Candidate forename		Candidate surname	

Centre number					Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

GCSE

A151/01

TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

Modules B4 C4 P4 (Foundation 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.

<u>OCR SUPPLIED MATERIALS:</u>

None

<u>OTHER MATERIALS REQUIRED:</u>

Pencil
Ruler (cm/mm)

<u>READ INSTRUCTIONS OVERLEAF</u>

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 <u>ALL</u> 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 version of the Periodic Table is provided separately.

- The total number of marks for this paper is <u>60</u>.

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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

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

EXPLAINING MOTION

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

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

momentum = mass × velocity

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

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

amount of energy transferred = 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

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

1   **Paul is investigating photosynthesis.
He grows five samples of cress, A, B, C, D and E.
Each sample gets a different number of hours of light
per day for three days.**
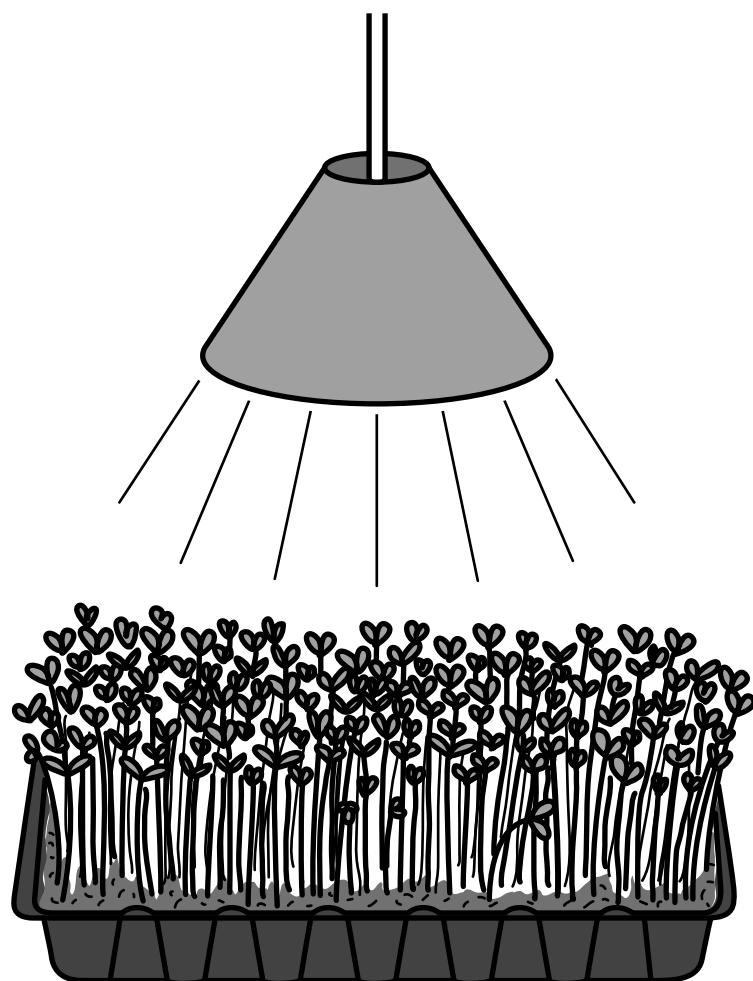
Here are his results.

Sample	Hours of light per day in hours	Average height at start in mm	Average height at end in mm	Height gained in mm
A	2	8	9	1
B	6	8		
C	12	8	14	6
D	18	8	17	9
E	24	8	17	9

(a) (i) Suggest what HEIGHT GAIN Paul is likely to find for sample B.

answer _____ mm [1]

(ii) Paul wants to grow lots of cress.
The lighting is expensive to use.
He uses the results to decide how many hours he will run the lights for each day.

How many hours should Paul run the lights for each day?

Explain your answer.

_____

_____

_____

_____ [2]

7

(iii) Paul's experiment investigates the link between two factors.

Put a tick (✓) in the box next to the correct option to complete each sentence.

The factor that Paul changes...

... is the amount of

light.	
growth.	
chlorophyll.	

At first, as this factor increases...

