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OCR
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F

Wednesday 5 June 2013 – Afternoon

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

B722/01 Additional Science modules B4 C4 P4 (Foundation Tier)

B736940613

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 30 minutes

B722201

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 (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found on the back page.
- 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 **85**.
- This document consists of **32** pages. Any blank pages are indicated.

DC (DTC 00703 5/12) 66102/3

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

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

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \frac{1}{2}mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$mgh = \frac{1}{2}mv^2$$

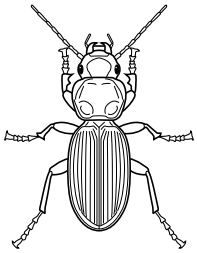
$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

Answer **all** the questions.

SECTION A – Module B4

1 Lily investigates animals in the school grounds.

One of the animals is the ground beetle.



Ground beetles are large insects.

They are predators of other insects.

Ground beetles are active at night. They move quickly across the ground to catch their prey.

(a) Lily's teacher tells her about three ways of catching insects: **nets**, **pitfall traps** and **pooters**.

Lily decides that pitfall traps are the best way of catching ground beetles.

(i) Write down **one** reason why pitfall traps are the best way of catching ground beetles.

Use information from the question to help you answer.

.....

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

(ii) Describe how Lily should set up a pitfall trap to catch ground beetles.

You may use a labelled diagram to help you answer.

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

Turn over for the remainder of question 1

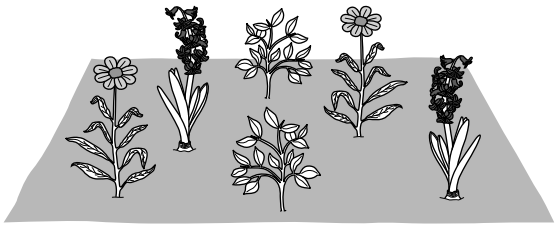
(b) Lily investigates ground beetles living in two different areas.

One area is overgrown.

The other area is a flower bed that is regularly looked after.

Both areas are the same size.

Overgrown area



Flower bed

Lily uses the capture-recapture method to estimate the population size of ground beetles in each area.

She catches ground beetles from each area, counts them, marks them, and then lets them go. This is the first sample.

The next night, Lily catches ground beetles from each area again. This is the second sample.

The table shows her results.

	Overgrown area	**Flower bed**
Number of ground beetles caught in the first sample	16	8
Number of ground beetles caught in the second sample	10	7
Number of ground beetles in the second sample that were previously marked	4	2

(i) Use the formula below to calculate an estimate of the population size in **each** area.

$$\text{population size} = \frac{\text{number in 1st sample} \times \text{number in 2nd sample}}{\text{number in 2nd sample previously marked}}$$

population in overgrown area = ... population in flower bed = ... **[2]**

(ii) Suggest **two** reasons for the difference in population size between the two areas.

1 .....

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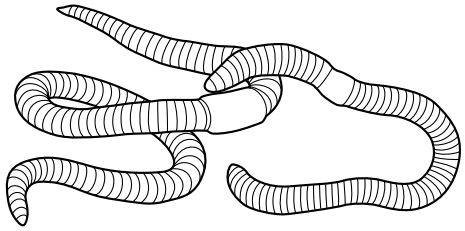
2 .....

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

(c) Earthworms also live in both areas.



Earthworms are detritivores which feed on dead vegetation.

Explain why detritivores help plant growth.

