

Candidate forename						Candidate surname					
Centre number						Candidate number					

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A151/02

TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A

Modules B4 C4 P4 (Higher Tier)

MONDAY 21 MAY 2012: Morning

DURATION: 1 hour

plus your additional time allowance

MODIFIED ENLARGED

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil


Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer ALL the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil () .
- The number of marks is given in brackets [] at the end of each question or part question.
- A list of physics equations is printed on pages 4 and 5.
- An enlarged copy of the Periodic Table will be provided.
- The total number of marks for this paper is 60.

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

THE EARTH IN THE UNIVERSE

$$\text{distance} = \text{wave speed} \times \text{time}$$

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

SUSTAINABLE ENERGY

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

$$\text{power} = \text{voltage} \times \text{current}$$

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

EXPLAINING MOTION

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

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

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

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

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

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

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

ELECTRIC CIRCUITS

power = voltage × current

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

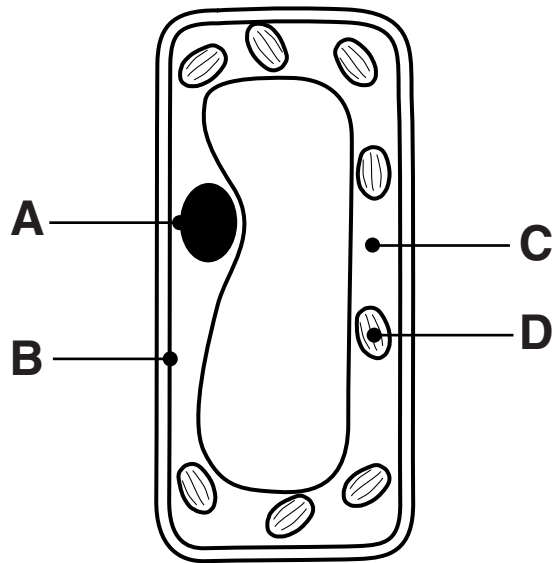
$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$

RADIOACTIVE MATERIALS

energy = mass × [speed of light in a vacuum]²

Answer ALL the questions.

1 (a) Here is a diagram of a cell from the leaf of a plant.



The structures shown in the diagram have different roles in photosynthesis.

Identify the structures and describe their roles in photosynthesis.



The quality of written communication will be assessed in your answer.

[6]

