THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

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Monday 14 January 2013 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A151/01 Modules B4 C4 P4 (Foundation Tier)

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)

Duration: 1 hour

MODIFIED LANGUAGE

* A 1 5 1 0 1 *

* 1 5 2 2 6 1 1 8 4 2 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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).
- Do **not** write in the bar codes.

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 page 2.
- The Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

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

Explaining motion

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

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

momentum = mass × velocity

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

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

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

Electric circuits

power = voltage × 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

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

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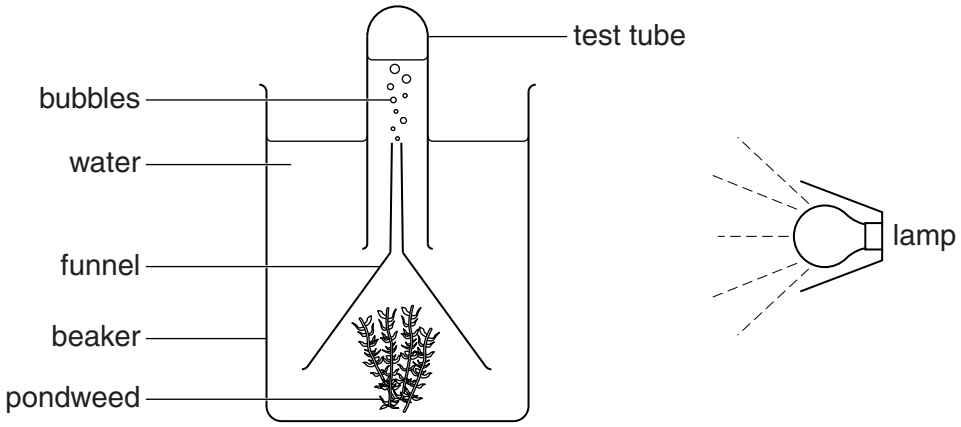
Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

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.

Distance from lamp to pondweed in cm	**Number of bubbles produced in 5 minutes**			
	Experiment 1	**Experiment 2**	**Experiment 3**	**Average**
10	21	21	18	
15	14	15	16	15
20	11	14	11	12
25	10	8	12	10

(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 when the lamp is at a distance of 10 cm.

average = ... **[1]**

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

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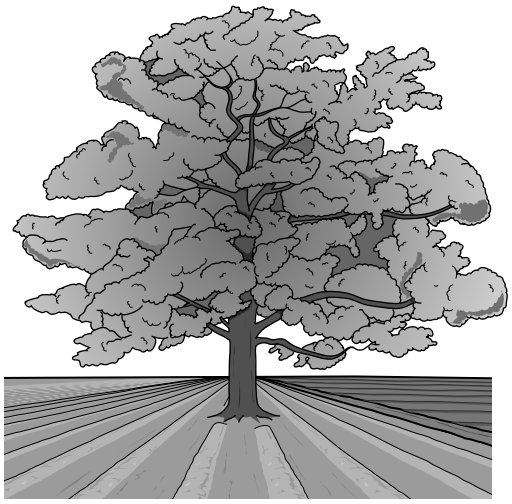
..... **[1]**

Question 1 continues on page 6

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

The field contains a large tree.



She thinks that at different distances from the tree, the number of plants growing will not be the same.

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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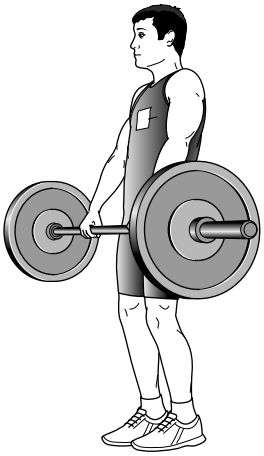
..... **[2]**

[Total: 7]

2 Nathan is weightlifting.



The four statements describe what happens.