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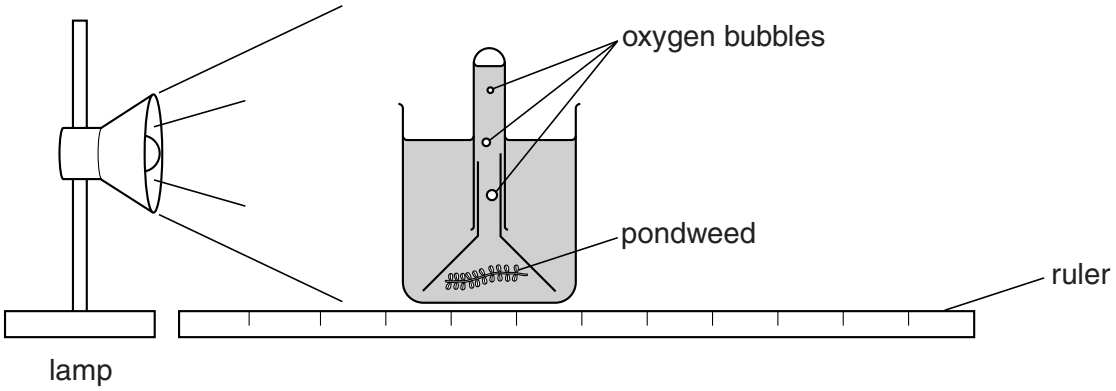
..... **[2]**

[Total: 9]

2 Sanjay investigates the amount of oxygen made by pondweed.

(a) He counts how many bubbles of oxygen are given off by pondweed at different distances from a lamp.



The table shows his results.

Distance between lamp and pondweed in cm	Number of bubbles given off by pondweed in 1 minute
10	48
20	25
30	12
40	7
50	5

(i) Describe and explain these results.

.....

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

(ii) Sanjay's friend says that counting bubbles is **not** a very good method for measuring the amount of oxygen.

Explain how Sanjay could change his method to get more accurate results.

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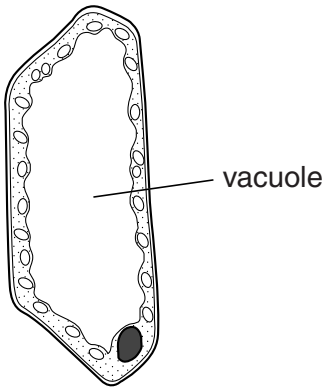
..... **[2]**

(b) Look at the diagram of a cell from the pondweed.



The cell contains a lot of water in its vacuole.

(i) By what process does water enter a cell?

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

(ii) Why do plant cells need water?

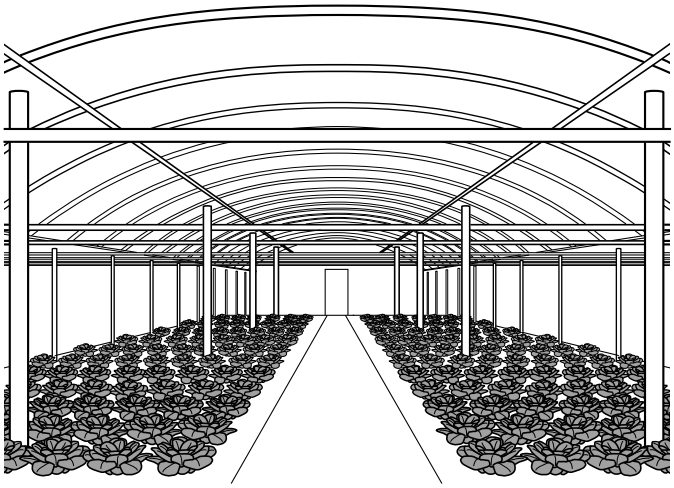
.....

.....

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

[Total: 8]

3 **(a)** Mary is a farmer. She grows lettuces in a glasshouse.



Mary makes sure that her lettuces are watered and have plenty of light.

Describe and explain **other** things that Mary can do to help her lettuces grow as well as possible.

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

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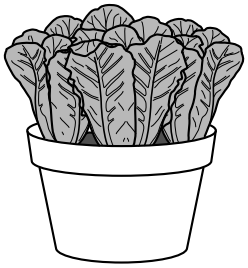
..... **[6]**

(b) Tom grows lettuces in a pot, in his garden.



Apart from watering his lettuces, Tom does not do anything else to help them grow.

Tom says, “My lettuces are more natural and taste better than Mary’s lettuces”.