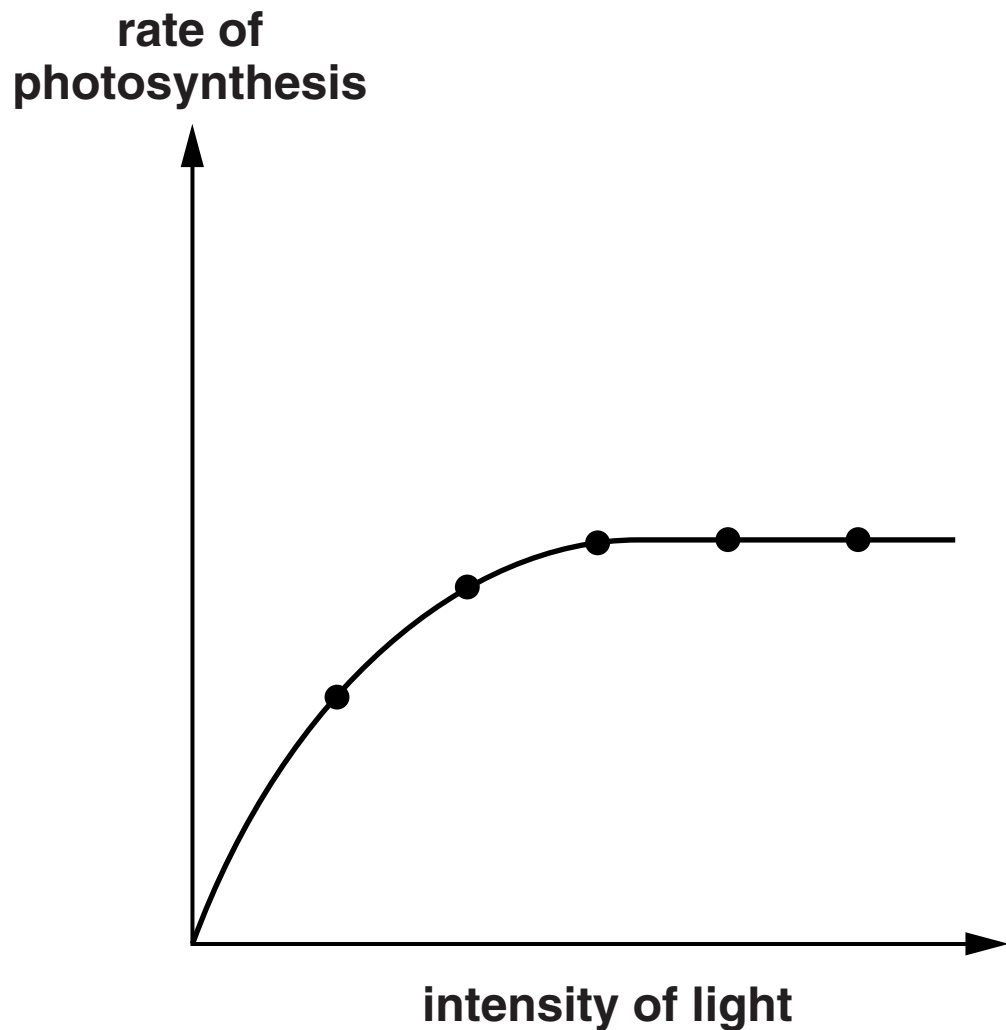
**(b) Paul is investigating photosynthesis.
He grows several samples of cress.**

**(i) Paul uses the mass of the cress as a measure
of the rate of photosynthesis.**

**Why can the mass of cress be used as a
measure of the rate of photosynthesis?**

[2]

- (ii) Each sample receives a different intensity of light.
Paul plots his results in a graph.



Paul repeats his experiment but this time gives all of the plants **MORE** carbon dioxide. His results are different from the first experiment.

Draw a line on the graph to show how the results would be different.

[1]

- (iii) Paul has to control factors other than the amounts of light and carbon dioxide in this experiment.

Suggest one OTHER factor and explain how failing to control it would affect his experiment.

