

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



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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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

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

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

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

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

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

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

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

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

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

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

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

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

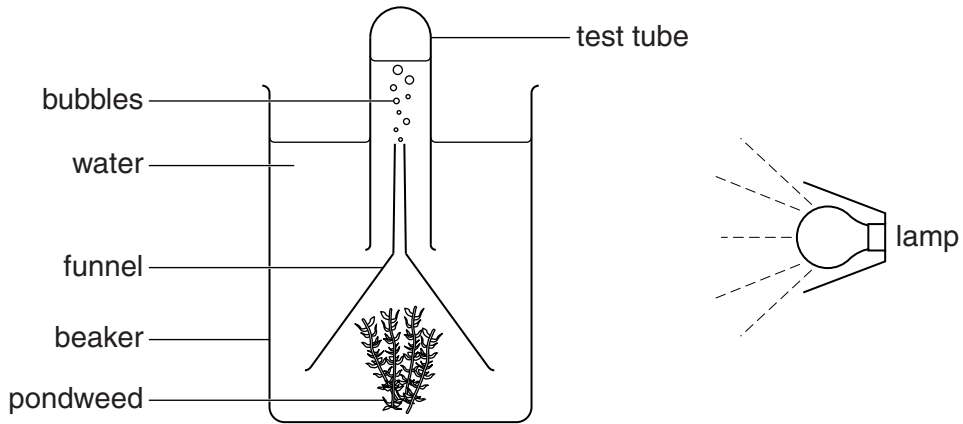
$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

3
BLANK PAGE

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 10cm from the lamp.

.....

 [1]

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

average = [1]

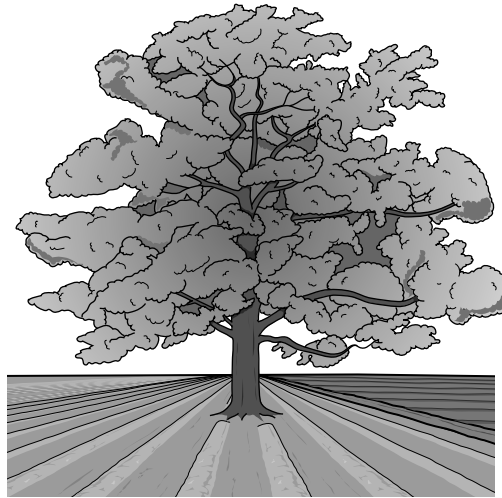
- (iii) What conclusion about photosynthesis can Anette make from these data?

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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 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**

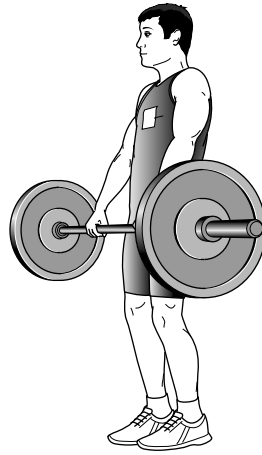
[1]