Discuss whether Tom’s views are **scientific**.

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

[Total: 8]

Section B begins on page 10

SECTION B – Module C4

4 This question is about elements in the Periodic Table.

Look at the list of elements.

aluminium	**nitrogen**
chlorine	**oxygen**
helium	**sodium**
iodine	**sulfur**
magnesium	**zinc**

(a) Answer the questions.

Choose **all** your answers from the list.

Each element can be used **once**, **more than once** or **not at all**.

The Periodic Table on the back page may help you.

(i) Which element is used for sterilising cuts and wounds?

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

(ii) Write down the **names** of two elements in the same **group** of the Periodic Table.

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

(iii) Write down the **name** of the element with the **atomic number** 12.

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

(b) The electronic structure of sulfur is 2.8.6.

Which **period** of the Periodic Table is sulfur in?

Explain your answer.

.....

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

(c) Sodium reacts with iodine.

Sodium iodide is made.

Write the **word** equation for this reaction.

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

(d) Look at the table. It shows part of an early version of the Periodic Table of the Elements.

The numbers are the relative atomic masses of the elements.

H 1	Li 7	Be 9	B 11	C 12	N 14	O 16
F 19	Na 23	Mg 24	A*l* 27	Si 28	P 31	S 32
C*l* 35.5	K 39					

Three chemists helped with the development of the Periodic Table.

One of the chemists was Mendeleev.

He used the work of two other chemists.

They were:

- Dobereiner, who noticed triads
- Newlands, who developed the law of octaves.

Write about the work of **Dobereiner** and **Newlands** which contributed to the development of the Periodic Table.

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

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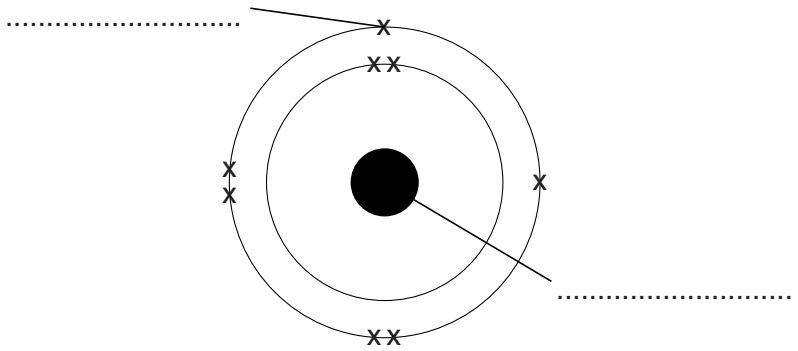
..... **[6]**

[Total: 12]

5 This question is about atomic structure.

(a) Look at the diagram of an atom of oxygen.

Complete the labels on the diagram.



[2]

(b) An atom of chlorine can be represented as

$$^{35}_{17}Cl$$

Different **isotopes** of chlorine exist.

Nick thinks the following are three isotopes of chlorine.

Only one is correct.

Which one?

$$^{35}_{16}Cl \qquad ^{37}_{17}Cl \qquad ^{37}_{18}Cl$$

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

[Total: 3]

6 Professor Hills investigates the reactions of the Group 1 metals, lithium, sodium and potassium, with water.

Look at his observations.

Metal	Observations
lithium	fizzes, moves across surface
sodium	fizzes rapidly, moves quickly across surface
potassium	fizzes violently, moves very quickly across surface, lilac flame seen

He concludes that the order of reactivity of the three metals is:

- potassium (most reactive)
- sodium
- lithium (least reactive).

(a) Write about how the evidence from Professor Hills' observations supports his conclusion.

.....

.....

.....

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

(b) Sodium, Na, reacts with water, H_2O.

Sodium hydroxide, NaOH, and hydrogen, H_2, are made.

Write a **balanced symbol** equation for this reaction.

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

[Total: 4]

7 This question is about metals.

Look at the table. It gives information about three metals.

