14+ ENTRANCE EXAMINATION

SOLIHULL

SAMPLE PAPER

SCIENCE

Read these instructions carefully

You have **one** hour in which to complete this examination.

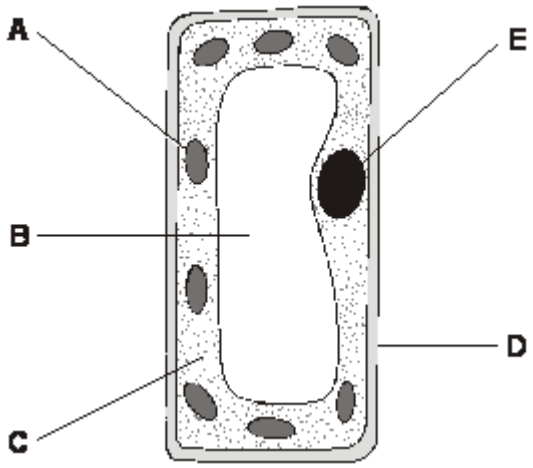
Attempt all questions.

You may use a calculator if you wish.

Write your answers in the spaces provided.

The marks awarded are next to each question.

Q1. The diagram shows a plant cell.



(a) Give the name of part A.

.....

Give the function of part A.

.....

.....

2 marks

(b) Give the name of part E.

.....

Give the function of part E.

.....

.....

2 marks

(c) Give the letters of **two** parts that are present in plant cells but **not** in animal cells.

..... and .....

1 mark

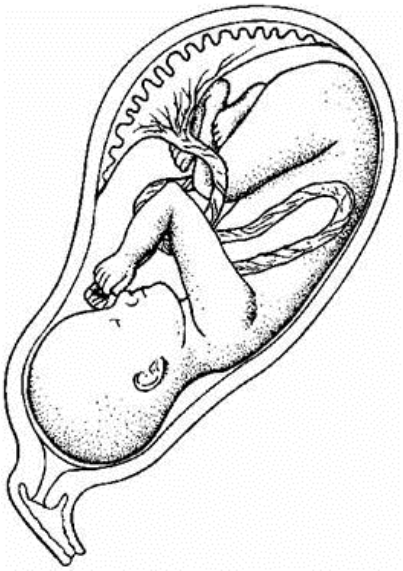
(d) How can you tell that the cell in the diagram is from a leaf and **not** from a root?

.....

1 mark

maximum 6 marks

Q2. The drawing shows a baby inside its mother's uterus.



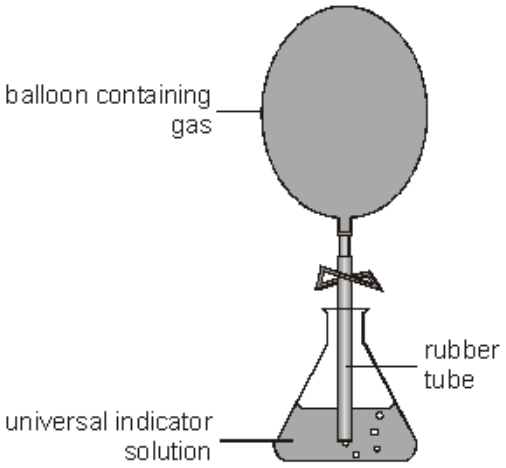
Some substances pass from the mother's blood to the baby's blood.
Other substances pass from the baby's blood to the mother's blood.

Which way, if any, do the substances in the table pass?
Tick **one** box in each row.

substance	passes from the mother's blood to the baby's blood	passes from the baby's blood to the mother's blood	does not pass between the mother's blood and the baby's blood
poisons from cigarette smoke			
oxygen			
digested food			
carbon dioxide			

4 marks

Q3. 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?

.....

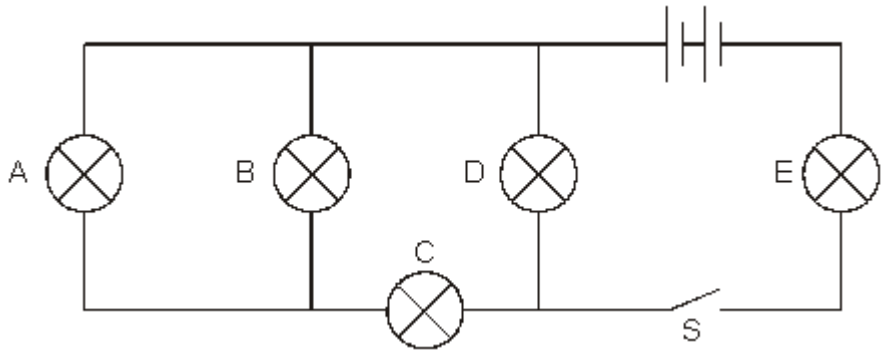
1 mark

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

zinc + hydrochloric acid → ..... + ...

