

Entrance Examinations (14+)

2017

Science

One Hour

This paper contains 14 questions on biology, chemistry and physics.

Attempt as many questions as you can and do not worry if you have not covered all the topics in your school.

There are 82 marks available.

You should show each step in your working and all rough work should be done on this paper.

You will need a ruler.

You may use a calculator.

NAME:.....

AGE:.....

PRESENT SCHOOL:.....

Total...../82
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Q1. Underline the word or phrase which best completes each of the following sentences.

(a) The foetus is protected from damage by the

amniotic fluid oviduct placenta ribcage.

(b) The substance made in photosynthesis which stores energy is

carbon dioxide glucose oxygen water.

(c) In a food chain the type of organism which feeds on a producer is a

decomposer primary consumer
Secondary consumer virus.

(d) Scurvy is caused by the lack of a

carbohydrate mineral protein vitamin.

(e) In sea water, salt is the

solute solvent solution sublimate.

(f) A substance which increases in mass when heated in air could be

copper copper carbonate
copper oxide copper sulphate.

(g) When a gas condenses to form a liquid, the particles which it contains

get larger get smaller
move closer together move further apart.

(h) When lighting a Bunsen burner, the air-hole should be

a quarter open closed fully open half open.

(i) To measure the density of a piece of metal, you need to know its mass and

Its length

its volume

its weight

the type of metal.

(j) A planet in our solar system which has rings is

Earth

Pluto

Saturn

Venus.

(k) A note of higher pitch than middle C has a greater

amplitude

frequency

sound

wavelength.

(l) The mass of this exam paper is nearest to

0.5 g

5 g

50 g

500 g.

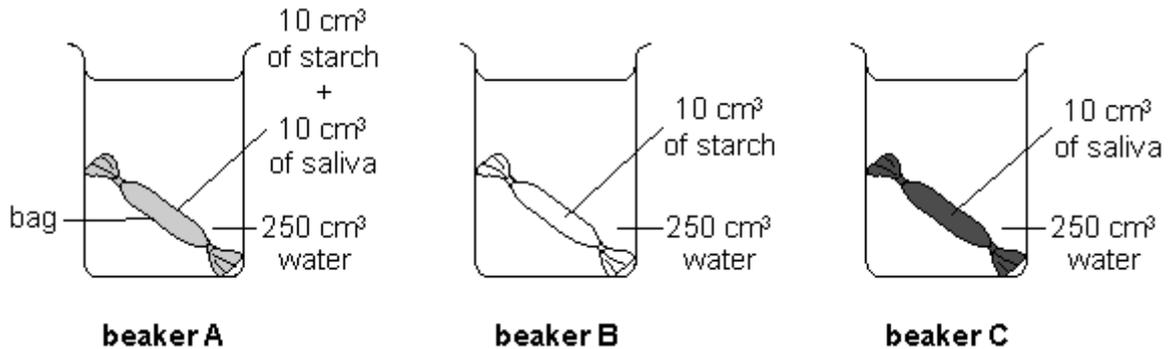
maximum 12 marks

Q2. Sally investigated how the human body digests and absorbs starch.

She used saliva to digest the starch.

To model digestion she used special bags made from a semi-permeable membrane. These bags have lots of very small holes.

Sally sets up the equipment as shown below. There is one special bag in each beaker.



She keeps the water in the beakers at 37°C.

After 20 minutes, Sally tested the contents of each beaker and bag for starch and sugar. The table below shows Sally's results.

	Was starch found in the bag?	Was sugar found in the bag?	Was starch found in the water?	Was sugar found in the water?
beaker A	✓	✓	✗	✓
beaker B	✓	✗	✗	✗
beaker C	✗	✗	✗	✗

(a) Suggest why Sally kept the water at 37°C.

.....

1 mark

(b) (i) Explain why sugar was found in the bag in beaker A.

.....

1 mark

- (ii) Starch was **not** found in the **water** outside the bag in any beaker. Suggest why.

.....

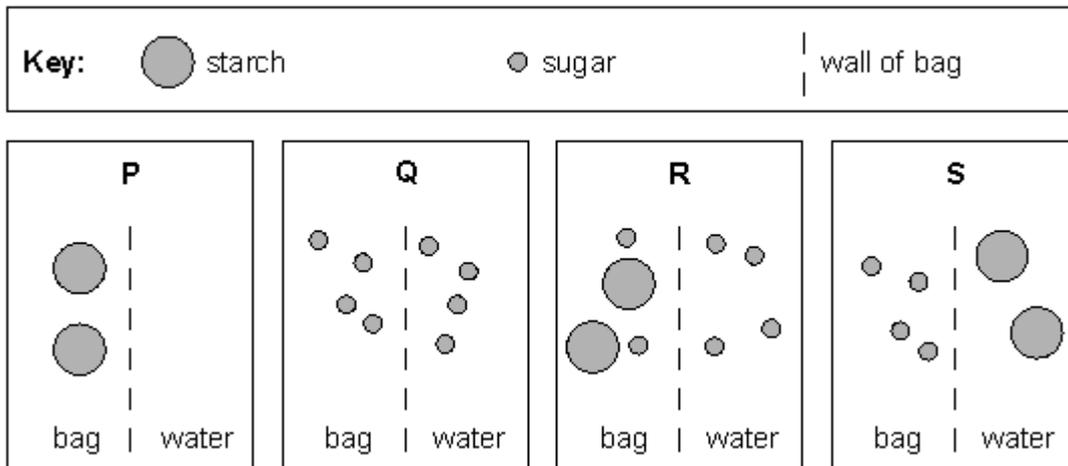
1 mark

- (c) Why did Sally set up beaker C? Tick the correct box.

for a fair test	<input type="checkbox"/>	for accuracy	<input type="checkbox"/>
for reliability	<input type="checkbox"/>	for a control	<input type="checkbox"/>

1 mark

- (d) Sally used diagrams to show what happened in her investigation.



Use the diagrams above to answer the following questions.

- (i) Which diagram shows the **results** of beaker **B**? Write the letter.

.....

1 mark

- (ii) Which diagram shows the **results** of beaker **A**? Write the letter.

.....

1 mark

(e) What does saliva contain that causes starch to change in beaker A?

.....

1 mark

(f) Sally chewed a piece of bread for 5 minutes without swallowing.
What would she notice about the taste of the bread after chewing for 5 minutes?
Use Sally's results to help you.

.....

1 mark
maximum 8 marks

Q3. (a) The table below shows the pH of four acidic liquids.

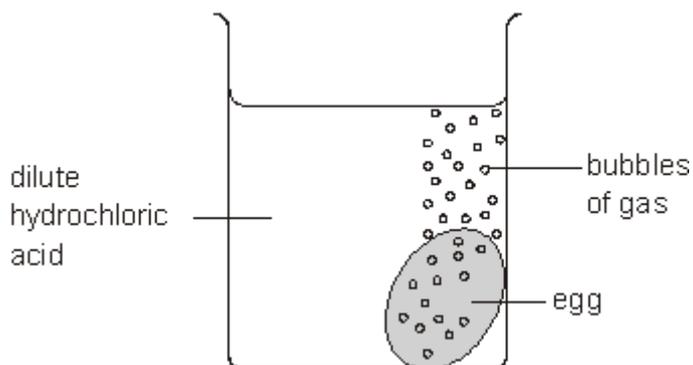
acidic liquid	pH
grapefruit juice	3.1
ethanoic acid	3.0
lemonade	4.4
dilute hydrochloric acid	1.0

Which of these liquids is the **least** acidic?

.....

1 mark

- (b) Emilio cooked an egg until it was hard-boiled. He put the egg in a beaker of dilute hydrochloric acid as shown.



- (i) The egg shell reacted completely with the acid. After two days the pH of the liquid in the beaker was 2.5.

How did the **acidity** of the liquid in the beaker change? Use the table above to help you.

.....

1 mark

- (ii) Emilio put another hard-boiled egg in some ethanoic acid. It took longer for the shell to react completely.

Use the table opposite to suggest a reason for this.

.....

1 mark

- (c) The chemical formulae for four acids are shown in the table below.

sulphuric acid	hydrochloric acid	nitric acid	ethanoic acid
H_2SO_4	HCl	HNO_3	CH_3COOH

- (i) Give the **name** of the element that is present in all four acids.

.....

1 mark

(ii) Give the **names** of the two **other** elements present in sulphuric acid.

1.

1 mark

2.

1 mark

(iii) How many atoms are there in the formula HNO_3 (nitric acid)?

.....

1 mark
maximum 7 marks

Q4. The table shows information about three planets in our solar system.

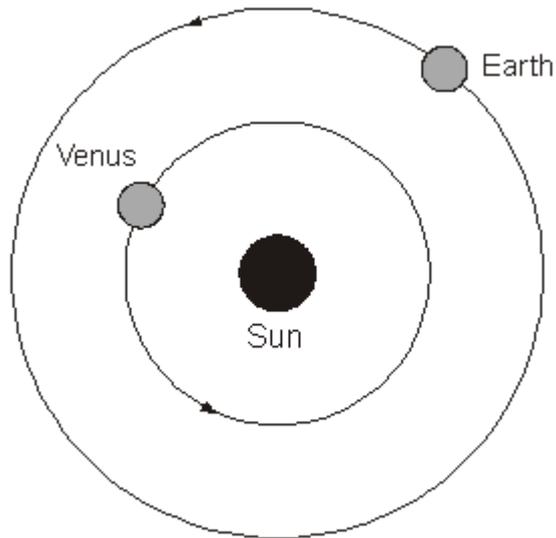
planet	time taken to orbit the Sun (Earth-years)
Mars	2.0
Venus	0.6
Earth	1.0

(a) Give **one** reason why Venus takes less time than Earth to orbit the Sun.

.....
.....

1 mark

- (b) The diagram below shows the orbits of Venus and Earth. The Sun is a source of light. Venus does **not** produce its own light.



not to scale

On the diagram above, draw rays of light to show how Venus can be seen from Earth. Use a ruler.

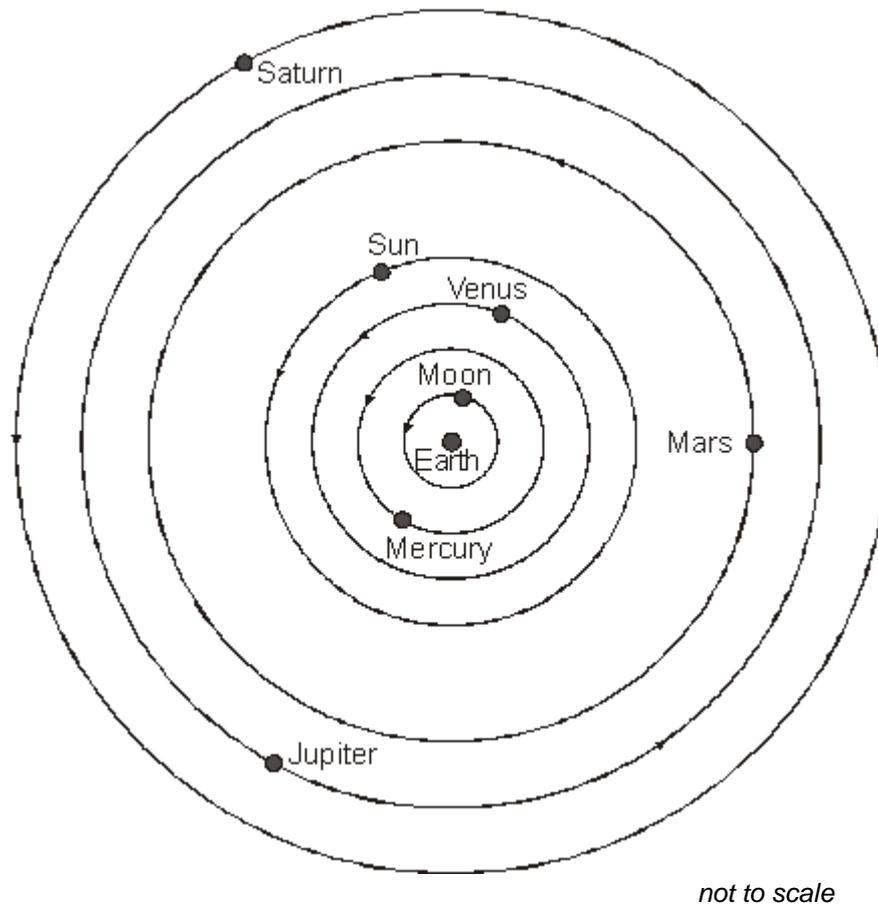
1 mark

Draw an arrow **on each** ray to show the direction of light.

1 mark

Question continues on the next page

- (c) The diagram below shows how the astronomer Ptolemy drew the solar system 2000 years ago.



- (i) The planets Uranus and Neptune are missing from his diagram.
Suggest why Ptolemy did **not** include these planets in his diagram.

.....
.....

1 mark

- (ii) Today we know the correct arrangement of the planets in our solar system.
Give **one** way the diagram above is incorrect.
Complete the sentence below.

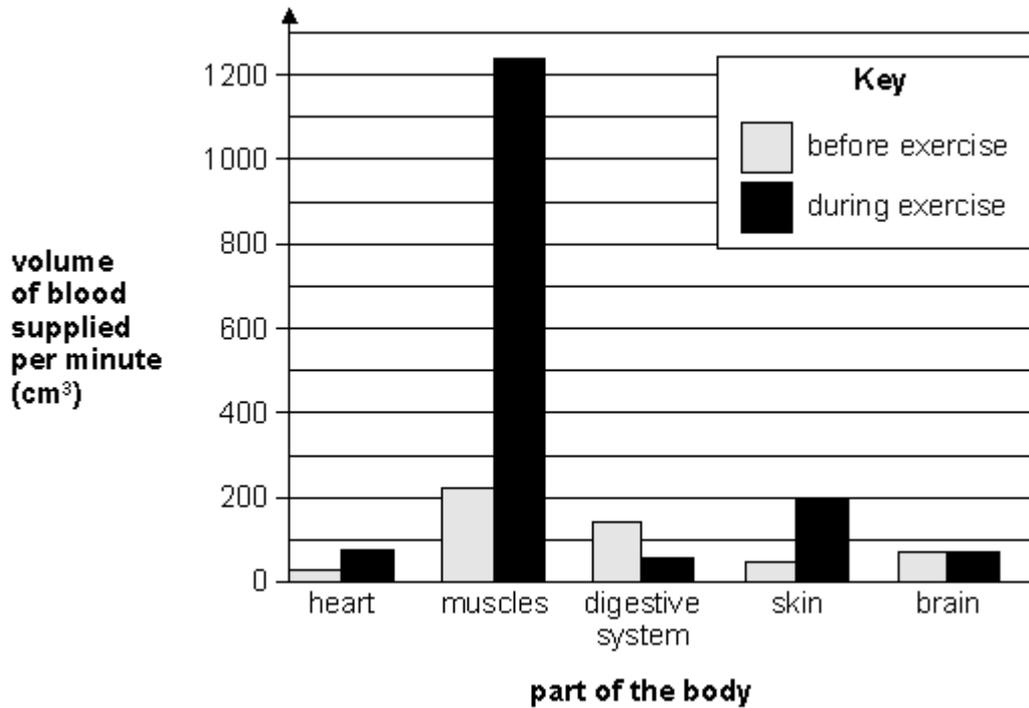
In the correct arrangement

.....

1 mark
maximum 5 marks

Q5. When people exercise, the volume of blood per minute needed to supply different parts of the body changes.

This is shown in the bar chart below.



(a) Explain why muscles need **more** blood during exercise. Give **three** reasons.

.....

.....

.....

.....

.....

3 marks

(b) Look at the bar chart.
Suggest why you should not go for a long run just after eating a meal.

.....

.....

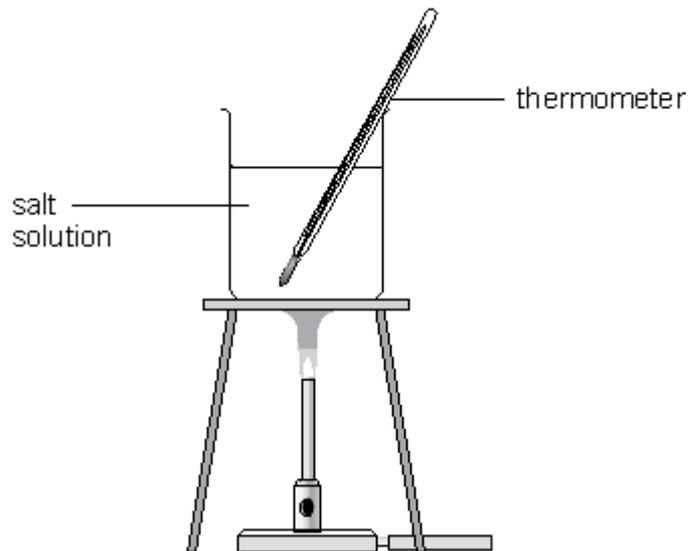
1 mark

(c) Why is it important that the blood supply to the brain stays constant?