Metal	Melting point in °C	Relative electrical conductivity (1 = low, 70 = high)	Density in g/cm^3	Cost of one kg in £
A	660	40	2.7	1.3
B	1083	64	8.9	4.7
C	962	67	10.5	602.8

(a) Look at the picture.

Metal **A** is used for making overhead power cables.

Metals **B** and **C** are much better conductors of electricity than metal **A**.

Explain why metal **A** is used to make overhead power cables, and not metals **B** or **C**.

Use information from the table to help you.

.....

.....

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

(b) Metal wires are used to support cable cars in ski resorts.

Metals used to support a cable car need other properties.

Which properties, **not given in the table**, are needed?

.....

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

(c) Metals are usually extracted from metal ores found in the ground.

Bornite is a metal ore.

Bornite has the formula Cu_5FeS_4.

Write down the **names** of the **elements** in bornite.

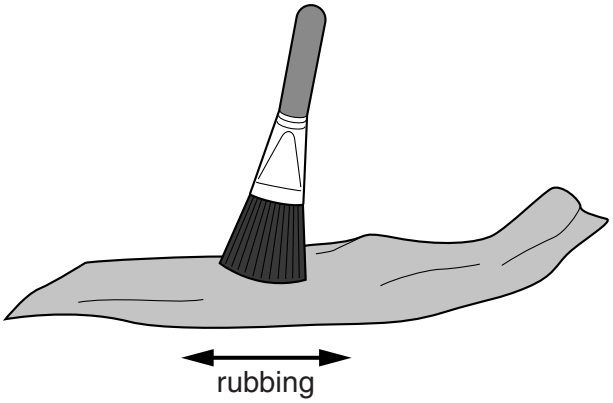
..... **[2]**

[Total: 6]

SECTION C – Module P4

8 This question is about electrostatic charge.

(a) (i) Connor rubs a cloth with a brush.

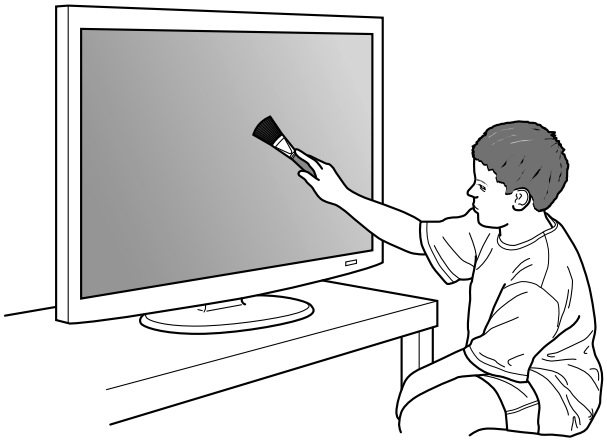


Complete the sentence.

After rubbing together, one of the objects has a ..... charge

and the other object has a ..... charge. **[1]**

(ii) Connor moves the charged brush close to the surface of a dusty television screen.



Describe what happens to the dust.

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

(b) Electrostatics can be dangerous or useful.

(i) Connor is wearing trainers and walks over the carpet in his kitchen.

He touches a metal tap and gets an electrostatic shock.

Put ticks (✓) in the boxes next to the **four** correct statements that help to explain why Connor received a shock.

Connor's trainers are conductors.	☐
The carpet is made from an insulating material.	☐
Charge conducts through the carpet.	☐
Connor becomes charged walking over the carpet.	☐
The carpet becomes charged by rubbing.	☐
The water tap is an insulator.	☐
The water tap is earthed.	☐

[2]