... there is

a decrease	
an increase	
no change	

in the growth.

To allow other scientists to repeat his investigation...

... Paul has to write a clear

method	
title	
conclusion	

in his report.

[2]

(b) Here is a diagram of a cell from the leaf of a plant.
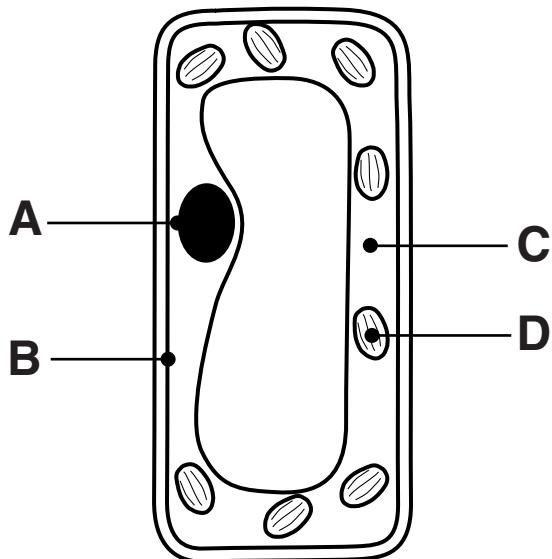
The structures shown in the diagram have different roles in photosynthesis.

Identify the structures and describe their roles in photosynthesis.

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

[Total: 11]

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Question 2 begins on page 12

