13+ ENTRANCE EXAMINATION

SOLIHULL

SAMPLE PAPER

SCIENCE

Read these instructions carefully

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

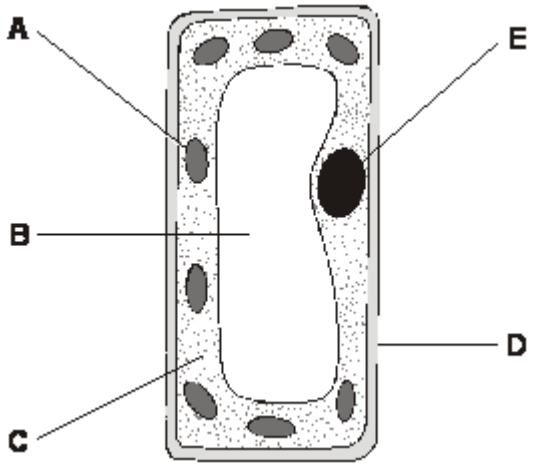
Attempt all questions.

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

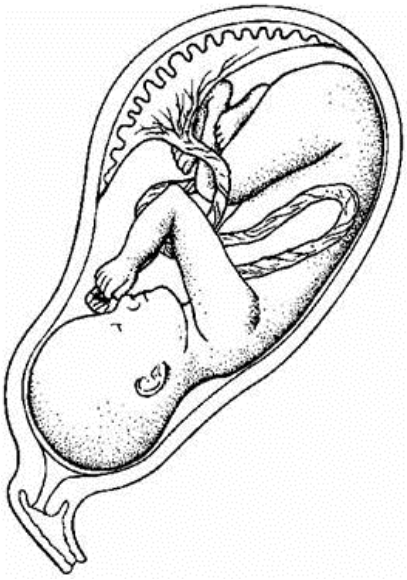
(d) How can you tell that the cell in the diagram is from a leaf and **not** from a root?

.....

1 mark

maximum 6 marks

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



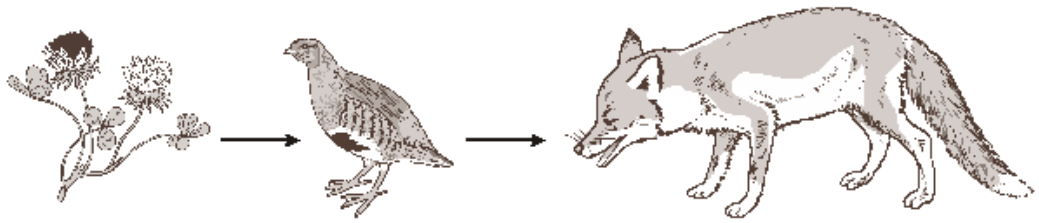
Some substances pass from the mother's blood to the baby's blood.
Other substances pass from the baby's blood to the mother's blood.

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

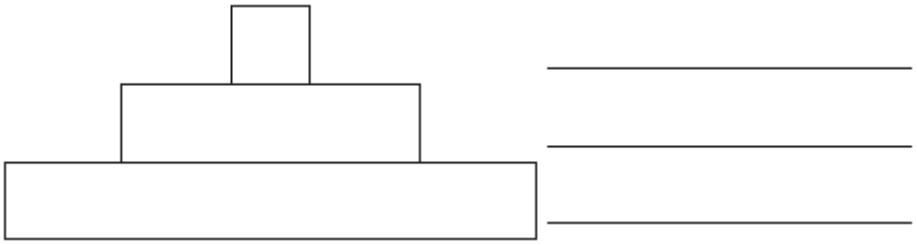
Q3. The drawings show part of a farmland food chain.



not to scale

(a) A pyramid of numbers represents the number of organisms at each stage in a food chain.

On each line by the pyramid of numbers below, write the name of the correct organism from the food chain above.



1 mark

(b) Partridges feed mainly on insects and wild plants (weeds).

Some farmers spray their crops with chemicals to kill insects and weeds.

How would this affect the number of foxes?

.....

Explain your answer.

.....

.....

1 mark

(c) Partridges build their nests on the ground among plants.
They lay up to 18 eggs in the nest.

Suggest why partridges need to lay so many eggs.

.....

.....

1 mark

(d) Some farmers leave a strip of land around the edge of each field which they do **not** spray with chemicals.

Suggest **two** reasons why this will lead to an increase in the number of partridges on these farms.

1 .....

