

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**A151/01**

**TWENTY FIRST CENTURY SCIENCE**  
**ADDITIONAL SCIENCE A**

**Modules B4 C4 P4 (Foundation Tier)**

**MONDAY 14 JANUARY 2013: Morning**

**DURATION: 1 hour**  
**plus your additional time allowance**

**MODIFIED ENLARGED 18pt**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.**  
**A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**

**Periodic Table (inserted)**

**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 4–5.
- An enlarged copy of the Periodic Table is inserted.
- 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**

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

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

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

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

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

$$\text{amount of energy transferred} = \text{work done}$$

$$\frac{\text{change in gravitational potential energy}}{\text{}} = \text{weight} \times \frac{\text{vertical height difference}}{\text{}}$$

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

## **ELECTRIC CIRCUITS**

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

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

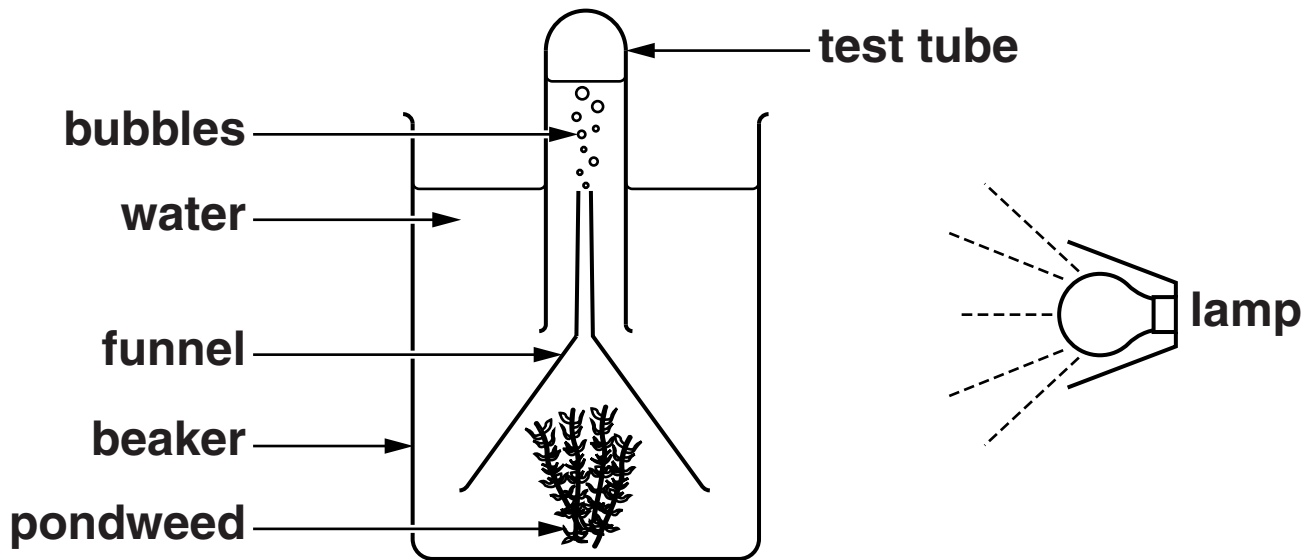
$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

## **RADIOACTIVE MATERIALS**

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

**Answer ALL the questions.**

**1 Anette does an experiment with pondweed.**



**The pondweed is photosynthesising.**

**(a) What is the name of the gas produced by photosynthesis?**

\_\_\_\_\_ [1]

**(b) Anette changes the distance of the lamp from the pondweed.**

**At each distance she counts the number of bubbles of gas collected in 5 minutes.**

**She does the experiment three times at each distance.**

**Here are her results.**

<b>DISTANCE FROM LAMP TO PONDWEED IN cm</b>	<b>NUMBER OF BUBBLES PRODUCED IN 5 MINUTES</b>			
	<b>EXPERIMENT 1</b>	<b>EXPERIMENT 2</b>	<b>EXPERIMENT 3</b>	<b>AVERAGE</b>
<b>10</b>	<b>21</b>	<b>21</b>	<b>18</b>	
<b>15</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>15</b>
<b>20</b>	<b>11</b>	<b>14</b>	<b>11</b>	<b>12</b>
<b>25</b>	<b>10</b>	<b>8</b>	<b>12</b>	<b>10</b>