2 marks
maximum 5 marks

Q4. (a) Max built **circuit 1** as shown below.



circuit 1

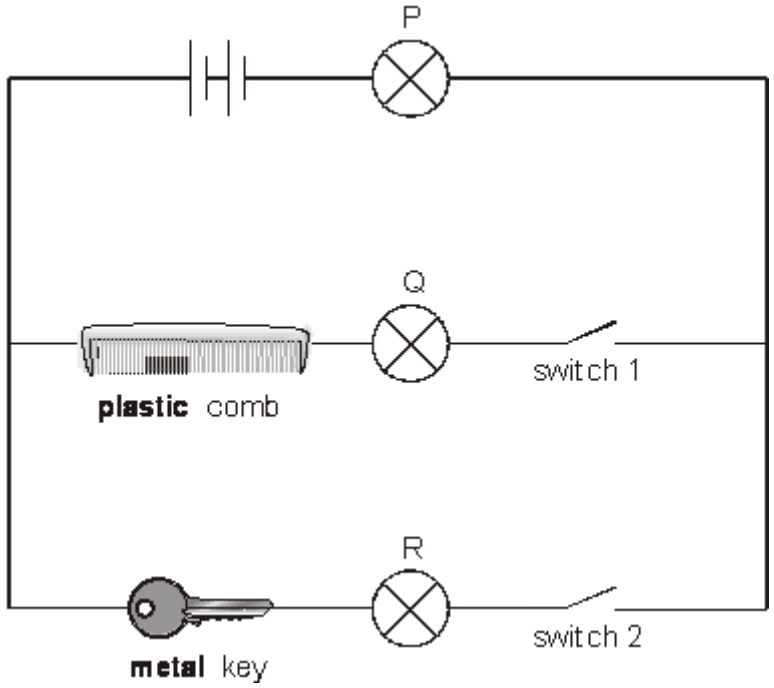
He closed the switch, S, and all the bulbs came on.
One of the bulbs then broke and **all** the bulbs went off.

Which bulb must have broken?
Give the letter.

.....

1 mark

(b) Max built **circuit 2** as shown below.
He connected a plastic comb and a metal key in different parts of the circuit.



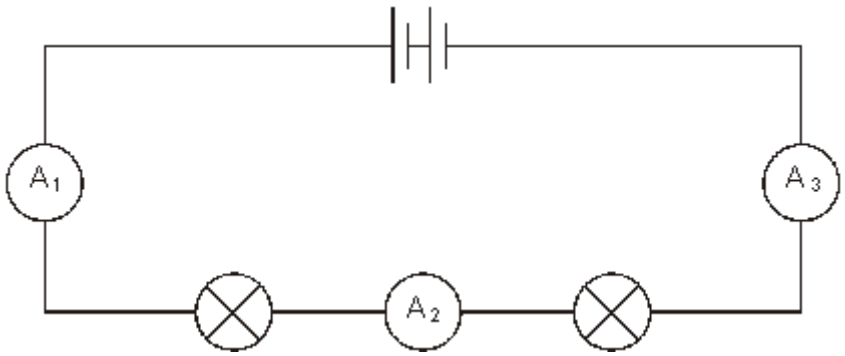
circuit 2

Look carefully at **circuit 2**.
Complete the table below to show which bulbs in circuit 2 will be on or off when different switches are open or closed.
Write **on** or **off** in the boxes below.

switch 1	switch 2	bulb P	bulb Q	bulb R
open	open	off	off	off
open	closed			
closed	open			

2 marks

(c) Max built **circuit 3** using a battery, two bulbs and three ammeters.



circuit 3

The current reading on ammeter A_1 was 0.8 amps.
What would be the reading on ammeters A_2 and A_3?
Place **one** tick in the table by the correct pair of readings.

readingon ammeter A_2 (amps)	reading on ammeter A_3 (amps)	correct pair of readings
0.8	0.8	
0.8	0.4	
0.4	0.8	
0.4	0.4	

1 mark
maximum 4 marks

Q5. Spots may be caused by bacteria in the skin. A researcher investigated the effect of spot-lotion on bacteria.

(a) He grew bacteria on the surface of jelly in a Petri dish.

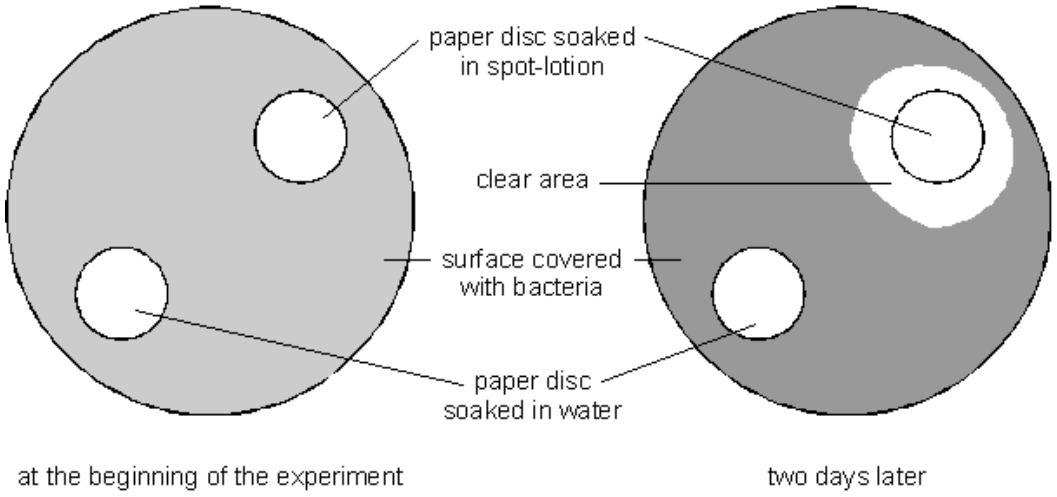
At what temperature would the bacteria reproduce quickly?