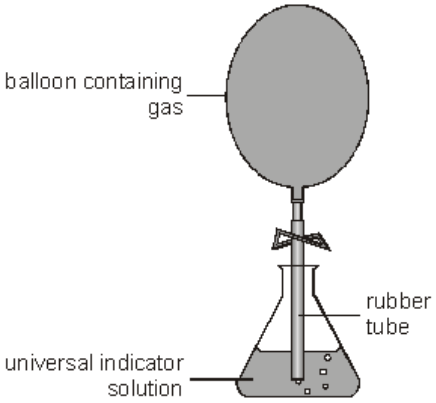
.....

2 .....

.....

2 marks
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?

.....

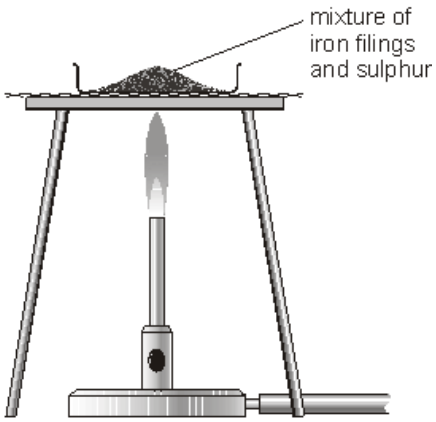
1 mark

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

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

2 marks
maximum 5 marks

Q5. 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.

.....

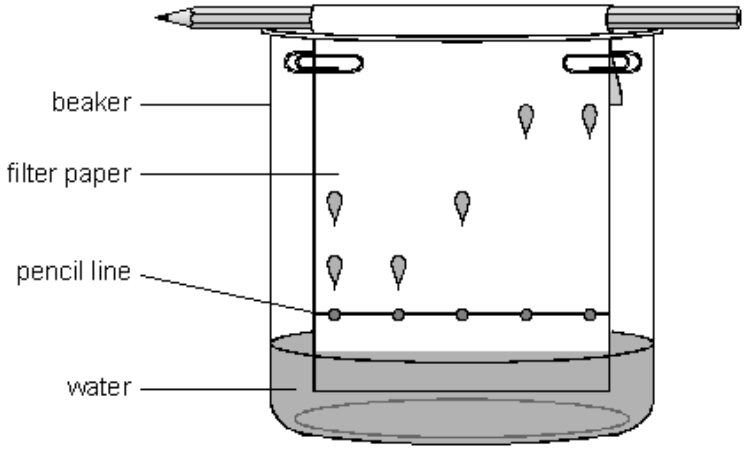
(ii) Some fossil fuels contain sulphur.
When fuels burn, sulphur reacts with oxygen.

Complete the word equation for this reaction.

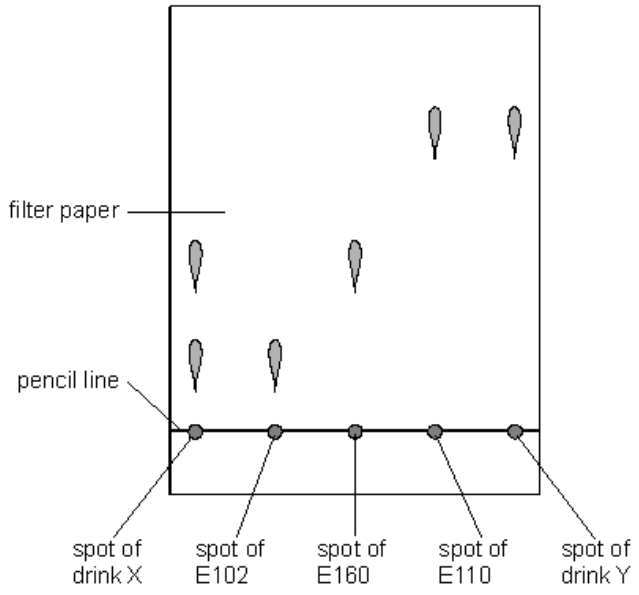
sulphur + oxygen → .....

2 marks
maximum 6 marks

Q6. Cathy has two orange drinks, X and Y. She uses chromatography to identify the coloured substances in the drinks. Her experiment is shown below.



Cathy made the chromatogram below using drink X, three food colourings, E102, E160, E110, and drink Y.



Cathy's chromatogram

(a) (i) Use Cathy's chromatogram to identify the **two** coloured substances in drink X.
Write their E numbers below.

1. ……

2. ……

2 marks

(ii) Draw another spot on Cathy's chromatogram to show what it would look like if drink Y contained E102 as well.