.....
.....

1 mark
maximum 5 marks

Q6. Neera and Tom dissolved different masses of salt in 500 cm³ of water. They measured the temperature at which each salt solution boiled.



(a) They wrote down the variables that might affect the investigation.

temperature of the laboratory	mass of salt dissolved in water	starting temperature of the water
boiling point of salt solution	volume of water	type of salt used

(i) What is the independent variable (the variable they changed) in their investigation?

.....

1 mark

- (ii) What is the dependent variable (the variable they measured) in their investigation?

.....

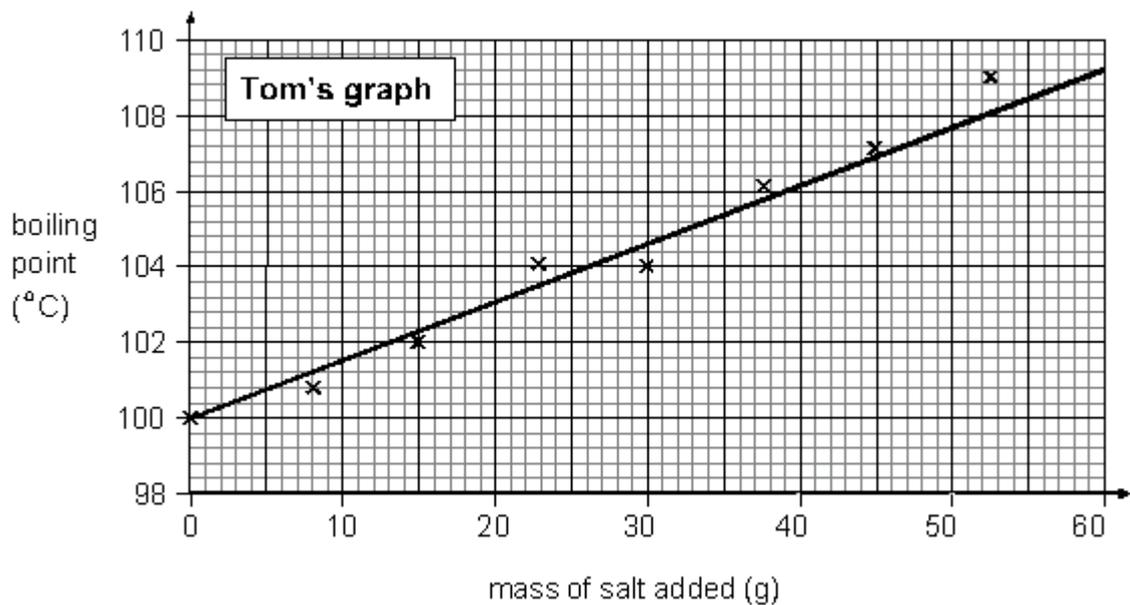
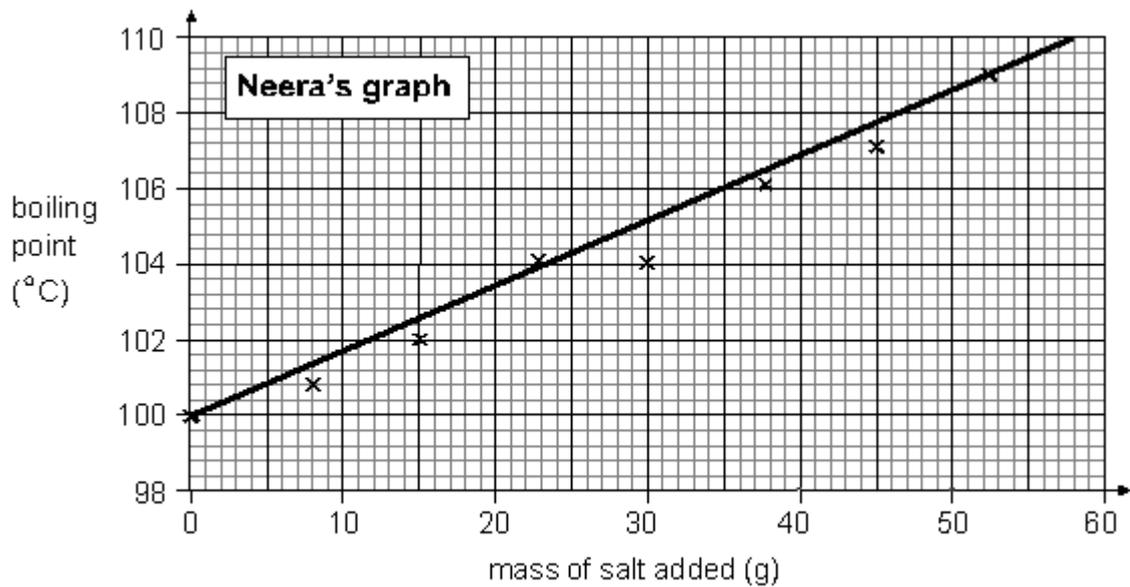
1 mark

- (iii) Which variable above would affect the experiment the least?

.....

1 mark

- (b) Neera and Tom plotted their results and drew the graphs shown below.



(i) How can you tell from the graphs that Neera and Tom started with pure water?

.....
.....

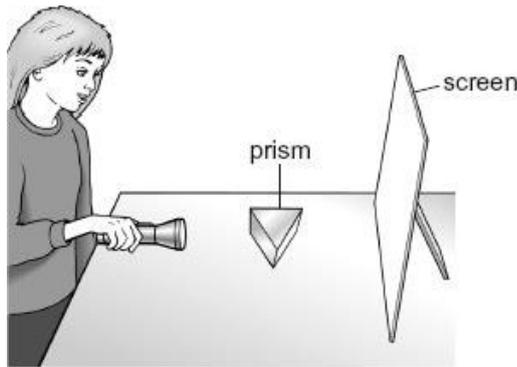
1 mark

(ii) Why is Tom's line of best fit better than Neera's line of best fit?

.....
.....

1 mark
maximum 5 marks

Q7. Ann shines a ray of white light at a glass prism.

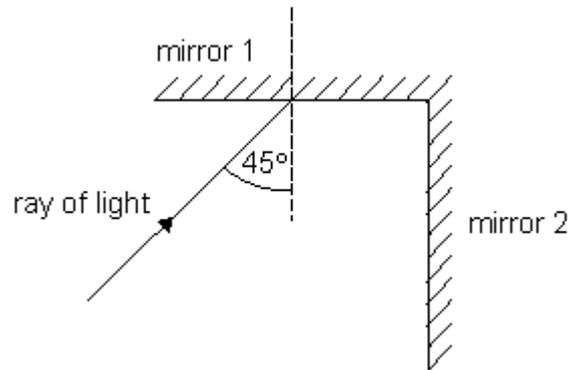


(a) Tick one box in each row to show if each sentence is **true** or **false**.

	true	false
The light refracts as it enters the prism.	<input type="checkbox"/>	<input type="checkbox"/>
The light refracts as it travels through the prism.	<input type="checkbox"/>	<input type="checkbox"/>
The light disperses as it leaves the prism.	<input type="checkbox"/>	<input type="checkbox"/>
The light forms a spectrum of colours on the screen.	<input type="checkbox"/>	<input type="checkbox"/>

2 marks

- (b) Ann places two mirrors at 90° and shines a ray of light at mirror 1.



- (i) **On the diagram above** continue the ray of light to show how it is reflected by both mirrors. Use a ruler.

2 marks

- (ii) **On the diagram above** label the incident ray (i) and the reflected ray (r) for the light striking **mirror 2**.

1 mark

- (c) Ann shines the torch at a red book.

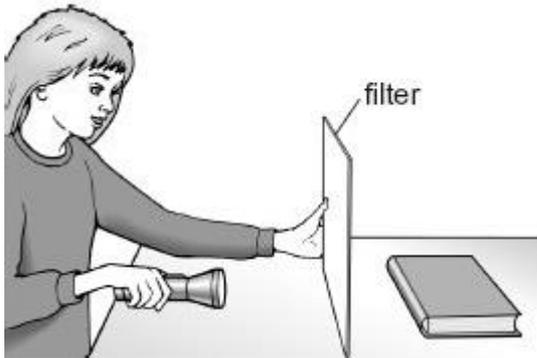


Explain why the object looks red in white light.

.....
.....

2 marks

- (d) In a dark room, Ann puts different coloured filters in front of the torch. She records the colour the book appears.

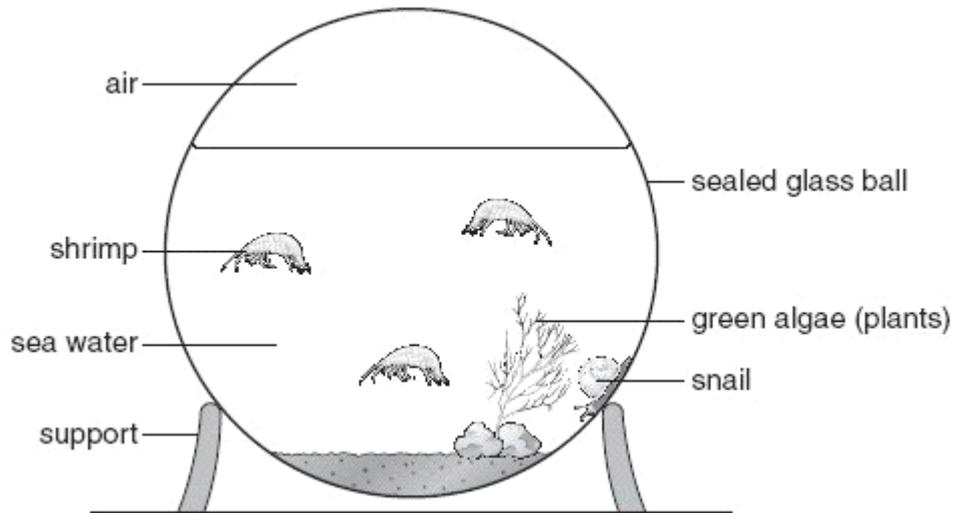


Complete the table below to show the colour that the book would appear. Tick **one** box in each row. The first one has been done for you.

colour of filter	What colour does the red book appear?		
	red	green	black
no filter	✓		
red filter			
green filter			

1 marks
maximum 8 marks

Q8. An ecosphere is a model habitat that can last for many years. The ecosphere below is a sealed glass ball containing sea water, green algae, bacteria, a snail and shrimps.



not to scale

(a) The ecosphere must receive plenty of light.

Explain why light is necessary for the survival of the green algae and the animals in the ecosphere.

.....

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.....

3 marks

(b) When organisms in the ecosphere die, they are broken down by bacteria. Nutrients, such as nitrates, are released back into the ecosphere.

Why is this necessary for the survival of the other organisms in the ecosphere?

.....

.....

1 mark

- (c) The table shows how the mass of oxygen dissolved in water changes with temperature.

temperature of the water (°C)	mass of oxygen dissolved (mg/100 cm ³)
15	10.2
17	9.7
19	9.3
21	9.0
23	8.7
25	8.4
27	8.1
29	7.9

This ecosphere was kept at a temperature between 17°C and 23°C.

In this ecosphere, respiration in the organisms is affected less if the temperature falls to 15°C than if it rises to 27°C.

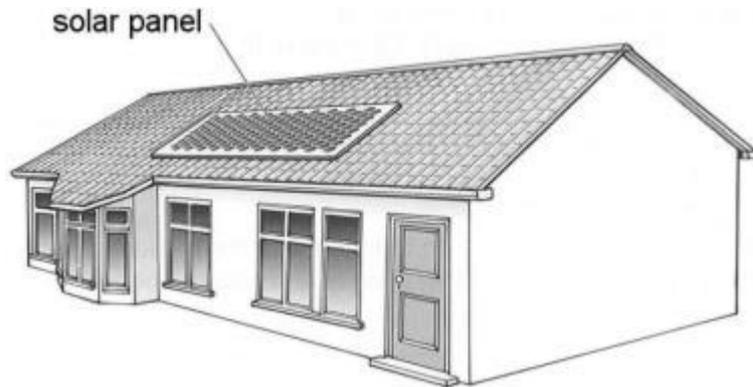
Use information in the table to explain this.

.....

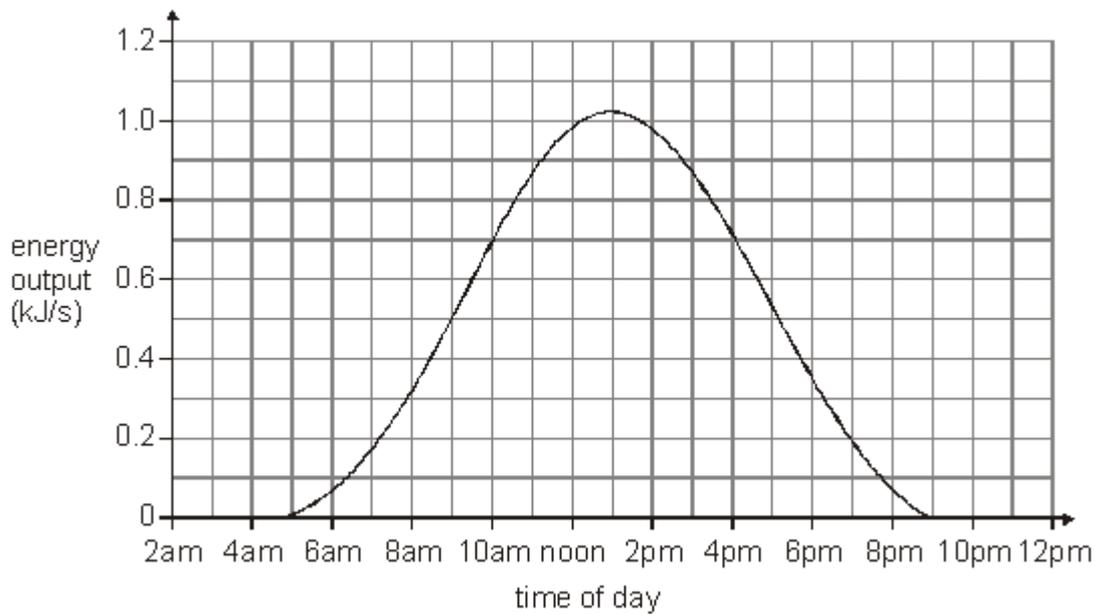
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1 mark
maximum 5 marks

Q9. The drawing below shows a solar panel fixed to the roof of a house in Britain.



(a) Daniel measured the energy output from this solar panel during one day in June. The graph below shows his results.



(i) Why does the energy output from the solar panel vary during the day?

.....
.....

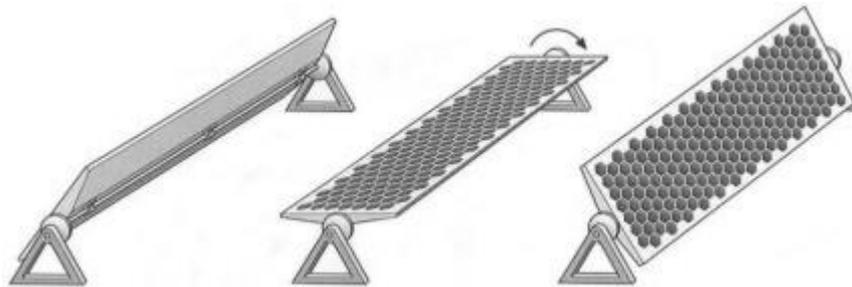
1 mark

- (ii) Daniel used the solar panel to run a motor.
The motor needs 0.7 kJ/s to run at full speed.
Use the graph to find out how long Daniel's motor would run at full speed.

