Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A215/02

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

UNIT 1: Modules B4 C4 P4
Higher Tier

WEDNESDAY 20 MAY 2009: Afternoon

DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper
Calculators may be used

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (KN) OV90903 13007/1

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.
- 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.
- 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 4 and 5.
- The Periodic Table is printed on the back page.

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved by the force

change in energy = work done

change in GPE = weight × vertical height difference

kinetic energy = $\frac{1}{2}$ × mass × [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

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

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

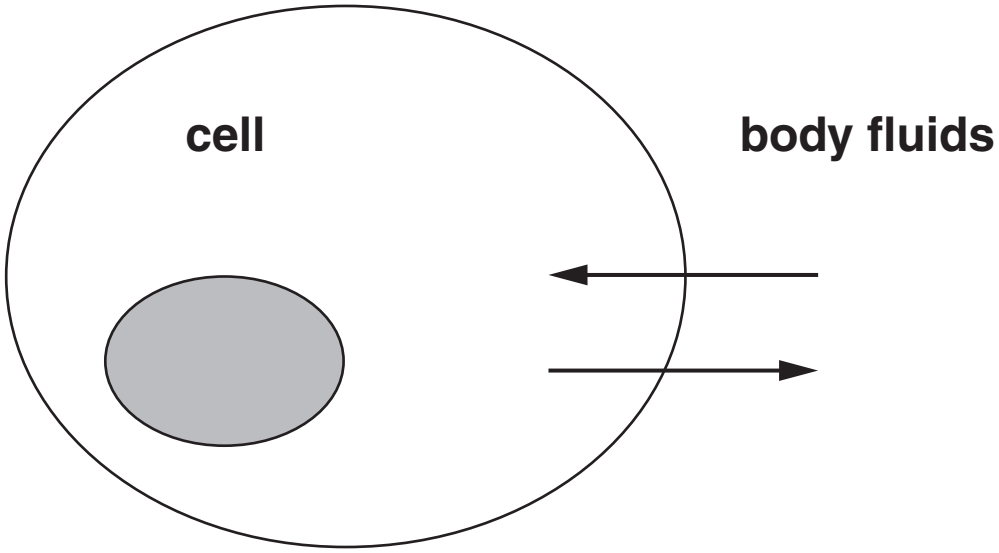
D dehydration develops

E body temperature increases above normal

				E

[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 <u>GAS</u> that moves into or out of cells by diffusion.

_____ **[1]**

(ii) What is the name of the process that describes the overall diffusion of <u>WATER</u> 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			

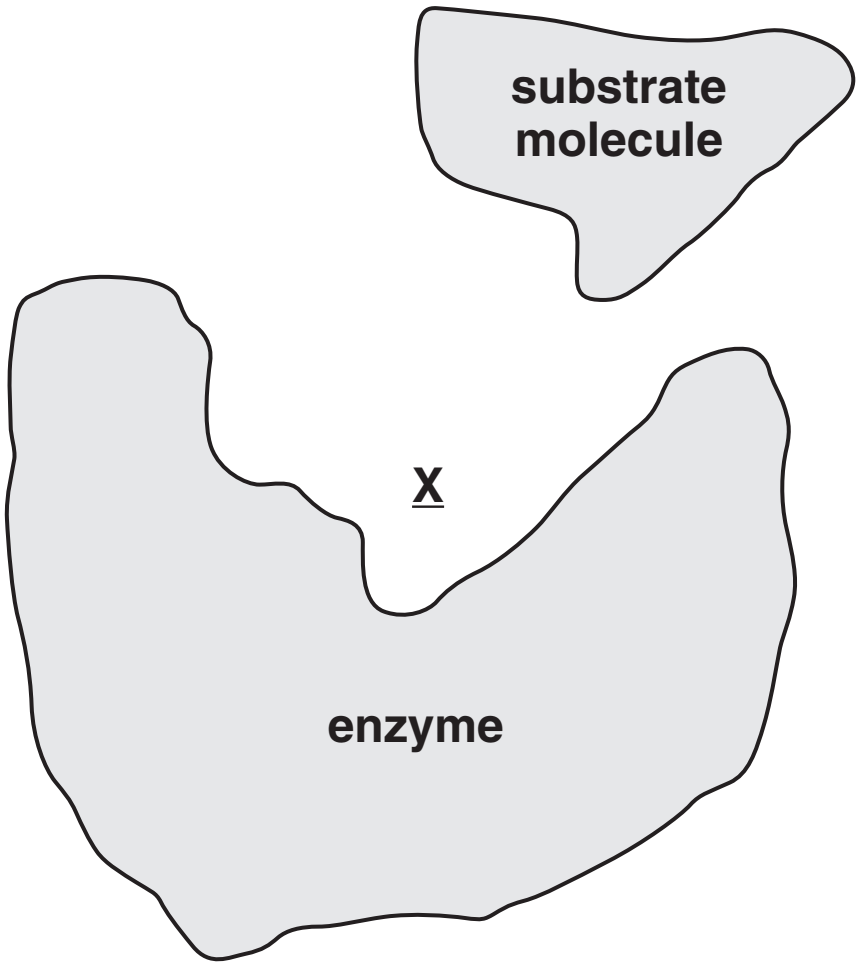
[3]

