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 25 MAY 2011: Morning
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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

DC (LEO/JG) 11MEP06224 46953/1

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. Pencil may be used for graphs and diagrams only.**
- **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).**
- **Answer ALL the questions.**

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 pages 4 and 5.**
- **The Periodic Table is provided.**

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

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

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

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

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

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

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

ELECTRIC CIRCUITS

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

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

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

$$\text{power} = \text{potential difference} \times \text{current}$$

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

THE WAVE MODEL OF RADIATION

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

Answer ALL the questions.

1 Vikram is studying enzymes.

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

Enzymes are …

… carbohydrates that slow down chemical reactions. ☐

… carbohydrates that speed up chemical reactions. ☐

… proteins that slow down chemical reactions. ☐

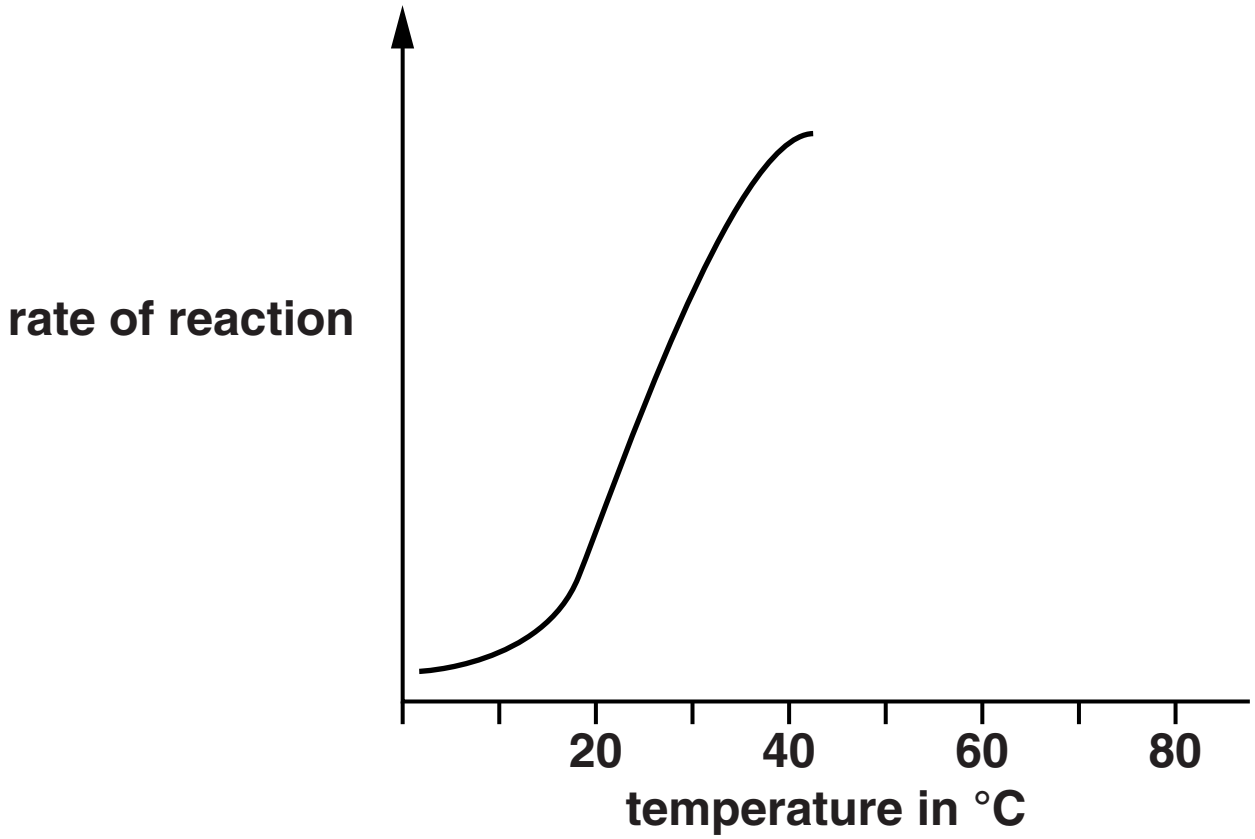
… proteins that speed up chemical reactions. ☐

[1]

(b) Vikram does some experiments with enzymes.