Tick the correct box.

100°C	☐	4°C	☐
37°C	☐	–15°C	☐

1 mark

(b) The researcher placed two small paper discs onto the surface of the jelly. One disc had been soaked in spot-lotion. The other disc had been soaked in water. The diagrams below show the jelly at the beginning of the experiment and two days later.



Suggest what had happened to the bacteria in the clear area around the paper disc soaked in spot-lotion.

……

……

1 mark

(c) What was the control in this experiment?

……

……

1 mark

(d) Give **two** safety precautions the researcher should take to avoid contact with the bacteria.

1. ……

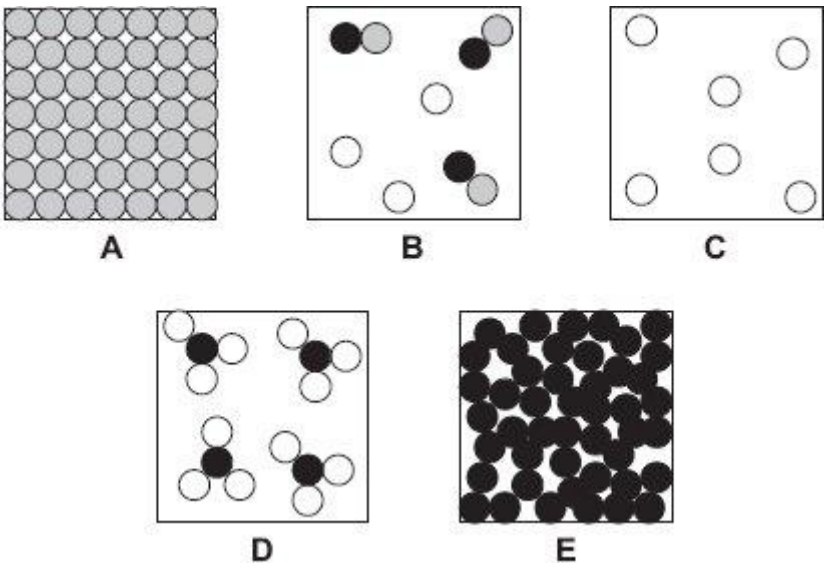
2. ……..

2 marks
Maximum 5 marks

Please turn over for question 6

Q6. (a) The diagrams below show the arrangement of atoms or molecules in five different substances A, B, C, D and E.

Each of the circles ○, ○ and ● represents an atom of a different element.



Give the letter of the diagram which represents:

(i) a mixture of gases;

.....

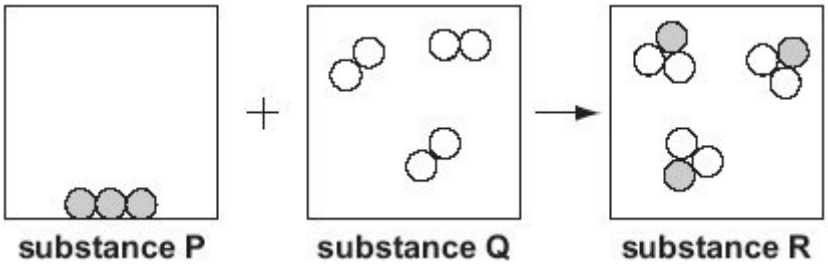
1 mark

(ii) a single compound.

.....

1 mark

(b) The diagram below shows a model of a chemical reaction between two substances.



(i) How can you tell from the diagram that a chemical reaction took place between substance P and substance Q?

.....

.....

1 mark

(ii) Substance P is carbon.

Suggest what substances Q and R could be.

substance Q .....

substance R .....

1 mark

(iii) How does the diagram show that mass has been conserved in this reaction?

.....

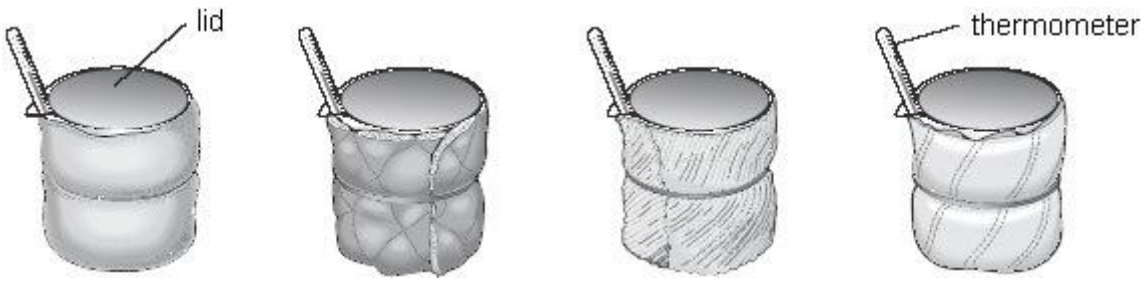
.....

1 mark

maximum 5 marks

Q7. A company has made a new material called 'Wellwarm'. They want to use 'Wellwarm' to make coats.

(a) A scientist tested 'Wellwarm' to see how well it insulated a beaker of hot water. She tested 'Wellwarm' and three other materials as shown below.



material A **material B** **material C** **material D**

She wrapped each beaker in a different material.
She recorded the temperature at the start and 20 minutes later.

(i) What was the independent variable that the scientist **changed**?

.....