**(i) Suggest why there was variation in the results at 10 cm from the lamp.**

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[1]

- (ii) Calculate the average (mean) number of bubbles collected with the lamp at a distance of 10 cm.**

**average = \_\_\_\_\_ [1]**

- (iii) What conclusion about photosynthesis can Anette make from these data?**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [1]



- (c) Anette wants to investigate the effect of SHADE on plants growing in a field.

The field contains a large tree.

She thinks that as she walks away from the tree, the number of the plants growing will change.

She plans an investigation to test this idea.

- (i) What items of equipment should she use to collect data for this investigation?

Put rings around the TWO correct answers.

LAMP

LIGHT METER

PH METER

QUADRAT

STOP WATCH

[1]

- (ii) Suggest what she would expect to find, and explain your answer.

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[2]

[TOTAL: 7]

## **2 Nathan is weightlifting.**

**The four statements describe what happens.**

- **His muscles respire AEROBICALLY as he stands on the stage before lifting the weights.**
- **He can stand for a long time.**
- **His muscles respire ANAEROBICALLY when he lifts the weights.**
- **He can not hold the weights for a long time.**

**Use your knowledge of the differences between AEROBIC and ANAEROBIC respiration to explain these statements.**



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

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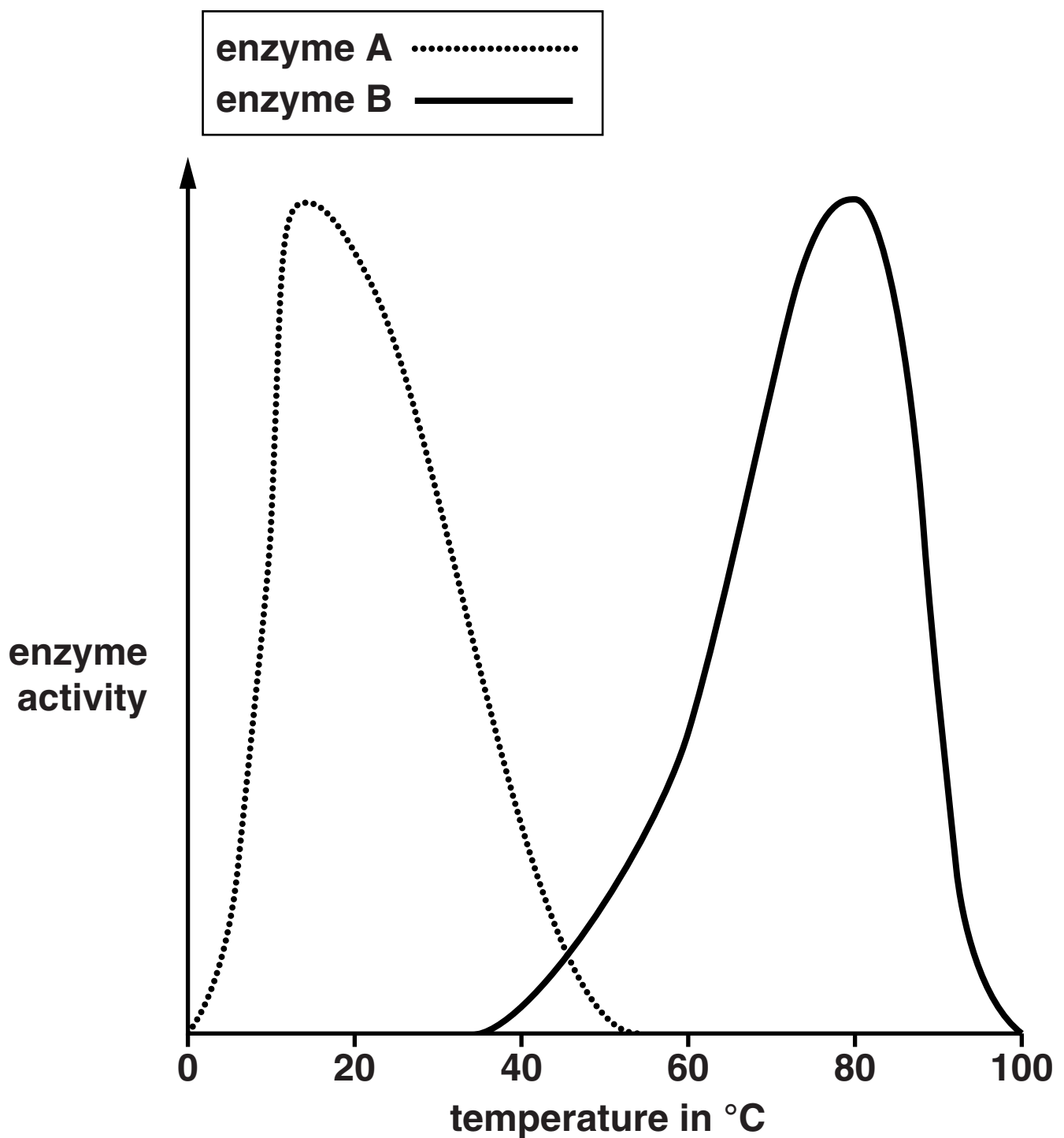
**[6]**