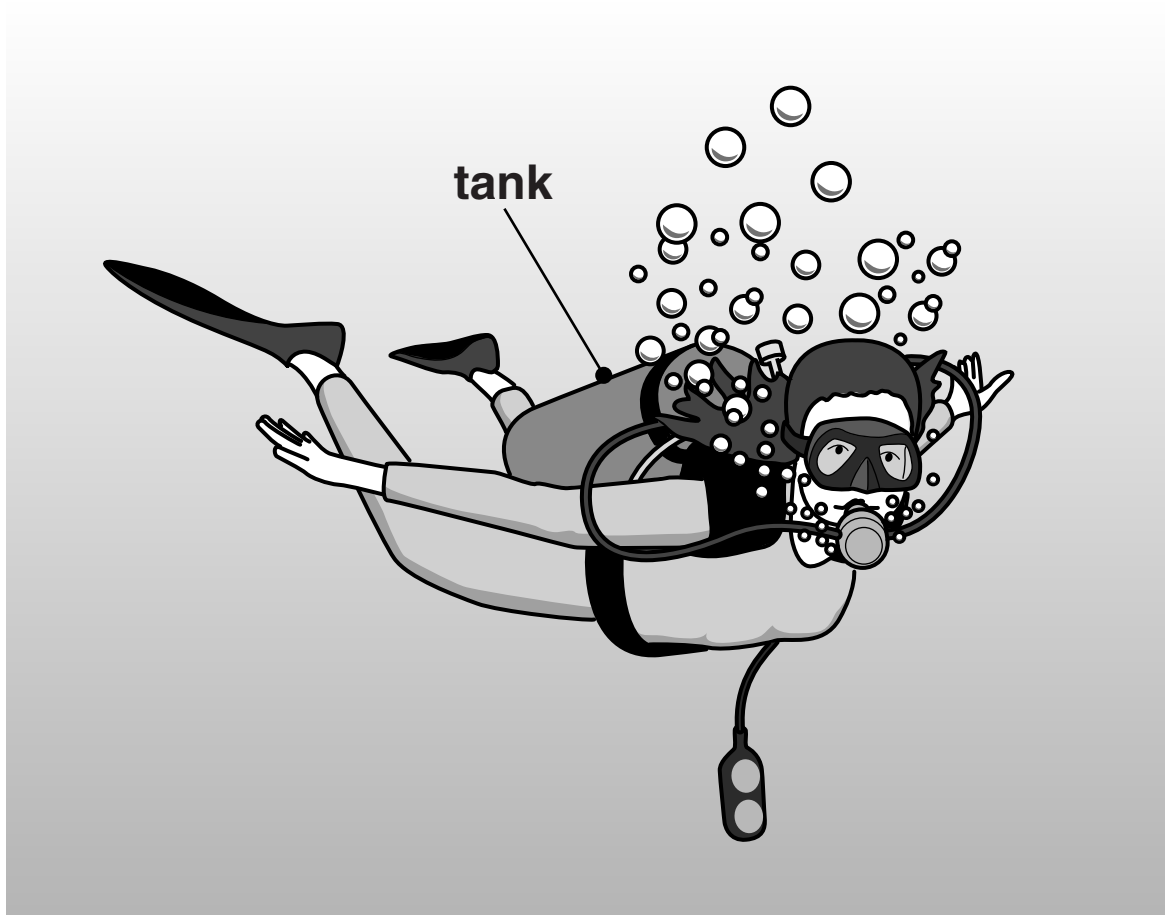
factor _____

explanation _____

_____ [2]

[Total: 11]

2 Caitlin goes scuba diving.



When she is at rest on the surface, Caitlin breathes in 4 litres of air every minute.

- (a) (i) She takes 5% of this air into her blood as oxygen.

What volume of oxygen from the air enters Caitlin's blood in one minute?

answer _____ litres

[1]

- (ii) Caitlin has a full tank of air, which gives her **30** litres of OXYGEN.

How long will she be able to stay under water if she uses oxygen at the same rate?

answer _____ minutes [2]

- (b) While she is underwater, Caitlin swims against strong currents.