1 mark

(ii) What was the dependent variable that the scientist **measured** during the investigation?

.....

1 mark

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

time (minutes)	**temperature of water (°C) wrapped in**			
	material A	**material B**	**material C**	**material D**
0	60	60	60	60
20	34	40	38	36

(i) The scientist said that the 'Wellwarm' material is the best insulator.
Which material was 'Wellwarm'? Use the results to help you.
Tick the correct box.

A ☐ B ☐ C ☐ D ☐

1 mark

(ii) Use the evidence in the results table to explain your choice.

.....

.....

1 mark

(c) The company made a coat from each of the four materials they tested.



A person tested the different coats by wearing each one in a cold room.
He measured the temperature inside each coat for 30 minutes.

Write down two **other** variables that should be controlled to make this a fair test.

1. .....

1 mark

2. .....

1 mark

(d) Write down one thing the scientists should do to make sure the person testing the coats is safe.

.....

1 mark

(e) Suggest **one** advantage of using a temperature sensor and data logger instead of a thermometer in this experiment.

.....

.....

1 mark

maximum 8 marks

Q8. James shone a ray of light at a mirror as shown below.

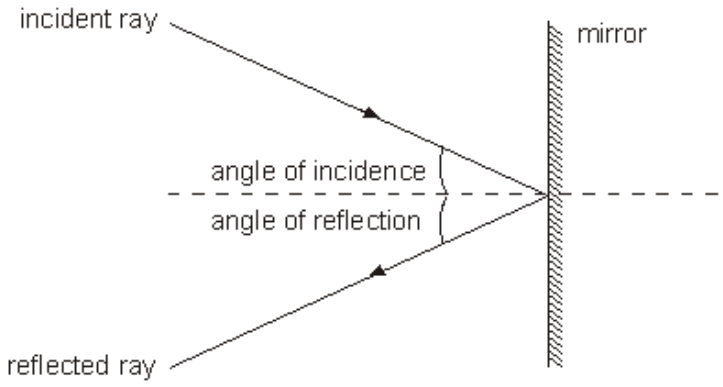


diagram 1

He measured the angle of **reflection** for different angles of incidence.
His results are shown below.

angle of **incidence** (º)	30	40	50	60	70
angle of **reflection** (º)	30	40	50	65	70

(a) Which angle of reflection was **not** measured accurately?

.....°

How can you tell this from the table?

.....

.....

1 mark

(b) James set up a different experiment as shown below.

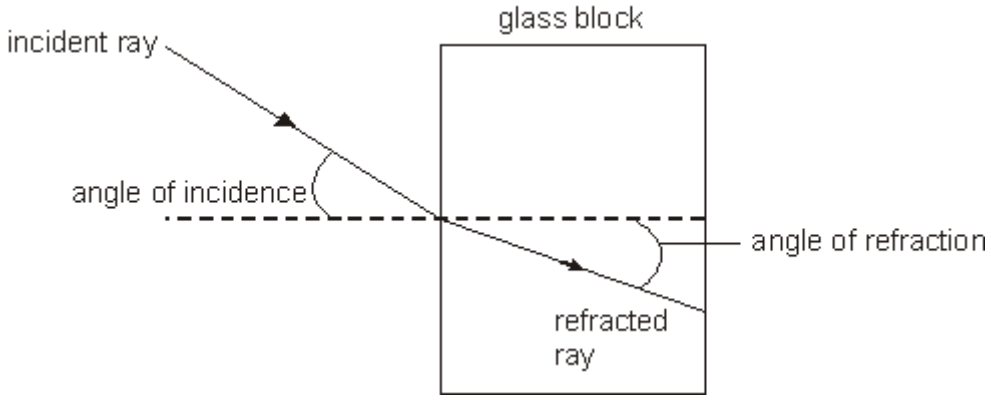
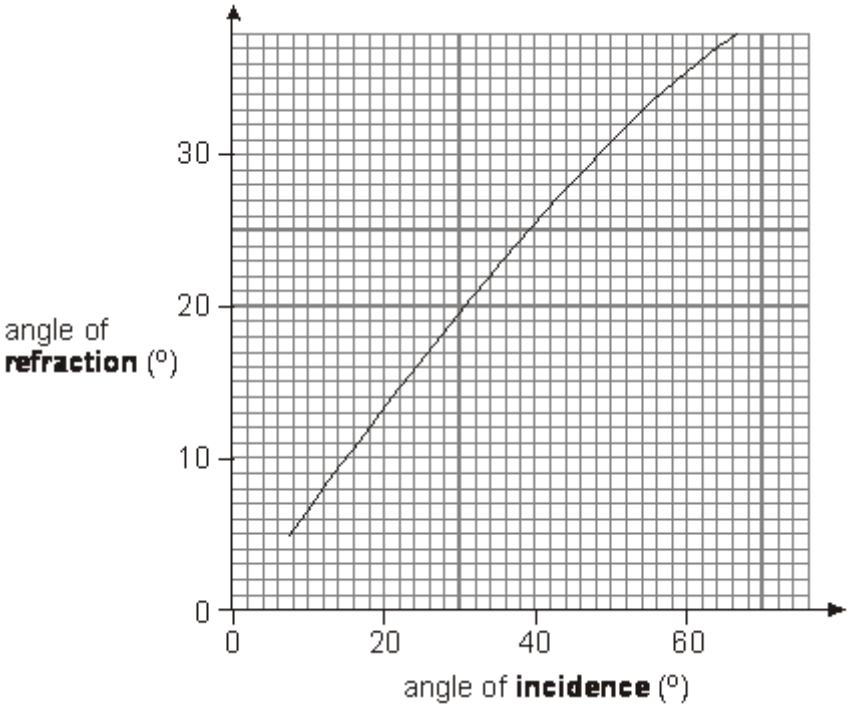


diagram 2

He measured the angle of **refraction** for different angles of incidence.