- His muscles respire **aerobically** as he stands 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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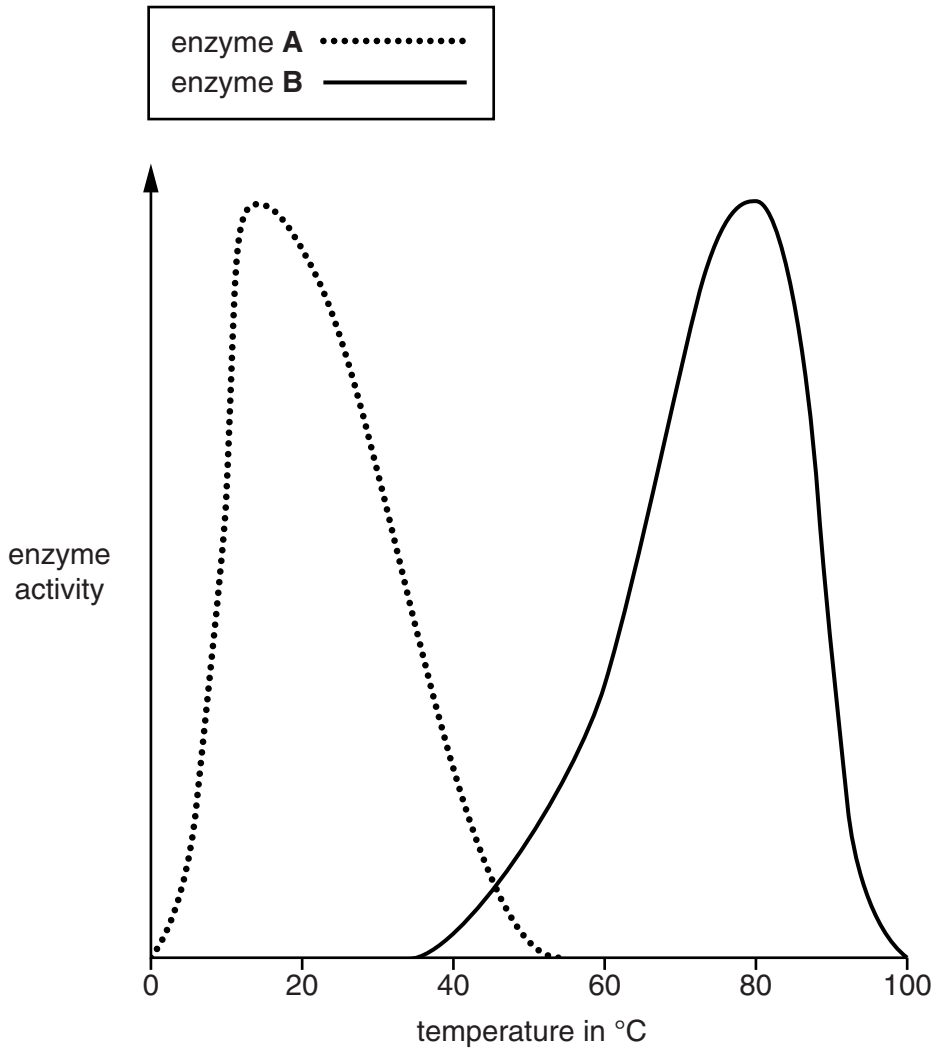
..... **[6]**