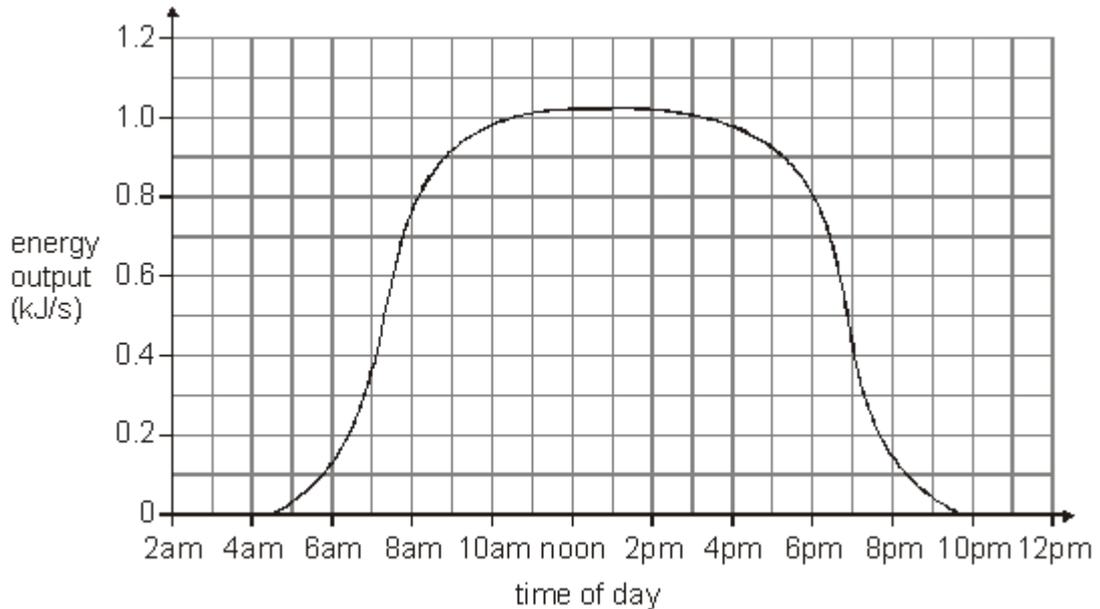
..... hours

1 mark

- (b) Daniel measured the energy output from a different solar panel.
This type of solar panel turns so that it always faces the Sun.



The graph below shows the energy output for this panel during one day in **mid-summer**.



- (i) On the graph above draw another curve to show how the energy output for this solar panel might vary on a day in **mid-winter**.

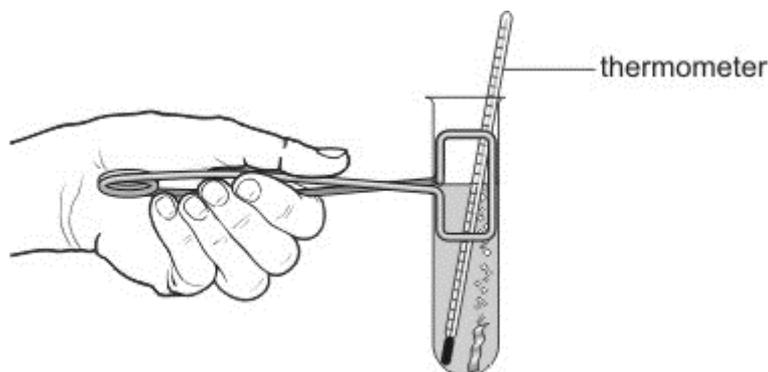
2 marks

- (ii) Between 7am and 7pm the solar panel turns through an angle of 180°. Calculate the angle the solar panel turns through each hour.

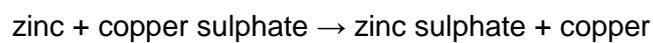
.....
.....degrees

1 mark
maximum 5 marks

- Q10.** Harry mixed zinc with copper sulphate solution in a test-tube. A displacement reaction took place and the temperature increased.



- (a) The word equation for the reaction is shown below.



Why is this reaction called a displacement reaction?

.....
.....

1 mark

- (b) Harry repeated the experiment with two other metals. He wanted to calculate the temperature rise each time. His results are shown below.

metal added to copper sulphate	temperature at the start (°C)	highest temperature reached (°C)	rise in temperature (°C)
zinc	20.0	36.5	16.5
iron	25.5	38.5	13.0
magnesium	19.5	87.5	68.0

Harry used different starting temperatures. Explain why this did **not** affect his results.

.....
.....

1 mark

- (c) Part of the reactivity series of metals is shown below.

most reactive sodium
 calcium
 magnesium
 aluminium
 zinc
 iron
 lead
least reactive copper

Use the reactivity series above to answer all the questions below.

- (i) Why was the highest rise in temperature obtained with magnesium and copper sulphate?

.....
.....

1 mark

- (ii) Why was the rise in temperature obtained with zinc and copper sulphate **not** much higher than the rise in temperature obtained with iron and copper sulphate?

.....
.....

1 mark

- (iii) In which of the following mixtures would there be a rise in temperature? Write **yes** or **no** in each blank box.

mixture	Would there be a rise in temperature?
aluminium + sodium chloride	
calcium + zinc sulphate	
lead + zinc chloride	
magnesium + iron chloride	

2 marks
maximum 6 marks

Q11. A company that sells bottled water claims in its advertisement:

Tap water contains large clusters of molecules. These are too large to pass through the tiny channels in the cell membranes that allow water into the cells of our bodies. Our special process makes the clusters of water molecules small enough to pass through the tiny channels.

A scientist says:

Water is absorbed by cells one molecule at a time so the size of the clusters of molecules does not matter.

- (a) What claim made by the company is the scientist challenging?

.....
.....

1 mark

(b)



Another company that sells bottled water makes these claims on its label:

This water makes you feel more beautiful.

This water reduces your blood pressure.

Explain why it is more difficult to compare any effects of drinking water on feeling more beautiful than on blood pressure.

.....
.....
.....

1 mark

(c) Consumers called for an 'independent study' of the company's claims.

Why is it important that any future study is 'independent' of the company?

.....
.....

1 mark

(d) Any study of the effects of different types of water should be done with people who do **not** know which type of water they are drinking.

Give a reason for this.

.....
.....

1 mark
maximum 4 marks

Q12.

The exhaust gases of a car with a petrol engine are analysed during its 'MOT test'. The results are shown below.

gas	% volume
carbon monoxide	3.0
carbon dioxide	13.0
oxygen	0.4
other gases	83.6

- (a) The air going into the engine contains about 20% of oxygen. Explain why there is only 0.4% of oxygen in the exhaust gases coming out of the car engine.

.....
.....

1 mark

- (b) (i) Petrol is a mixture of compounds which contains only carbon and hydrogen. Complete combustion of petrol produces carbon dioxide and **one** other substance. What is this other substance?

.....

1 mark

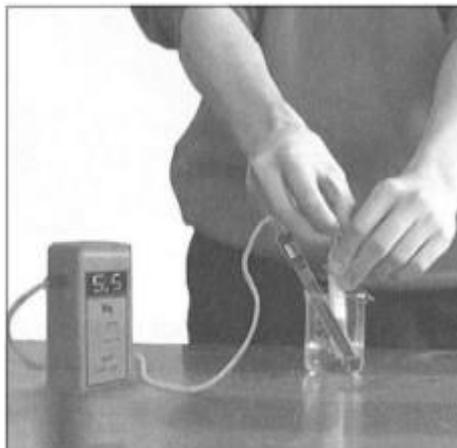
- (ii) When petrol is burned in the car engine, carbon monoxide is produced as well as carbon dioxide.

Explain why carbon monoxide is dangerous and may kill you.

.....
.....

1 mark
Maximum 3 marks

Q13. A pupil used a sensor to record the change in pH of 10 cm³ of an acid solution when an alkali solution was added a little at a time. The concentrations of the alkali and acid solutions were fixed.

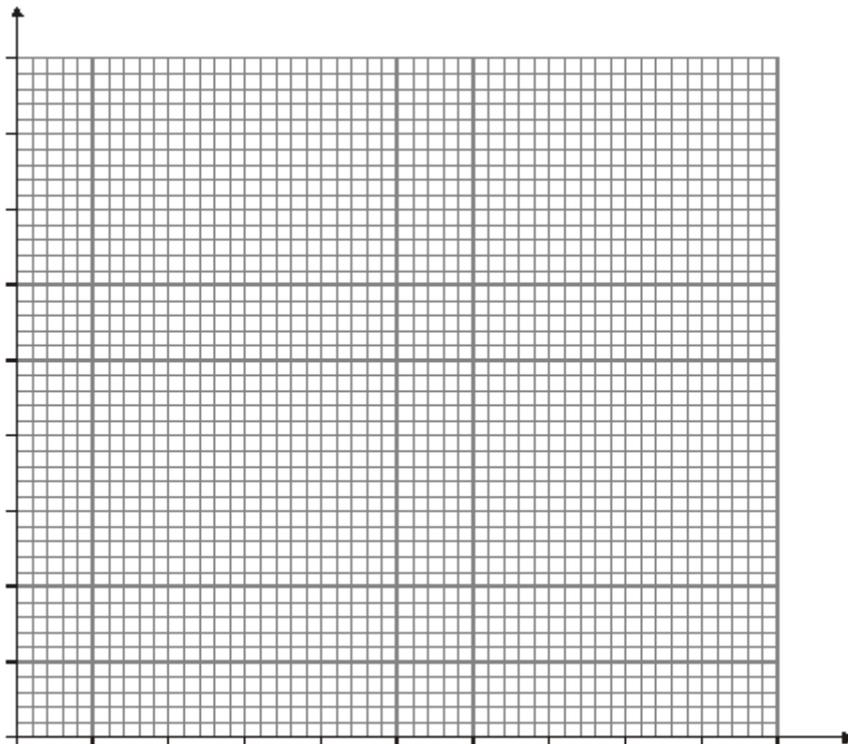


His results are shown in the table below.

volume of alkali added (cm³)	pH of resulting mixture
0.0	5.0
2.0	5.0
4.0	5.0
6.0	5.5
8.0	6.0
10.0	7.0
12.0	8.0
14.0	8.5
16.0	9.0
18.0	9.0
20.0	9.0

(a) Use his results to draw a graph on the grid below.

- Label the axes.
- Plot the points.
- Draw a smooth curve.



4 marks

(b) Look at the graph.
What would be the likely pH of the solution if the pupil added a further 2 cm³ of alkali solution?

.....

1 mark
maximum 5 marks

Questions continue on the next page

- Q14.** (a) Megan was doing time-trials on her bike around a 400 metre horizontal track.
- (i) She took 32 seconds to travel 400 m.
What was her average speed? Give the unit.

.....

.....

1 mark

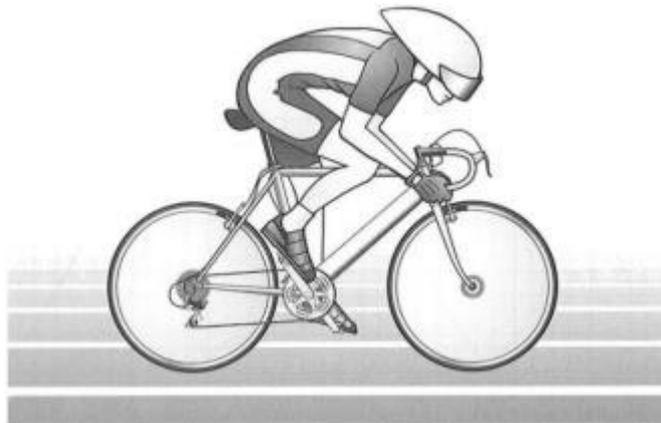
- (ii) Compare the forward force on the bike with the backward force on the bike when Megan was travelling at a constant speed.

.....

.....

1 mark

- (b) Megan then crouched down over the handlebars to make herself more streamlined, as shown below.
She continued to pedal with the same force as before.



Compare the forward and backward forces on Megan and her bike now.

.....

.....

1 mark

Explain your answer.

.....

.....

1 mark
maximum 4 marks

END OF TEST

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14+ Entrance 2016

SCIENCE

One hour

This paper contains 12 questions on biology, chemistry and physics.

Attempt as many questions as you can, and do not worry if you have not covered all the topics in your school.

There are 82 marks available.

You should show each step in your working and all rough work should be done on this paper.

You will need a ruler.

You may use a calculator.

NAME:.....

AGE:.....

PRESENT SCHOOL:.....

Total...../82
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Q1. Underline the correct word or phrase in the following questions.

- a) Disease can be caused by
bacteria **poor diet** **viruses** **any of these**
- b) The heart is
a cell **a tissue** **an organ** **an organism**
- c) The metal which reacts most readily with oxygen is
copper **iron** **magnesium** **sulphur**
- d) When the brakes of a bicycle are used to slow it down, kinetic energy is converted into
thermal energy **light energy**
potential energy **friction energy**
- e) In the presence of water, anhydrous cobalt chloride turns from
blue to pink **blue to white** **pink to blue** **white to blue**
- f) Respiration occurs in cells. Which of the following best describes the function of respiration?
To release energy **To produce carbon dioxide**
To produce oxygen **To take in oxygen**
- g) One component which gives out light when a current flows through it is a
buzzer **LED** **LDR** **relay**
- h) Chloroplasts are always found in the cells of
fruit **leaves** **petals** **roots**

i) Which of the following statements best describes the arrangement of particles in a solid?

Far apart and moving slowly

Close together and vibrating

Close together and stationary

Very far apart and moving quickly

j) Both the solute and the solvent can be obtained from a solution by

chromatography

distillation

evaporation

filtration

k) The pollutant mostly responsible for causing acid rain is

methane

carbon monoxide

CFCs

sulphur dioxide

l) When a flower is fertilised, the ovule will develop into a

bulb

fruit

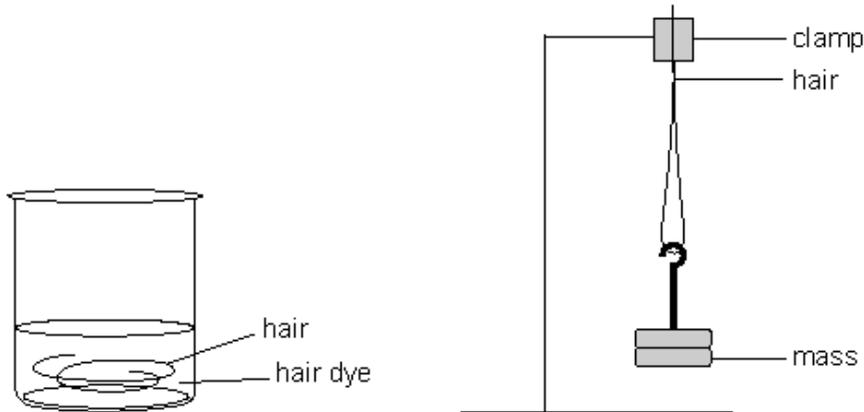
seed

shoot.

maximum 12 marks

Q2.

Jason wanted to find out if hair dye makes hair weaker.
He used 5 hairs of equal length.
He soaked each hair in a different concentration of hair dye for 15 minutes.
He added masses to each hair until it broke.



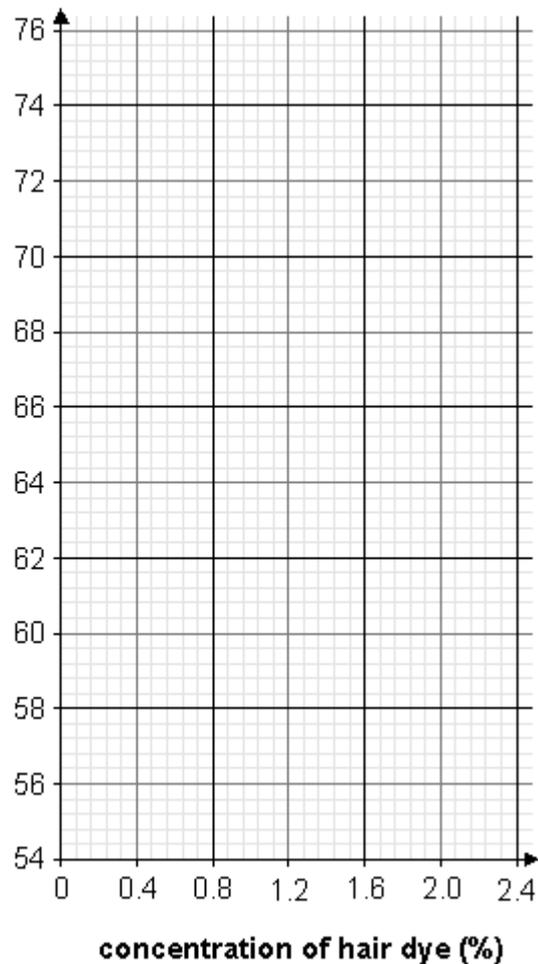
not to scale

(a) The table below shows Jason's results.

