ST ALBANS SCHOOL

13+ Examination 2016

SCIENCE

(CALCULATORS MAY BE USED)

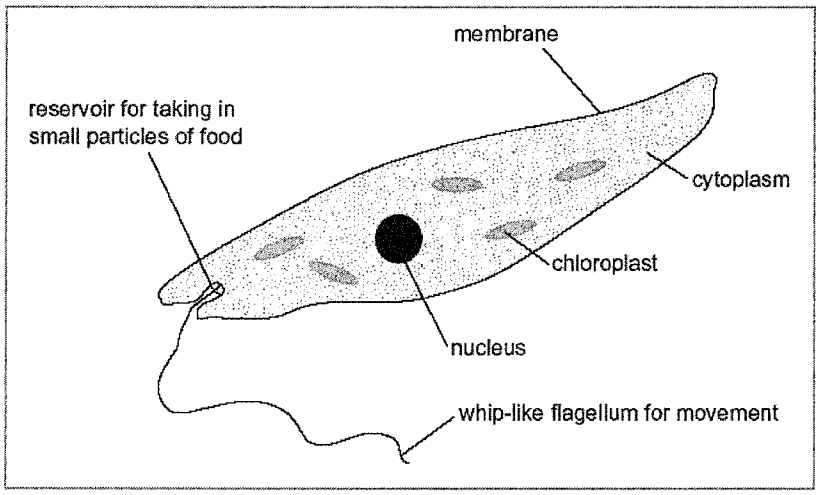
(90 minutes)

Surname	First Name

Date of Birth

Score Total

1. The diagram below shows an organism called Euglena. It is unicellular and lives in ponds.



(a) Euglena has features that are present in both animals and plant cells. List **two** structures that would be found in an animal cell.

1. _____ 2. _____

2 marks

(b) What evidence is there that Euglena has some features of a plant cell?

_____

_____

1 mark

(c) What is the function of the cell membrane?

_____

_____

1 mark

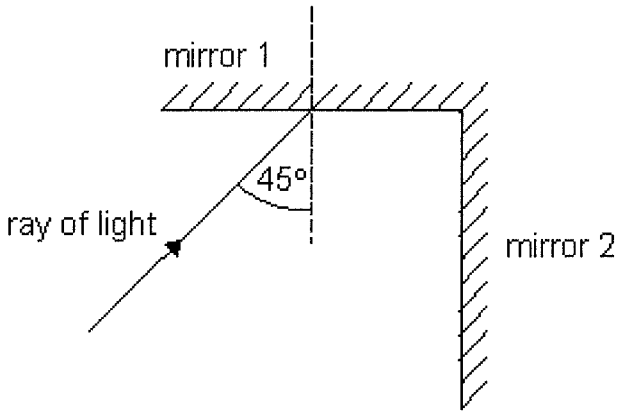
(d) What is contained in the nucleus?

_____

1 mark

(Maximum 5 marks)

2. (a) Two mirrors are placed at 90° and a ray of light is shone at mirror 1.



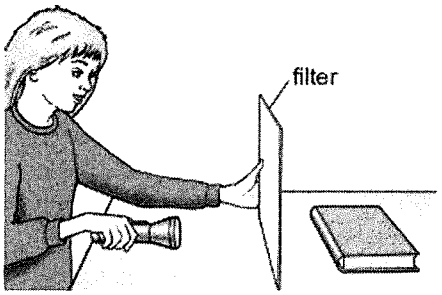
(i) **On the diagram above** continue the ray of light to show how it is reflected by both mirrors. Use a ruler.

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

(b) Ann shines the torch at a red book. She puts different colour filters in front of the torch and records the colour the book appears.