1 mark

(iii) Chromatography separates the coloured substances in a drink.
How can you tell from a chromatogram how many coloured substances there are in a drink?

.....

.....

1 mark

(b) (i) The spots show up well on filter paper. Give **one other** reason why filter paper is used in this experiment.

.....

.....

1 mark

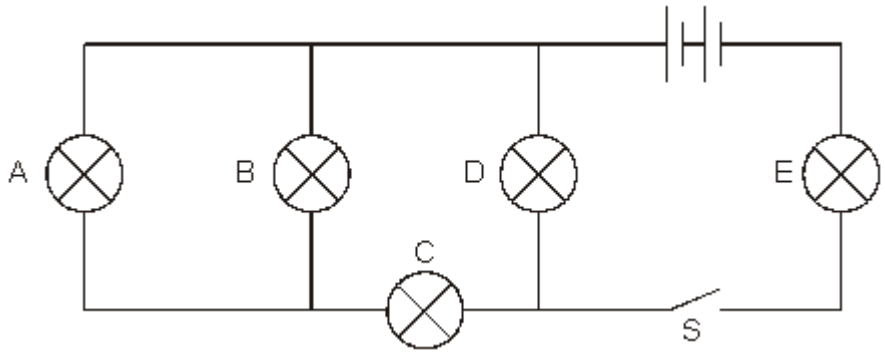
(ii) The line across the bottom of a chromatogram should be drawn with a pencil, **not** with ink.
Why should the line **not** be drawn with ink?

.....

.....

1 mark
Maximum 6 marks

Q7. (a) Max built **circuit 1** as shown below.



circuit 1

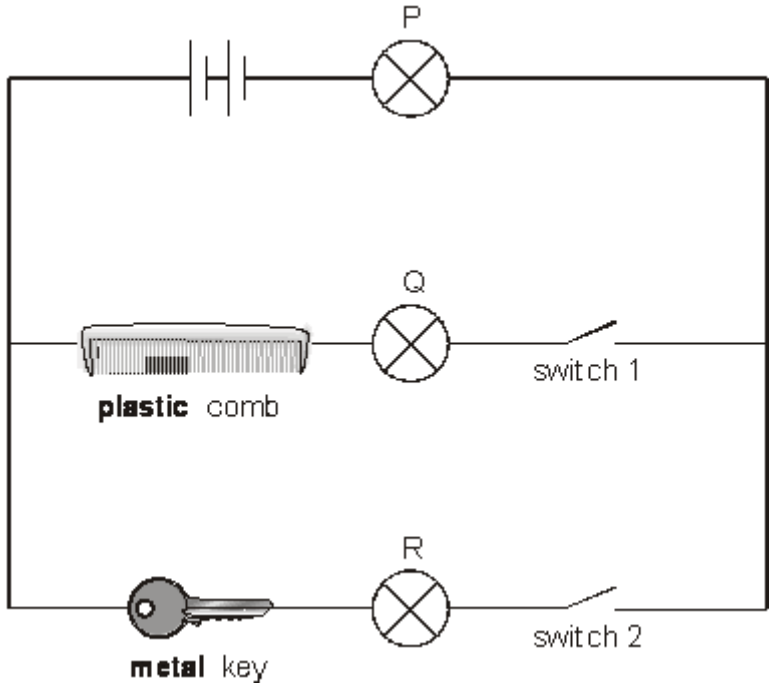
He closed the switch, S, and all the bulbs came on.
One of the bulbs then broke and **all** the bulbs went off.

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**.

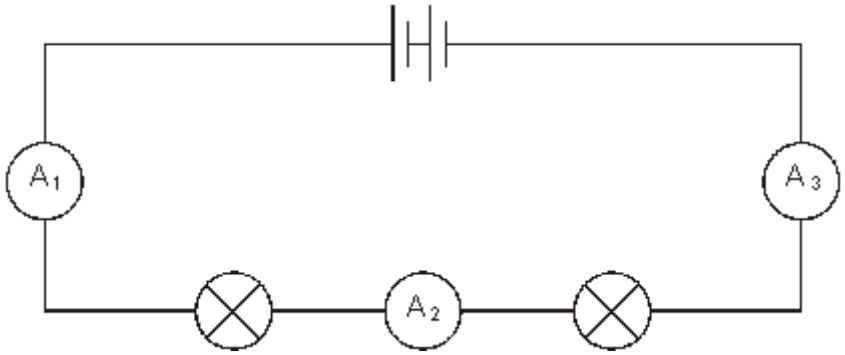
Complete the table below to show which bulbs in circuit 2 will be on or off whendifferentswitches are open or closed.