He measures the rate of reaction at different temperatures.

Here is a graph of his results.



	As the temperature …	… the frequency of collisions …	… and the rate of reaction …
A	… increases …	… decreases …	… increases.
B	… increases …	… increases …	… increases.
C	… decreases …	… increases …	… increases.
D	… decreases …	… decreases …	… increases.

Which row, A, B, C or D, is the best explanation for his results?

row _____ **[1]**

(c) Vikram continues to increase the temperature in his experiment.

What will happen?

Put a (ring) around the correct word in each sentence.

The rate of reaction will INCREASE / DECREASE / STAY THE SAME.

This is because the enzyme is BROKEN DOWN / DENATURED / KILLED.

The enzyme now has the wrong SHAPE / MASS / CHEMICALS for the other molecules to fit.

[2]

[Total: 4]

2 Susan looks at red blood cells using a microscope.

She adds distilled water to them.

Explain what will happen to the red blood cells in the distilled water.

_____

_____

_____

_____ **[3]**

[Total: 3]

3 Experiments show that chemical X moves into muscle cells by diffusion.

What does this tell you about the concentration of X inside the muscle cell?

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

The concentration of X inside the muscle cell is …

… greater than outside the cell. ☐

… the same as outside the cell. ☐

… less than outside the cell. ☐

[1]

[Total: 1]

4 Arjun is doing a long distance swim in the cold sea.

His body tries to maintain a constant core temperature.

To do this, his body detects his blood temperature, processes the information, and then makes a response.

(a) Use words from the list to complete the sentences.

You may use each word once, more than once, or not at all.

HYPOTHALAMUS

PITUITARY

SKIN

SWEATING

VASOCONSTRICTION

VASODILATION

Arjun's blood temperature is detected by

receptors in his _____ .

This information is processed in the

_____ .

Effectors in blood vessels then cause

_____ . **[1]**

(b) In temperature regulation, vasoconstriction and vasodilation are antagonistic effects.

What is the advantage of this?

Put a tick (✓) in the box next to the BEST answer.

It allows a stronger response. ☐

It allows energy to be saved. ☐

It allows a more sensitive response. ☐

It allows temperature to vary across a wider range. ☐

[1]

[Total: 2]

5 Connor is at a party. He is hot and begins to sweat. He produces less urine.

(a) The concentration of Connor's urine is controlled by a hormone.

What is the name of this hormone?

_____ **[1]**

(b) Which gland releases this hormone?

Put a (ring) around the correct answer.

hypothalamus

pituitary

thyroid

pancreas

[1]

(c) Connor then drinks some alcohol.

Alcohol affects the production of the hormone.

The concentration of Connor's urine changes.

Describe the effect on hormone production AND explain how this changes the urine produced.