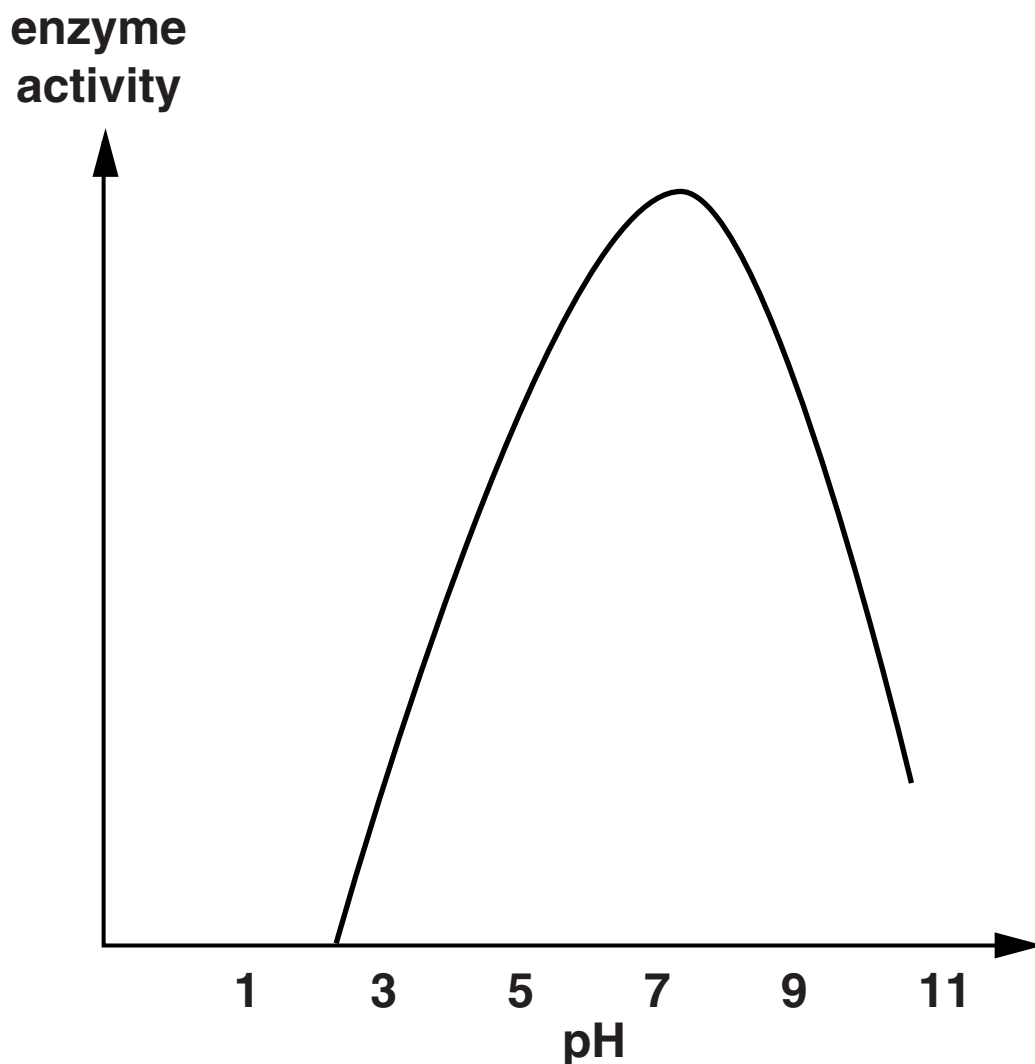
Use your knowledge of respiration to explain how this could affect how long she can now stay under water.

[2]

[Total: 5]

- 3 This question is about enzymes.
Enzyme **Y** helps to digest some foods in the small intestine.
Some people are unable to make enzyme **Y** in their small intestines.

- (a) The activity of enzyme **Y** at different **pH** levels is measured.
The results are plotted on this graph.



Food goes through the stomach before it enters the small intestine.
The **pH** in the stomach is **2**.

The pH in the small intestine is 7.5.

Use the graph to explain if scientists should develop a pill containing enzyme Y for people to swallow.

Use ideas about the active site in your answer.

[3]

- (b) One group of scientists claim to be the first to repair cells that can not make enzyme Y. They make their claim in a newspaper.

Other scientists question this claim.

What are the reasons for this?

Put ticks (✓) in the boxes next to the TWO correct answers.

It costs a lot of money to make enzymes.

☐

The work has not been peer reviewed.

☐

The cells were taken from a rat.

☐

The process has only been done in single cells.

☐

The enzyme is only **95%** effective.

☐

The test has not been repeated by other scientists.

