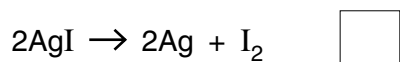
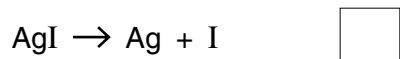
This is caused by silver iodide in the glass.

The formula of silver iodide is AgI.

- (a) The sunglasses go dark in bright light.

In the reaction, silver iodide makes silver **atoms** and iodine **atoms**.

Put a tick (✓) in the box next to the equation for this reaction.



[1]

- (b) An iodine atom has 53 protons in its nucleus.

An iodine atom has a relative atomic mass of 127.

- (i) How many **electrons** are in an iodine atom?

Put a **ring** around the correct answer.

53      74      127      180

[1]

- (ii) Iodine is in group 7 of the Periodic Table and it forms iodide ions.

How does an iodine atom form an iodide ion?

Put a tick (✓) in the box next to the correct answer.

It gains 1 electron.

It gains 7 electrons.

It loses 1 electron.

It loses 7 electrons.

[1]

(iii) The electron arrangement of an iodine atom is 2.8.18.18.7.

Fill in the boxes to show the electron arrangement for an **iodide ion**.

[1]

(iv) Put a tick (✓) in the box next to an electron arrangement of an element which would have similar properties to iodine.

2.7.8.18

18.8.7.2

2.8.18.7

7.18.8.2

[1]

(c) Iodine atoms do not react in the same way as iodide ions.

Here are four students' explanations for this difference.

**Wendy**  
Iodide ions are made of iodine which has already reacted.

**Owen**  
Iodide ions have a different electron arrangement from iodine atoms.

**Pamela**  
Iodine atoms are made of pure chemical, iodide ions aren't.

**Gareth**  
Iodide ions have more energy than iodine atoms.

Who gave the **best** explanation?

answer ..... [1]

[Total: 6]

4 Sodium, potassium, rubidium and caesium are in group 1 of the Periodic Table.

(a) They are all easy to melt.

Here are some of their melting points.

element	melting point
sodium	98 °C
potassium	63 °C
rubidium	39 °C
caesium	

Predict the melting point of caesium.

answer ..... °C [1]

(b) The metals are solids at room temperature.

Why is it important to say 'at room temperature'?

Put a tick (✓) in the box next to the best answer.

Because melting point decreases when room temperature increases.

Because melting point increases when room temperature increases.

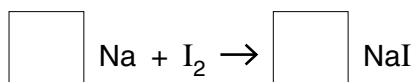
Some of them might melt if the room temperature gets any hotter.

Some of them might melt if the room temperature gets any colder.

[1]

(c) Sodium reacts with iodine to make sodium iodide.

Balance the equation for this reaction.



[1]

[Total: 3]

- 5 NASA plans to send a mobile laboratory to the surface of Mars.



One idea is to use a laser to find out what elements are in Martian rocks.

The laser heats a rock until it vaporises.

The vapour gives out light.

The mobile laboratory then identifies the elements present.

- (a) What is the best way of identifying the elements present in the rock?

Put a tick (✓) in the box next to the **best** answer.

Analyse the spectrum emitted by the vapour.

Photograph broken samples of rock under a microscope.

Find the temperature that the rocks melt at.

Collect the vapour and carry out an automatic titration.

[1]

(b) Previous Mars missions have found traces of sodium chloride.

Liquid sodium chloride conducts electricity.

Solid sodium chloride does not.

Draw **one** line linking the two statements which best explain this.

Liquid and solid sodium chloride  
are both made of ions.

or

Only the solid is made of ions.

or

Only the liquid is made of ions.

or

Liquid and solid sodium chloride  
are both made of atoms.

Ions can move through the  
liquid and the solid.

or

Ions can move through the  
solid only.

or

Ions can move through the  
liquid only.

[2]

(c) Some scientists think that there is also some sodium nitride,  $\text{Na}_3\text{N}$ , on Mars.

Sodium nitride contains sodium ions and nitride ions.

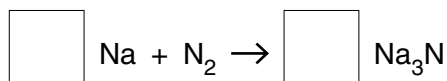
(i) Put a **ring** around the symbol for a nitride ion.

$\text{N}^{3+}$      $\text{N}^{2+}$      $\text{N}^+$      $\text{N}^-$      $\text{N}^{2-}$      $\text{N}^{3-}$

[1]

(ii) The sodium nitride is formed when sodium reacts with nitrogen.