_____

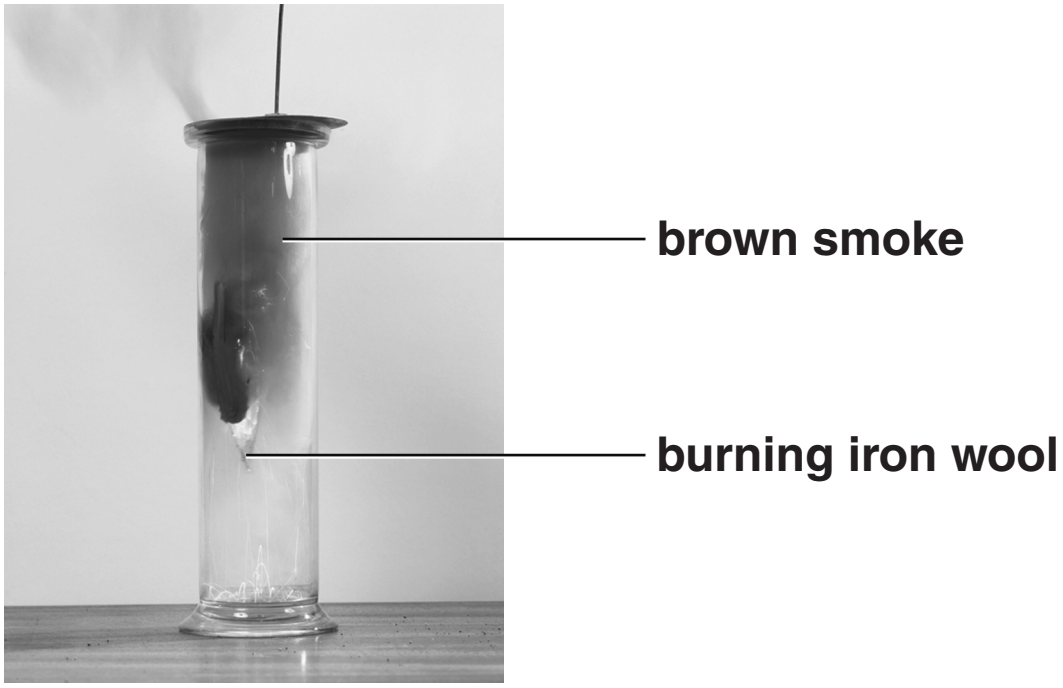
_____

_____

_____ **[2]**

[Total: 4]

6 William's teacher burns some hot iron wool in chlorine gas.



(a) The iron reacts with the chlorine to make a brown smoke.

The brown smoke is made of small particles of solid iron chloride, $FeCl_3$.

Write numbers in the boxes to balance the equation for this reaction.

$$\square\ Fe + \square\ Cl_2 \rightarrow \square\ FeCl_3$$

[1]

(b) Chlorine is a halogen.

Complete the table about the halogens.

HALOGEN	COLOUR	STATE AT ROOM TEMPERATURE [SOLID/LIQUID/GAS]
chlorine	green	
bromine		liquid
iodine	grey/black	

[1]

(c) William's teacher then burns some sodium in a jar of chlorine gas.

When the sodium burns it makes sodium chloride.

sodium + chlorine → sodium chloride

Write the chemical formula of sodium chloride.

answer _____ [1]

[Total: 3]

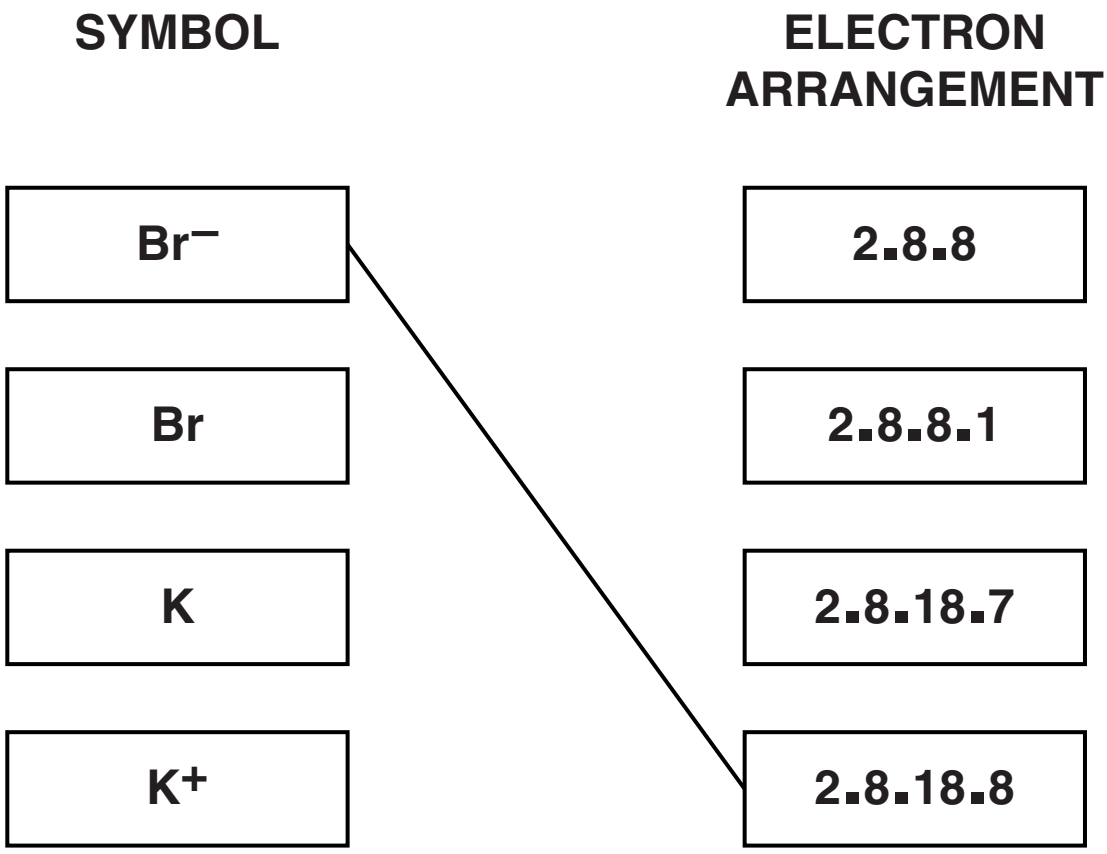
7 Potassium bromide contains potassium ions, K^+, and bromide ions, Br^-.