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.



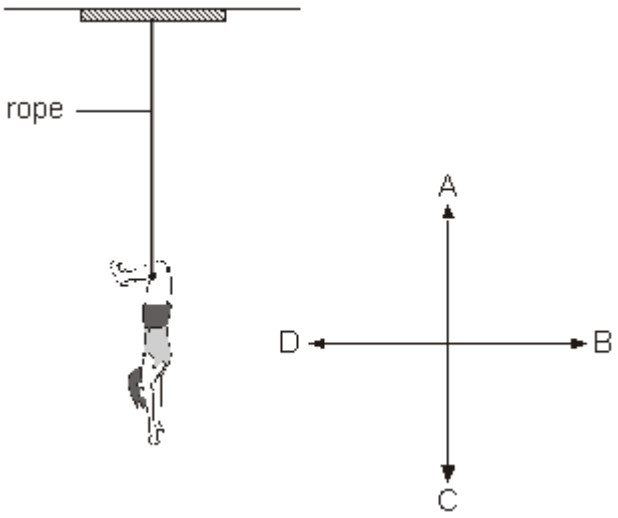
circuit 3

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

Q8. The diagram below shows Jo hanging on a trapeze (swing) in a circus.



(a) (i) Which arrow, A, B, C or D, shows the direction of Jo's weight?

.....

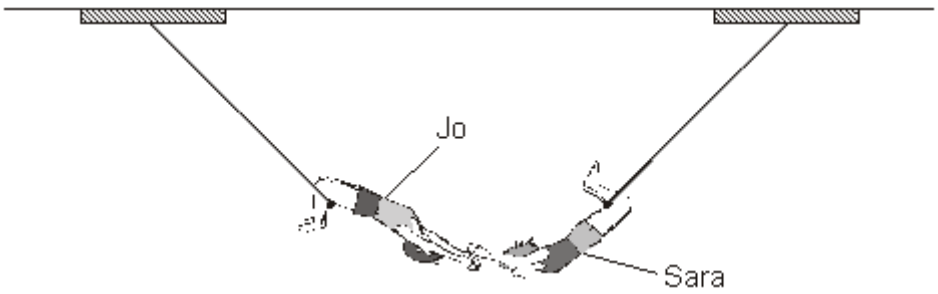
1 mark

(ii) Which arrow, A, B, C or D, shows the direction of the force of the rope on Jo?

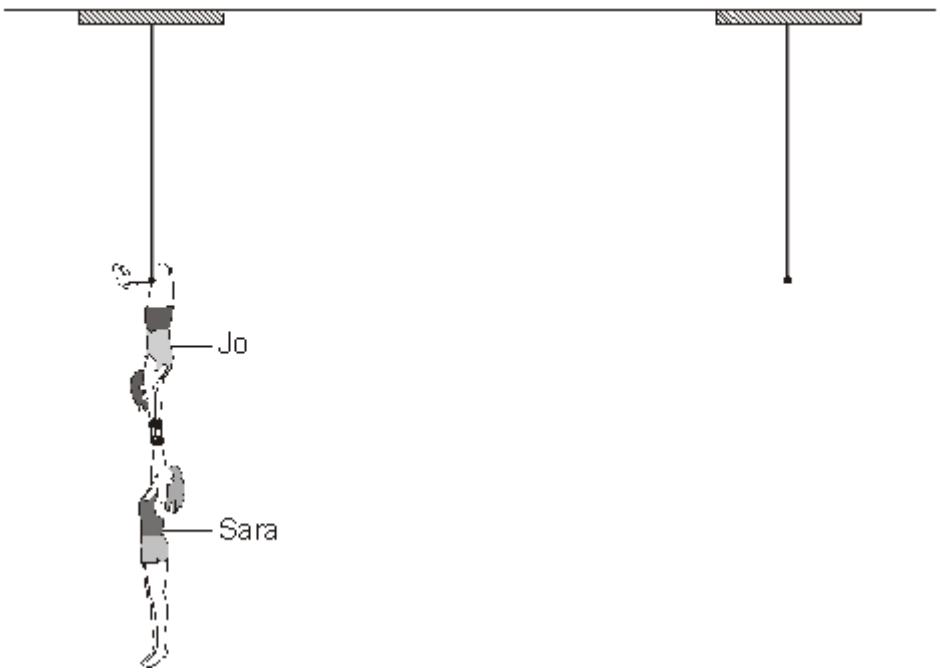
.....

1 mark

(b) Sara swings towards Jo.