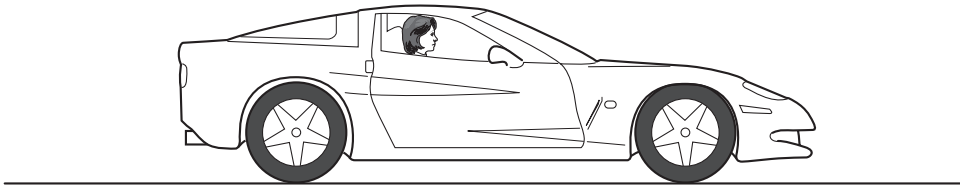
Write numbers in the boxes to balance the equation for the reaction.



[2]

[Total: 6]

- 6 Sylvia drives her car along a horizontal road at a constant speed of 12 m/s.



- (a) Sylvia has a mass of 65 kg.

How is her kinetic energy calculated?

Put a (ring) around the correct answer.

$65 \times 12 \text{ J}$

$0.5 \times 65 \times 12 \times 12 \text{ J}$

$0.5 \times 65 \times 12 \text{ J}$

$0.5 \times 65 \times 12 \times 2 \text{ J}$

[1]

- (b) Put a (ring) around the correct word to complete these sentences.

Friction is a type of **energy** **force** **power**.

The car moves at a steady speed against friction.

The kinetic energy of the car **decreases** **increases** **stays the same**.

This is because the engine of the car is able to do **energy** **power** **work** on the car.

[1]

- (c) The wheels apply a backwards force of 500 N on the road when the car is moving at a constant speed of 12 m/s.

How much **work** do the wheels do on the car when it moves a distance of 10 m?

Put a (ring) around the correct answer.

**120 J**

**500 J**

**5000 J**

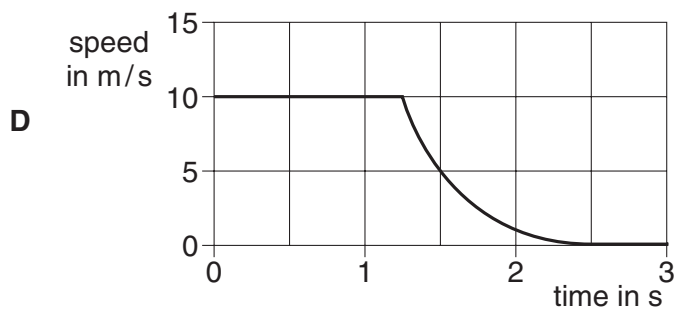
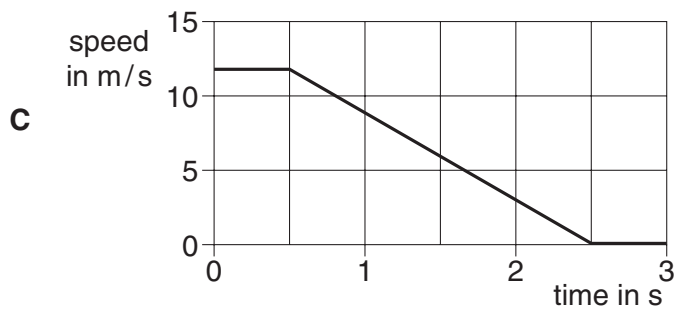
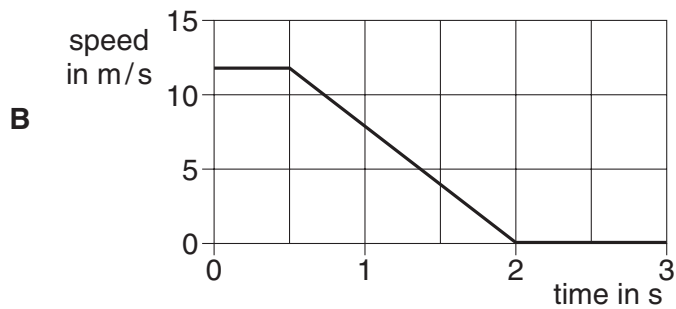
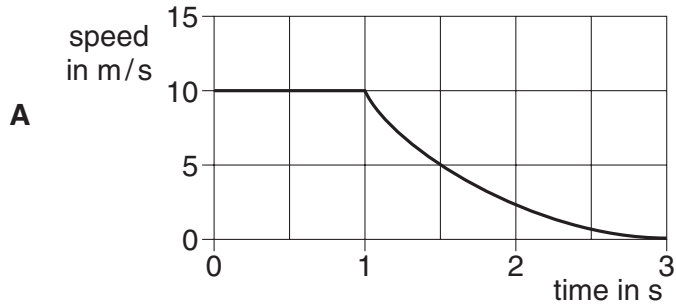
**6000 J**

[1]

(d) Sylvia spots a child in the road ahead and stops the car.

Her speed drops steadily from 12 m/s to 0 m/s in 2 s.