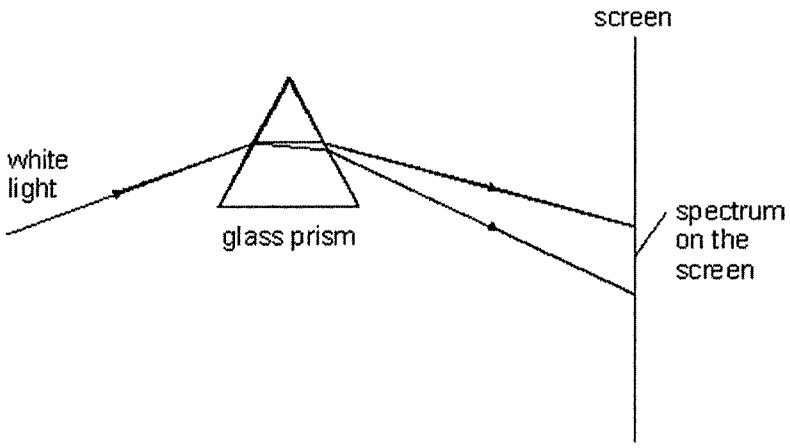


Complete the table below to show the colour that the book would appear.
Tick **one** box in each row. The first one has been done for you. 1 mark

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

(Maximum 4 marks)

3. When white light is shone through a glass prism the light bends and splits into the colours of the spectrum.



(a) (i) What word describes the bending of light as it enters and leaves glass?

_____

1 mark

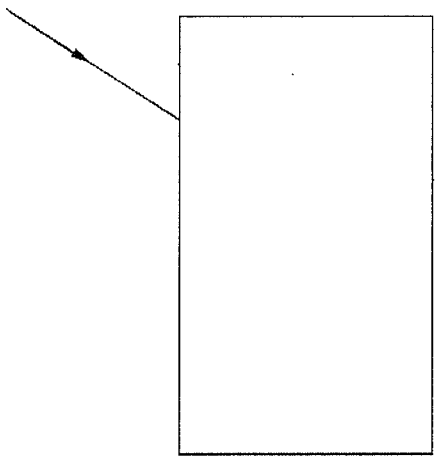
(ii) What word describes the splitting of light into the colours of the spectrum?

_____

1 mark

(b) (i) Completed the diagram below to show the path of a ray of white light as it travels through and emerges from the other side of a rectangular glass prism.

2 marks



(ii) Draw in the path of a ray of light which enters as 90° to the surface.

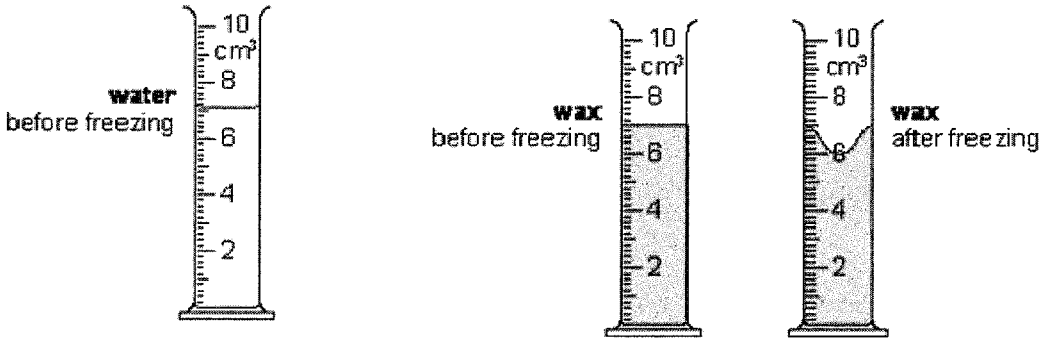
1 mark

(Maximum 5 marks)

4. Paul poured 7 cm^3 of water into a measuring cylinder.

He poured 7 cm^3 of melted wax into another measuring cylinder.

He put both measuring cylinders into a freezer for 24 hours.



(a) (i) Look at the measuring cylinder containing the wax.
What happened to the volume of the wax after freezing?

The volume of the wax_____

1 mark

(ii) What would you expect to happen to the volume of the water in the other cylinder after freezing?

_____

1 mark

(b) The measuring cylinders were taken out of the freezer and left in a room at 20°C.

- Frozen water melts at 0°C.
- Wax melts at 53°C.

What would the physical state of each substance be at 20°C?