If an atom gains an electron it turns into a negative ion.

If an atom loses an electron it turns into a positive ion.

(a) Draw lines to link each SYMBOL for an atom or ion to its correct ELECTRON ARRANGEMENT.

One has been done for you.



[2]

(b) The potassium bromide forms ionic crystals.

Matilda dissolves potassium bromide crystals in a beaker of water.

Complete the sentence to describe what happens to potassium bromide crystals when they dissolve.

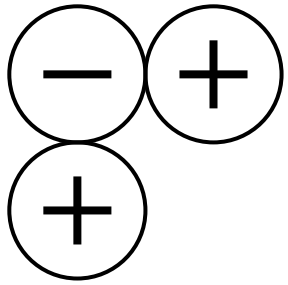
Draw ONE line to link the correct START and MIDDLE of the sentence, and one line to link the correct MIDDLE and END.

START	MIDDLE	END
Atoms turn into ions …		… and settle to the bottom.
OR		OR
Ions stay as ions …	which move … closer together …	… and escape by evaporation.
OR	OR	OR
Ions turn into atoms…	which move … further apart …	… and move randomly through the solution.
OR		OR
Ions turn into molecules …		… and move to opposite sides of the beaker.

[2]

(c) Matilda starts to draw a diagram of the ions in a potassium bromide crystal.

Continue her diagram by drawing in FOUR more of the ions.



[1]

(d) Matilda does an experiment to show that potassium bromide is ionic.

How does she do this?

Your answer should include

- **what she should do**
- **how she can tell that the potassium bromide is ionic.**

_____

_____

_____ **[2]**

[Total: 7]

8 Edith does a project on atoms and ions.

She finds out how many electrons, protons and neutrons they have.

Here are her results.

Write the correct symbol for EACH atom or ion including its charge where needed.

You may use the Periodic Table on the back page to help you.