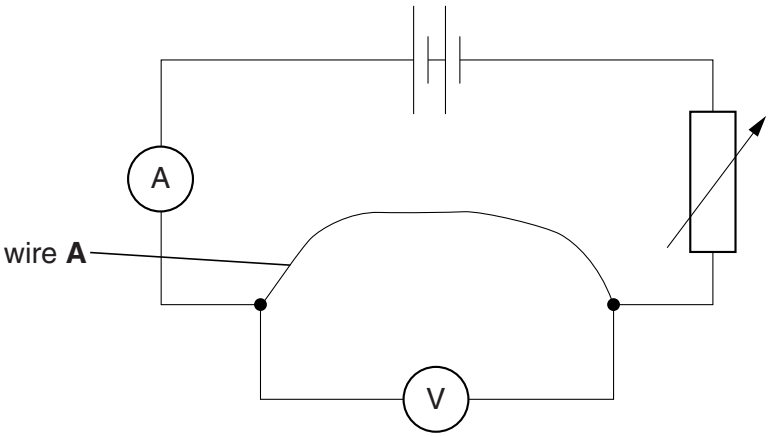
(ii) Electrostatic shocks are useful for restarting the human heart.

Write down one **other** use for electrostatics.

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

[Total: 6]

9 Manisha is investigating this electrical circuit.



(a) The current in wire **A** is 2 A and the voltage across it is 6 V.

Calculate the resistance of the wire.

.....

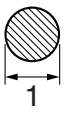
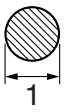
.....

.....

resistance = ... ohms **[2]**

(b) Manisha repeats the experiment with two different wires made from the same material.

Look at her results for the three wires **A**, **B** and **C**.

Wire	Voltage in volts	Current in amps	Length of wire in cm	Thickness in mm
A	6	2.0	100	
B	6	4.0	50	
C	6	1.0	50	

Describe how the thickness and length of the wires affects the current and the resistance.

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

(c) Manisha replaces the wire with a lamp.

She wants to compare the **power** of the lamp with the power of wire **A**.

Look at her results.

Component in circuit	Voltage in volts	Current in amps
wire **A**	6	2
lamp	6	0.9

Manisha calculates the power of wire **A** as 12W.

Manisha thinks that the power of the lamp is about half that of wire **A**.

Is she correct?

.....

Use calculations to explain your answer.

.....

.....

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

[Total: 7]

10 Patrick's doctor wants him to have a scan.

The scan will be of an internal organ in his body and will be carried out by a radiographer.

(a) A radioactive isotope will be injected into Patrick.

It acts as a tracer so that the radiographer will be able to scan the internal organ.

Look at the table containing information about three radioactive isotopes.

Isotope	Half-life	Nuclear radiation emitted
A	10 days	alpha
B	12 years	beta
C	6 hours	gamma

Use information about each isotope to suggest and explain which isotope is the best one to use for the scan.

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

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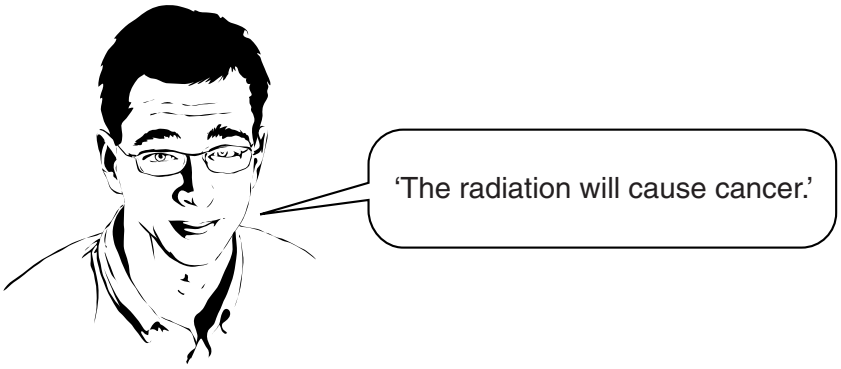
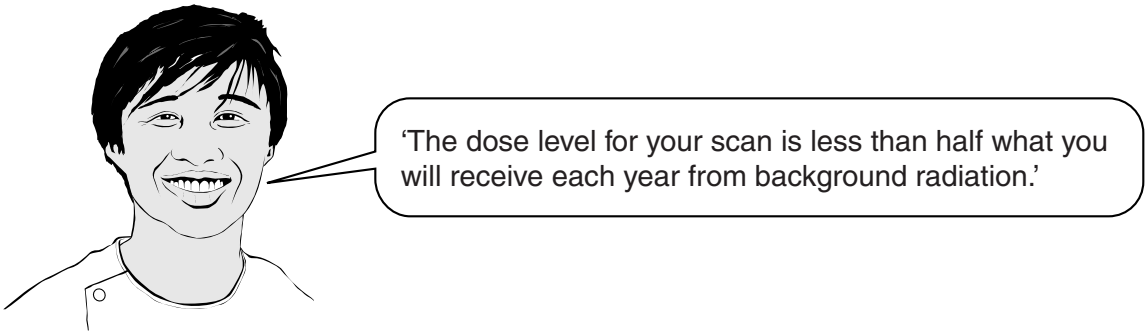
..... **[6]**