☐

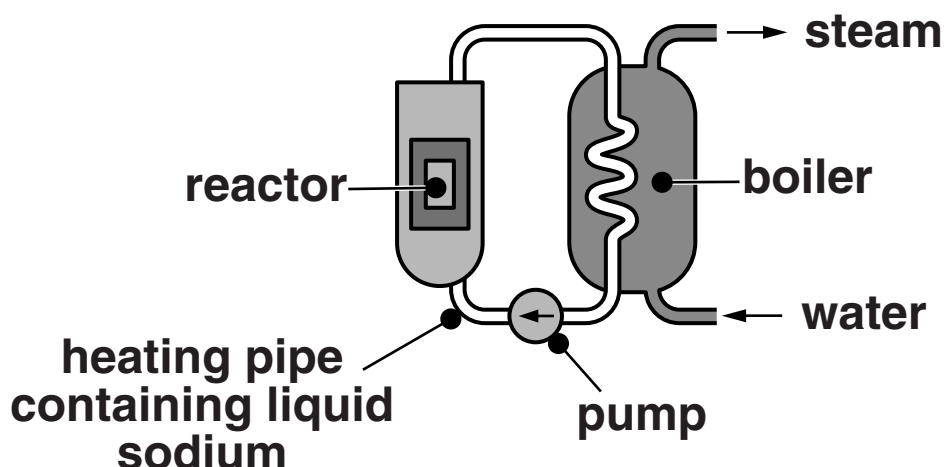
[1]

[Total: 4]

- 4 In some nuclear power stations sodium is used to carry the heat from the reactor to the boiler. Heat from the hot sodium turns the water in the boiler into steam.

heat from hot reactor goes into sodium

heat from hot sodium goes into water boiler



The sodium must be melted so that it can flow through the pipes.

Sodium is a Group **1** metal.
Here is some information about Group **1** metals.

	Melting point	Boiling point
Lithium	180 °C	1342 °C
Sodium		883 °C
Potassium	63 °C	760 °C

(a) Estimate the melting point of sodium.

answer _____ °C

[1]

(b) A student thinks that using sodium in a nuclear power station might cause problems.

He has two REASONS

- the melting point makes it difficult to use sodium in pipes
- the sodium might be dangerous if the pipes leak inside the boiler.

Suggest and explain what these problems might be.

[3]

(c) When sodium reacts it makes a positive ion.

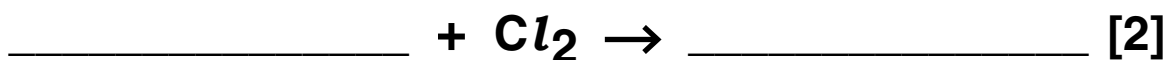
What happens when an atom changes into a POSITIVE ion?

[1]

[Total: 5]

5 Sodium reacts with chlorine to make sodium chloride.

(a) Complete the balanced symbol equation for this reaction.



(b) A group of students describe what happens when sodium chloride crystals dissolve in water.

Some of these statements are true, and some are false.

Put a tick (✓) in the correct box next to each statement to show if it is TRUE or FALSE.

When sodium chloride crystals dissolve in water ...

	TRUE	FALSE
... the ions move freely.	<input type="checkbox"/>	<input type="checkbox"/>
... the ions turn into atoms.	<input type="checkbox"/>	<input type="checkbox"/>
... hydrogen gas is made.	<input type="checkbox"/>	<input type="checkbox"/>
... the solution conducts electricity.	<input type="checkbox"/>	<input type="checkbox"/>
... the ions separate from each other.	<input type="checkbox"/>	<input type="checkbox"/>
... the crystals float on the surface and react.	<input type="checkbox"/>	<input type="checkbox"/>

[2]

- (c) Salt crystals from sea water are impure. They contain sodium chloride and also compounds of other elements.

We can find out what other elements are present by using a spectroscope.

Explain how the results of spectroscopy show that sodium and other elements are present.

[3]

- (d) Complete the table about the particles in an atom of sodium.

Use the Periodic Table to help you.

Particle	Number in an atom of sodium
electron	<hr/>
proton	<hr/>
<hr/>	12

[2]

[Total: 9]

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QUESTION 6 BEGINS ON PAGE 20

- 6 Mendeleev put all the elements that he knew about into a Periodic Table.
He used increasing atomic mass as the basis for his table.