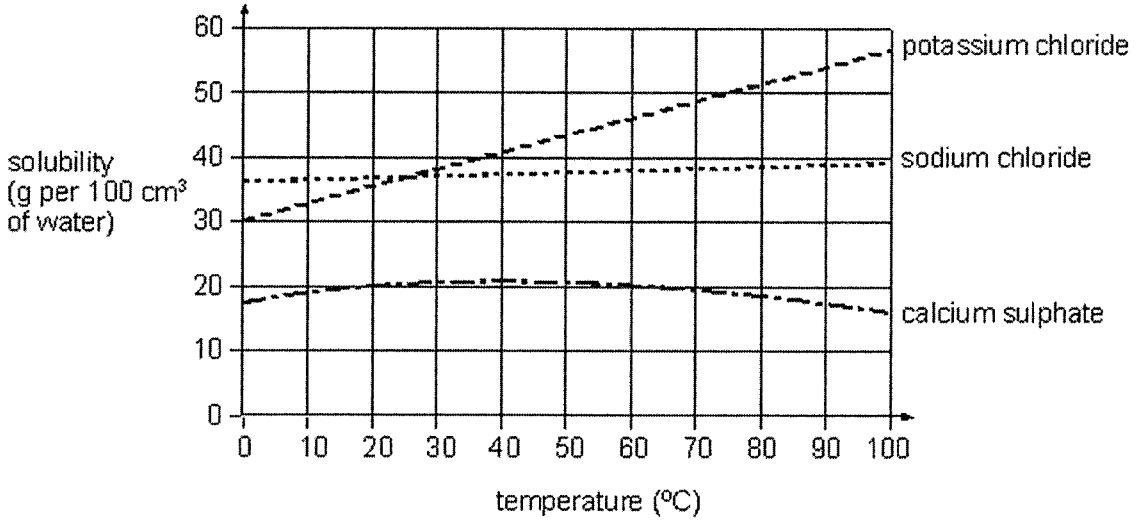
Choose from **gas** or **liquid** or **solid.**

water _____

wax _____

2 marks
(Maximum 4 marks)

5. The graph shows how the solubility of three salts, sodium chloride, potassium chloride and calcium sulphate, changes as the temperature changes.



(a) What is the solubility of potassium chloride at 75°C ? _____

1 mark

(b) Use the graph to compare the solubility of sodium chloride and potassium chloride in the temperature range 10°C to 90°C.

_____

_____

_____

2 marks

(c) Ken had a beaker containing 54 g of potassium chloride dissolved in 100 cm^3 of water at 90°C.

He cooled the solution to 40°C.

What would he see in the beaker as the solution cooled to 40°C?

Use the graph to help you.

_____

1 mark

Explain your answer.

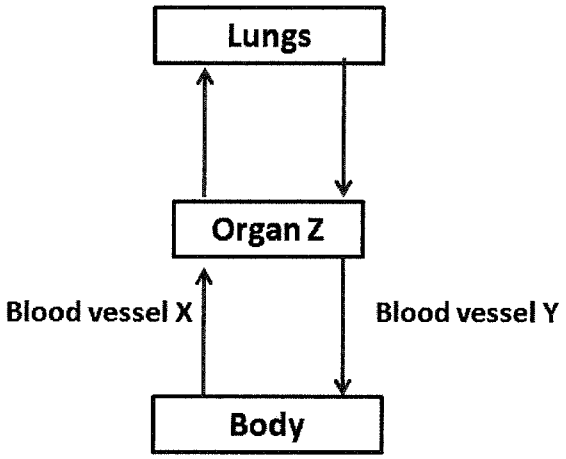
_____

_____

1 mark

(Maximum 5 marks)

6. The diagram to the right is a simplified model of the human circulatory system.



(a) (i) What type of blood vessel is X?

_____ 1 mark

(ii) What type of blood vessel is Y?

_____ 1 mark

(iii) Name organ Z?

_____ 1 mark

(b)A student measured their pulse (heart rate) before swimming 10 lengths of a pool. They measured it again afterwards. What effect will swimming 10 lengths have on her pulse rate?

_____

1 mark

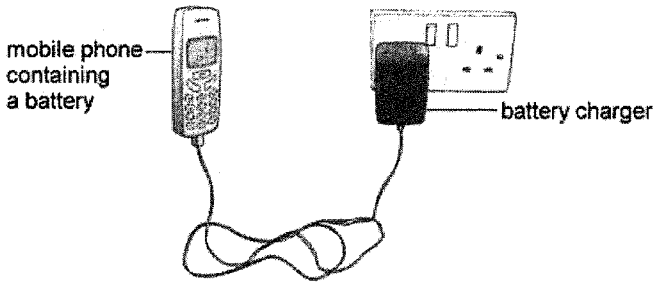
(c) Energy is needed for exercise. Write the **word equation** for the process that releases energy in humans.