(b) Patrick is worried about the risk from the radiation.

His friend Dermot says that:



The radiographer Sheng Li tells him that:



Patrick considered the statements from both people.

How did this help him to decide to have the scan?

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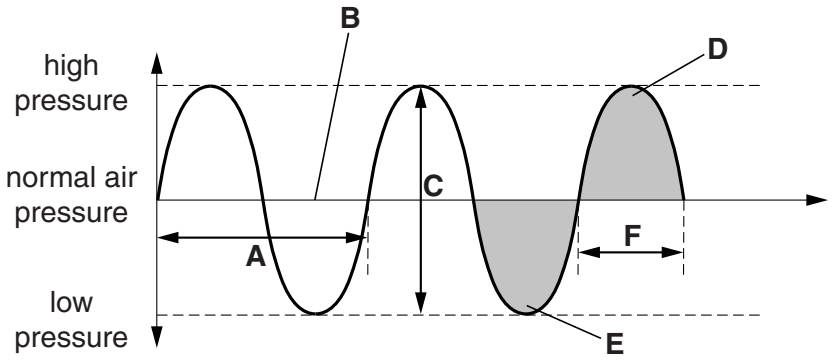
..... **[2]**

Turn over for the remainder of question 10

(c) Ultrasound can also be used for scanning.

Ultrasound waves can be shown by a wave diagram.



Look at the wave diagram.

(i) Which letter represents a **compression**? .....**[1]**

(ii) Which letter represents the **wavelength**? .....**[1]**

[Total: 10]

11 Rosalind is studying nuclear reactions.

(a) Nuclear **fusion** releases large amounts of energy.

What is **essential** for nuclear fusion?

Choose from

V a nuclear reactor

W an electrostatic precipitator

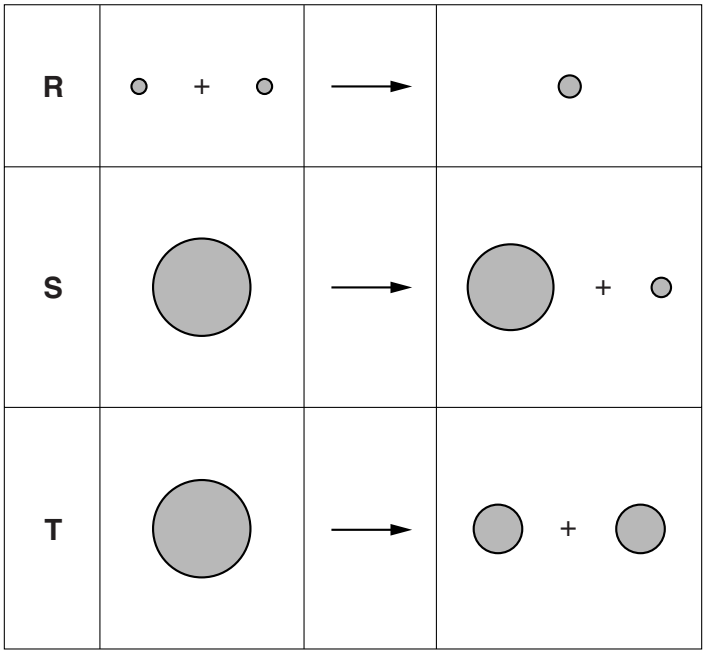
X a temperature of millions of degrees Celcius

Y a radioactive element such as Uranium

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

(b) Rosalind looks at some diagrams of nuclear reactions.