2 **Caitlin goes scuba diving.**
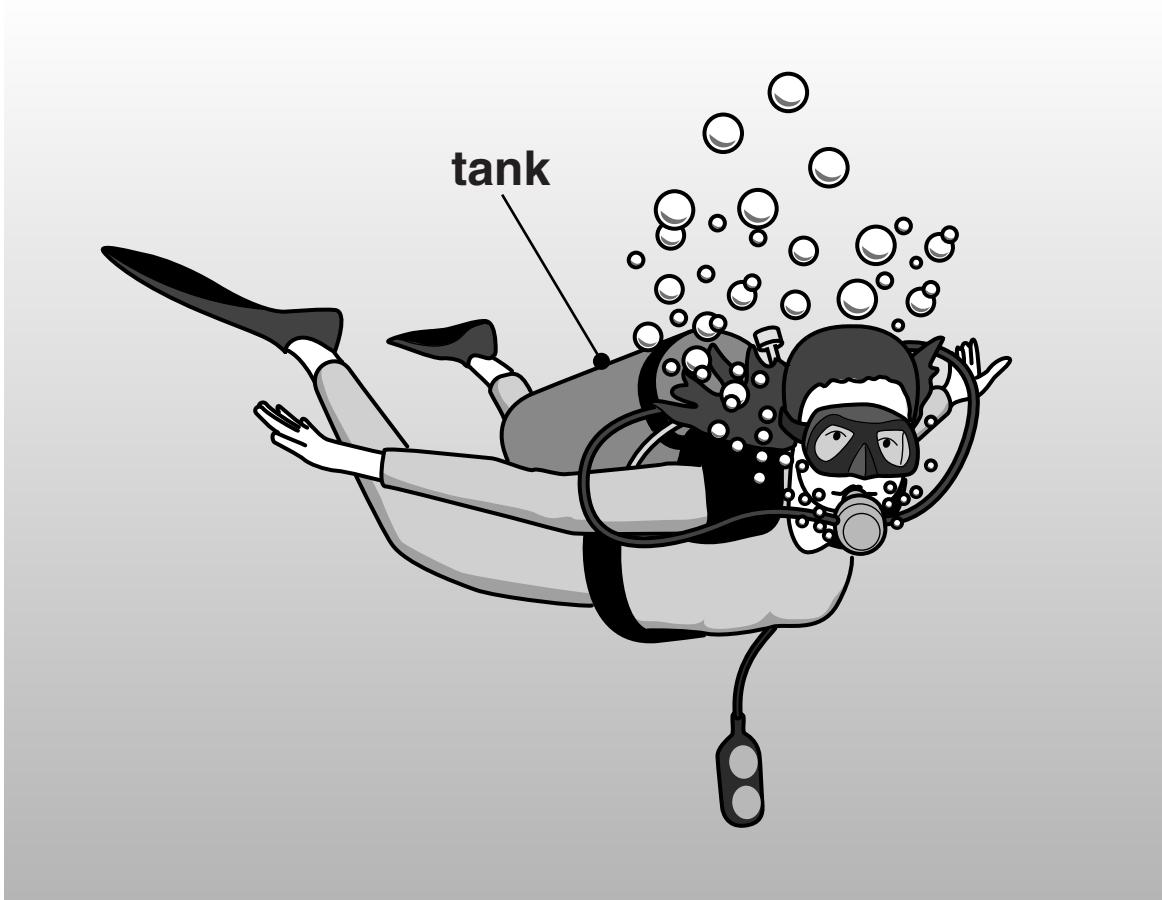
tank

She uses air from a tank on her back while she is underwater.

(a) **When Caitlin is resting she uses 4 litres of air in a minute.**
When she is swimming she uses 6 litres of air in a minute.

Explain why there is this difference.

_____

_____

_____ **[2]**

(b) Caitlin's tank gives her **180** litres of air.
She uses **6** litres of air a minute.
Caitlin can choose a dive that lasts **20**, **25** or **30** minutes.
Caitlin has to allow a **5** minute safety margin.
She wants to go on the longest dive possible using this tank.

Explain which dive she should choose.

Use calculations in your answer.

_____

_____

_____ **[2]**

(c) While Caitlin has lots of air, energy is released by aerobic respiration.
If she runs out of air underwater she uses a different form of respiration to swim to the surface.

Name this type of respiration.

_____ **[1]**

[Total: 5]

3 Gary investigates the effect of temperature on the activity of an enzyme which attacks stains.
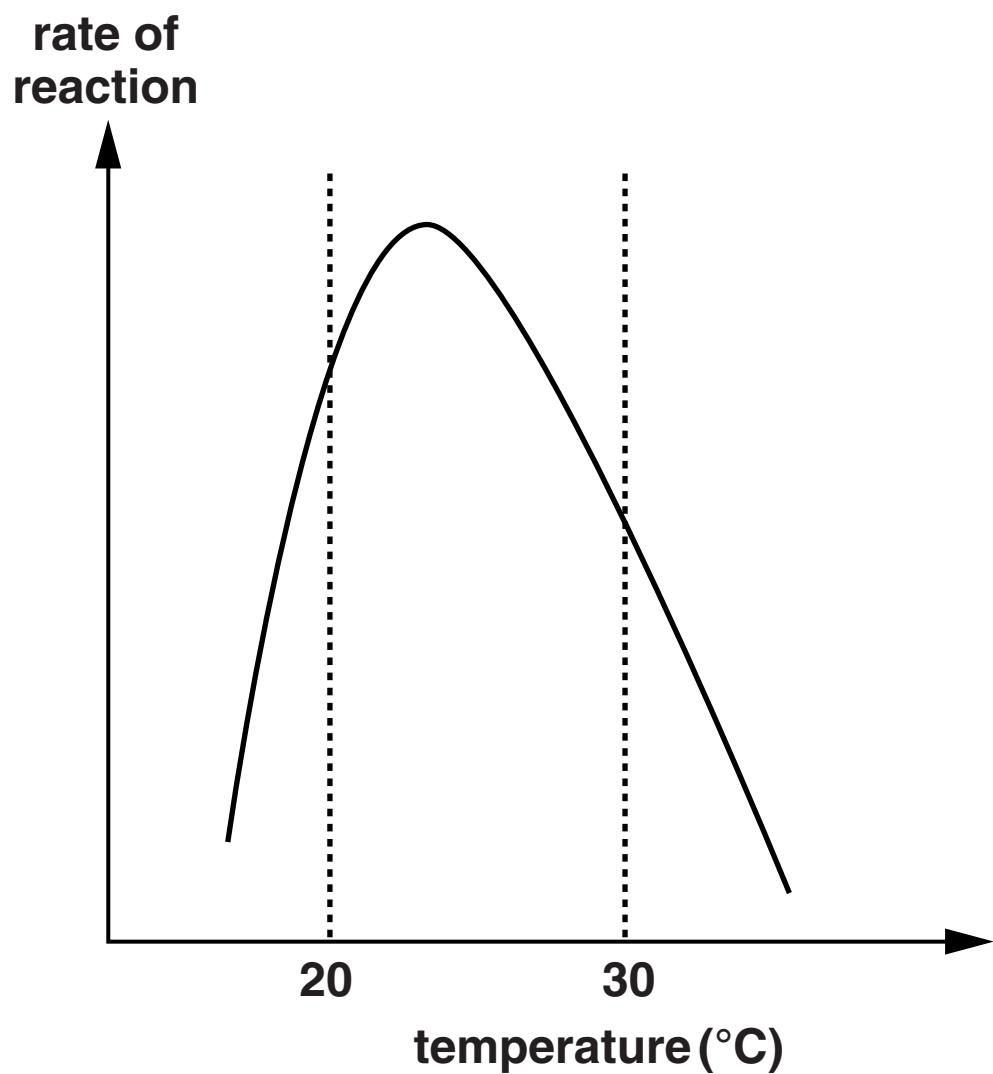
(a) A biological washing powder cleans clothes at **70 °C**.
Gary thinks that the enzyme is suitable to use at this temperature.