Sara lets go of her trapeze and Jo catches her.



(i) What happens to the downward force on the rope of Jo's trapeze?
Tick the correct box.

increases	decreases	stays the same	there is **no** force
☐	☐	☐	☐

1 mark

(ii) Explain your answer.

.....

1 mark

(c) Jo lets go of the trapeze and both Sara and Jo fall into a safety net below them.

What happens to the downward force on the rope when Jo lets go?

.....

1 mark
maximum 5 marks

Q9. 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.

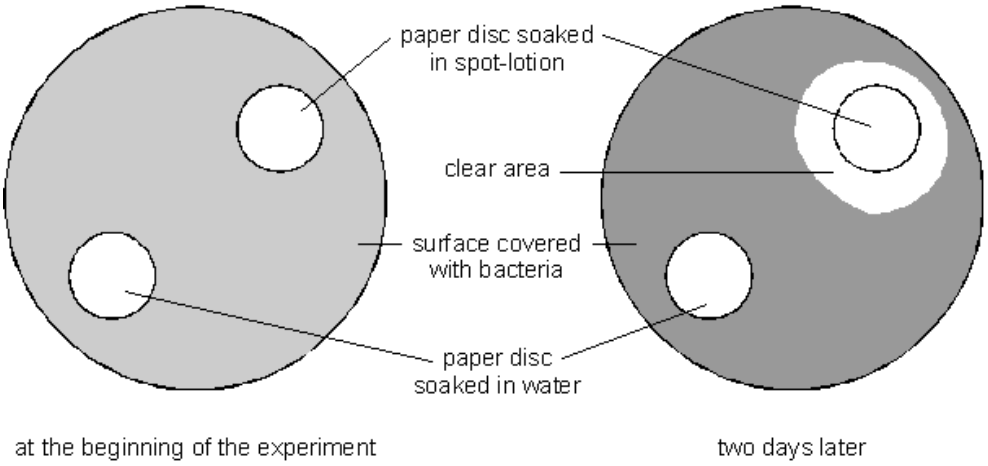
At what temperature would the bacteria reproduce quickly?

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. ……

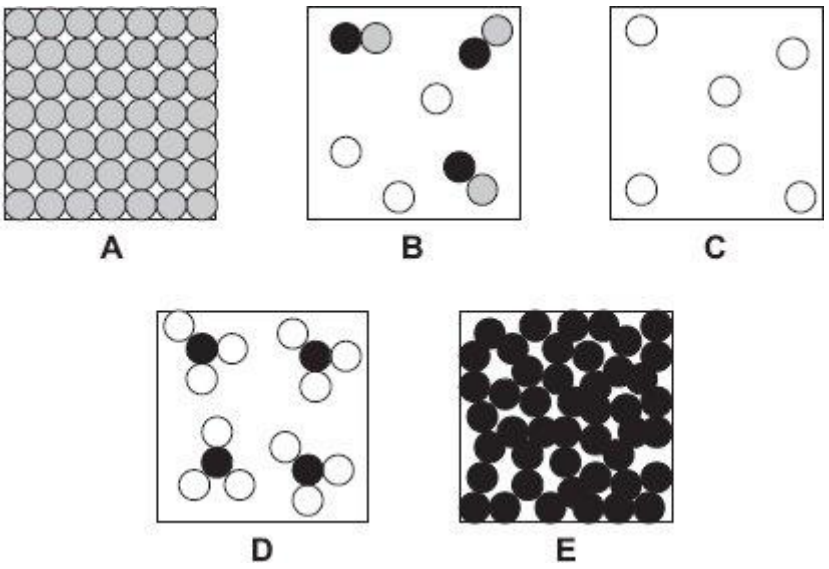
2. ……..

2 marks
Maximum 5 marks

Please turn over for question 10

Q10. (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;

.....

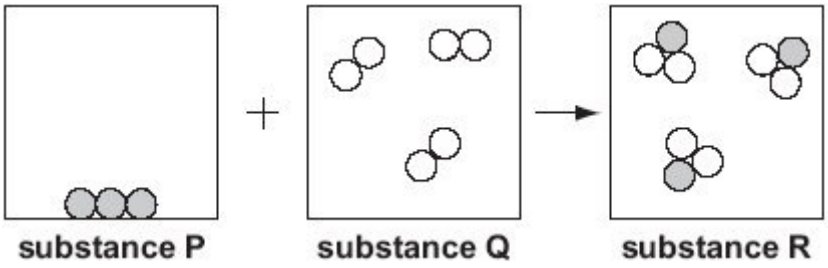
1 mark

(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?