Here is part of Mendeleev's table.

	1	2		3	4	5	6	7
	1							
atomic mass	1							
symbol	H							
	7	9		11	12	14	16	19
	Li	Be		B	C	N	O	F
	23	24		27	28	31	32	35.5
	Na	Mg		Al	Si	P	S	Cl
	39	40		A	B	75	79	80
	K	Ca				As	Se	Br
	85	88		115	119	122	128	127
	Rb	Sr		In	Sn	Sb	Te	I

Mendeleev made important decisions about

- positions **A** and **B**
- elements **Te** and **I**.

Describe these decisions and explain why Mendeleev took them.

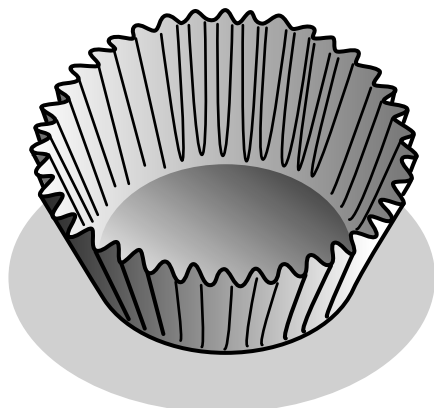


The quality of written communication will be assessed in your answer.

[6]

[Total: 6]

- 7 Jim investigates how paper cake cases fall through the air.
He thinks that they fall at a steady speed.**



**Jim releases the same cake case at different heights above the floor.
He times how long it takes for it to reach the floor.
Here are some of his results.**

Height of drop in m	Time of fall in s	Speed in m/s	Average speed in m/s
1.00	2.00	0.500	<hr/>
1.00	2.05	0.488	
1.00	1.90	0.526	
0.50	1.07	0.467	0.489
0.50	0.98	<hr/>	
0.50	1.02	0.490	

(a) (i) Complete the TWO gaps in the table. [2]

(ii) Use the data in the table to comment on Jim's idea that the cake cases fall at a steady speed.

[1]

(b) For each height, Jim measures the time of fall more than once.

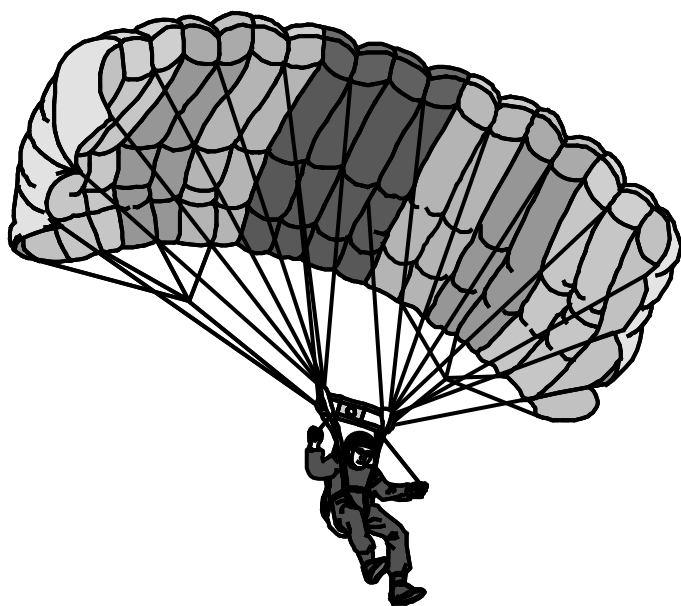
The measurements are not the same.

Suggest TWO reasons why.

[2]

[Total: 5]

- 8 Ben uses a parachute to fall to the ground at a safe, steady speed.



Discuss the energy transfers which allow Ben and his parachute to drop at a steady speed.



The quality of written communication will be assessed in your answer.