Is Gary correct?

Explain your answer.

_____

_____

_____

_____ **[2]**

(b) A scientist claims to have made a new enzyme which works well at all temperatures.
She makes her claim in a newspaper before she tells any other scientists.
Other scientists question her claim.

What are the reasons for scientists questioning the claim?

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

Making enzymes is very expensive. ☐

The work has not been peer reviewed. ☐

The enzyme has only been made in small amounts. ☐

The enzyme is easy to make. ☐

The enzyme has not been tested by other scientists. ☐

[2]

[Total: 4]

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**Question 4 begins on page 18**

4 **Chlorine is used to kill bacteria in swimming pools.**

(a) A dilute solution of chlorine is harmful, but not toxic.

Which symbol should go on bottles of chlorine solution?

Put a tick (✓) in the box next to the correct answer.
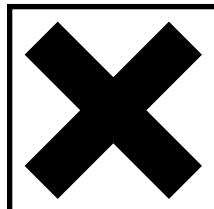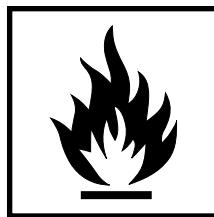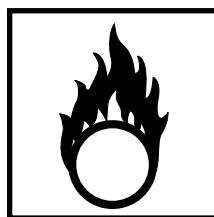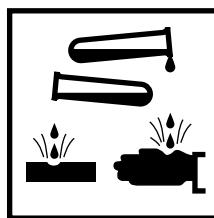
[1]

(b) Chlorine, bromine and iodine are halogens. Some halogens will react with other halogen compounds.

Halogen added	Sodium bromide solution	Sodium chloride solution	Sodium iodide solution
Bromine	no reaction	no reaction	reaction
Chlorine	reaction	no reaction	reaction
Iodine	no reaction	no reaction	no reaction

Use the table to put the three halogens in order of their reactivity.

most reactive _____

_____

least reactive _____

[1]

(c) Chlorine reacts with sodium iodide.

Sodium chloride and iodine are made.

Write a word equation for this reaction.

_____ [1]

[Total: 3]