_____

2 marks
(Maximum 6 marks)

7. (a) Jacquie has a mobile phone. Energy is stored in the battery of the phone.

The drawing shows the battery being charged.



(i) Which energy transfer takes place in the battery as it is being charged? Tick the correct box.

chemical to sound ☐

sound to thermal ☐

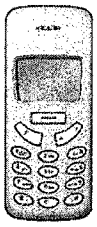
electrical to chemical ☐

thermal to electrical ☐

1 mark

(ii) When the battery is fully charged, Jacquie unplugs the phone.

Which energy transfers take place when the mobile phone rings? Tick the correct box.



chemical to electrical to sound ☐

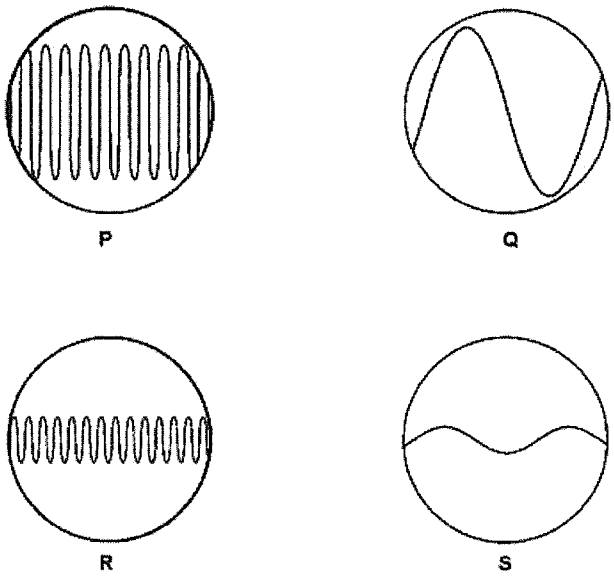
electrical to chemical to sound ☐

kinetic to electrical to sound ☐

thermal to electrical to sound ☐

1 mark

(b) Jacquie can change the ring-tone of her phone.
The diagrams below show the patterns made by four sound waves on an oscilloscope screen.
They are all drawn to the same scale.



Write the letter of the sound wave that matches each of the descriptions below.

(i) a loud sound with a low pitch _____

(ii) a quiet sound with a high pitch _____

(iii) a loud sound with a high pitch _____

3 marks
(Maximum 5 marks)

8. A video recorder is loaded with a tape which plays for 180 minutes.
The length of the tape is 260 m.

(a) (i) Calculate the speed of the tape, in metres per minute.

_____ m/min

2 marks

(ii) What is the speed of the tape in metres per second?

_____ m/s

1 mark
(Maximum 3 marks)

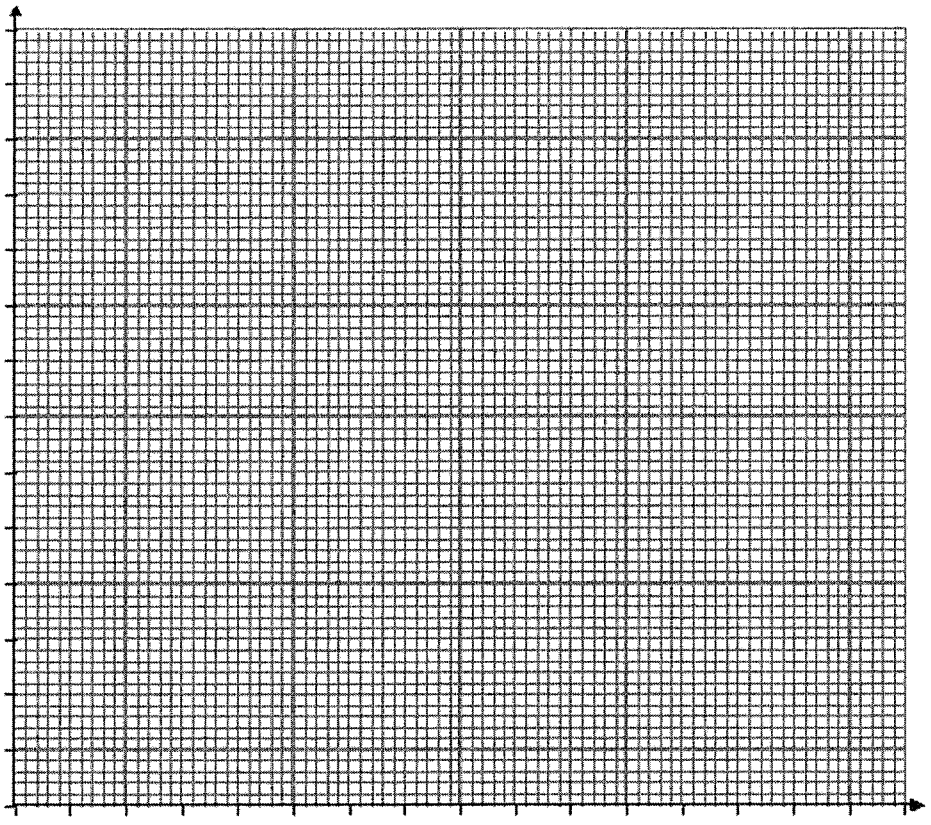
9. Six groups of pupils burned magnesium in air. The magnesium reacted with oxygen to form magnesium oxide.