**[TOTAL: 6]**

3 Corinne does an experiment using two different enzymes, A and B.

She records the activity of each enzyme at different temperatures.

She plots her results on a graph.



**(a) Both enzymes work on the same chemical.**

**One of the enzymes is from a bacterium that lives in hot springs at 80 °C.**

**The other enzyme is from a bacterium that lives in the sea at 14 °C.**

**Corinne concludes that enzyme A comes from the bacterium that lives in the sea.**

**Explain why Corinne's conclusion is correct.**

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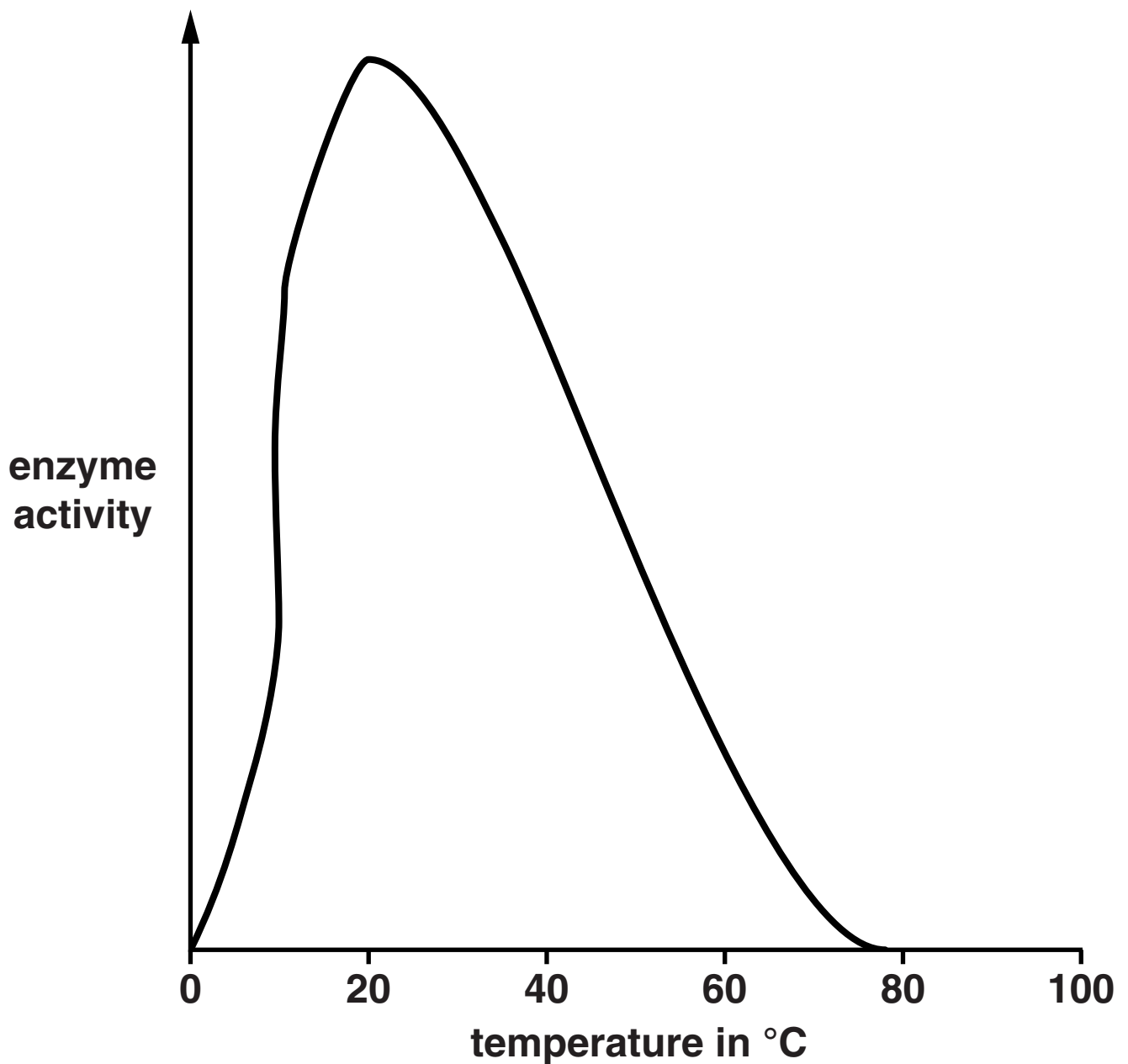
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**[2]**

**(b) Corinne does the same experiment with a different enzyme, C.**

**This enzyme works on the same chemical as enzymes A and B.**

**She plots her results on a graph.**



**She finds that enzyme C works best at 20°C.**

**She heats a fresh sample of the enzyme to 100°C and then cools it back to 20°C.**

**She then uses this enzyme in an experiment.**

**Suggest and explain what the result of the experiment would be.**

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[2]

**[TOTAL: 4]**

**4 Ryan investigates osmosis in pieces of raw potato.**

**He cuts six cylinders of potato, each with the same shape and mass.**

**He places each potato cylinder in a sugar solution.**

**Each solution contains the same sugar, but at a different concentration.**

**After 2 hours, he records the mass of each cylinder and calculates its percentage (%) change in mass.**

**Here are his results.**

<b>CONCENTRATION OF SUGAR SOLUTION IN g/dm<sup>3</sup></b>	<b>PERCENTAGE (%) CHANGE IN MASS OF POTATO CYLINDER</b>
<b>0</b>	<b>+7</b>
<b>20</b>	<b>+3</b>
<b>40</b>	<b>+1</b>
<b>60</b>	<b>−1</b>
<b>80</b>	<b>−4</b>
<b>100</b>	<b>−6</b>