5 Joe evaporates some seawater.
Crystals of sodium chloride (salt) begin to form.
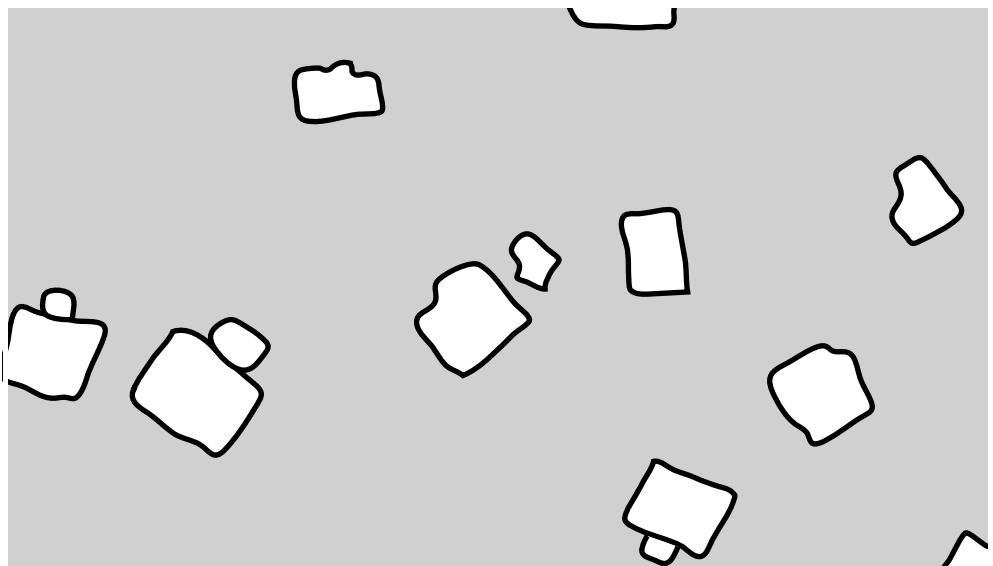
(a) Joe writes down the colour of the salt crystals.

What colour are they?

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

blue ☐

brown ☐

green ☐

colourless ☐

[1]

(b) Joe knows that salt is sodium chloride.
He does a flame test to show that there is sodium in his salt crystals.
He can tell that the flame contains sodium just by looking at it.
When he uses a spectroscope to look at the flame he finds out even more.

How does the flame show that sodium is present?

_____

_____

_____

_____ **[3]**

(c) Sodium chloride can be made by reacting sodium atoms with chlorine atoms.
It is the arrangement of electrons and protons in the atom which makes sodium atoms react in the way they do.

(i) There are **11** electrons in a sodium atom.

How many PROTONS are there in a sodium atom?

Put a ⬭ring⬭ around the correct answer.

2

8

11

23 **[1]**

(ii) **The electron arrangement of a sodium ATOM is 2.8.1**

A sodium atom loses one electron to make a sodium ion.

What is the electron arrangement of a sodium ION?

Put a (ring) around the correct answer.

2.8

2.7.1

1.8.1

2.8.1

[1]

(iii) Sodium chloride is an ionic solid.

Two of these statements about sodium chloride are true.

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

Solid sodium chloride always conducts electricity. ☐

Solid sodium chloride often conducts electricity. ☐

Melted sodium chloride conducts electricity. ☐

Sodium chloride solution conducts electricity. ☐

[1]

[Total: 7]

6   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.

heating pipe containing liquid sodium

heat from hot reactor goes into sodium   **reactor**   **boiler**   **heat from hot sodium goes into water boiler**