His results are shown in the graph.



Use the graph to answer the questions below.

(i) When the angle of **refraction** is 20°, what is the angle of **incidence**?

.....°

1 mark

(ii) What conclusion could James draw from his graph?
Complete the sentence below.

When light passes from air into glass, the angle of **incidence** is

always ..... the angle of **refraction**.

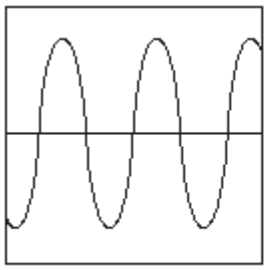
1 mark

(c) **On diagram 2,** draw a line to continue the refracted ray as it leaves the glass block.

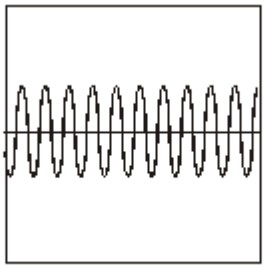
1 mark

maximum 4 marks

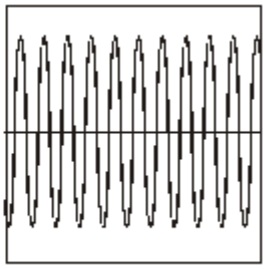
Q9. (a) The diagrams below show the patterns produced on an oscilloscope by three different sound waves.



A



B



C

(i) Which **two** waves have the same loudness?
Write the letters.

..... and .....

How do the diagrams show this?

.....

.....

1 mark

(ii) Which **two** waves have the same pitch?
Write the letters.

..... and .....

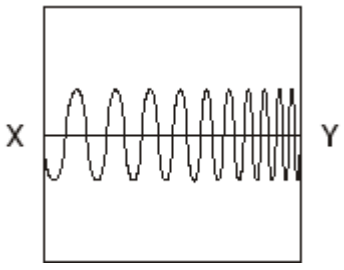
How do the diagrams show this?

.....

.....

1 mark

(iii) Shuli is listening to a sound that produces the pattern below.



Describe how the sound that Shuli **hears** changes between X and Y.

.....

1 mark

(b) The table below shows the maximum time a person can listen to music at different sound levels without damage to the ear.

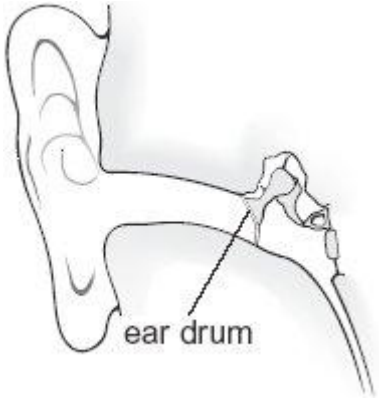
sound level (decibels)	maximum time (hours)
86	8
88	4
90	2
92	1
94	0.5

Estimate the maximum time a person could listen to a sound of 87 decibels.

..... hours

1 mark

(c) The diagram below shows part of the human ear.



What happens to the ear drum as a sound gets louder?

.....

.....

1 mark

maximum 5 marks

Q10. **Table 1** gives information about 100 g of five different foods.

food	energy per 100 g of food (kJ)	nutrients per 100 g of each food			
		protein (g)	fat (g)	carbohydrate (g)	calcium (mg)
banana	403	1.2	0.3	23.2	6
wholemeal bread	914	9.2	2.5	41.6	54
butter	3031	0.5	81.7	0	15
cheese	1708	22.5	34.4	0.1	720
milk	275	3.2	3.9	4.8	115

table 1

(a) Look at **table 1**.

(i) Which of the four **nutrients**, protein, fat, carbohydrate or calcium, provides most of the energy in the cheese?

.....

(ii) Which of the four **nutrients** provides most of the energy in the wholemeal bread?

.....

(iii) Which of the four **nutrients** is needed for growth and repair?

.....

3 marks

(b) The recommended daily amount of protein for a woman is 45 g.
Look at **table 1**.
How many grams of cheese would provide 45 g of protein?
Tick the correct box.

50 g ☐ 100 g ☐ 150 g ☐ 200 g ☐

1 mark

(c) **Not** all the types of nutrients needed for a balanced diet are shown in **table 1**.

Give the name of **one** of the missing types of nutrient.

.....

1 mark

(d) **Table 2** shows the recommended daily amount of calcium for a person in four stages of the human life cycle.
We need calcium for healthy teeth and bones.

person	recommended daily amount of calcium (mg)
a baby aged 6 months	600
a woman before she is pregnant	500
a pregnant woman	1200
a breast-feeding woman	

table 2

(i) Use information in **table 2** to estimate how much calcium a breast-feeding woman should have each day.