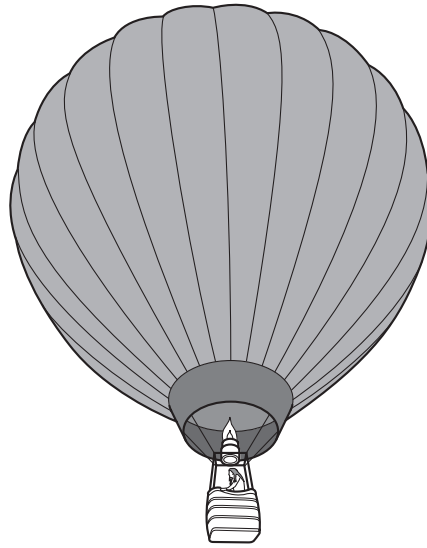
Which of these speed-time graphs, **A**, **B**, **C** or **D**, shows this?



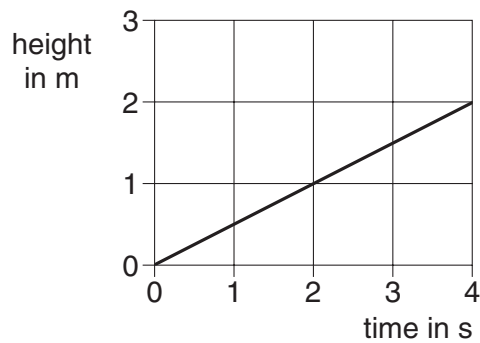
answer ..... [1]

[Total: 4]

7 Serena goes up in a hot air balloon.



(a) The graph shows the balloon leaving the ground at a steady speed.



How fast is she moving upwards?

Put a (ring) around the correct answer.

0.5m/s

2m/s

4m/s

8m/s

[1]

(b) The weight of the balloon pulls it down.

Another force, the upthrust, pushes it up.

Put a tick (✓) in the box next to the statement which shows that these forces must be the **same** size.

The balloon contains hot air.

The weight of the balloon stays the same.

The balloon has a constant speed.

The air around the balloon is heavy.

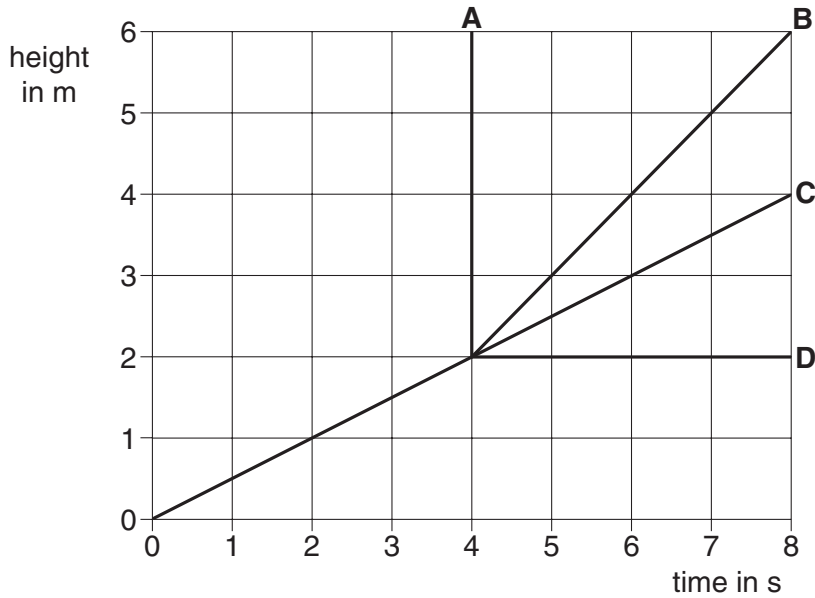
[1]



(c) After 4 seconds Serena releases a sandbag.

This suddenly doubles the speed of the balloon.

Which of the lines, **A**, **B**, **C** or **D**, shows the new, constant speed of the balloon?



correct line ..... [1]

(d) The sandbag falls a distance of 2 m to the ground.

It has a weight of 100 N and a mass of 10 kg.

(i) How much gravitational potential energy does it lose before it hits the ground?

Put a **ring** around the correct answer.

- 5 J      20 J      50 J      200 J**

[1]

(ii) If there is no friction, how fast is the sandbag moving when it hits the ground?