.....

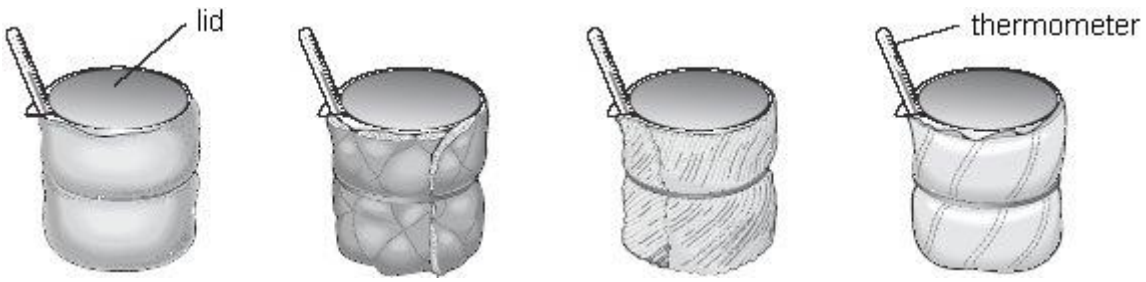
.....

1 mark

maximum 5 marks

Q11. 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.

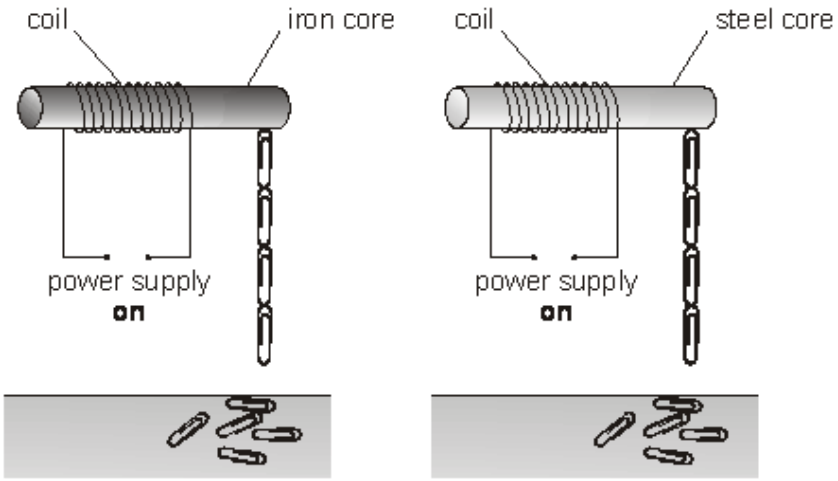
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.....

1 mark

maximum 8 marks

Q12. David made two electromagnets as shown below.
He used paper-clips to test the strength of each electromagnet.
He switched on the power supply in both circuits.



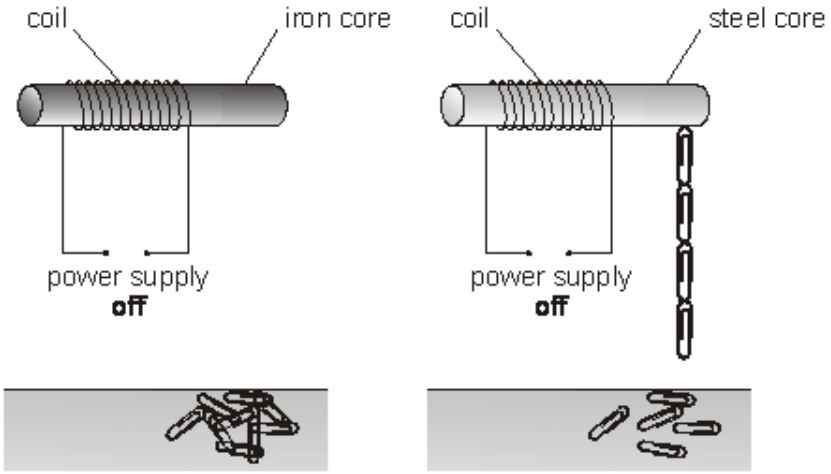
(a) How can you tell that the strength of both electromagnets is the same?

.....

.....

1 mark

(b) David switched off the power supply in both circuits.
The paper-clips fell off the iron core, but **not** off the steel core.



Why is iron used, rather than steel, for the core of an electromagnet?
Use the diagrams above to help you.

.....

.....