→ **steam**

← **water**

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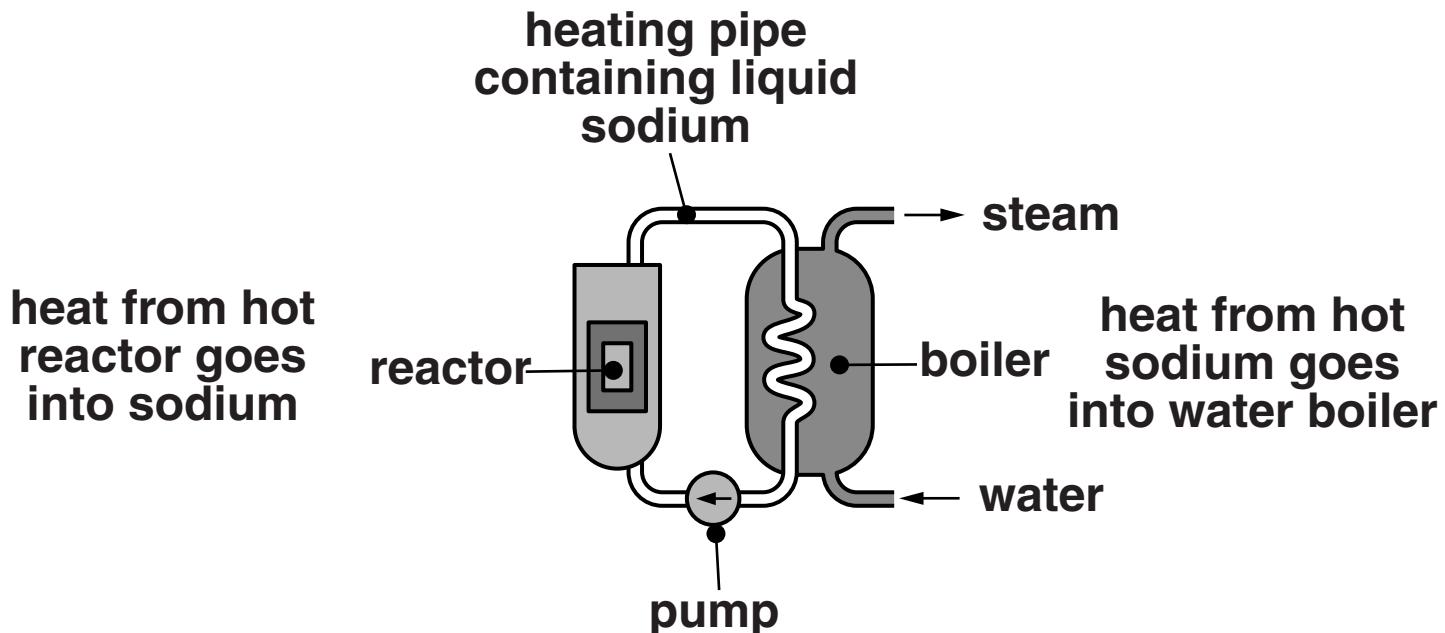
The sodium must be melted so that it can flow through the pipes.

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.

Put a (ring) around the best answer.

43 °C

98 °C

183 °C

883 °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 boilers.

Suggest and explain what these problems might be.

_____

_____

_____

_____ [3]

[Total: 4]

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

    Opposite is part of Mendeleev's table.

    Two important features of Mendeleev's table were
    •   leaving spaces at A and B
    •   the arrangement of Te and I.

    Explain why these features were so important.

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

    _____

    _____

    _____

    _____

    _____

    _____

    _____

    _____

    _____ [6]

[Total: 6]

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

1 ← atomic mass
H ← symbol

27

8 Jim investigates how paper cake cases fall through the air.
He thinks that they fall at a steady speed.
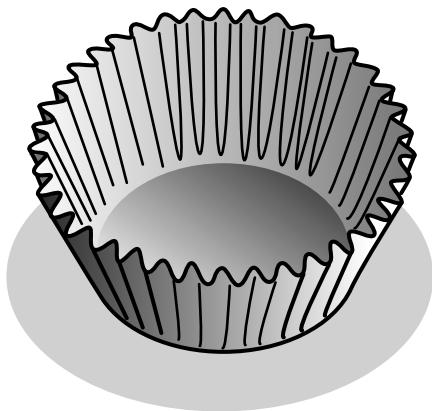
Jim releases the same cake case at different heights above the floor.
He times how long it takes for it to reach the floor.
Here are some of his results.

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	
1.00	2.05	0.488	_____
1.00	1.90	0.526	
0.50	1.07	0.467	
0.50	0.98	_____	0.489
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) Draw straight lines to link each FEATURE of Jim's experiment to its correct NAME.

FEATURE   NAME

| speed of the cake case as it falls |
| weight and size of the cake case |
| height of release above the floor |

| controlled factor |
| changed factor |
| outcome variable |

[2]

[Total: 5]

9 **Jill throws a ball into the air.**
She catches it when it comes down again.
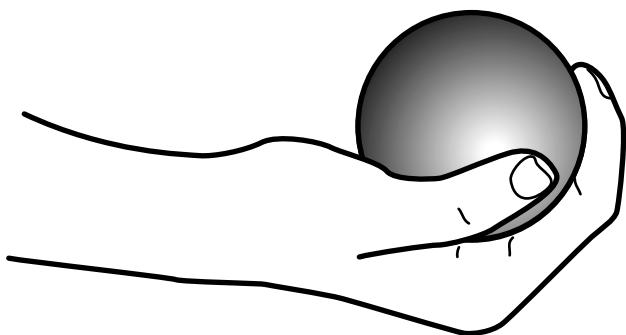
Use ideas about force and momentum to explain how the speed of the ball changes while it is in the air.