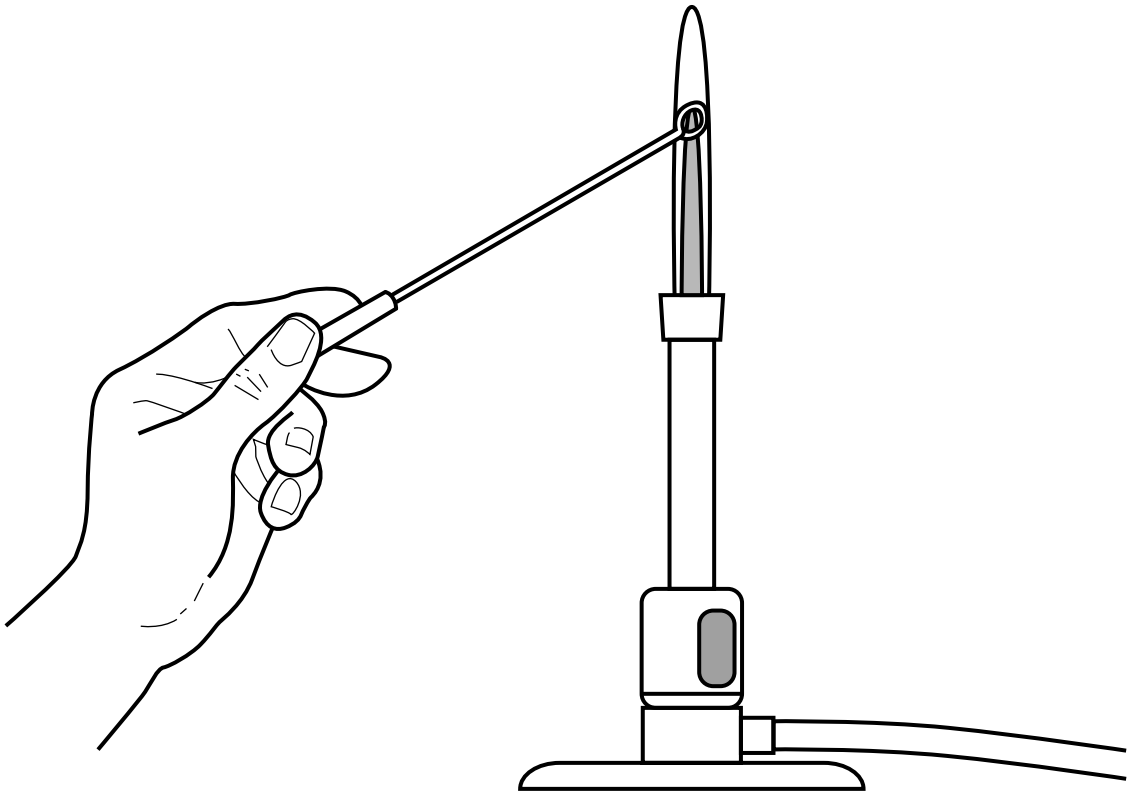
number of protons	number of neutrons	number of electrons	symbol
3	4	3	Li
9	10	10	_____
11	12	10	_____
15	16	15	_____

[2]

[Total: 2]

9 Stephen makes some sodium chloride in the laboratory.

He looks at its flame colour through a spectroscope.



Here is the spectrum that he sees.

He finds the spectrum for sodium in a book. It looks like this.

What can he tell about his own sample? Explain how he can tell.

_____

_____

_____ **[2]**

[Total: 2]

10 Reshma runs at a hurdle and jumps over it.

(a) As Reshma moves over the bar, she is moving horizontally with a speed of 8 m/s.

Her mass is 50 kg.

What is the correct way of calculating her kinetic energy?

Put a (ring) around the correct answer.

50 × 8

50×8^2

$\frac{1}{2} \times 50 \times 8^2$

$\frac{1}{2} \times 50 \times 8$

[1]

(b) The diagram shows Reshma when she is moving forwards above the bar.

At that instant, she has both kinetic and gravitational potential energy.

Explain how their values change as she drops down towards the ground again.