(i) Plot a graph of Jason's results **and** draw a line of best fit.

concentration of hair dye (%)	mass needed to break the hair (g)
0.4	71
0.8	67
1.2	64
1.6	61
2.0	58

mass needed to break the hair (g)



3 marks

(ii) Use the graph to work out the mass needed to break hair soaked in water (0% hair dye).

..... g

1 mark

(b) What was the independent variable that Jason **changed** in this experiment?

.....

1 mark

(c) What was the dependent variable that Jason **measured** in this experiment?

.....

1 mark

(d) What is the relationship between the concentration of hair dye and the mass needed to break the hair?

.....

.....

1 mark

(e) Jason wanted to investigate whether soaking hair in dye for different amounts of time affected the strength of the hair.

Jason drew a table for his results.

Add headings **and** units to the table below for Jason's investigation.

heading 1 (.....)	heading 2 (.....)

4 marks
maximum 11 marks

Q3. Diagram 1 shows a baby in its mother's uterus.

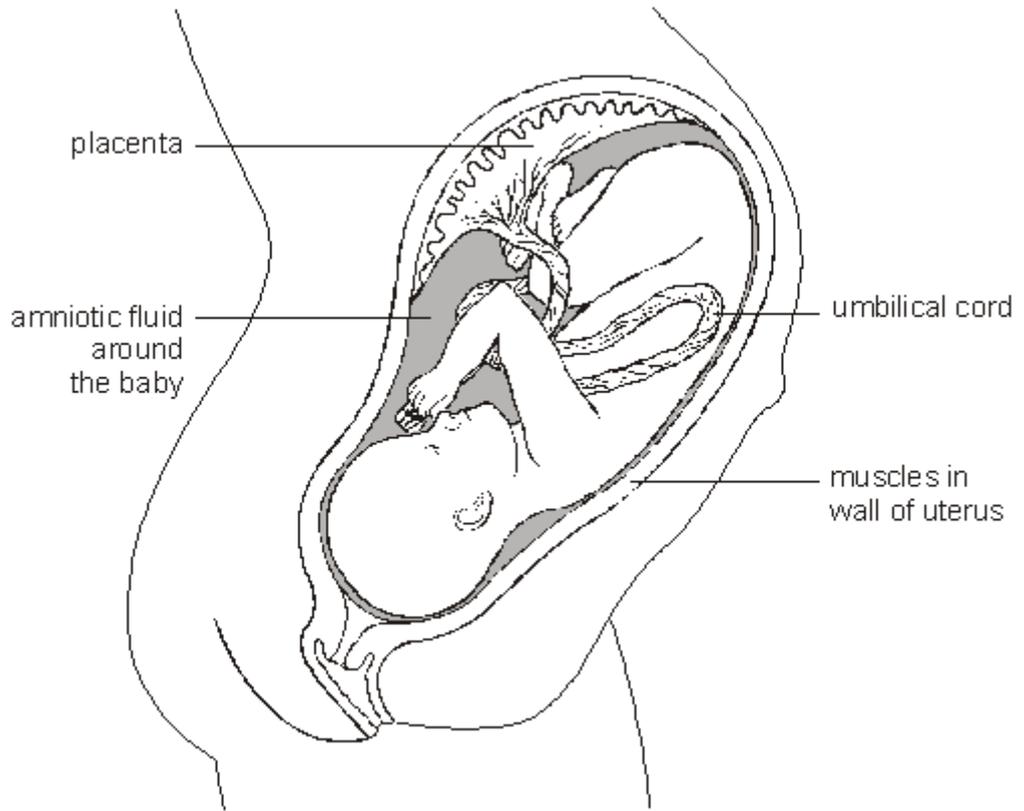


diagram 1

(a) What is the normal length of pregnancy in humans?

..... months

1 mark

(b) (i) What is the function of the amniotic fluid around the baby?

.....

1 mark

(ii) As a baby is born, it is pushed out of the mother's body.

Look at the diagram above.

What happens in the wall of the uterus to push the baby out?

.....

.....

1 mark

(c) How does a baby get oxygen from its mother while it is inside its mother's uterus?

.....
.....

1 mark

(d) **Diagram 2** shows a section through the mother's lungs.

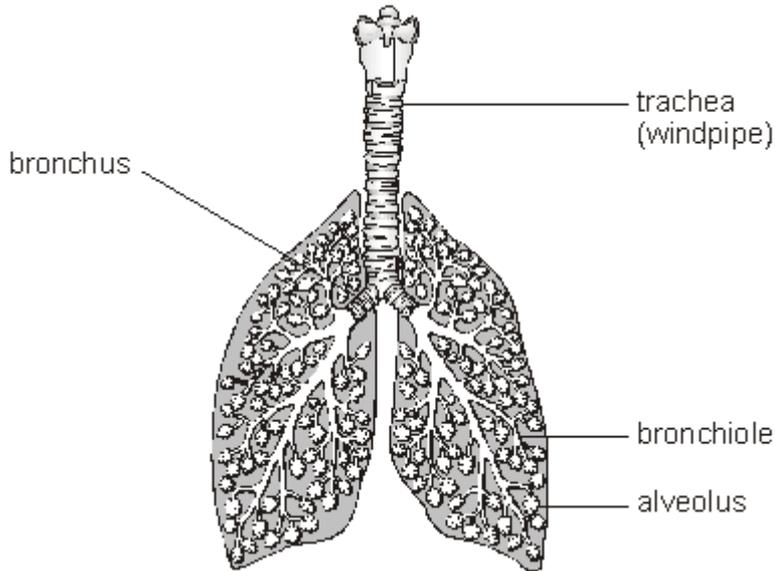


diagram 2

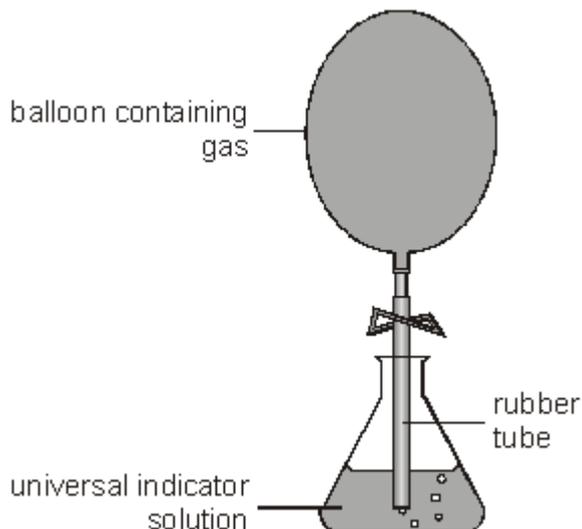
Look at **diagram 2**.

From which labelled part is oxygen absorbed into the blood?

.....

1 mark
maximum 5 marks

- Q4.** A scientist compared the acidity of four gases to see which gas might cause acid rain. She used four balloons to collect the gases. She then bubbled the gases, in turn, through a fresh sample of green, neutral, universal indicator solution.



- (a) Three of the gases caused the indicator to change colour. The scientist added drops of alkali to the indicator until the indicator changed back to green. Her results are shown in the table below.

gases collected	change in colour of indicator	number of drops of alkali needed to change the indicator back to green
exhaust gases from a car	green to red	31
carbon dioxide	green to red	160
air	no change	0
human breath	green to yellow	10

Use information in the table to answer part (i) and part (ii) below.

- (i) Which gas dissolved to form the most acidic solution?

.....

Explain your choice.

.....

.....

1 mark

(ii) Which gas formed a neutral solution?

.....

Explain your choice.

.....

.....

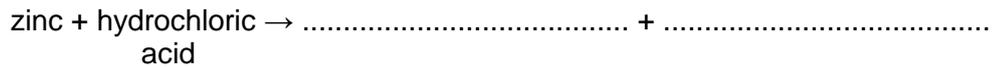
1 mark

(iii) What effect does an alkali have on an acid?

.....

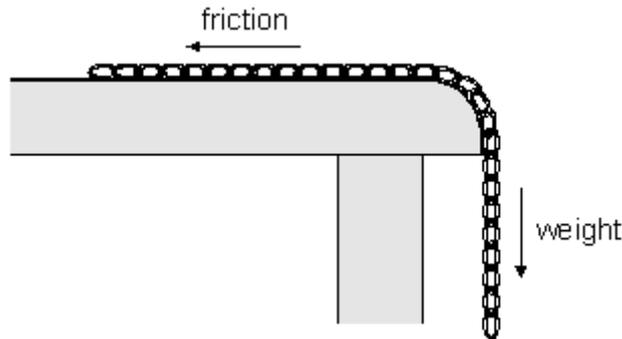
1 mark

(b) Some metals react with acids in the air.
Complete the word equation for the reaction between zinc and hydrochloric acid.



2 marks
maximum 5 marks

Q5. The diagram shows a chain hanging down over the edge of a table.



Two of the forces on the chain are:

- the weight of the part of the chain which is hanging over the edge;
- friction between the chain and the table.

(a) The chain is **not** moving. What does this tell you about these two forces acting on the chain?

.....

1 mark

(b) The chain is moved slightly to the right. It begins to slide off the table.

(i) What does this tell you about these two forces now?

.....

1 mark

(ii) Describe how the size of each force changes as the chain slides off the table.

• weight of the part of the chain hanging over the edge

.....

• friction between the chain and the table

.....

2 marks

(iii) How does the speed of the chain change as it slides off the table?

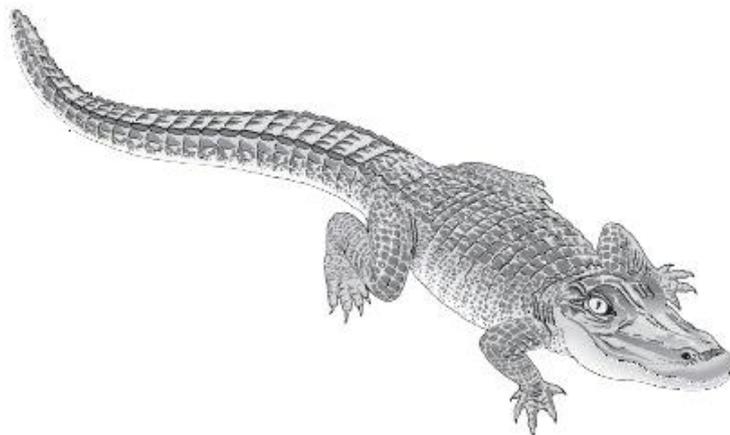
.....

.....

1 mark

Maximum 5 marks

Q6. The drawing below shows an alligator.



(a) Alligators are carnivores.
What does the word carnivore mean?

.....

1 mark

(b) Alligators lay eggs in nests made from plant material.
The eggs have tough shells containing calcium carbonate.

(i) How does the eggshell help the developing alligator to survive before it hatches?

.....
.....

1 mark

(ii) Rotting plant material in the nest is acidic.
When the acid comes into contact with calcium carbonate in the eggshell it makes the shell weaker.

Why does the acid weaken the eggshell?

.....
.....

1 mark

(iii) Suggest **one** reason why it is helpful to the developing alligator in the egg if the eggshell becomes weaker.

.....
.....

1 mark

Question continues on the next page

- (b) The table below shows the percentage of female and male alligators that hatch from the eggs when the eggs are kept at different temperatures.

temperature (°C)	% eggs hatching as females	% eggs hatching as males
26	100	0
28	100	0
30	100	0
32	86	14
34	0	100
36	0	100

- (i) Use the table to suggest how a zookeeper could make sure only females hatch from the eggs.

.....
.....

1 mark

- (ii) Between which **two** temperatures are 50% of the eggs likely to hatch as females?

Tick the correct box.

between 26°C and 30°C

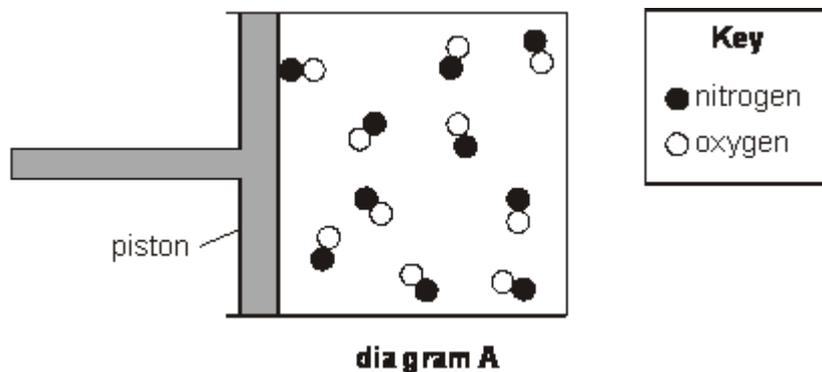
between 30°C and 32°C

between 32°C and 34°C

between 34°C and 36°C

1 mark
maximum 6 marks

- Q7.** Diagram **A** represents a gas in a container.
The gas can be compressed by moving the piston to the right.



- (a) (i) How can you tell that the substance in the container is a gas?

.....

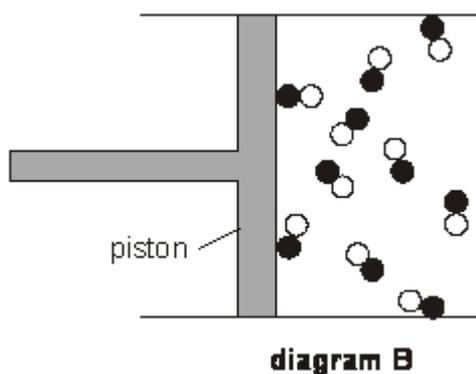
1 mark

- (ii) How can you tell from the diagram that the gas is pure?

.....

1 mark

- (b) The piston is moved to the right as shown in diagram **B**.



How can you tell, from diagram **B**, that the pressure of the gas has increased?

.....

1 mark

- (c) Diagram **C** shows what happened to the molecules after the gas was compressed more.

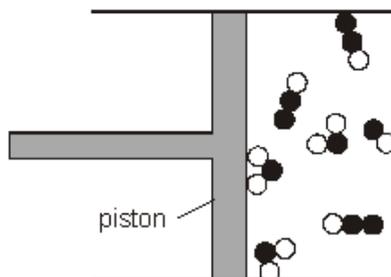


diagram **C**

- (i) How can you tell that a chemical reaction happened when the gas was compressed?

.....

1 mark

- (ii) The mass of the gas in both diagrams **B** and **C** was 0.3 g.
 Why did the mass of the gas **not** change when it was compressed?

.....

1 mark

- (iii) Complete the table below with the correct chemical formula of each substance. Use the key to help you.

substance	formula

Key	
	nitrogen
	oxygen

1 mark

- (iv) What is the **name** of the substance represented by the symbol ?

.....

1 mark
 maximum 7 marks

Q8. Oliver clamped a wooden plank to a desk. There was a 40 cm overhang as shown in diagram 1.