..... mg

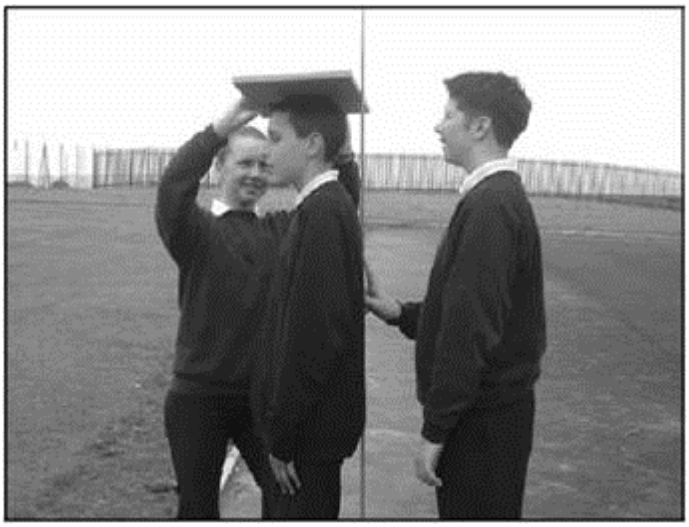
(ii) Explain why she would need this amount of calcium.

.....

.....

2 marks
maximum 7 marks

Q11. A group of pupils recorded some different characteristics of pupils in their class.



The table below shows their results.

name	gender	height, in cm	mass, in kg	hand span, in cm	arm span, in cm	eye colour
Julie	girl	152	48	17.2	160	blue
Laura	girl	157	54	15.0	141	green
Aftab	boy	159	49	18.4	172	brown
Jenna	girl	144	46	17.4	161	hazel
Barry	boy	148	49	17.4	162	blue
Oliver	boy	172	57	21.5	204	brown
Safina	girl	155	48	16.8	158	brown
Maria	girl	154	50	17.9	166	green
Amanat	girl	162	46	16.2	150	brown
Thomas	boy	157	49	19.9	186	blue

(a) Oliver concluded that boys do **not** have green eyes.

Explain why his conclusion is **not** justified.

.....

1 mark

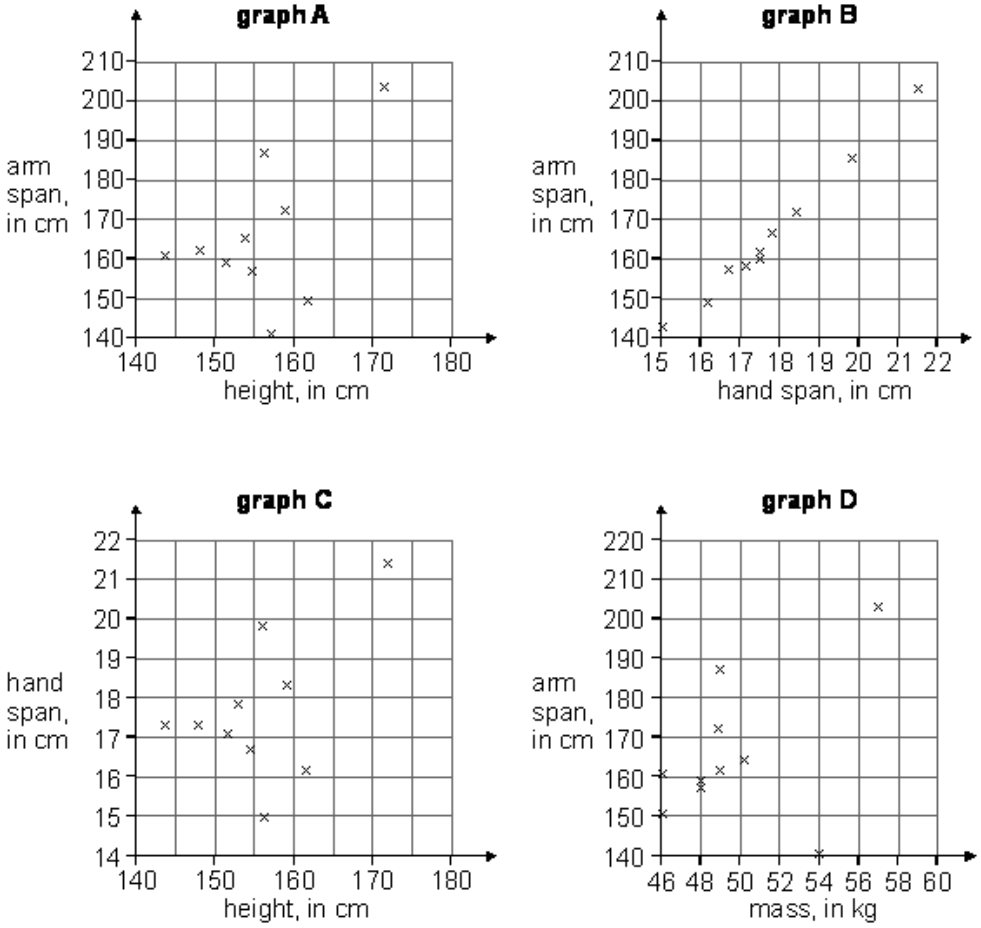
(b) Name **two continuous** variables in their table.

1. .....

2. .....

1 mark

(c) Look at the scatter graphs below.