[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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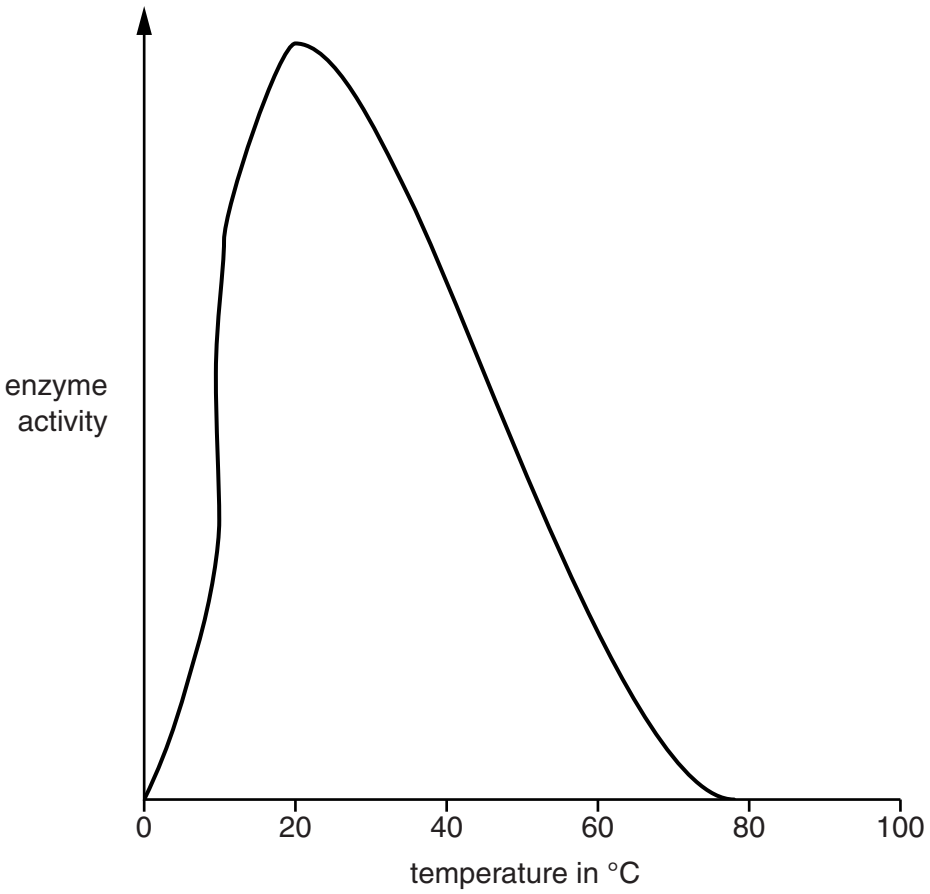
..... **[2]**

(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 cylinder of potato in a sugar solution.

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

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

Here are his results.

Concentration of sugar solution in g/dm^3	**Percentage (%) change in mass of potato cylinder**
0	+7
20	+3
40	+1
60	–1
80	–4
100	–6

(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^3.

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 g/dm^3 of sugar. ☐

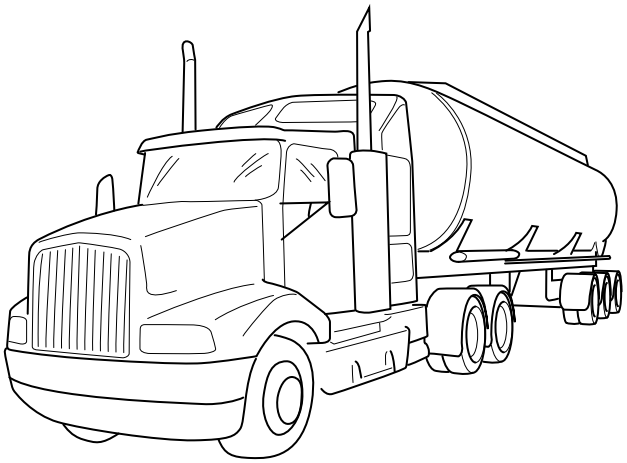
Repeat each concentration and calculate the average percentage change in mass. ☐

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.



(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.

$$2Fe + 3Cl_2 \longrightarrow 2FeCl_3$$

(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**
Cl_2			
Fe			
$FeCl_3$			

[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 NaC*l*.

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

$$2Na + Cl_2 \longrightarrow 2NaCl$$

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?