[Total: 8]

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 <u>STOP</u> enzyme reactions happening.**

Which of these statements explains why?

Put a tick (✓) in the box next to the <u>BEST</u> answer.

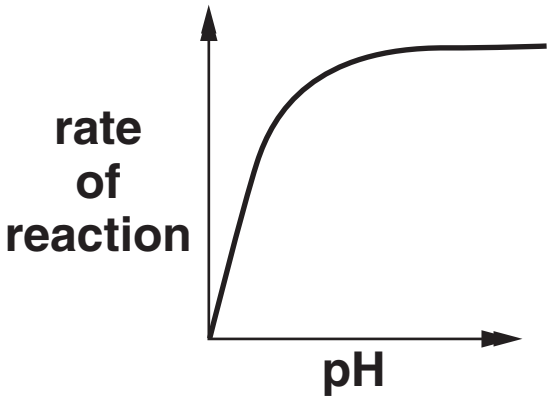
The enzymes move closer together.	☐
The enzyme changes shape.	☐
The substrate molecules move too quickly.	☐
The substrate molecules move further apart.	☐

[1]

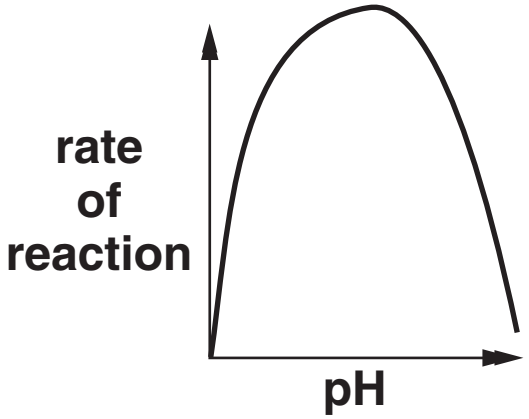
(b) The rate of an enzyme reaction can be shown on a graph.

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

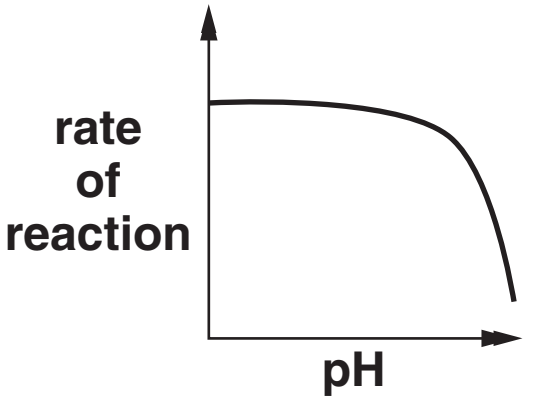
Put a tick (✓) in the correct box.