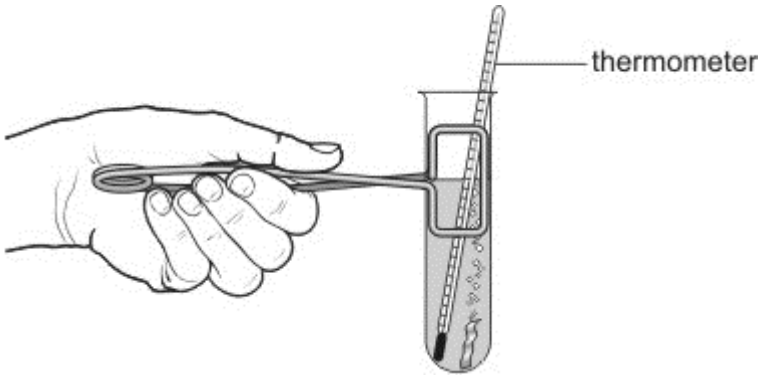
Use the data in the scatter graphs to show whether each of the conclusions below is **true**, **false** or you **cannot tell**.

conclusions	**true** or **false** or **cannot tell**
Graph C shows that the shortest pupil has the smallest hand span.	.....
Graph B shows the strongest correlation between two variables.	.....
Graph A looks similar to graph C because of the high correlation of arm span to hand span.	.....
Boys are generally taller than girls.	.....

2 marks

Maximum 4 marks

Q12. 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.

zinc + copper sulphate → zinc sulphate + copper

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.

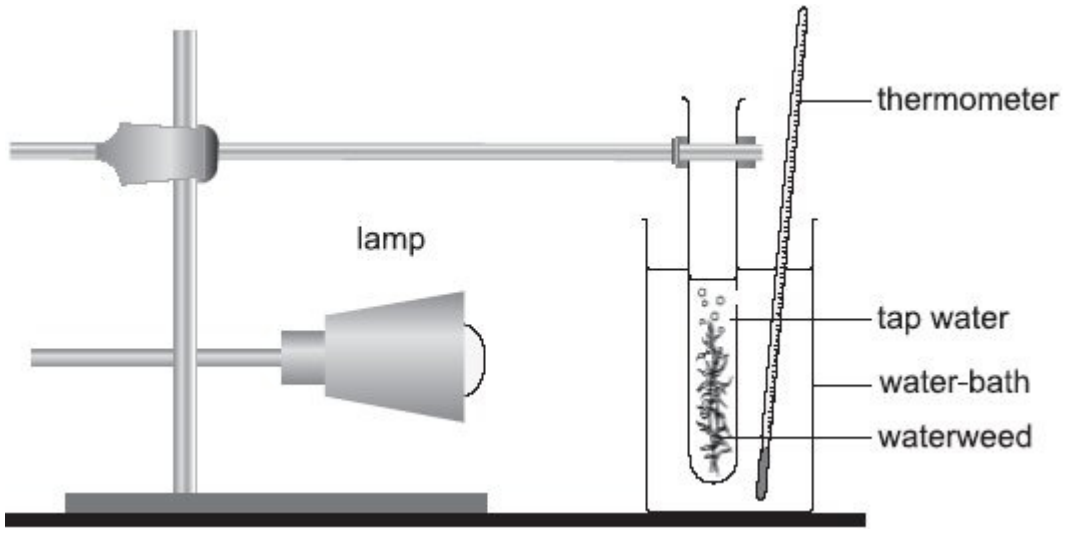
mixture	**Would there be a rise in temperature?**
aluminium + sodium chloride	
calcium + zinc sulphate	
lead + zinc chloride	
magnesium + iron chloride	

2 marks

maximum 6 marks

Q13. Suzi investigated how temperature affects the number of bubbles produced by waterweed in one minute.

She set up the experiment as shown below.



When the temperature of the water was 10°C the waterweed did **not** produce bubbles.

(a) Suzi increased the temperature of the water in the water-bath to 20°C.
The waterweed started to produce bubbles.
She waited two minutes before starting to count the bubbles.

Explain why she waited for two minutes before she started to count the bubbles.

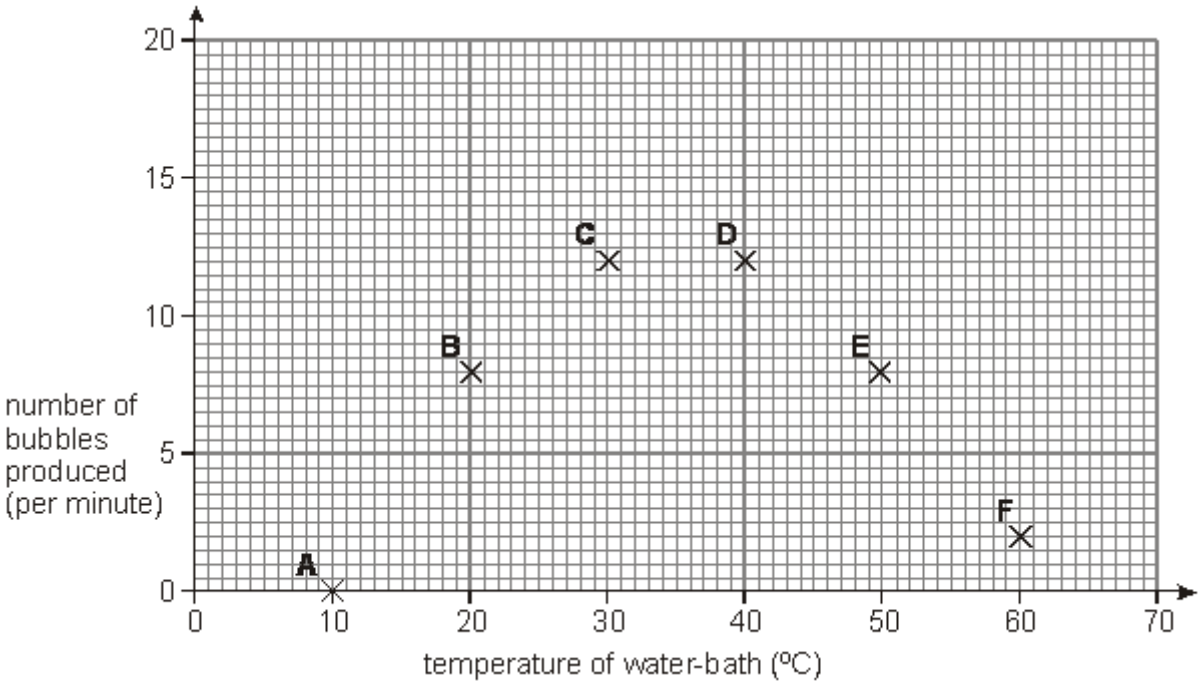
.....