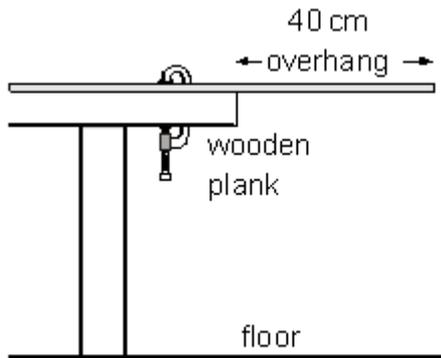


diagram 1

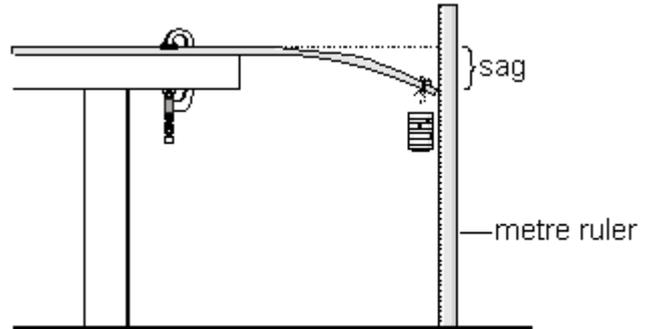
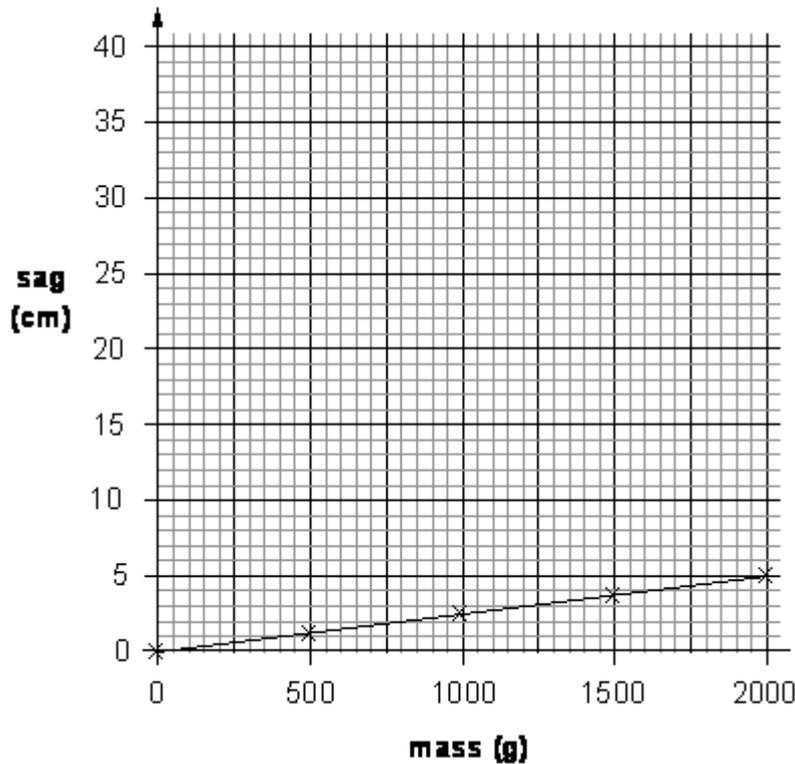


diagram 2

Oliver added masses to the end of the wooden plank as shown in diagram 2. He measured the sag (see diagram 2). The graph below shows his results.



(a) What measurements would Oliver need to take to work out the sag?

.....

.....

1 mark

- (b) Oliver repeated his test with a new plank with an 80 cm overhang. His results are shown below.

mass (g)	sag (cm)
0	1.0
500	15.0
1000	25.0
1500	31.0
2000	35.0

- (i) Plot the results from Oliver's second test on the grid on the previous page. Use the points to draw a line of best fit.

2 marks

- (ii) In the second test the plank sagged with **no** mass added to it. Explain what caused this sag.

.....

1 mark

- (c) Compare the results of Oliver's two tests.

- (i) How are the results **similar** for each test?

.....

.....

1 mark

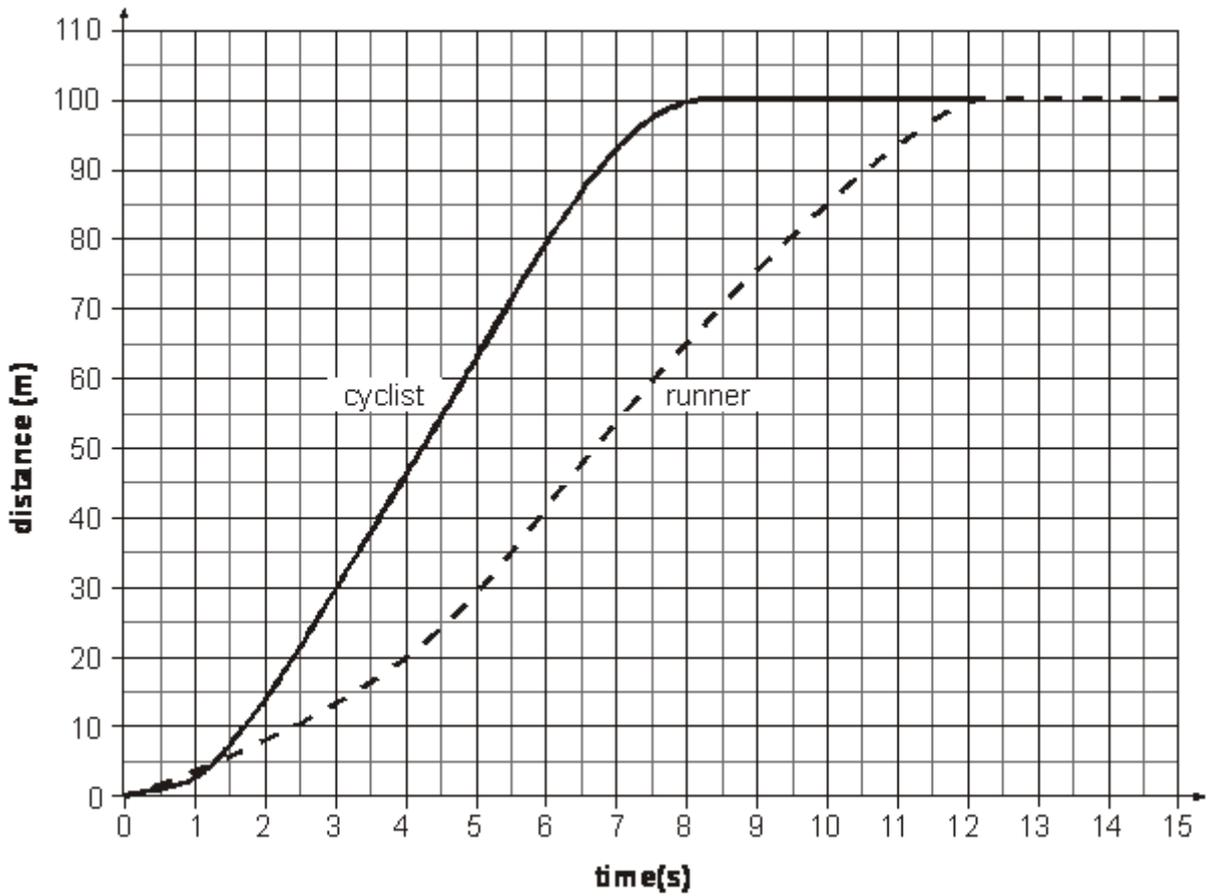
- (ii) How are the results **different** in the second test?

.....

.....

1 mark
maximum 6 marks

Q9. A cyclist and a runner have a race.
The distance-time graph for the race is shown below.



Use the graph to answer the following questions.

(a) (i) How much time did it take the cyclist to travel 100 m?

..... s

1 mark

(ii) When the cyclist finished the race how far behind was the runner?

..... m

1 mark

(iii) How much more time did the runner take compared with the cyclist to complete the race?

..... s

1 mark

- (b) The cyclist is travelling at a constant speed between 3 seconds and 6 seconds.
How does the graph show this?

.....
.....

1 mark

- (c) (i) When the race started, a walker set off at a steady speed of 2m/s.

Draw a line on the graph on the previous page to show the distance covered by the walker in the first 15 seconds. Use a ruler.

1 mark

- (ii) Calculate how much time it will take for the walker to walk 100m.

.....
..... S

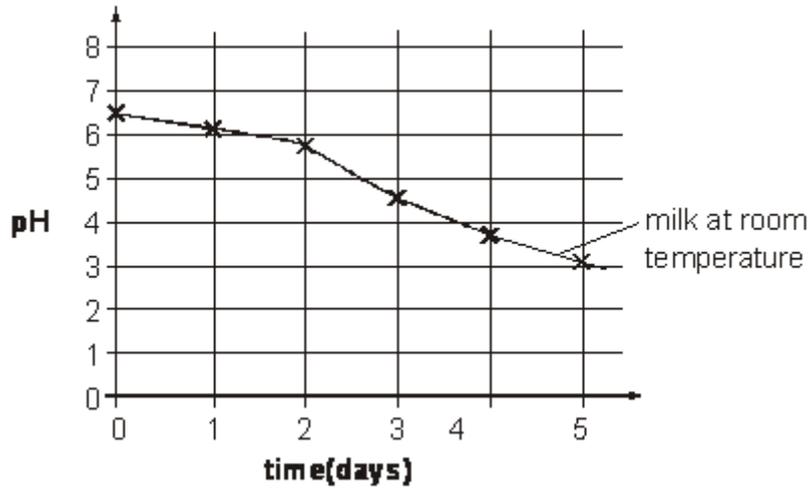
1 mark
maximum 6 marks

Test continues on the next page

Q10. Jane stored some milk at room temperature for five days in a sealed container. She used a pH sensor and data logger to record the pH of the milk for 5 days.

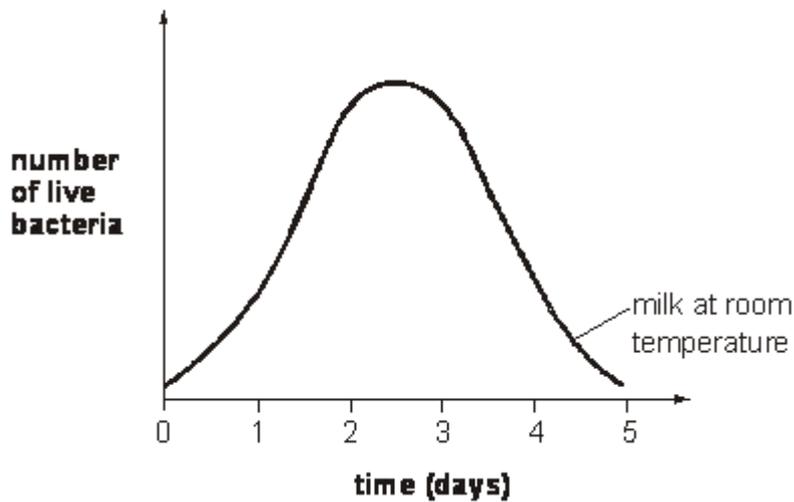
Her results are shown below.

graph 1



(a) Jane predicted that the number of live bacteria in the milk would change as shown below.

graph 2



(i) Suggest one reason why the number of live bacteria would start to decrease after 3 days.

.....
.....

1 mark

- (ii) What evidence from **graph 1** suggests that there were still some live bacteria in the milk on day 5?

.....

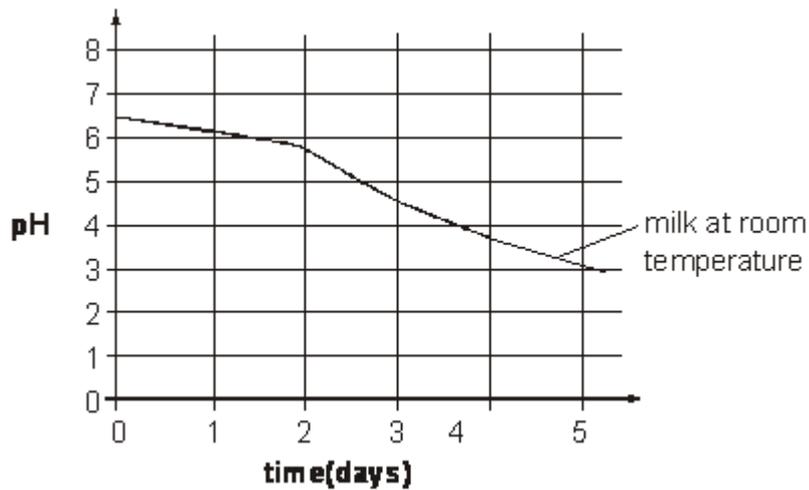
.....

1 mark

- (b) Jane put some fresh milk in a sealed container in the fridge. She measured the pH of the milk every day for five days.

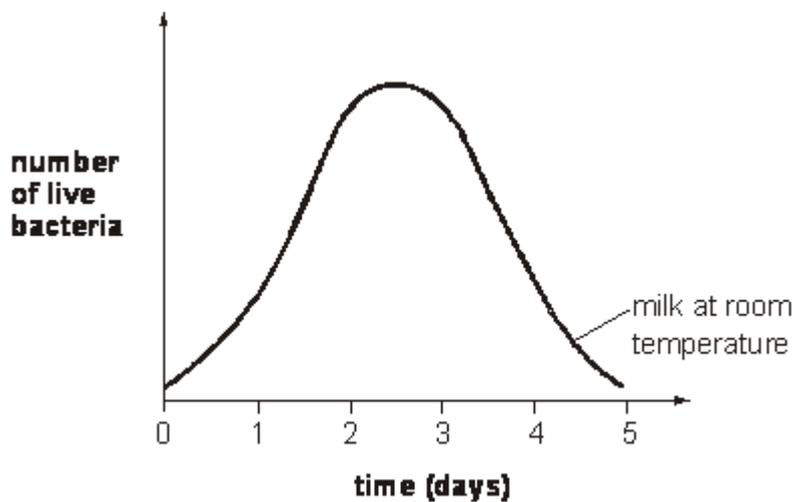
- (i) On **graph 3** below, draw a line to show the pH of the **refrigerated milk** for five days.

graph 3



2 marks

- (ii) On **graph 4** below, draw a line to predict how the number of live bacteria in **refrigerated milk** will change over five days.



1 mark
maximum 5 marks

Q11. Solder is a mixture of lead and tin.
The melting point of solder depends on the amount of tin in the mixture.

(a) Look at the table below.

amount of tin in solder (%)	melting point of solder (°C)
0	327
30	255
40	235
50	212
60	188
70	192
80	205
90	220
100	232

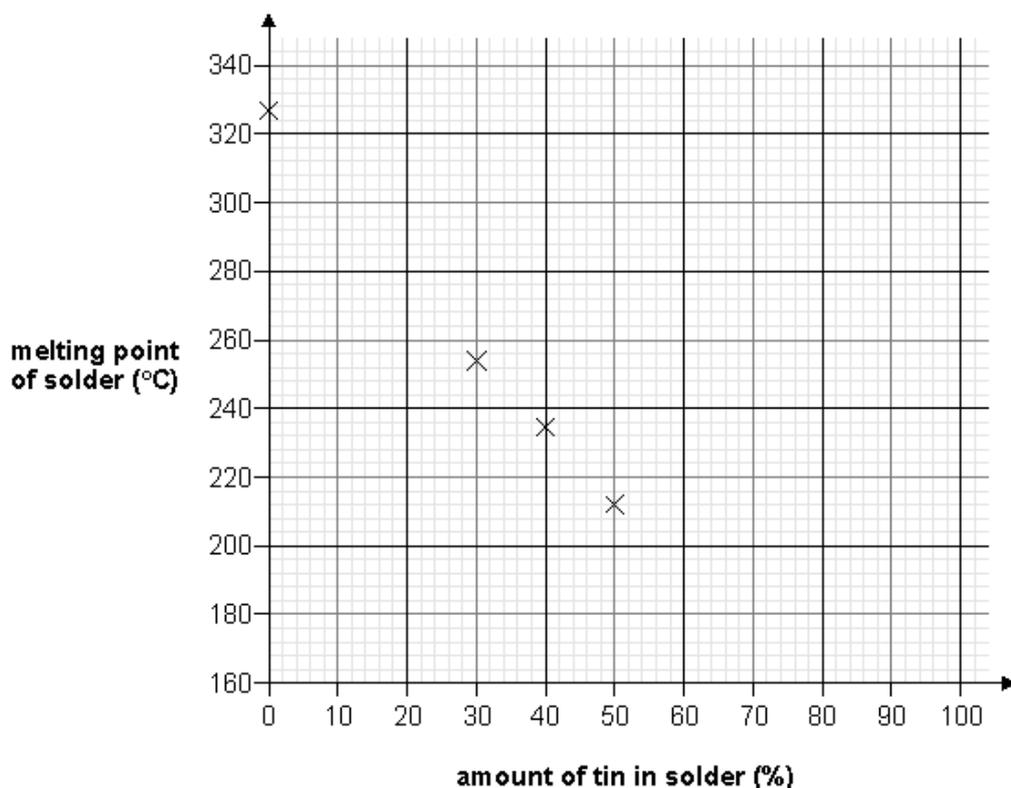
(i) The melting point of pure tin is 232°C.
What is the melting point of pure lead?

..... °C

1 mark

(ii) Use the data in the table to plot the points on the grid below.
Four of the points are plotted for you.

Draw an appropriate line of best fit.



3 marks

- (b) Use your graph to estimate the amount of tin needed to make solder with the **lowest** melting point.