In the diagrams, the circles represent different sized nuclei.



Rosalind decides that diagram **R** represents nuclear **fusion**.

She is correct.

Explain why.

.....

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

[Total: 2]

SECTION D

12 Jenny and Bob are learning about the heart.

(a) They have been learning about **cardiac output**.

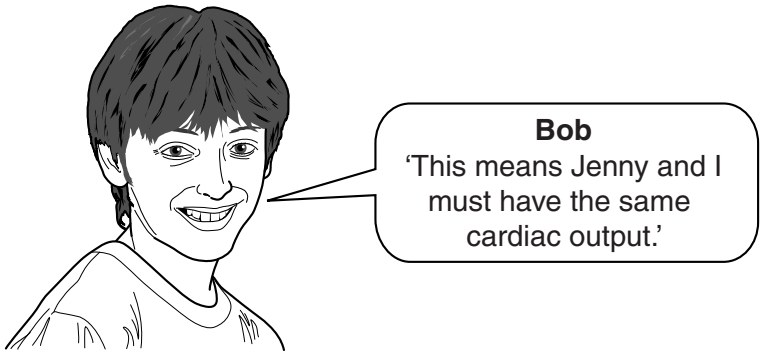
This is the volume of blood that the heart pumps out every minute.

Their teacher says that, on average, a person's cardiac output is 6 litres per minute.

(i) Calculate the average volume of blood the heart pumps out in **one hour**.

answer = ... litres **[1]**

(ii) The teacher says that, on average, a person's cardiac output is 6 litres per minute.



Bob's statement is not true. Explain why.

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

(b) There are three main ways in which doctors can measure cardiac output.

Method 1: A doctor injects a small amount of radioactive glucose solution into a blood vessel. She measures the radioactivity.

Method 2: A doctor takes blood samples from an artery. She measures the oxygen content.

Method 3: A doctor measures the blood flow using an ultrasound scan.

Doctors usually prefer to use **method 3**.

Suggest **one** reason why this is.

.....

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

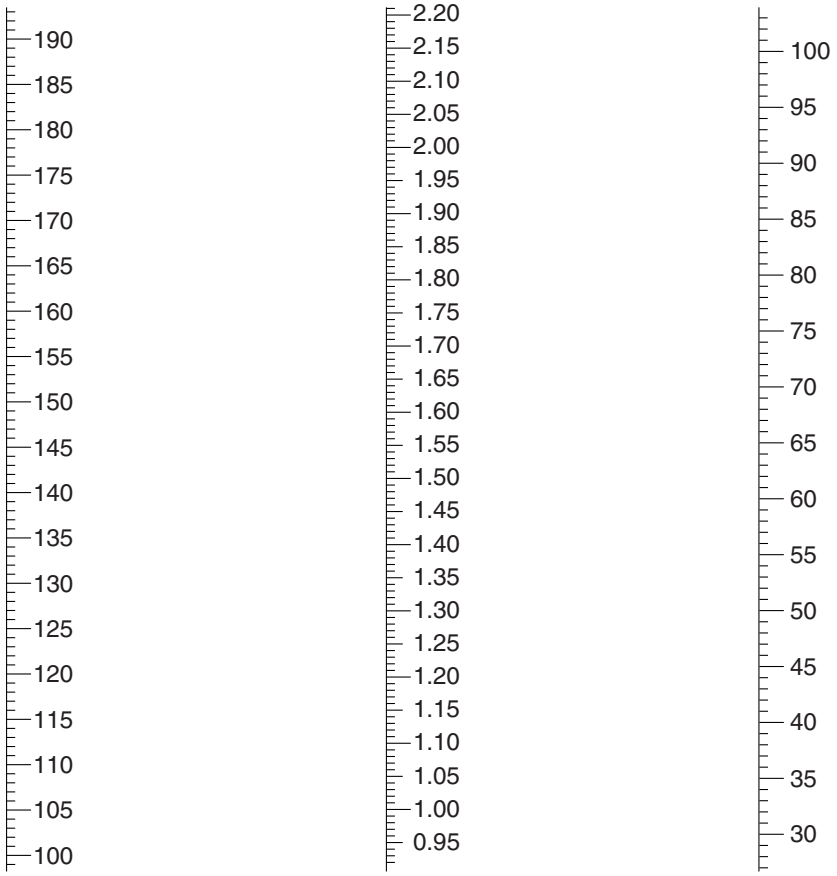
Turn over for the remainder of question 12