**(a) Put a ring around the correct choice to complete each sentence.**

**The membrane of the potato cells is**

**NOT / PARTIALLY / COMPLETELY permeable.**

**The concentration of the cell contents is between**

**0 AND 20 /**

**40 AND 60 /**

**80 AND 100 g/dm<sup>3</sup>.**

**In osmosis, the overall movement of water is from one solution to**

**A MORE CONCENTRATED /**

**AN EQUALLY CONCENTRATED /**

**A LESS CONCENTRATED solution.**

**[2]**

**(b) Ryan suggests ways to get a better estimate of the concentration of the cell contents.**

**Put a tick (✓) in the box next to Ryan's best suggestion.**

**Record the change in mass in g instead of percentage change.** ☐

**Repeat the experiment using different sizes of potato cylinder.** ☐

**Repeat the experiment with concentrations greater than  $100\text{ g/dm}^3$  of sugar.** ☐

**Repeat each concentration and calculate the average percentage change in mass.** ☐

**Soak the potato in pure water before the experiment.** ☐

**[1]**

**[TOTAL: 3]**

- 5 The chemical industry uses large amounts of chlorine. Some of this chlorine is transported across the country by lorry.

(a) The lorry has this hazard symbol on the side.



What does the symbol mean?  
Put a ring around the correct answer.

CORROSIVE

EXPLOSIVE

FLAMMABLE

TOXIC

[1]

- (b) Chlorine is made up of molecules.  
Which diagram shows a molecule of chlorine?

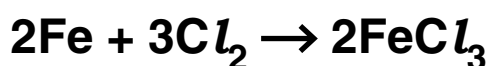
Put a ring around the correct answer.



[1]

- (c) The chlorine is carried in a steel tank.  
Steel is mainly iron.  
The chlorine does not react with the tank unless there is a very hot fire.

At high temperatures, iron reacts with chlorine gas to make small crystals.



- (i) Write a word equation for this reaction.

\_\_\_\_\_ [2]

- (ii) Put a tick (✓) in the correct box to show if each substance is a solid, a liquid or a gas at room temperature and pressure.

	SOLID	LIQUID	GAS
$\text{Cl}_2$			
Fe			
$\text{FeCl}_3$			

[2]

- (d) Here is some information about one atom of chlorine.  
Complete the table.

atomic (proton) number	17
relative mass	35
number of electrons	

[1]

[TOTAL: 7]

**6 Sodium and potassium are both Group 1 metals. Sodium is a reactive metal.**

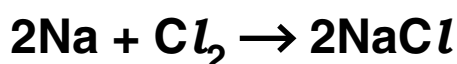
**(a) Sodium reacts with chlorine to make sodium chloride.**

**The formula for sodium chloride is NaCl.**

**Look up the symbol for potassium in the Periodic Table and write the formula for potassium chloride.**

\_\_\_\_\_ [1]

**(b) The equation for the reaction between sodium and chlorine is**



**How many atoms of sodium react with one molecule of chlorine?**

\_\_\_\_\_ [1]

**(c) The electronic configuration of sodium is 2.8.1**

**What do the numbers 2.8.1 tell you?**

\_\_\_\_\_  
\_\_\_\_\_ [2]

**(d) Melted sodium chloride conducts electricity.  
Use ideas about particles to explain why.**

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**[3]**

**[TOTAL: 7]**

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**TURN OVER FOR QUESTION 7**

**7 X, Y and Z are three elements in the Periodic Table.**

<b>ELEMENT</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
<b>atomic (proton) number</b>	<b>less than 12</b>	<b>12</b>	<b>more than 12</b>
<b>melting point in °C</b>	<b>1278</b>	<b>649</b>	<b>839</b>
<b>density in g/cm<sup>3</sup></b>	<b>1.85</b>	<b>1.74</b>	<b>1.54</b>
<b>reaction with water</b>	<b>no reaction</b>	<b>slow</b>	<b>rapid</b>
<b>formula of chloride</b>	<b><math>\text{XCl}_2</math></b>	<b><math>\text{YCl}_2</math></b>	<b><math>\text{ZCl}_2</math></b>
<b>formula of oxide</b>	<b><math>\text{XO}</math></b>	<b><math>\text{YO}</math></b>	<b><math>\text{ZO}</math></b>
<b>melting point of oxide in °C</b>	<b>2550</b>	<b>2852</b>	<b>2554</b>

**Jo thinks that X, Y and Z are in the same Group.  
Ann thinks that they are not.**

**Who is right?**

**Use evidence from the table to support your answer.**





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

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**[6]**

**[TOTAL: 6]**

- 8 Tom investigates the effect of different road surfaces on how quickly a car can stop.