..... %

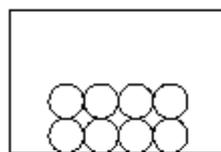
1 mark

- (c) Describe how the melting point of solder changes with the amount of tin in the solder.

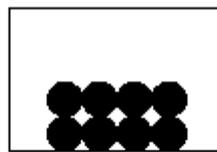
.....

2 marks

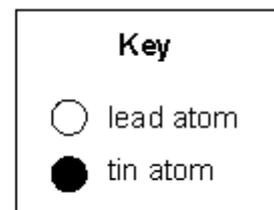
- (d) The diagrams below show the arrangement of atoms in solid samples of pure lead and pure tin.



pure lead



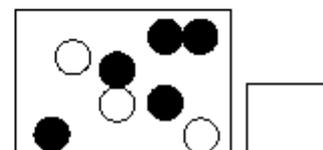
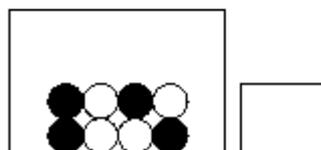
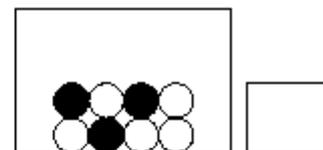
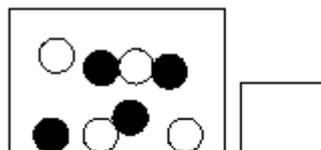
pure tin



Which box shows the correct arrangement of the lead atoms and tin atoms in a sample of solder that has a melting point of 212°C at room temperature?

Use the table above.

Tick the correct box.

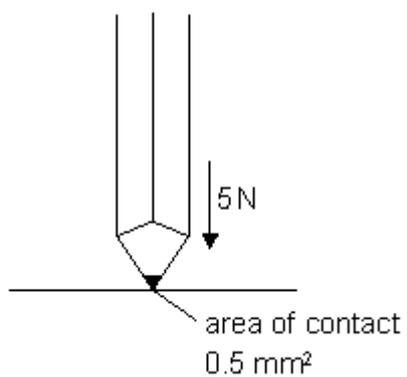


1 mark
 maximum 8 marks

Q12. Jenny is doing her homework.



(a) When Jenny writes, the pencil exerts a force of 5N on the paper.



not to scale

The area of the pencil in contact with the paper is 0.5 mm^2 .

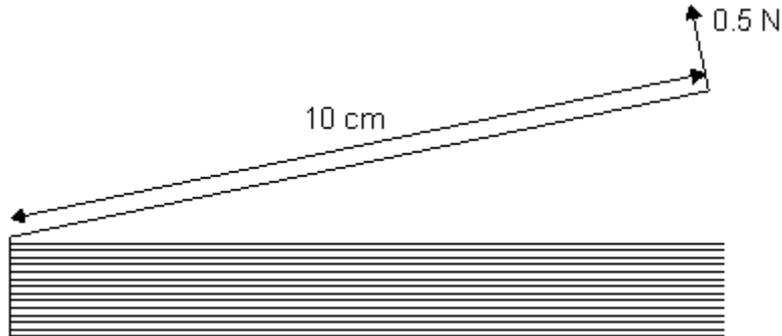
Calculate the pressure of the pencil on the paper.
Give the unit.

.....
.....

2 marks

Question continues on the next page

- (b) Jenny puts a book on her desk.
 She lifts the cover up with her finger, using a force of 0.5 N.
 The cover is 10 cm wide.



Calculate the turning moment on the cover of the book.
 Give the unit.

.....

2 marks

- (c) Jenny's book has an area of 200 cm^2 .
 It exerts a pressure of 0.05 N/cm^2 on the desk.

What is the weight of the book? (Show all workings)

.....

2 marks
 maximum 6 marks

END OF TEST



Entrance Examinations (14+)

2015

SCIENCE

One Hour

This paper contains 13 questions on biology, chemistry and physics.

Attempt as many questions as you can, and do not worry if you have not covered all the topics in your school.

There are 82 marks available.

You should show each step in your working and all rough work should be done on this paper.

You will need a ruler.

You may use a calculator.

NAME:.....

AGE:.....

PRESENT SCHOOL:.....

Total...../82%
---------------	--------

Q1. Underline the correct word or phrase in the following questions.

a) Which one of the following is the **smallest** cell?

bacterium **human egg cell** **nerve cell** **photosynthetic plant cell**

b) By what process is heat energy transferred to us from the sun?

conduction **convection** **radiation** **evaporation**

c) Which of the following is the chemical symbol for sodium?

Sm **Na** **S** **Sn**

d) Which one of the following is **not** a part of the digestive system?

kidney **large intestine** **small intestine** **stomach**

e) A unit for pressure is

N/m³ **Nm²** **N/m²** **Nm**

f) Which method of separation is best for purifying water containing small quantities of dissolved minerals?

chromatography **evaporation** **distillation** **filtration**

g) Which of the following describes a bat?

invertebrate without jointed legs **invertebrate with jointed legs**
cold blooded vertebrate **warm blooded vertebrate**

h) Which statement is **false** about the force of gravitational attraction?

it acts towards the centre of an object **it happens between all objects**
it is larger if the mass of the object is larger **it decreases if the distance between objects decreases**

- i) Which of the following is a harmless colourless gas at room temperature, formed by the combustion of a fossil fuel?

nitrogen oxide

carbon dioxide

water

carbon monoxide

- j) Which food is a good source of vitamin C?

a piece of chicken

a potato

an orange

milk

- k) If a car travels 600m in 60 seconds its speed will be

10m/s

10mph

36000m/s

10 km/s

- l) Which of the following food chains is in the wrong order?

plant plankton → animal plankton → krill → whale

fish → shrimps → seal → bear

fruit bush → field mouse → owl → fox

leaves → caterpillar → robin → hawk

Maximum 12 marks

Q2. In 2007, a new law came in to stop people smoking in public buildings.

- (a) Smoking can be very harmful.
Which three problems can be caused by smoking?

Tick the **three** correct boxes.

being out of breath easily	<input type="checkbox"/>	lung cancer	<input type="checkbox"/>
being overweight	<input type="checkbox"/>	food poisoning	<input type="checkbox"/>
heart disease	<input type="checkbox"/>		

2 marks

- (b) Some scientists investigate 'passive smoking'. Passive smoking is when people breathe in smoke from other people's cigarettes.
They checked the health of three groups of people.

group A	group B	group C
non-smokers who spend no time in smoky places	non-smokers who spend time in smoky places	smokers who spend time in smoky places

- (i) Which group of people breathe in the **least** cigarette smoke?
Tick the correct box.

group A	<input type="checkbox"/>	group B	<input type="checkbox"/>	group C	<input type="checkbox"/>
---------	--------------------------	---------	--------------------------	---------	--------------------------

1 mark

- (ii) Which **two** groups will help scientists find out the effects of passive smoking?
Tick the **two** correct boxes.

group A	<input type="checkbox"/>	group B	<input type="checkbox"/>	group C	<input type="checkbox"/>
---------	--------------------------	---------	--------------------------	---------	--------------------------

1 mark

- (c) People in **group B** are likely to have similar health problems to people in **group C**. Explain why.

.....

.....

1 mark

- (d) Four scientists investigated passive smoking. The table below shows the number of people each scientist studied from each group.

scientist	group A	group B	group C
David	289	3	18
Olga	8	6	11
Peter	402	399	403
Mary	15	210	511

Which scientist is likely to get the most reliable results?
Tick the correct box.

David Olga

Peter Mary

1 mark

Explain why you have chosen this answer.

.....

.....

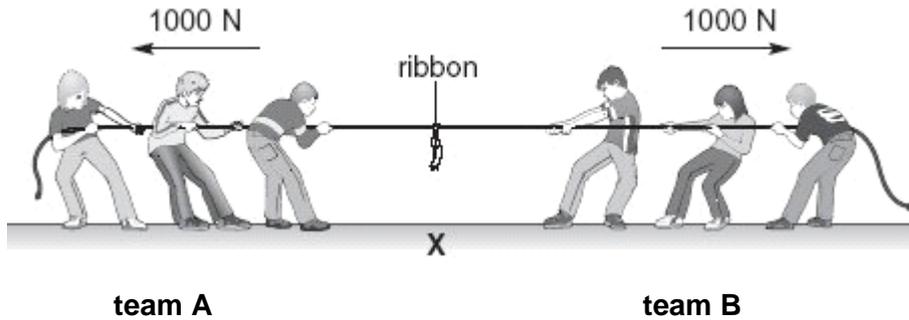
1 mark

maximum 7 marks

Q3.

The drawings in parts (a), (b) and (c) show two teams of pupils in a tug-of-war. There is a ribbon tied to the middle of the rope.

(a) The sizes and directions of the forces of each team are shown.



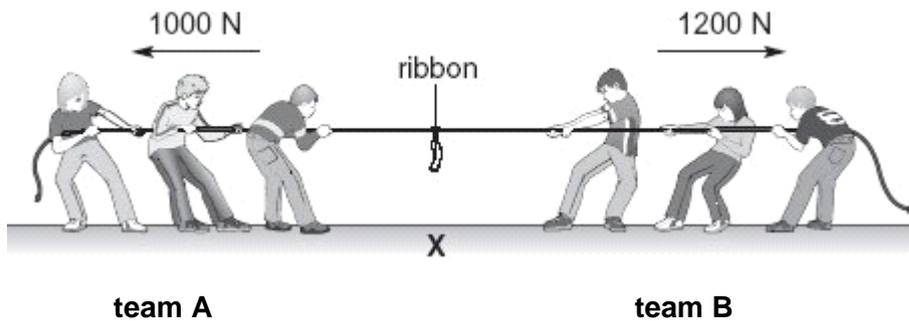
The ribbon stays above point X on the ground. Give the reason for this.

.....

.....

1 mark

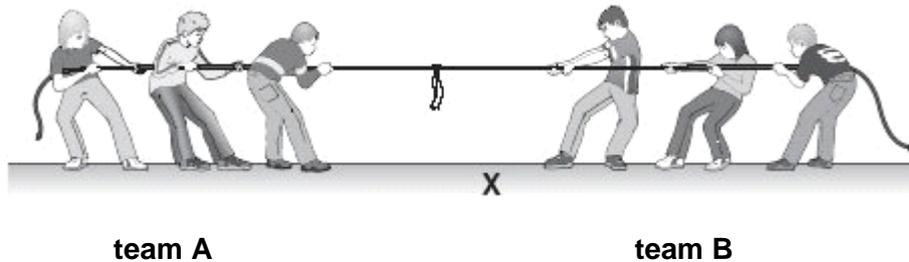
(b) The teams then pull with the forces shown below.



Draw an arrow on the rope to show the direction in which the ribbon will move.

1 mark

(c) Later, the ribbon was to the left of point X as shown below.



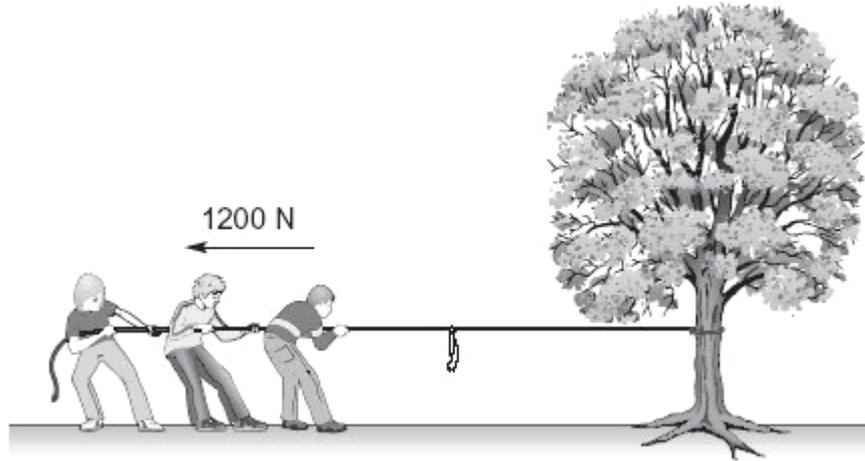
Why did the ribbon move towards the left?

.....

.....

1 mark

- (d) Team A practises by pulling a rope tied to a tree.



The team pulls with a force of 1200 N but the tree does **not** move.

What is the force of the tree on the rope?
Tick the correct box.

zero less than 1200 N 1200 N more than 1200 N

1 mark

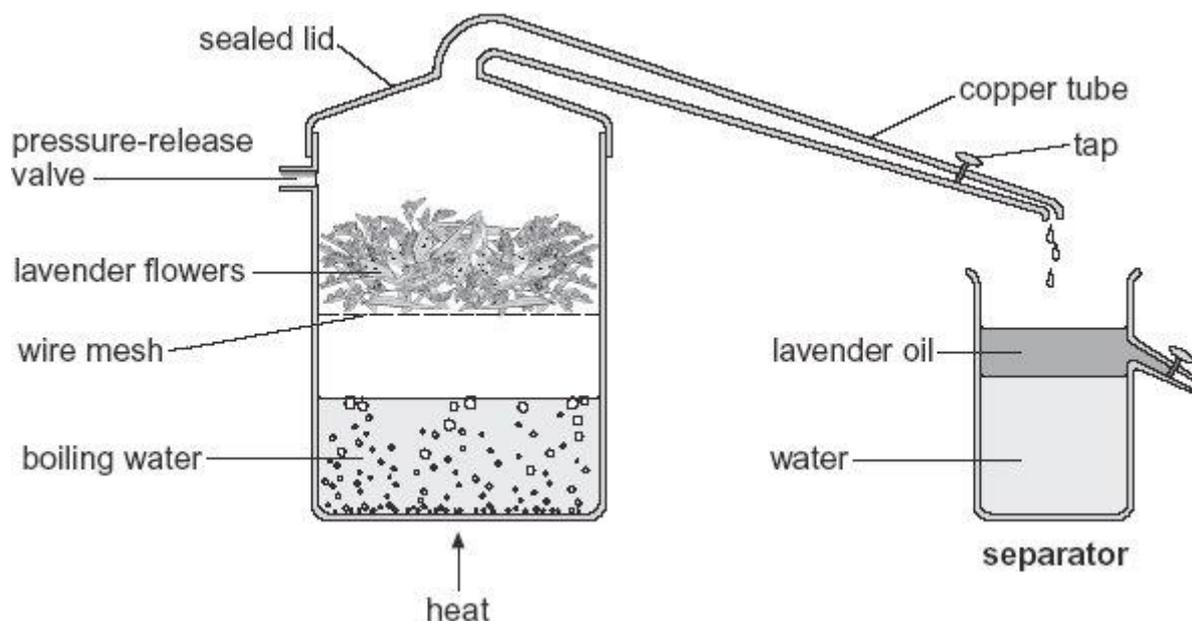
- (e) The pupils do **not** slip because there is a force between their shoes and the ground. What is the name of this force?

.....

1 mark
maximum 5 marks

Q4.

Lavender oil is a perfume obtained from lavender flowers.
 Steam at 100°C is passed through the flowers in the apparatus below.



not to scale

Water vapour and lavender oil vapour pass down a copper tube towards a separator.

(a) (i) The lavender flowers are heated in a container with a sealed lid.

Why must the lid be sealed?

.....

1 mark

(ii) What would happen if the container did **not** have a pressure-release valve?

.....

1 mark

(b) Lavender oil vapour and water vapour cool as they pass down the copper tube.
A mixture of lavender oil and water collects in the separator.

(i) What is the change in the physical state of both lavender oil vapour and water vapour as they cool?

from to

1 mark

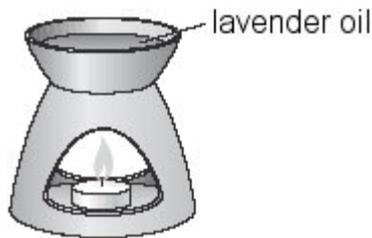
(ii) Look at the separator.

How does this show that the water is denser than lavender oil?