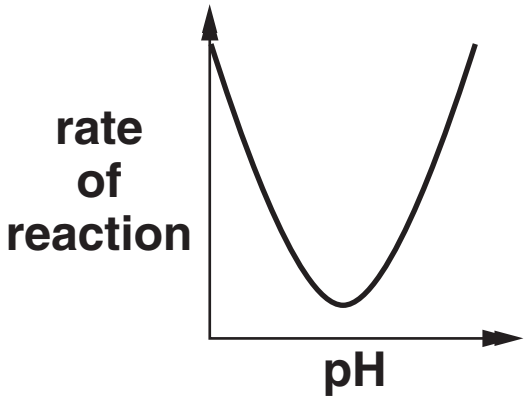
Graph A ☐



Graph B ☐



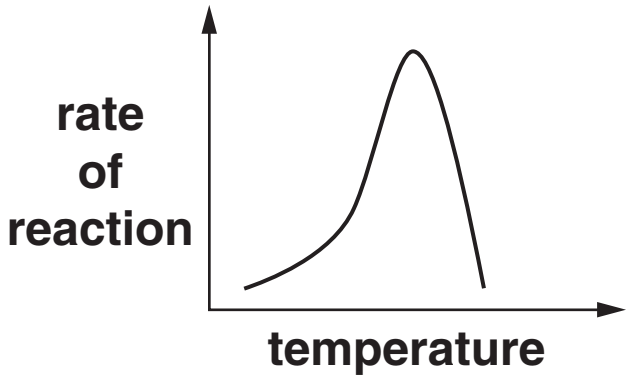
Graph C ☐



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.

$AgI \rightarrow Ag + I$ ☐

$2AgI \rightarrow 2Ag + I_2$ ☐

$Ag + I \rightarrow AgI$ ☐

$AgI \rightarrow Ag^+ + I^-$ ☐

[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.

☐ Na + I_2 → ☐ NaI

[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 <u>ONE</u> line linking the two statements which best explain this.

Liquid and solid sodium chloride are both made of ions.	Ions can move through the liquid and the solid.
or	or
Only the solid is made of ions.	Ions can move through the solid only.
or	or
Only the liquid is made of ions.	Ions can move through the liquid only.
or	
Liquid and solid sodium chloride are both made of atoms.	

[2]

(c) Some scientists think that there is also some sodium nitride, Na_3N, on Mars.

Sodium nitride contains sodium ions and nitride ions.

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

N^{3+} N^{2+} N^{+} N^{-} N^{2-} 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.

$\square\ Na + N_2 \rightarrow \square\ Na_3N$

[2]

[Total: 6]

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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 × 12 J

0.5 × 65 × 12 × 12 J

0.5 × 65 × 12 J

0.5 × 65 × 12 × 2 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

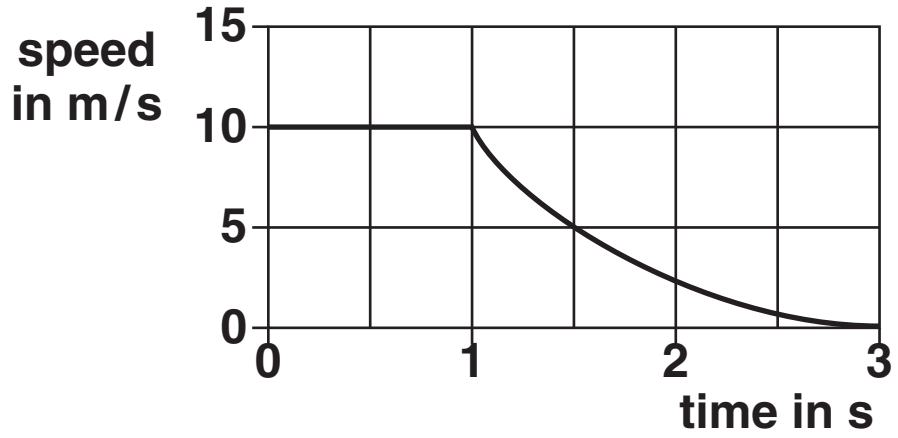
[1]

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

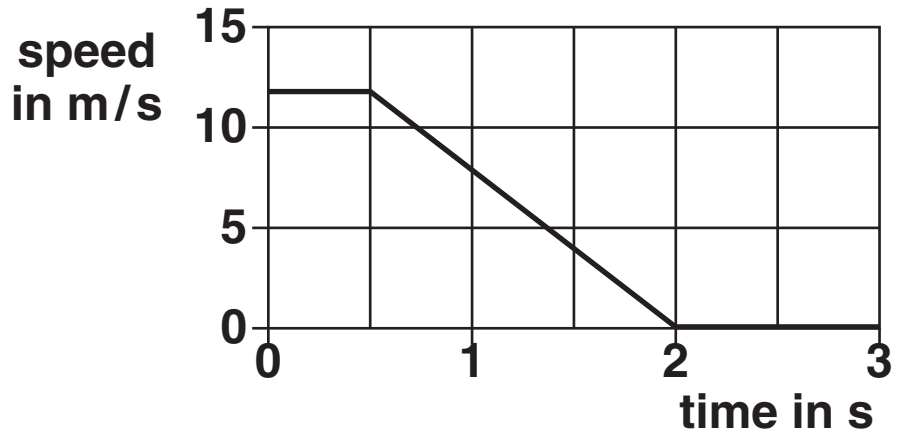
Her speed drops steadily from 12 m/s to 0 m/s in 2 s.