The same car is tested on three different road surfaces.

The brakes are applied when the car is going at 15 m/s.

Tom measures the time between applying the brakes and the car coming to a halt.

Here are his results.

ROAD SURFACE	TIME IN SECONDS FOR THE CAR TO STOP FROM 15 m/s			
	FIRST TRY	SECOND TRY	THIRD TRY	MEAN
GripMore	1.9	2.1	2.0	2.0
SlideLess	1.7	2.0	2.3	2.0
StopSure	2.4	2.6	2.2	2.4

- (a) Tom does three time measurements for each road surface.

He never gets the same result for the same road surface.

Suggest why.

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[1]

- (b) Tom decides that StopSure is the worst surface. Give TWO reasons why he can't be sure which of GripMore or SlideLess is the best.**

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[2]

- (c) Suggest TWO things Tom could do to help him to decide which is the best surface.**

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[2]

**[TOTAL: 5]**

**9 Jim ignites a firework rocket and stands well back.**

**The rocket emits a lot of hot gas in a downwards direction.**

**Use ideas of forces to explain how this makes the rocket move upwards.**



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

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**[6]**

**[TOTAL: 6]**

**10 Here is some data for three different electric cars.**

<b>NAME OF CAR</b>	<b>TOP SPEED IN m/s</b>	<b>ACCELERATING TIME IN s</b>	<b>TOTAL MASS IN kg</b>
<b>CitiStroll</b>	<b>25</b>	<b>10</b>	<b>200</b>
<b>EasyShop</b>	<b>15</b>	<b>5</b>	<b>400</b>
<b>GoFar</b>	<b>20</b>	<b>4</b>	<b>600</b>

**The ACCELERATING TIME is how long it takes for each car to reach its top speed from a standing start.**

- (a) The manufacturers of GoFar claim that their car has the greatest acceleration.  
Are they right? Justify your answer.  
Use calculations in your answer.**

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[2]