(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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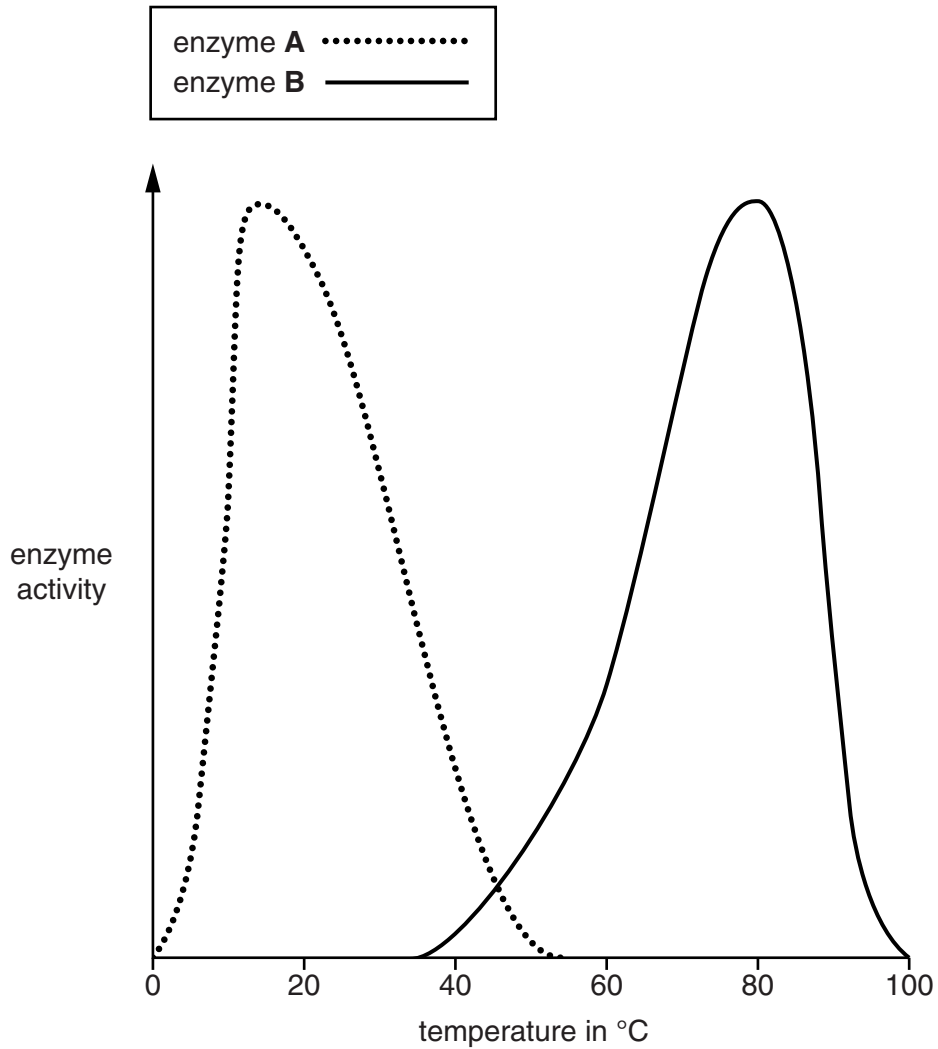
..... [6]

[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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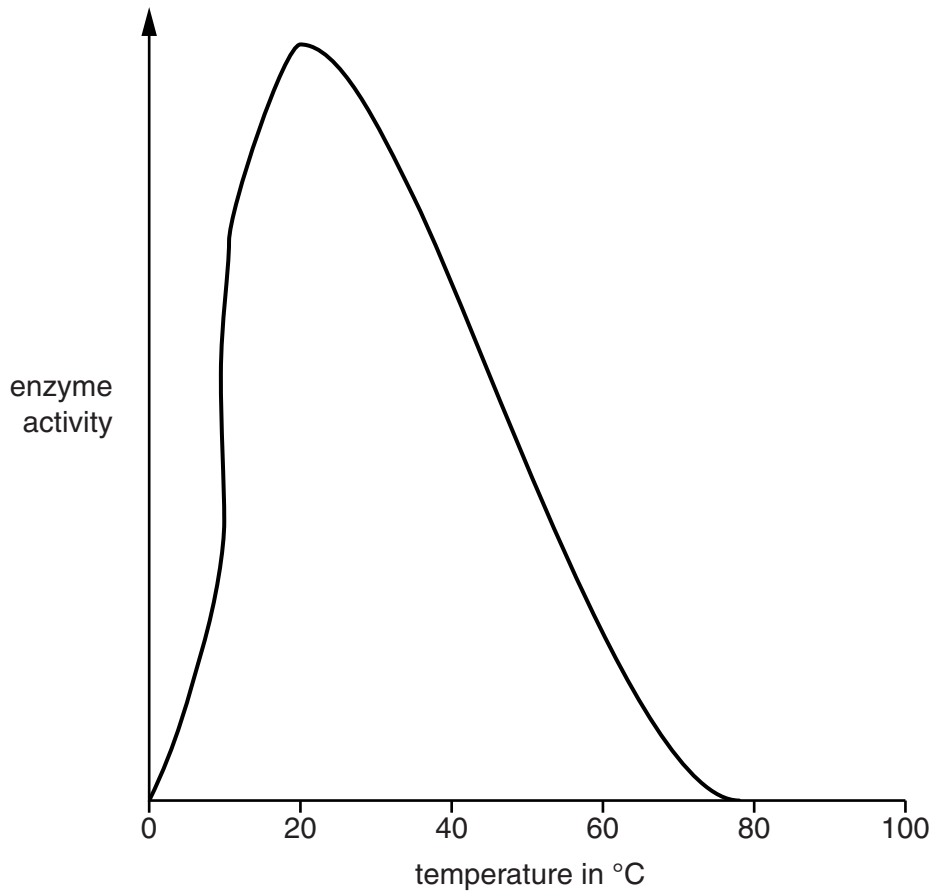
.....

[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.

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 $100 \text{ g}/\text{dm}^3$ of sugar.