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..... **[2]**

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

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..... **[3]**

[Total: 7]

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

Element	**X**	**Y**	**Z**
atomic (proton) number	less than 12	12	more than 12
melting point in °C	1278	649	839
density in g/cm^3	1.85	1.74	1.54
reaction with water	no reaction	slow	rapid
formula of chloride	XCl_2	YCl_2	ZCl_2
formula of oxide	XO	YO	ZO
melting point of oxide in °C	2550	2852	2554

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 stopping completely.
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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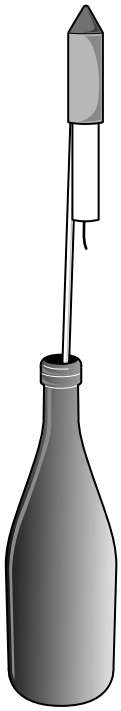
..... **[2]**

[Total: 5]

9 Jim lights 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.

Name of car	Top speed in m/s	Accelerating time in s	Total mass in kg
CitiStroll	25	10	200
EasyShop	15	5	400
GoFar	20	4	600

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? Give reasons for 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]**

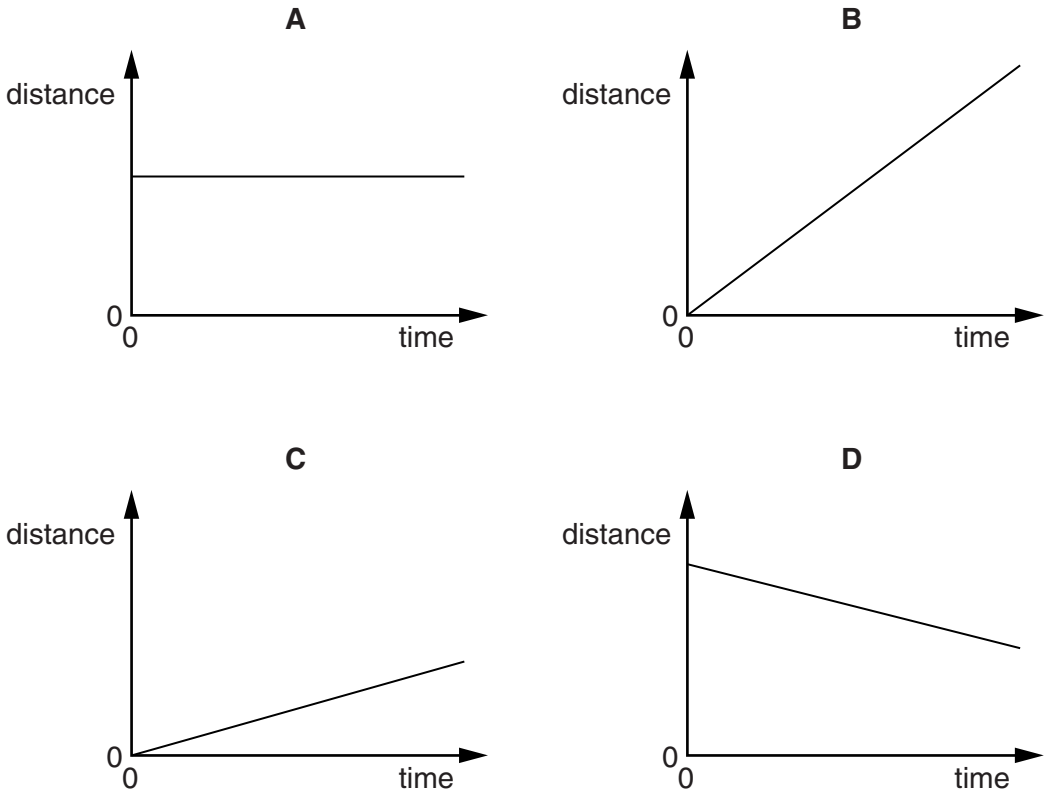
(c) Here are some statements about cars as they accelerate.
Put ticks (✓) in the boxes next to the **two** correct statements.

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

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.