- (b) Calculate the kinetic energy of a GoFar car at its top speed.**

**kinetic energy = \_\_\_\_\_ J [1]**

**(c) Here are some statements about cars as they accelerate.**

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

**The driving force does work on the car.**

☐

**The kinetic energy of the car remains constant.**

☐

**The weight of the car decreases as it speeds up.**

☐

**The driving force is greater than the counter force.**

☐

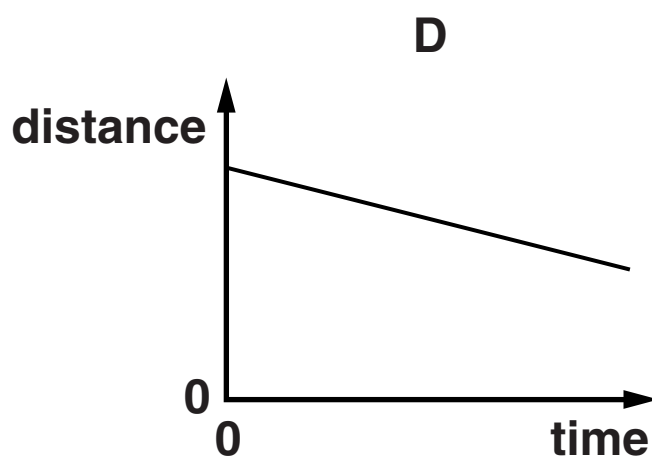
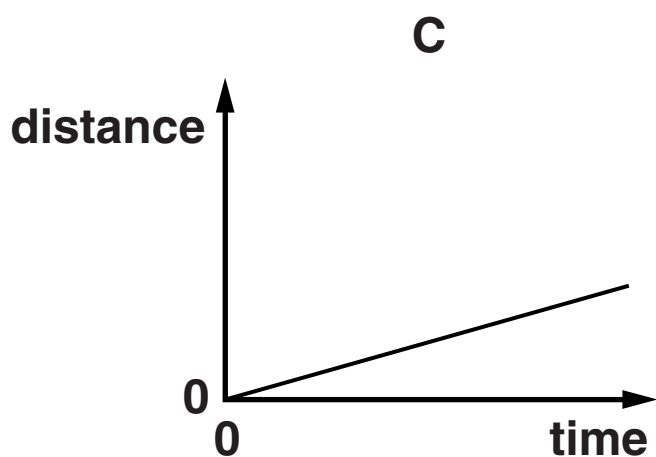
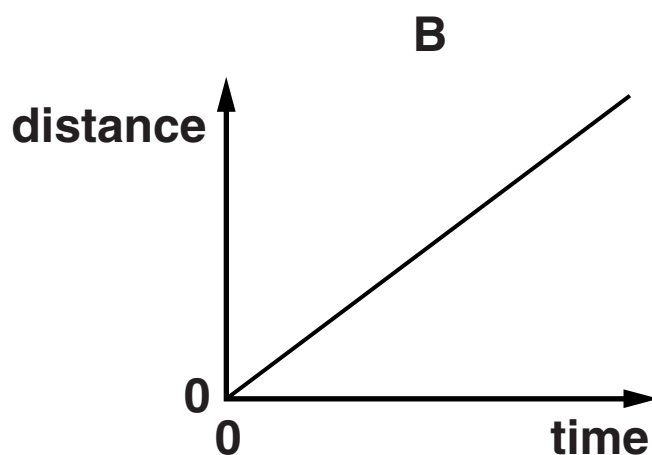
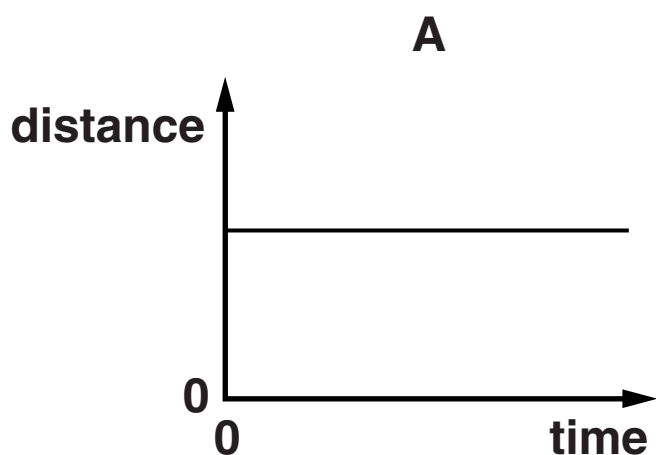
**The reaction from the ground decreases the momentum.**

☐

**[2]**

**[TOTAL: 5]**

**11 Here are distance-time graphs for four different bicycles A, B, C and D.**



**(a) Which bicycle is not moving?**

answer \_\_\_\_\_ [1]

**(b) Which bicycle has the greatest speed?**

answer \_\_\_\_\_ [1]

**[TOTAL: 2]**

**12 Sally climbs the stairs at a steady speed.**

**Put a (ring) around the correct choice to complete each sentence.**

**As Sally climbs, her legs push UP / DOWN on each step.**

**The reaction force from each step pushes UP / DOWN on Sally.**

**As she goes up the stairs at a steady speed, she increases her**

**GRAVITATIONAL POTENTIAL ENERGY /**

**KINETIC ENERGY / MOMENTUM.**

**[2]**

**[TOTAL: 2]**

**END OF QUESTION PAPER**



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