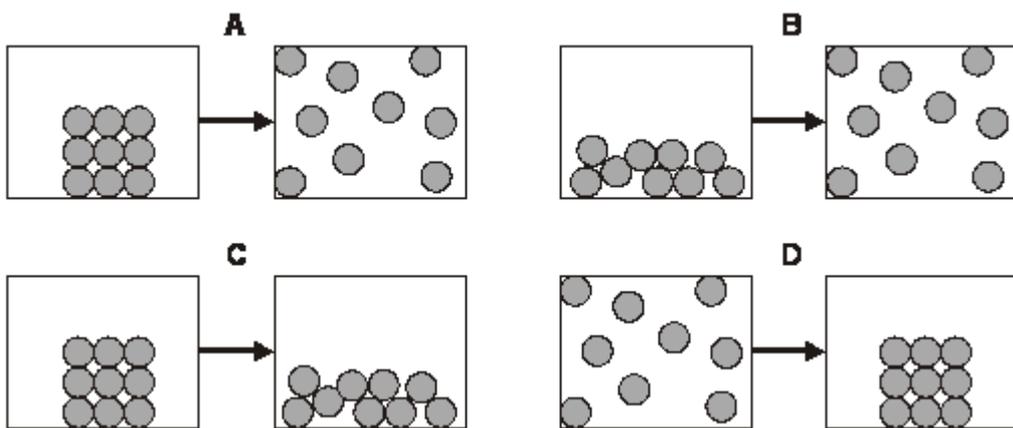
.....
.....

1 mark

(c) Rosie poured some lavender oil into an oil burner.
She heated it with a candle.



The oil changed state.



Which diagram represents this change of state?
Write the letter.

.....

1 mark
maximum 5 marks

Q5. (a) When fertilisation takes place, the nucleus of a sperm joins with the nucleus of an ovum (egg).

In which part of the reproductive system does fertilisation normally take place in humans?

Tick the correct box.

cervix	<input type="checkbox"/>	ovary	<input type="checkbox"/>
oviduct	<input type="checkbox"/>	uterus	<input type="checkbox"/>

1 mark

(b) The table below gives information about fertilisation in three animals.

animal	Does fertilisation take place inside or outside the body?	Number of eggs released at a time
human	inside	1
bird	inside	4
frog	outside	3000

Frogs release their eggs and sperm into water.
The eggs are fertilised in the water.

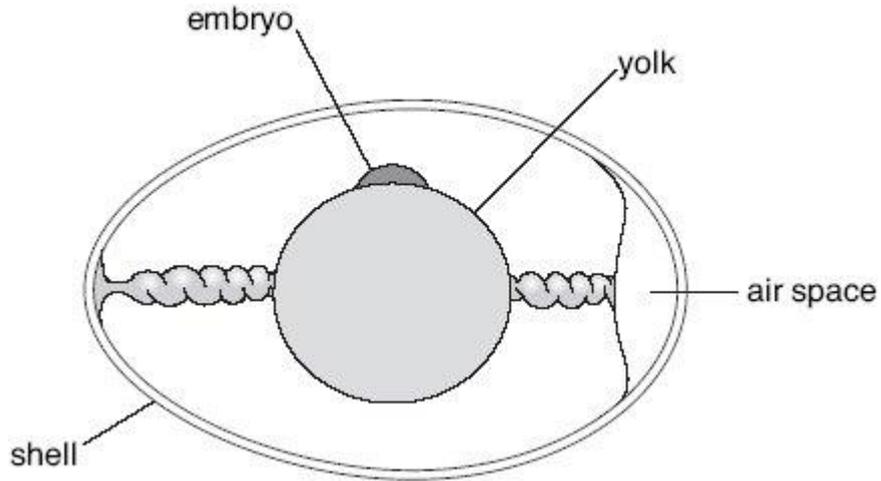
Why is it an advantage for frogs to release large numbers of eggs and sperm?

.....

.....

1 mark

(c) The diagram shows a section through a fertilised egg of a bird.



(i) The shell of a bird's egg is porous. This means it has microscopic holes in it.

Why does it need to be porous?

.....

1 mark

(ii) Give **one** other function of the egg shell.

.....

1 mark

(d) A bird's egg contains yolk which is a food store for the developing chick. A human egg does **not** contain yolk.

Why does a human egg **not** need to contain a food store for the embryo?

.....

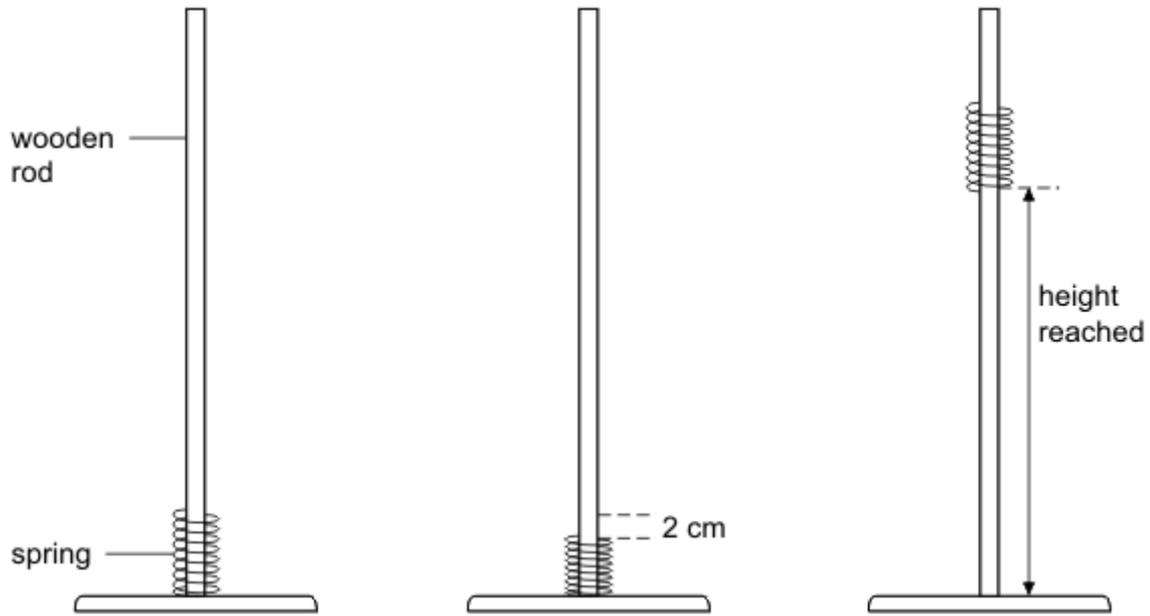
.....

1 mark
maximum 5 marks

Q6. Jenny put a spring over a wooden rod.

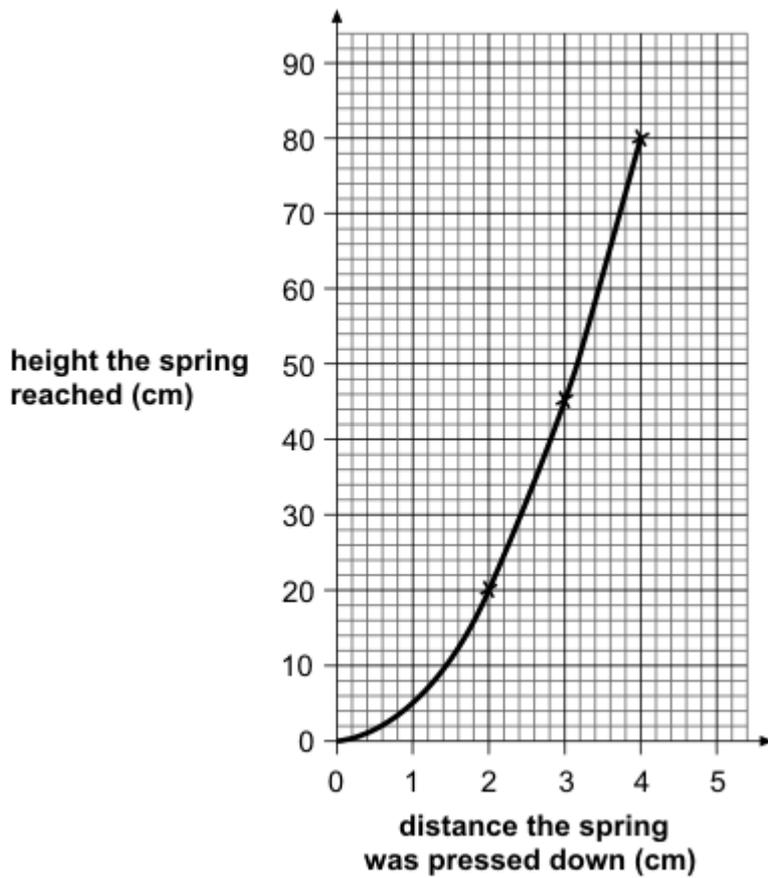
She pressed the spring down 2 cm.

She let go of the spring and measured the height it reached.



not to scale

Jenny repeated her experiment. She pressed the spring down more each time. Her results are shown in the graph below.



- (a) Use Jenny's graph to complete the table below.

distance the spring was pressed down (cm)	height the spring reached (cm)
2	
3	
4	

1 mark

- (b) Jenny said, 'If I double the distance I press the spring down, the height it reaches will also double'.

How do the results show she was wrong?

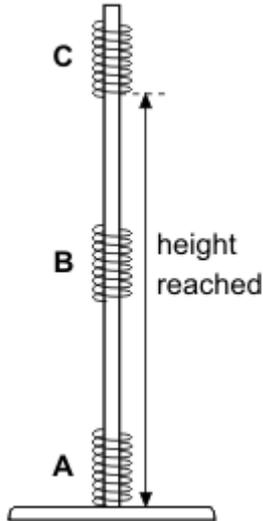
.....

.....

1 mark

Question 6 continues on the next page

(c) This diagram shows the moving spring in three different positions.



Complete the sentences below by choosing words from the box. You can use each word more than once.

most some least

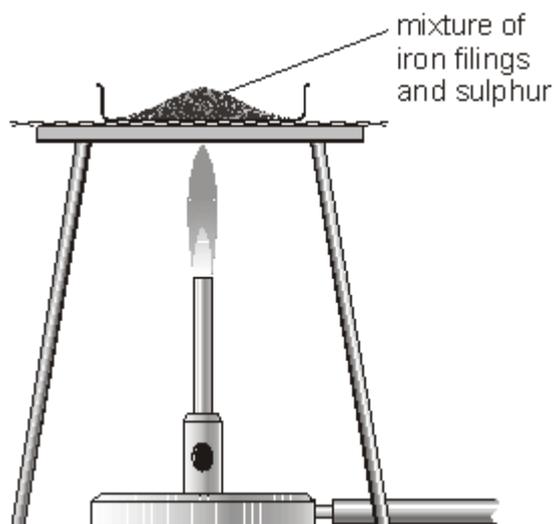
(i) When the spring is moving at **B** it has kinetic energy and gravitational potential energy. 1 mark

(ii) When the spring reaches **C** it has gravitational potential energy and kinetic energy. 1 mark

(iii) When the spring stops at **A** it has kinetic energy and gravitational potential energy. 1 mark
maximum 5 marks

Q7.

A teacher mixed iron filings with sulphur on a metal tray.
 She heated the mixture in a fume cupboard.
 Sulphur is yellow. Iron filings are grey.



The mixture glowed very brightly. The teacher turned off the bunsen burner.
 The glow spread through the mixture.
 When the mixture cooled, a black solid called iron sulphide was left.

(a) From this information, give **one** way you can tell that a chemical reaction took place.

.....

1 mark

(b) What type of substance is each of the chemicals involved in this reaction?
 Choose from:

metallic element	mixture	non-metallic element	compound
---------------------	---------	-------------------------	----------

iron

sulphur

iron sulphide

2 marks

- (c) Raj held a magnet near to each of the three chemicals.

By each chemical in the table, write **yes** or **no** to show if the chemical was magnetic.

One has been done for you.

chemical	Was the chemical magnetic?
sulphur	
iron	
iron sulphide	no

1 mark

- (d) (i) When iron is heated with sulphur, iron sulphide is formed.
Give the name of the solid formed when **zinc** is heated with sulphur.

.....

- (ii) Some fossil fuels contain sulphur.
When fuels burn, sulphur reacts with oxygen.

Complete the word equation for this reaction.

sulphur + oxygen →

2 marks
maximum 6 marks

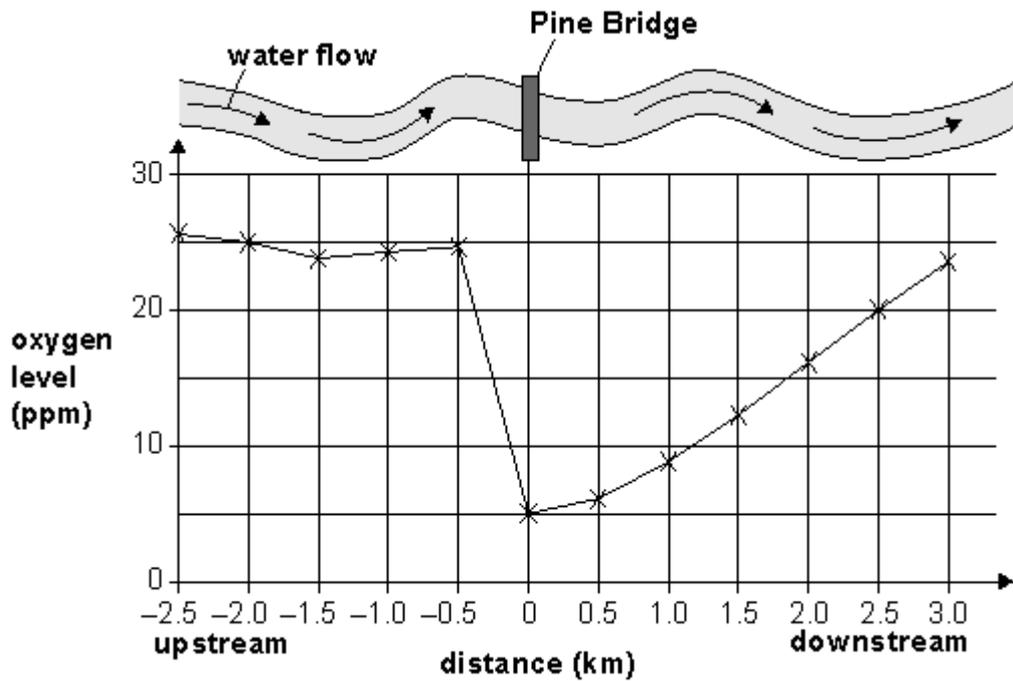
Q8. The information below comes from a newspaper report.

River Pollution

Scientists from the Environment Agency were called to investigate a river.

Local fishermen reported that they had not caught trout in the river at Pine Bridge for many months. There were more algae growing in the river and it had a bad smell.

Scientists measured the oxygen levels in the water upstream and downstream from Pine Bridge. The results are shown below.



(a) (i) What was the oxygen level in the river at Pine Bridge?

..... ppm

1 mark

(ii) Describe what happens to the oxygen level in the river as you travel **downstream** from Pine Bridge.

.....

1 mark

- (b) Trout only live in water with oxygen levels higher than 20 ppm.
How far **downstream** from Pine Bridge would you be likely to find trout?
Write the unit.

.....

1 mark

- (c) The scientists collected samples of the river animals found at different places.

animals collected	distance from Pine Bridge (km)								
	-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0
stonefly nymphs	✓	✓	✓	✓					
mayfly nymphs	✓	✓	✓	✓					
freshwater shrimps	✓	✓	✓	✓					✓
caddis fly larvae	✓	✓	✓	✓					
rat-tailed maggots					✓	✓			
sludge worms					✓	✓	✓		
water lice							✓	✓	✓
bloodworms							✓		

Trout only live in water with oxygen levels higher than 20 ppm.
Give the name of one **other** animal that **only** lives in oxygen levels above 20 ppm.
Use the table and the information above to help you.

.....

1 mark

- (d) Use the information above.
Name **two** animals that are **only** found when the oxygen level is below 10 ppm.

1. 2.