_____

_____

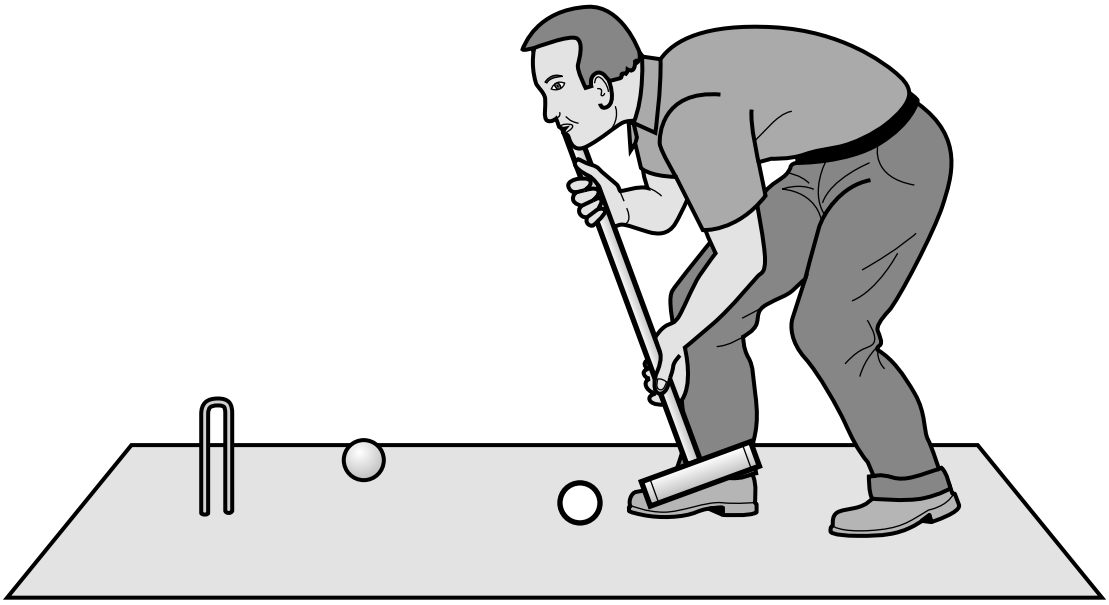
_____

_____

_____ **[3]**

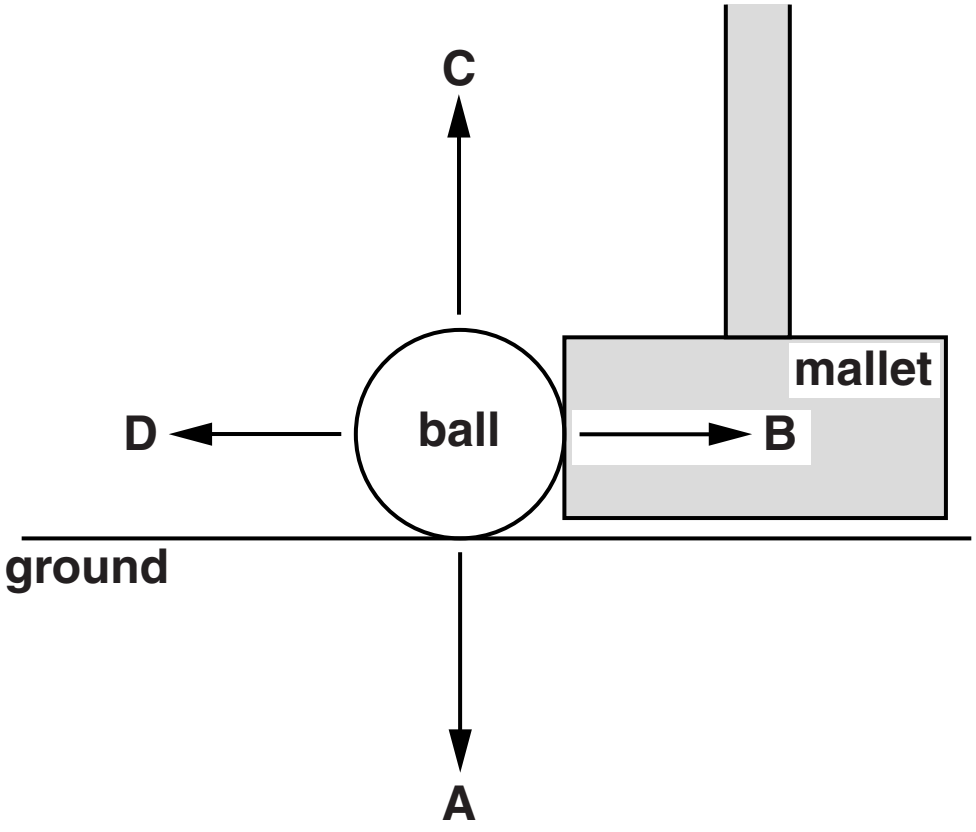
[Total: 4]

11 Jim enjoys playing croquet.



(a) Jim hits the ball with the mallet.