.....

1 mark

(b) Suzi counted the number of bubbles produced at six different temperatures.

Her results are shown on the graph below.



(i) Draw a smooth curve on the graph.

1 mark

(ii) Use your curve to find the temperature of water which produced the most bubbles per minute.

.....°C

1 mark

(c) Suzi predicted that the higher the temperature the more bubbles would be produced.

Which points on the graph support Suzi's prediction?

.....

1 mark

(d) Suzi's data does **not** show clearly the exact temperature at which most bubbles were produced.

How could she improve the data she collects to find this temperature?

.....

.....

1 mark

maximum 5 marks

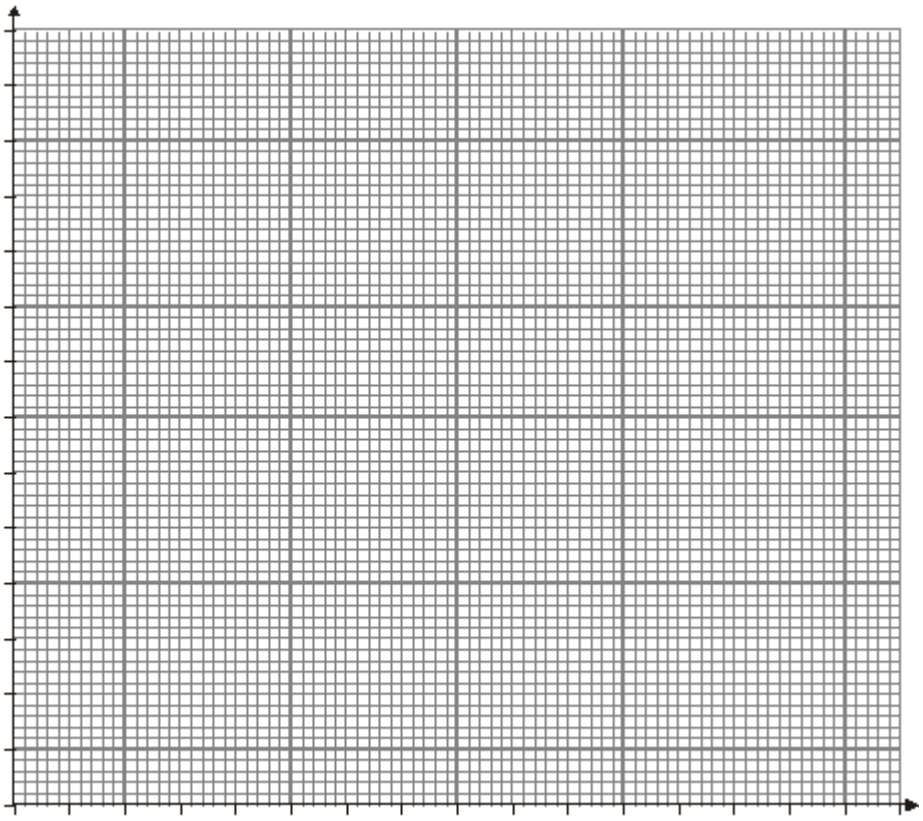
Q14. Six groups of pupils burned magnesium in air. The magnesium reacted with oxygen to form magnesium oxide.

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

Q15. (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

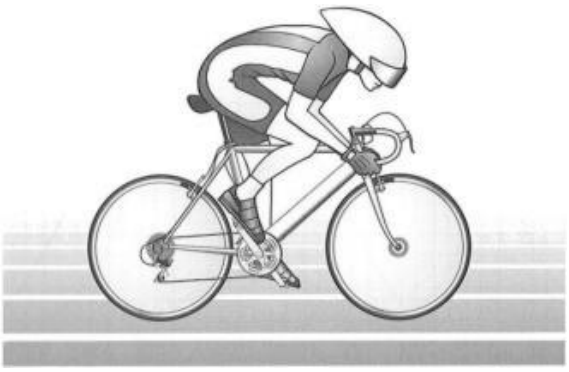
(ii) Compare the forward force on the bike with the backward force on the bike when Megan was travelling at a constant speed.

.....

.....

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 QUESTIONS