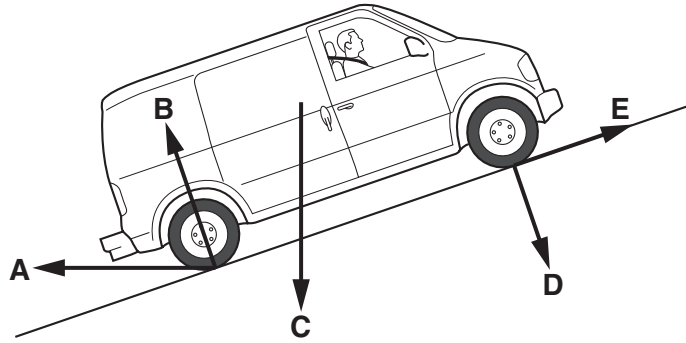
Put a **ring** around the correct answer.

- 6.3 m/s      20 m/s      40 m/s      2000 m/s**

[1]

[Total: 5]

8 Alan parks his van on a hill.



(a) Which force, **A**, **B**, **C**, **D** or **E**, shows the friction on the parked van?

friction force arrow ..... [1]

(b) Here are some statements about the forces on the parked van.

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

All of the forces cancel each other out.

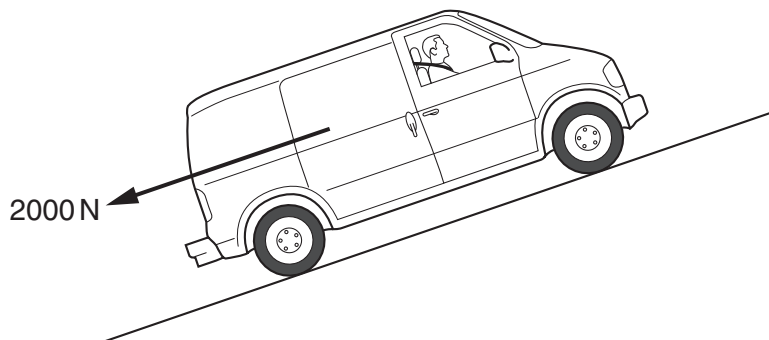
The reaction and weight have the same size.

The reaction acts at right angles to the road surface.

The friction is equal to the weight minus the reaction.

[1]

(c) The brakes fail and the van rolls down the hill.



The resultant force pulling the van down the hill is 2000 N.

The van has a mass of 1000 kg.

How fast is the van moving 5 seconds after the brakes fail?

Put a **ring** around the correct answer.

5 m/s

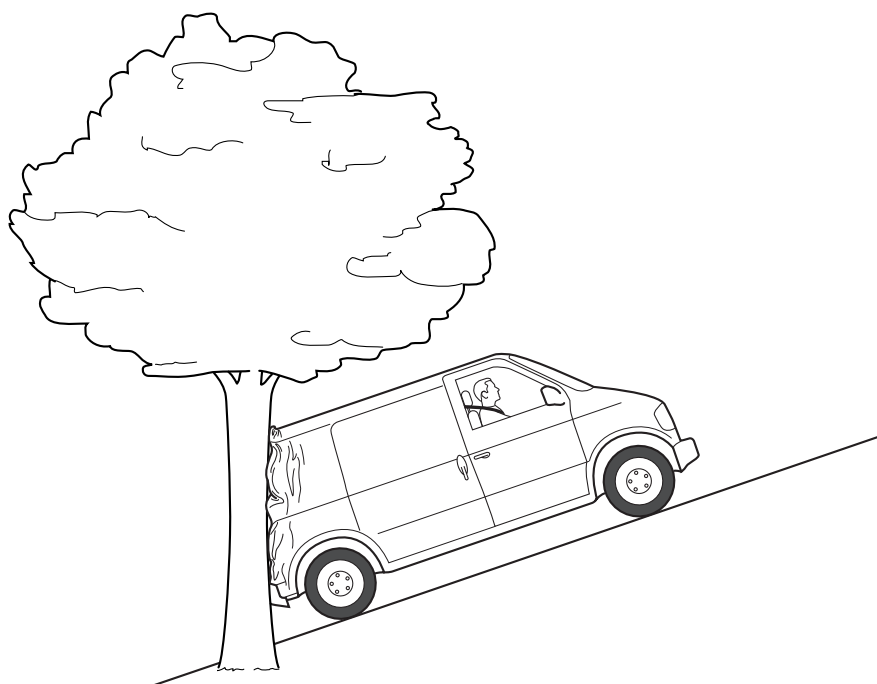
10 m/s

20 m/s

40 m/s

[1]

(d) The van hits a tree and stops.



Alan is unhurt because the back of the van crumples.

Complete the sentences. Choose words from the list.

**force      gravitational      heat      kinetic      momentum      weight**

When the van crumples it slowly absorbs the ..... energy.

Alan loses his ..... slowly, so the ..... acting on him is too small to damage him.

[2]

[Total: 5]

**END OF QUESTION PAPER**

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