The diagram shows four possible directions of forces on the ball.



(i) Three of these forces act on the ball at the instant it is hit by the mallet.

Complete the table with A, B, C or D to show the direction of these forces.

weight due to gravity	
reaction from the ground	
driving force from the mallet	

[1]

(ii) In this case, all three forces have the same size of 5 N.

What is the size of the resultant force on the ball?

resultant force = _____ N [1]

(b) Jim hits the ball again.

The mallet hits the ball with a force of 5 N, changing its momentum by 2.5 kg m/s.

For how long is the mallet in contact with the ball?

Put a (ring) around the correct answer.

0.25 s

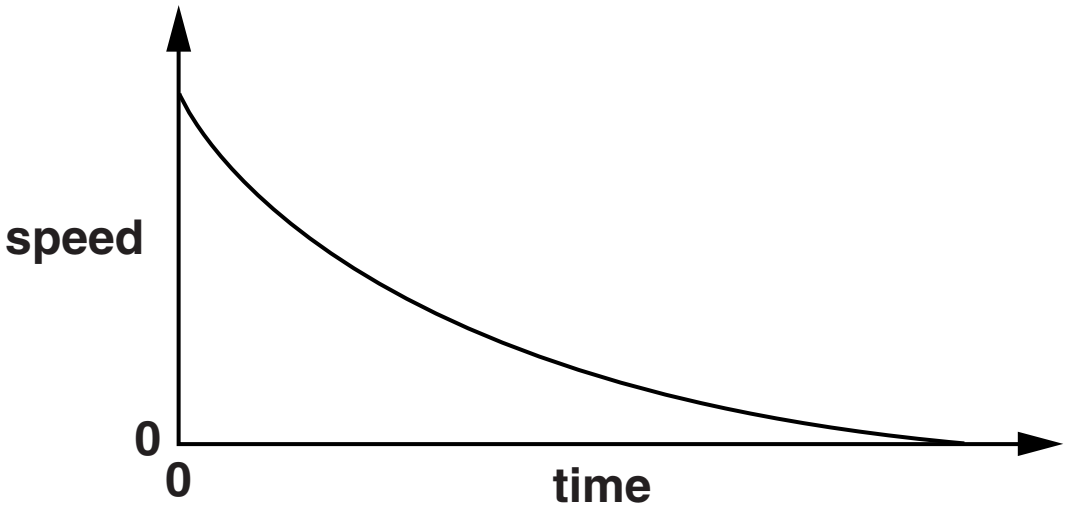
0.5 s

1.0 s

2.0 s

[1]

(c) The graph shows how the speed of the ball changes with time AFTER Jim has hit it.



Here are some possible explanations for the shape of the graph.

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

Work done on the moving ball reduces its kinetic energy. ☐

The driving force on the ball is greater than the counter force. ☐

The force from the mallet decreases the momentum of the ball. ☐

The friction on the ball from the ground reduces its momentum. ☐

The reaction from the ground reduces the momentum of the ball. ☐

[2]

[Total: 5]

12 Pete enjoys a short run.

(a) Pete has a mass of 60 kg.

His weight is 600 N.

He runs at a steady speed of 5 m/s.

How much momentum does he have in kg m/s?

Put a (ring) around the correct answer.