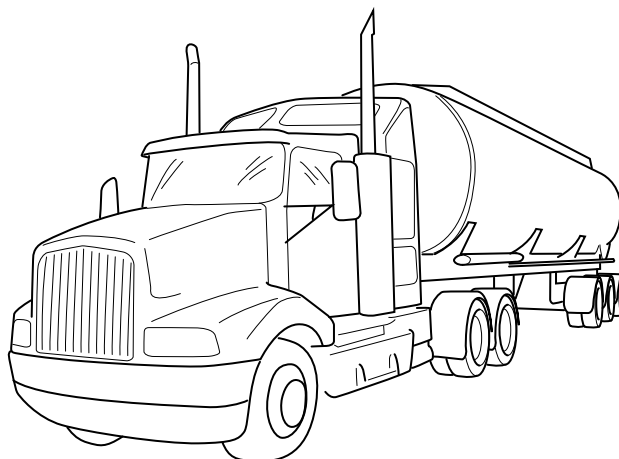
Repeat each concentration and calculate the average percentage change in mass.

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.



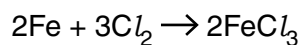
[1]

- (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.



- (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]

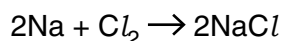
6 Sodium and potassium are both Group 1 metals.
Sodium is a reactive metal.

(a) Sodium reacts with chlorine to make sodium chloride.
The formula for sodium chloride is 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?

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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 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.

.....
..... [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.

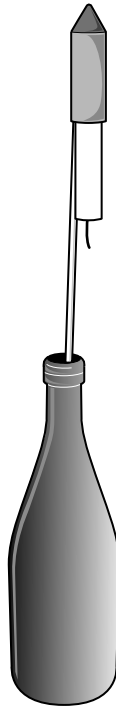
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..... [2]

(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.

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? 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]

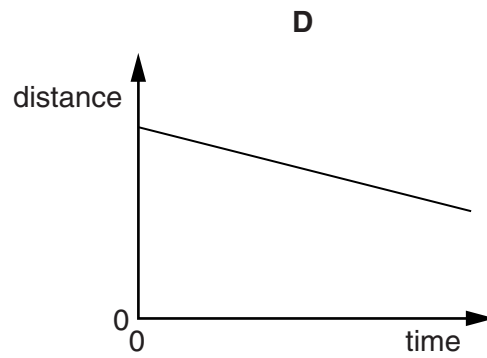
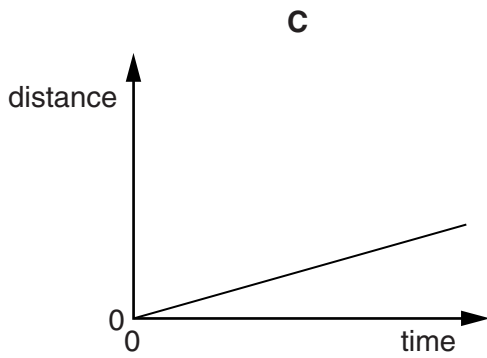
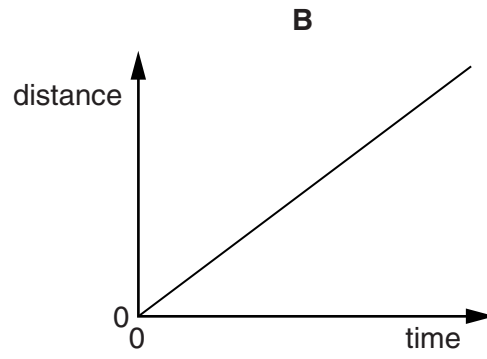
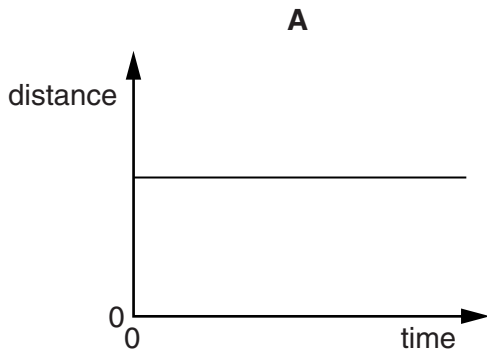
(c) Here are some statements about cars as they accelerate. Put ticks (✓) in the boxes next to the **two** correct statements.

- 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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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 O oxygen 8	17 Cl chlorine 17	18 Ar argon 18								
	19 K potassium 19	20 Ca calcium 20	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36		
	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
	55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 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						

1
H
hydrogen
1

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.