[6]

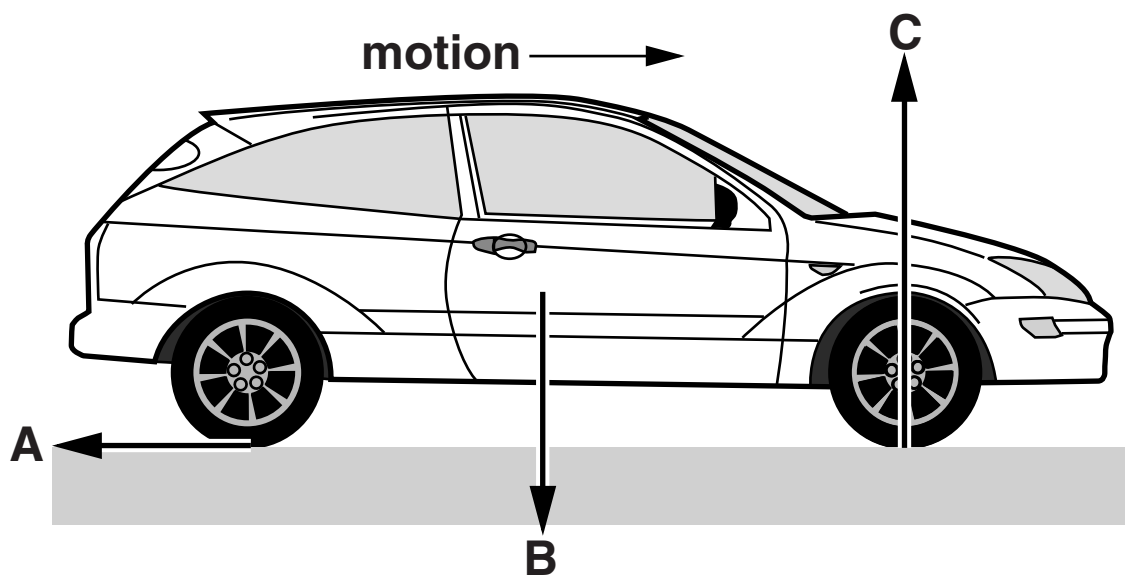
[Total: 6]

- 9 A car with a mass of **800 kg** travels at a speed of **15 m/s** on level ground.

(a) Calculate the braking force needed to stop the car in **2 s**.

force = _____ N [2]

(b) The brakes are applied so that all four wheels lock and the car skids to a halt.
The diagram shows three forces, **A**, **B** and **C**, acting on the car as it slows down.



(i) Draw lines to link each FORCE with its NAME.

force	name
A	mass of entire car
	weight of entire car
B	friction on one wheel from the ground
	reaction on one wheel from the ground
C	force on one wheel from the engine

[2]

(ii) Here are some relationships between the forces while the car is skidding to a stop on level ground.