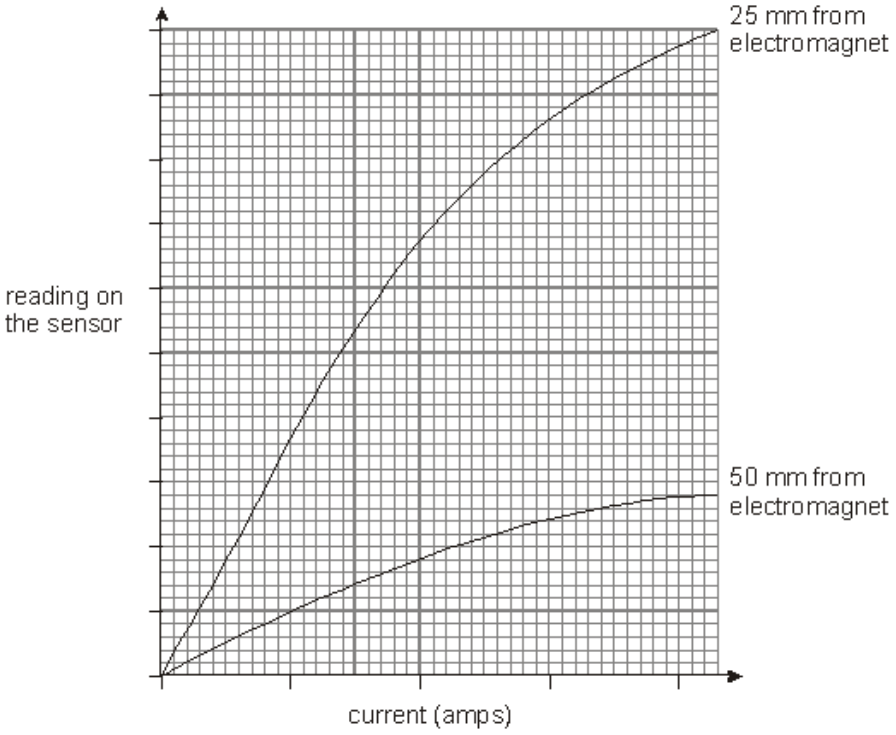
1 mark

(c) David used a sensor to measure the strength of an electromagnet.

He placed the sensor 25 mm from the electromagnet and increased the current in the coil.

He repeated the experiment with the sensor 50 mm from the electromagnet.

The graph below shows his results.



(i) How did the distance of the sensor from the electromagnet affect the reading on the sensor?

.....

.....

1 mark

(ii) How did the size of the current in the coil affect the strength of the electromagnet?

.....

.....

1 mark

(iii) What else could David do to an electromagnet to change its strength?

.....

.....

1 mark

maximum 5 marks

Q13. James shone a ray of light at a mirror as shown below.

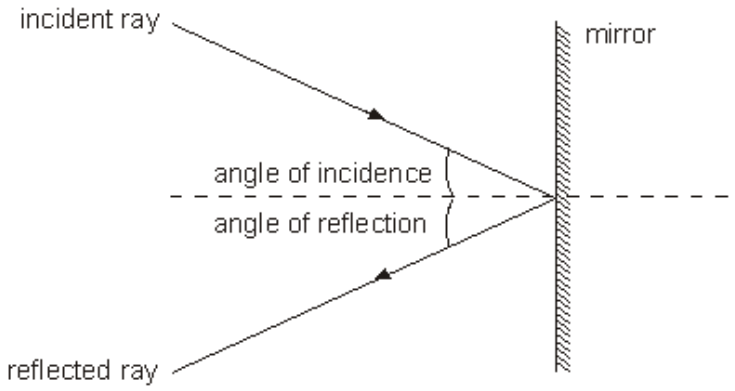


diagram 1

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

angle of **incidence** (°)	30	40	50	60	70
angle of **reflection** (°)	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.