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

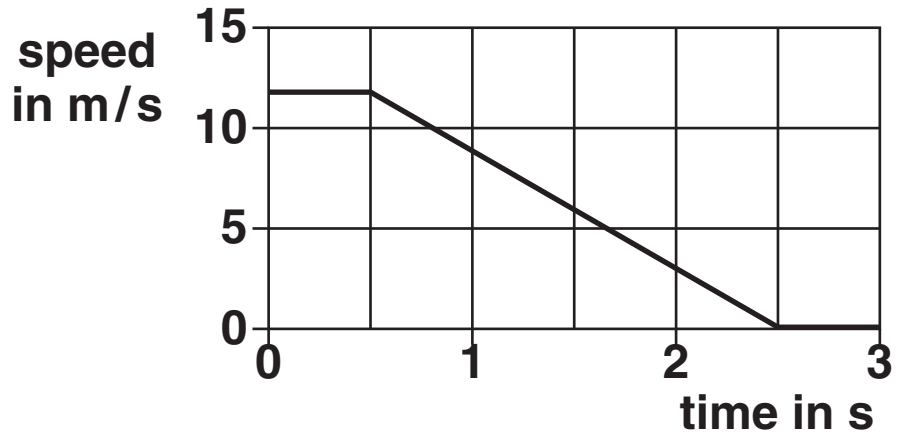
A



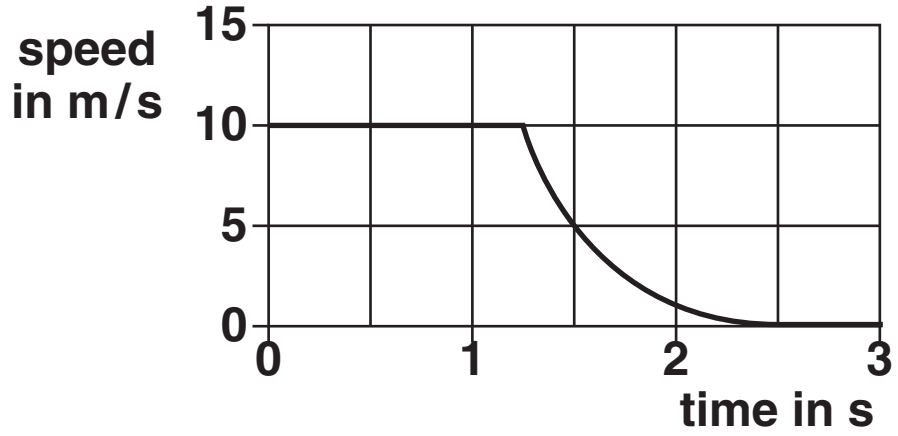
B



C



D

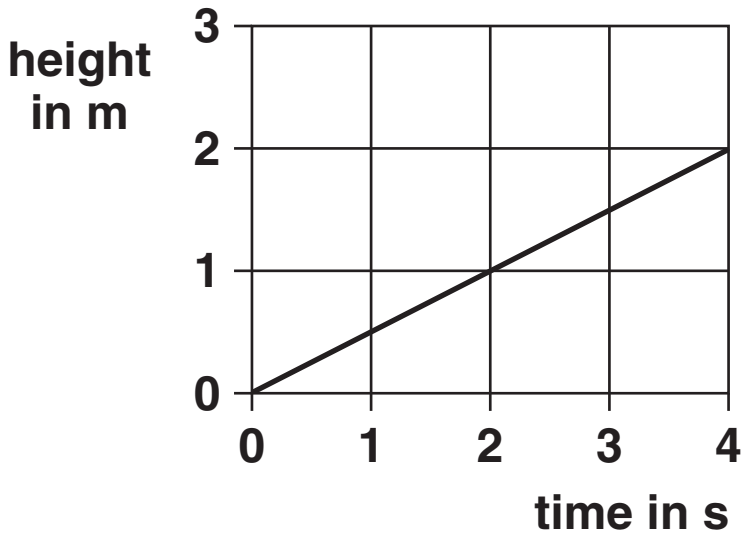


answer _____ [1]

[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.