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

$$B - C = A$$

☐

$$B - 4C = 0$$

☐

$$B + C = A$$

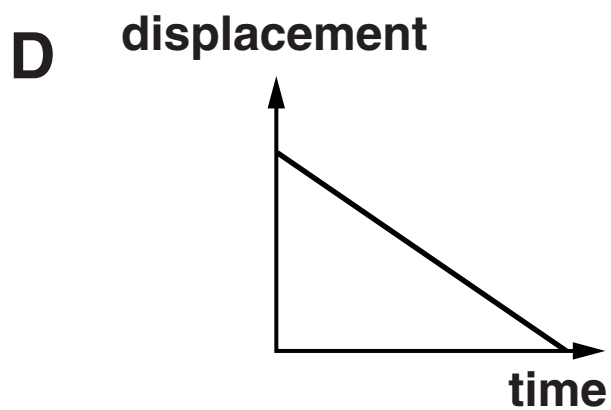
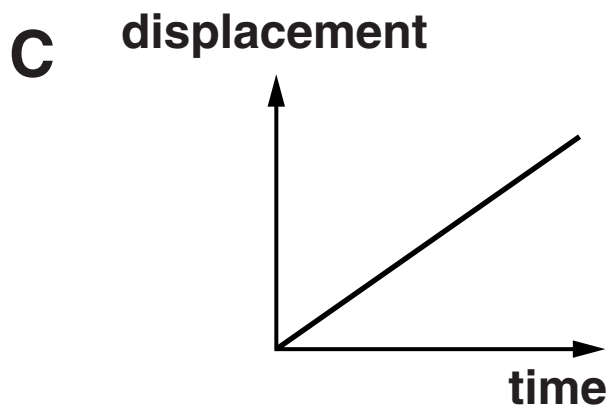
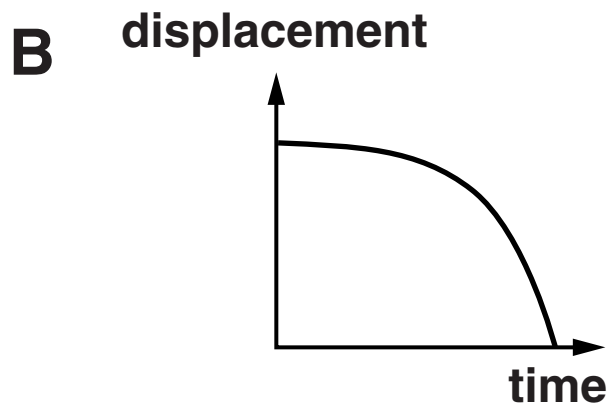
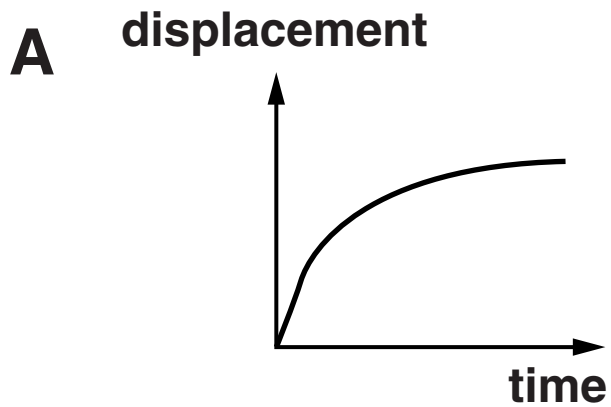
☐

$$A + B + C = 0$$

☐

[1]

(c) Here are four possible displacement-time graphs for the car as it slows down.



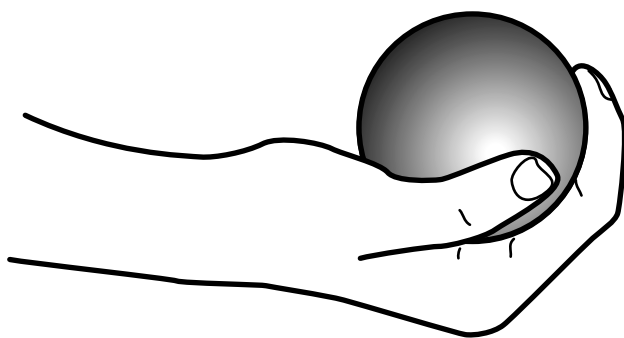
Which graph, **A**, **B**, **C** or **D**, is correct for a car which is slowing down?

answer _____

[1]

[Total: 6]

- 10 Jill throws a ball into the air.
She catches it when it comes down again.**



- (a) Here are some statements about the ball in its flight.**

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

The resultant force on the ball is downwards throughout the flight.

☐

The resultant force on the ball is zero at the highest point of the flight.

☐

Air resistance and gravity act in the same direction throughout the flight.

☐

The resultant force on the ball is upwards as it rises and downwards as it falls.

☐

[1]

- (b) When Jill catches the ball, she allows her hand to move down with the ball.**

Explain what effect this action has on the impact force of the ball on her hand.

[2]

[Total: 3]

END OF QUESTION PAPER

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