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

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

[Total: 6]

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10 Ben uses a parachute to fall to the ground at a safe, steady speed.
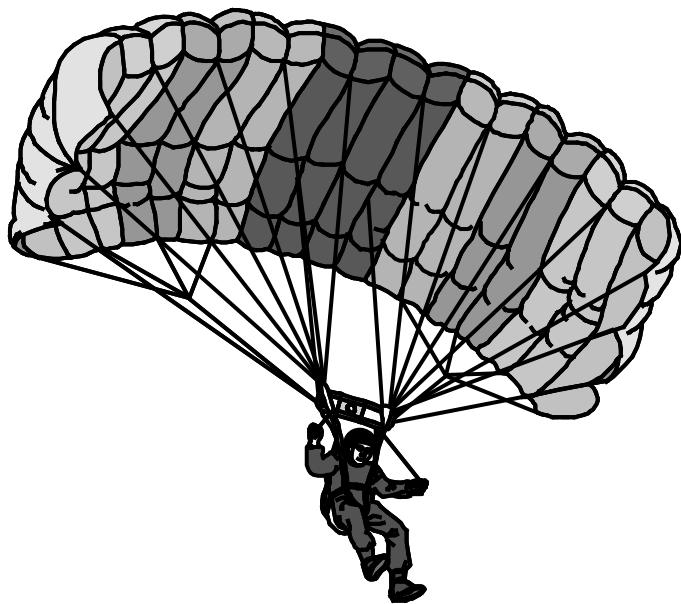
(a) Here are some statements about the energy transfers which happen while he falls at a steady speed.

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

Ben loses kinetic energy. ☐

Ben gains kinetic energy. ☐

Ben has a constant kinetic energy. ☐

Ben loses gravitational potential energy. ☐

Ben gains gravitational potential energy. ☐

Ben has a constant gravitational potential energy. ☐

[2]

(b) Ben lands on the ground.
His weight is **800 N**.
For a safe landing, the force on his feet must be less than **3200 N**.
The impact with the ground lasts for **0.2 s**.

(i) Calculate his maximum safe change of momentum during landing.

maximum safe momentum = _____ kg m/s [2]

(ii) His speed just before he hits the ground is **5 m/s**.
His mass is **80 kg**.

Does he make a safe landing? Justify your answer.

_____

_____

_____ [2]

[Total: 6]

11 **Mike is walking forwards across level ground.**
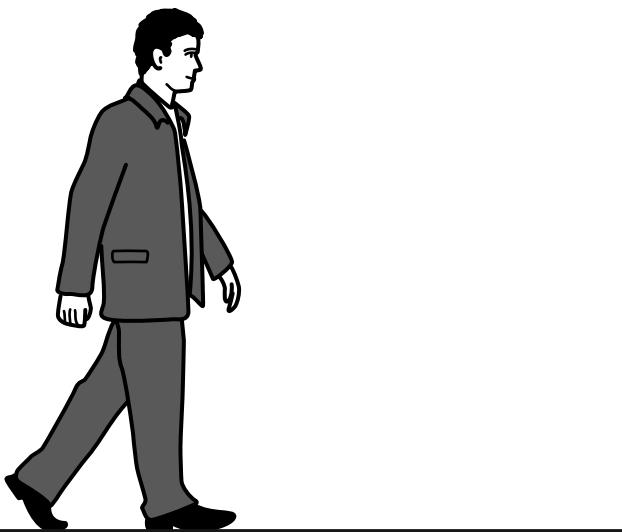
Describe all the forces acting on Mike.

_____

_____

_____

_____ **[3]**

[Total: 3]

END OF QUESTION PAPER

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