0.5 m/s 2 m/s 4 m/s 8 m/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 <u>SAME</u> size.

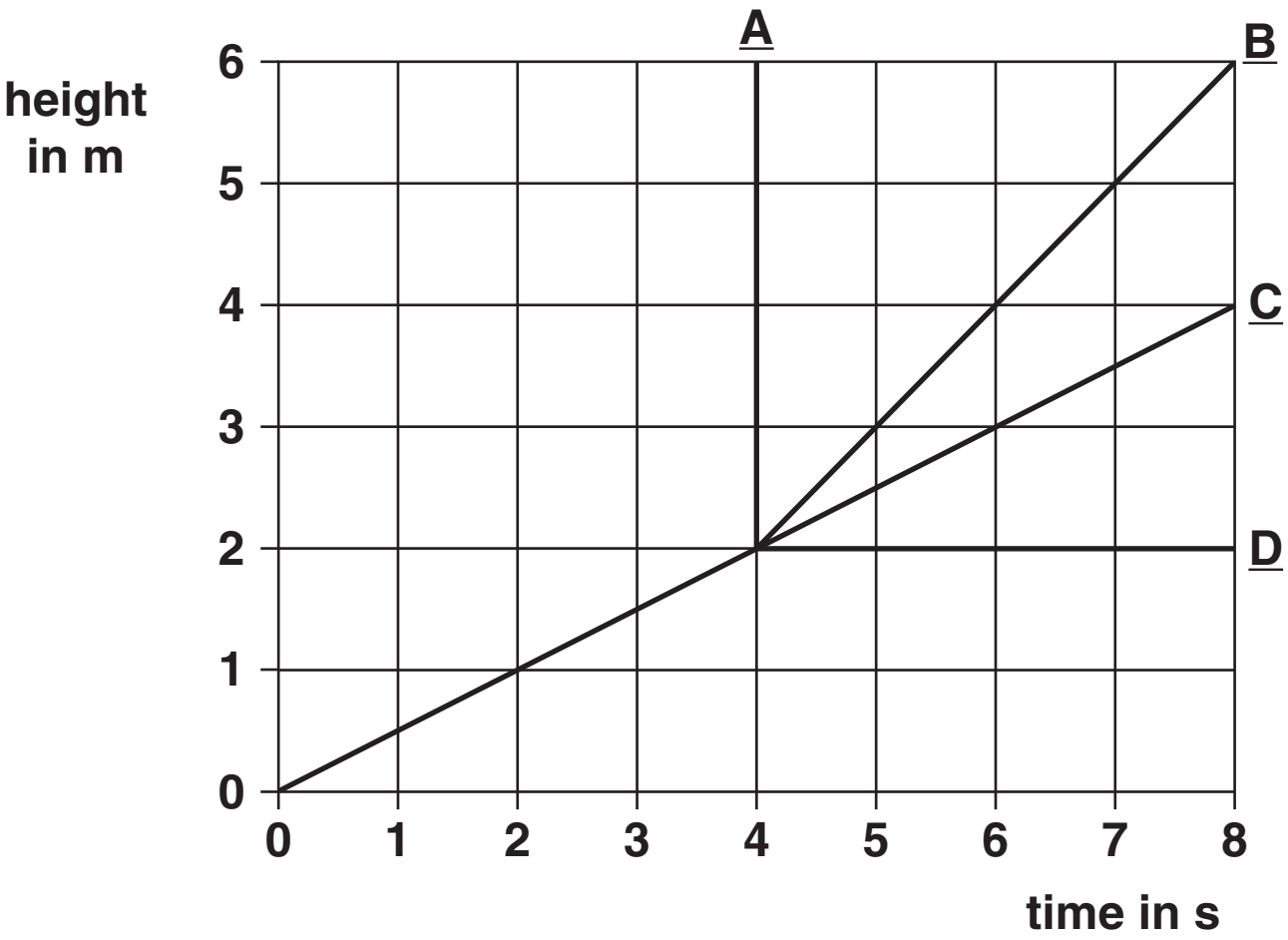
The balloon contains hot air.	☐
The weight of the balloon stays the same.	☐
The balloon has a constant speed.	☐
The air around the balloon is heavy.	☐