(c) Jenny finds another way of measuring how well her heart works.

To do this she needs to find out her surface area.

(i) Jenny's body mass is 67 kg and her height is 135 cm.

She uses these scales to work out her surface area.



Draw a straight line from Jenny's height on the left scale to her mass on the right scale.

Where the line crosses the surface area scale, read off and record her surface area.

Jenny's surface area = ... m^2 **[1]**

(ii) Jenny's new method is called the **cardiac index**.

This is calculated using the formula:

$$\textbf{cardiac index} = \frac{\textbf{cardiac output}}{\textbf{surface area of the body}}$$

A cardiac index of 3.5 is normal.

Up to 0.7 higher or lower than 3.5 is still healthy.

Jenny's cardiac **output** is 6 litres per minute.

Calculate Jenny's cardiac index.

What does Jenny's cardiac index tell you about her heart?

cardiac index = ...

.....

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

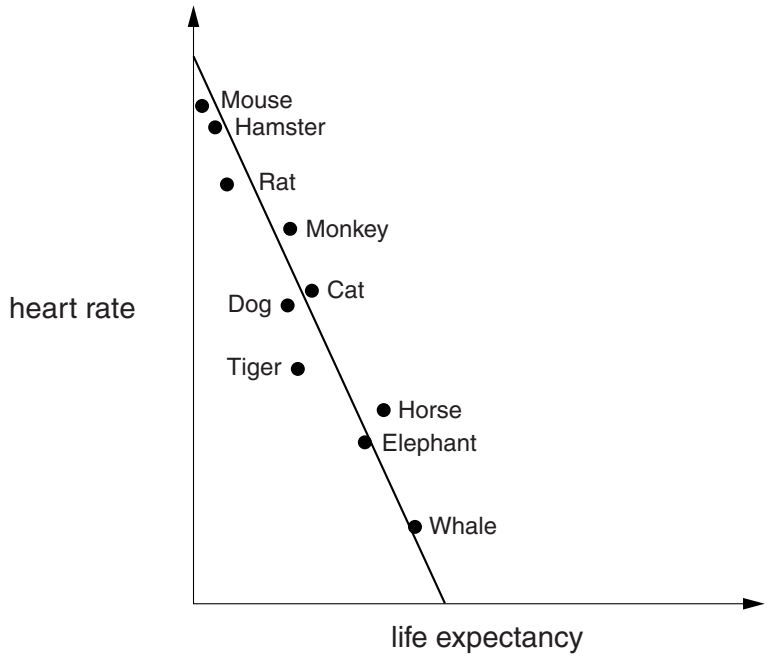
(iii) Why is cardiac **index** a better measurement to use than cardiac **output**?

.....

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

Turn over for the remainder of question 12

(d) Jenny looks at this graph. It shows information about heart rate and life expectancy of different mammals.



What does this graph tell you about the heart rate and life expectancy of larger mammals?

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

[Total: 10]

END OF QUESTION PAPER

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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.