2 marks

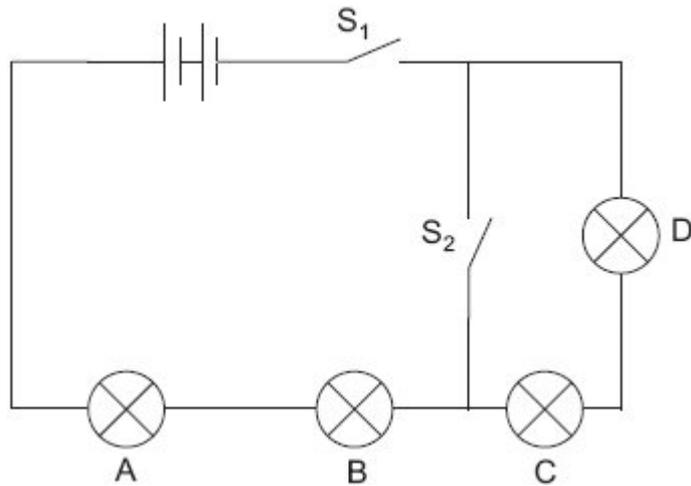
- (e) In the river, trout are predators. Near Pine Bridge, the number of trout decreased.
Suggest **one** reason why pollution may cause the trout population to decrease.

.....

.....

1 mark
maximum 7 marks

Q9. Lorna built the circuit drawn below. All the bulbs are identical.

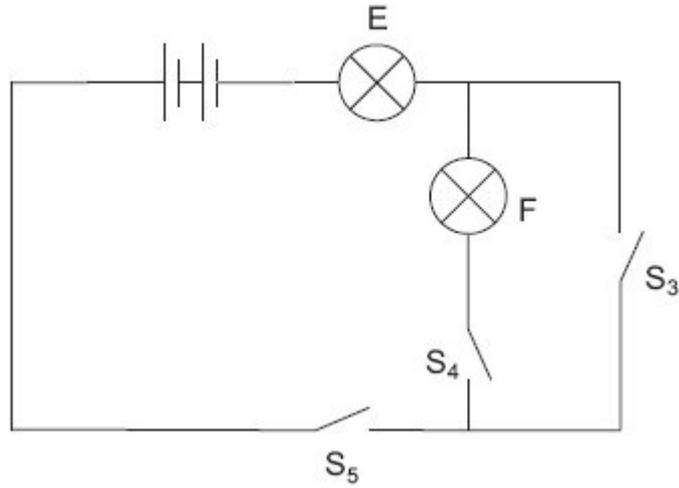


(a) Complete the table below by writing **on** or **off** for each bulb.

3 marks

switch		bulb			
S_1	S_2	A	B	C	D
open	open	off	off	off	off
open	closed				
closed	open				
closed	closed				

(b) Lorna then built a different circuit as shown below.



How could Lorna get both bulbs to light at the same time in this circuit?

.....

.....

1 mark
maximum 4 marks

Test continues on the next page

- Q10.** (a) The fire extinguisher below contains a compound called sodium hydrogencarbonate.



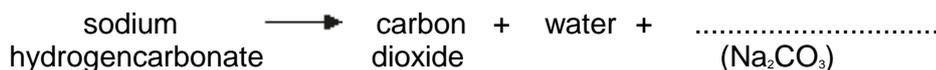
contains sodium
hydrogencarbonate
powder

The formula for sodium hydrogencarbonate is NaHCO_3 .

When sodium hydrogencarbonate is heated it breaks down to produce carbon dioxide, water and a compound with the formula Na_2CO_3 .

This is shown in the equation below.

- (i) Complete the word equation below.



1 mark

- (ii) Complete the table below to show the mass of water produced when 168 g of sodium hydrogencarbonate breaks down completely.

compound	reactant or product	mass (g)
sodium hydrogencarbonate	reactant	168
carbon dioxide	product	44
water	product	
Na_2CO_3	product	106

1 mark

- (iii) How much carbon dioxide is produced when 336 g of sodium hydrogencarbonate breaks down completely?

..... g

1 mark

(b) The diagram below shows two other types of fire extinguisher.



contains carbon dioxide gas



contains water

To put out a fire, you have to do one or more of the following:

- keep oxygen away from the fire
- take the heat away from the fire
- take the fuel away from the fire.

The density of carbon dioxide is about 1.8 g per 1000 cm³.
The density of air is about 1.2 g per 1000 cm³.

(i) Use the information above to explain why carbon dioxide is used to put out fires.

.....
.....
.....

2 marks

(ii) When water from the fire extinguisher is sprayed over a fire, the water evaporates.

Why does evaporation cool the fire down?

.....
.....

1 mark
maximum 6 marks

Q11. Josh has a helium-filled balloon.



(a) He wants to calculate the speed of his balloon as it rises to the ceiling.

(i) What **two** measurements should he take to calculate the average speed of his balloon?

1

2

1 mark

(ii) How can he use these measurements to calculate the speed of his balloon?

.....

.....

1 mark

- (b) Josh attached different masses to his balloon. For each mass, he calculated the speed of rise of the balloon. His results are shown below.

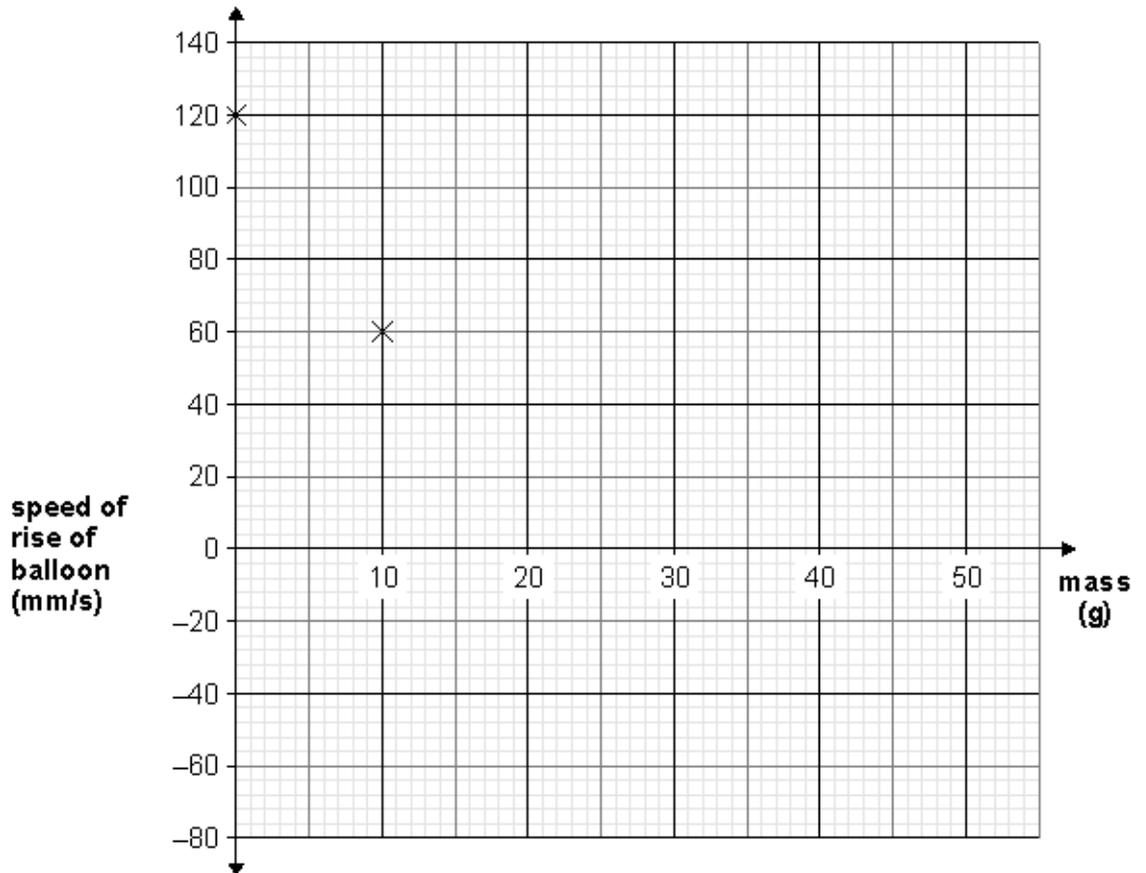
mass (g)	speed of rise (mm/s)
0	120
10	60
20	40
30	-20
40	-70

- (i) How does the table show that the balloon went downwards?

.....

1 mark

- (ii) Josh plotted two points on the graph as shown. Complete the graph by plotting the missing points **and** draw a line of best fit.



2 marks

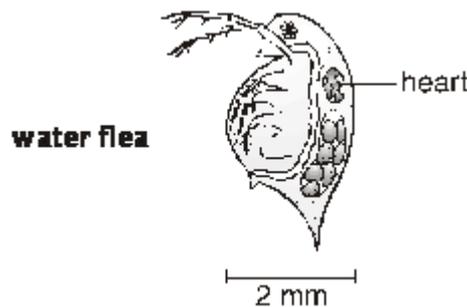
(iii) From the graph, find the mass needed to keep the balloon floating in one place.

..... g

1 mark
maximum 6 marks

Q12.

Kava is a drug. It dissolves in alcohol but **not** in water.
A scientist tested kava to see if it can reduce the human heart rate.
Before testing the drug on humans, she tested it on water fleas.



(a) She gave two groups of water fleas a different treatment.

group	number of water fleas	treatment
1	20	one drop of kava dissolved in alcohol
2	20	one drop of alcohol

- She placed the water fleas in a dish of water under a microscope.
- She measured the heart rate of each water flea before the treatment.
- She waited 30 seconds after the treatment was given and measured the heart rate again.
- She calculated the average heart rate for each group.

(i) Why did the scientist measure the heart rate of the water fleas before the treatment?

.....
.....

1 mark

(ii) After giving the treatment, why did she wait for 30 seconds before measuring the heart rate?

.....
.....

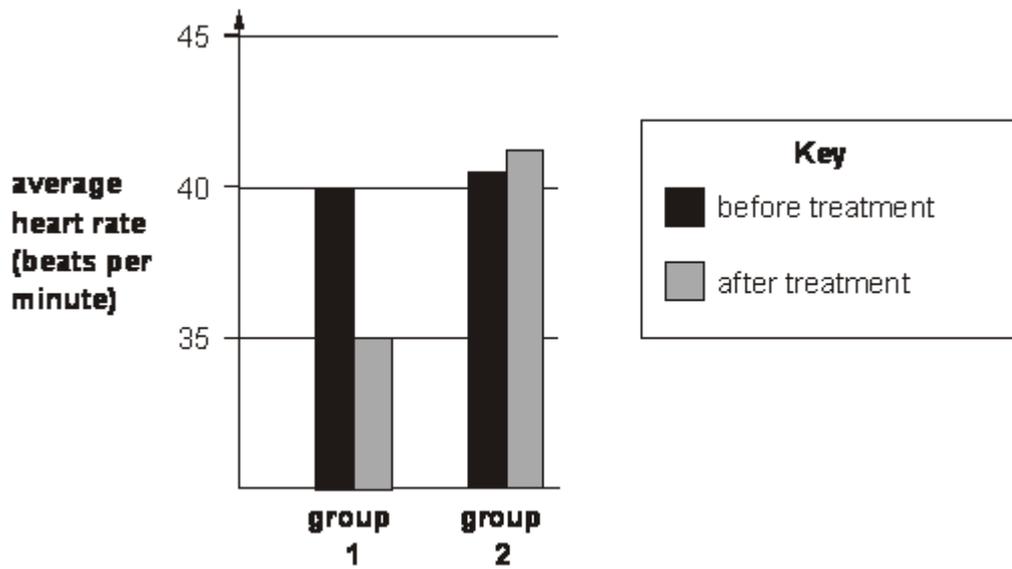
1 mark

(iii) How could the scientist increase the reliability of the investigation?

.....
.....

1 mark

(b) The results of the experiment are shown below.



(i) How will the results from group 2 help in the experiment?

.....
.....

1 mark

- (ii) How can the scientist use the results above to work out the effect of kava **alone** on the average heart rate of water fleas?

.....
.....

1 mark

- (c) From this experiment, why could she **not** be certain how kava will affect humans?

.....
.....

1 mark
maximum 6 marks

Test continues on the next page

Q13.

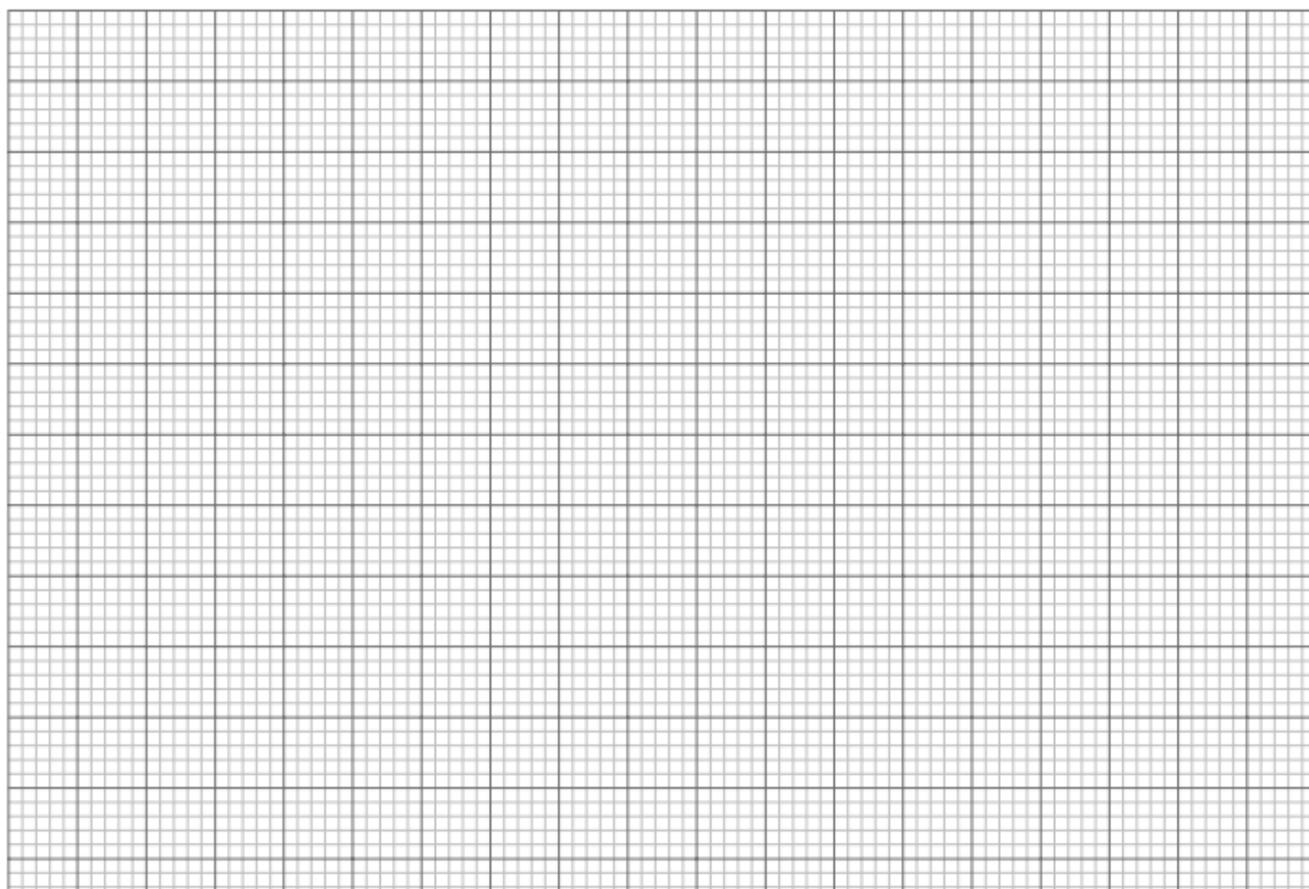
Six groups of pupils burned magnesium in air. The magnesium reacted with oxygen to form magnesium oxide.

They recorded the mass of magnesium used and the mass of magnesium oxide formed. Their results are shown in the table.

group	mass of magnesium (g)	mass of magnesium oxide (g)
A	3.2	5.2
B	3.8	6.5
C	4.2	7.0
D	4.9	8.6
E	5.4	8.0
F	6.1	10.7

(a) Use their results to draw a graph below.

- Decide the scale for each axis.
- Label the axes.
- Plot the points.
- Draw a line of best fit.



4 marks

- (b) (i) Which group's results do **not** fit the general pattern?
Give the letter.

1 mark

- (ii) How should the class deal with this 'odd' result?

.....
.....

1 mark

- (c) Use the graph to predict the mass of magnesium oxide that will be formed by burning 7.0 g of magnesium.

..... 9

1 mark

- (d) The results show the relationship between the mass of magnesium and the mass of magnesium oxide formed.

What conclusion could you draw about this relationship?

.....
.....
.....
.....

1 mark
maximum 8 marks

END OF EXAM