12

120

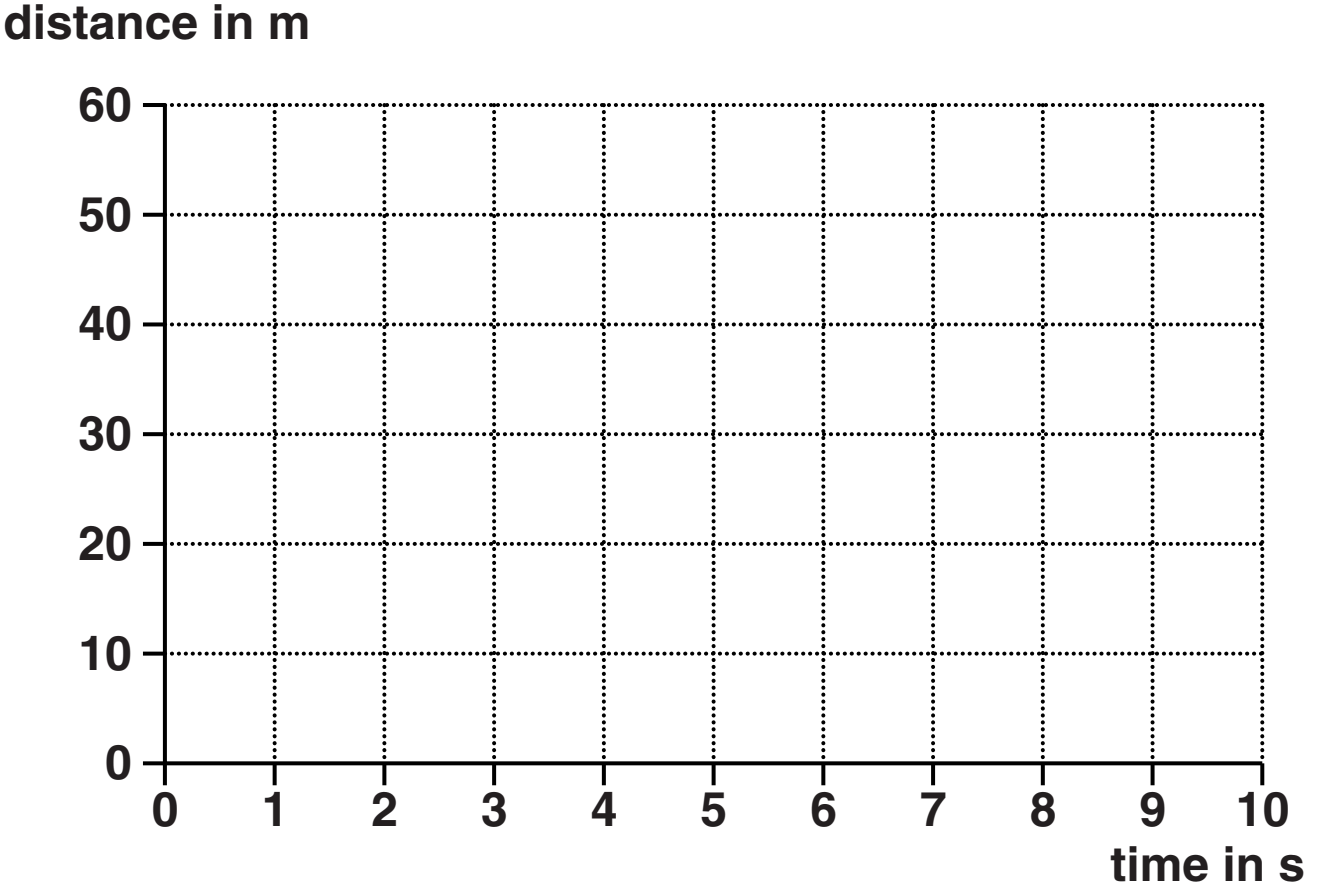
300

750

3000

[1]

(b) Draw a distance-time graph for Pete as he runs forward at a steady speed of 5 m/s for 10 s of his run. When the time is 0 s his distance is 0 m.



[2]

(c) Pete runs uphill at a steady speed.

Draw straight lines to link the START of each sentence to its correct END.

START	END
	… remains constant.
Pete's kinetic energy …	
	… heats up the air as he moves.
A force on Pete from the ground …	
	… increases steadily with time.
Pete's gravitational potential energy …	
	… pushes him in the direction of his motion.

[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.