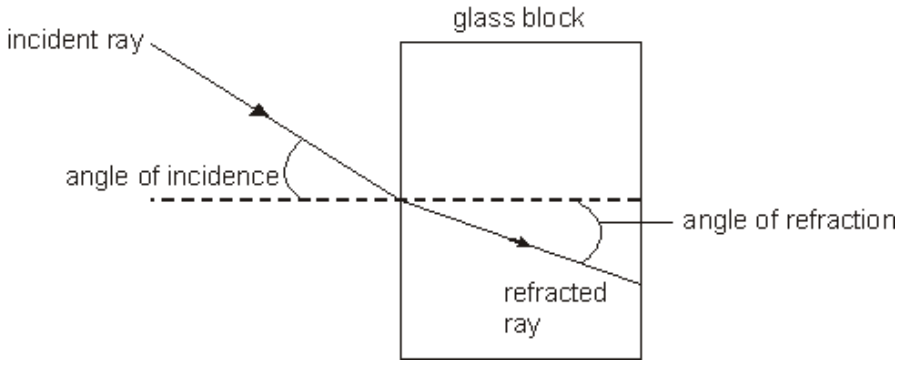
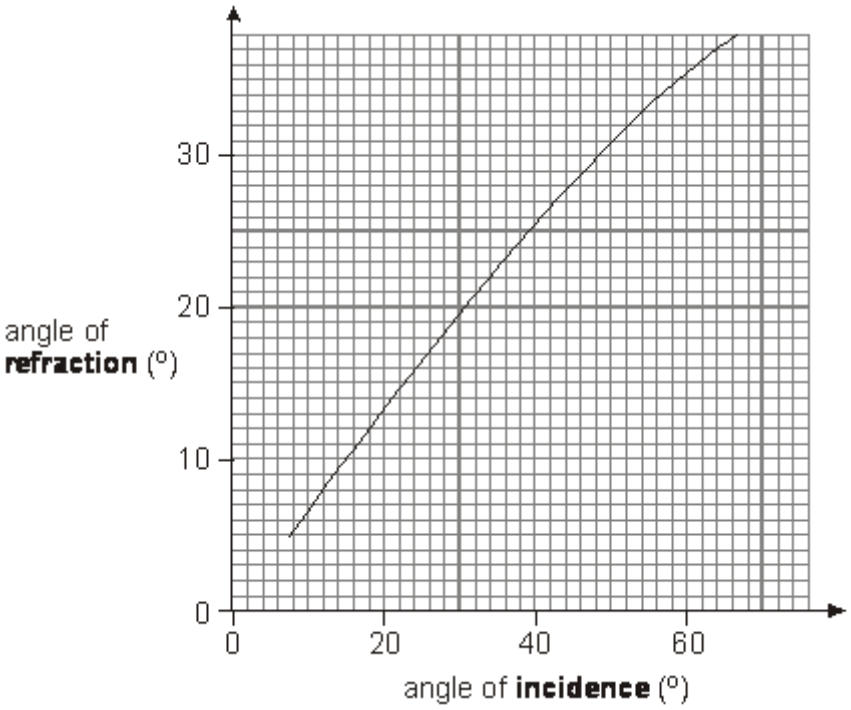


diagram 2

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

Q14. **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

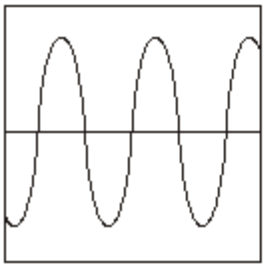
(ii) Explain why she would need this amount of calcium.

.....

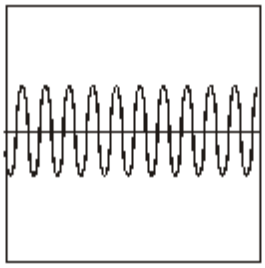
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2 marks
maximum 7 marks

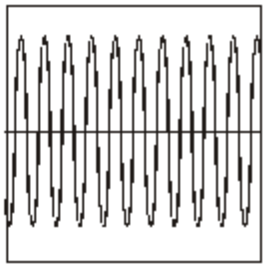
Q15. (a) The diagrams below show the patterns produced on an oscilloscope by three different sound waves.



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 .....

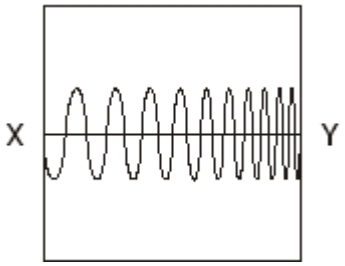
How do the diagrams show this?

.....

.....

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.

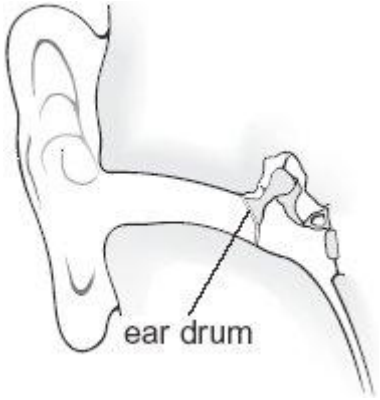
sound level (decibels)	maximum time (hours)
86	8
88	4
90	2
92	1
94	0.5

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

END OF QUESTIONS