[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 20J 50 J 200 J

[1]

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

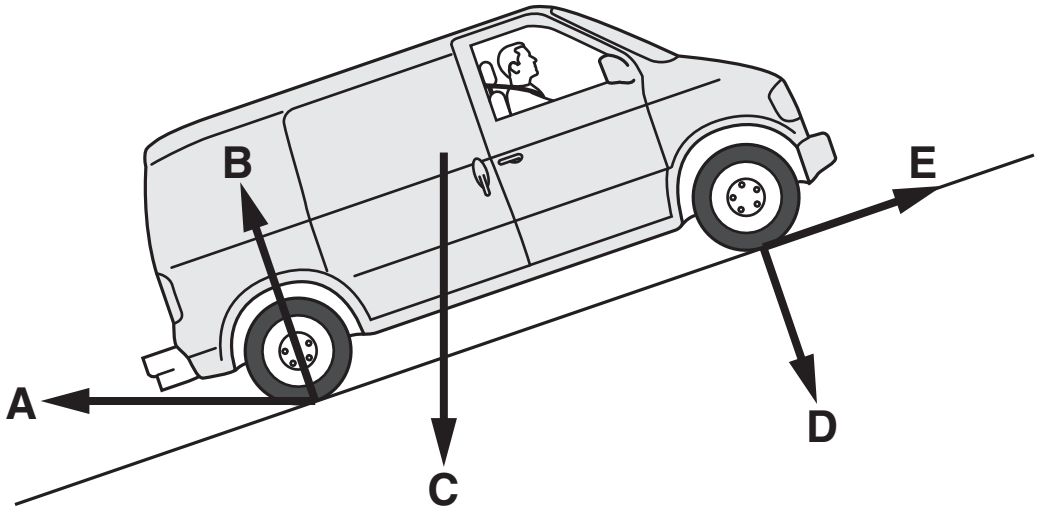
Put a (ring) around the correct answer.

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. ☐

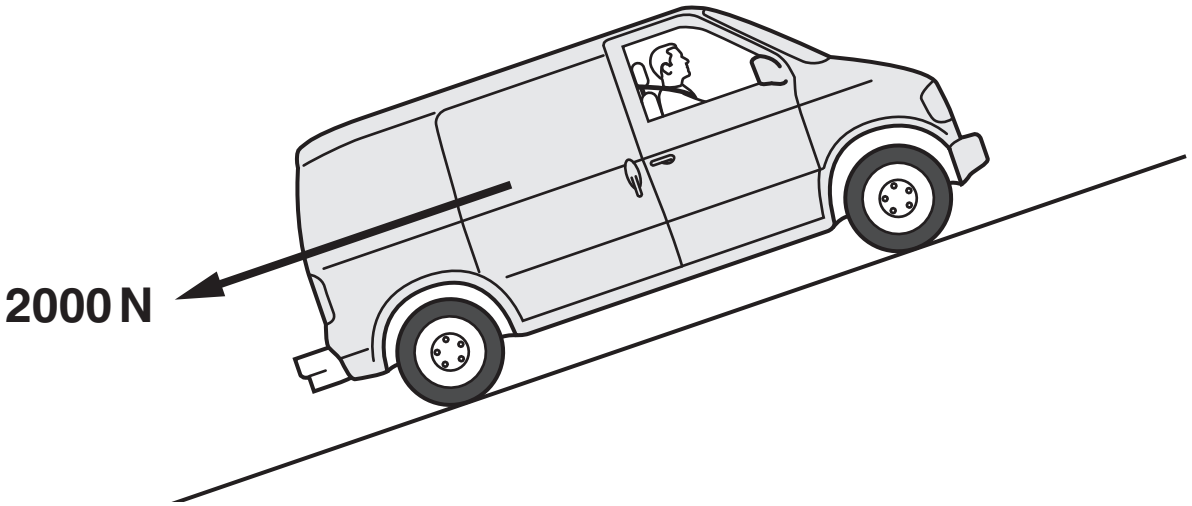
The reaction and weight have the same size. ☐

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

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.