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.

_____g

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

(e) Write a Word equation **and** Symbol equation for the reaction.

i) Word Equation:

_____

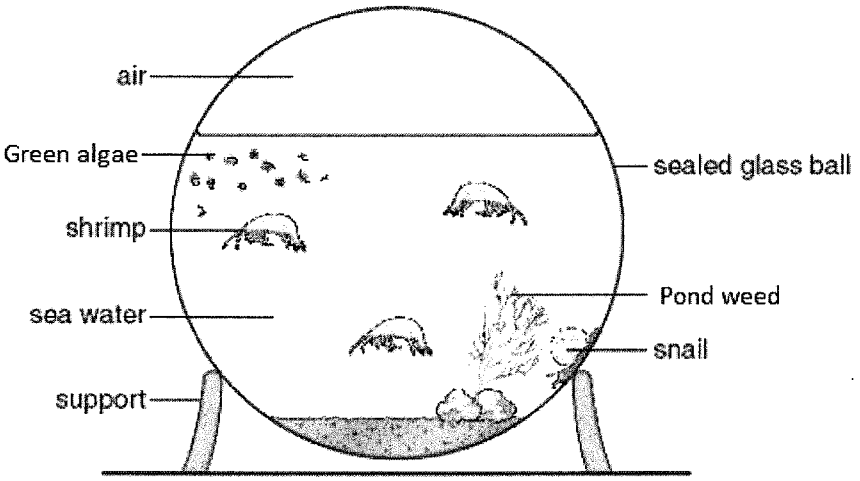
ii) Symbol Equation:

_____

2 marks
(Maximum 10 marks)

Turn over page

10. The diagram below shows an enclosed ecosystem called an ecosphere. It is a sealed glass ball containing sea water, plants (sea algae and pond weed), a snail and shrimps.



not to scale

(a) Why is it important the outside of the biosphere is made of glass?

_____

_____

_____

2 marks

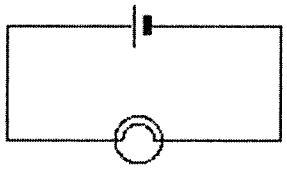
(b)Fill in the table below to show the processes that occur in the specimens in the biosphere.

You should use a tick (✓) to indicate the process happens and a cross (✗) to indicate if the process does not happen. The first row has been done for you.

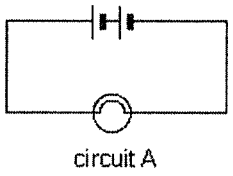
	Photosynthesis	**Respiration**	**Growth**	**Reproduction**
Snail	✗	✓	✓	✓
Green algae				
Sea Water				
Shrimp				
Pond weed				

4 marks
(Maximum 6 marks)

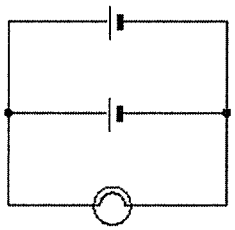
11. John connects up the circuit shown.



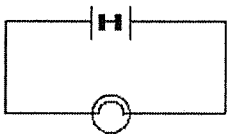
The bulb is not bright enough. His friend suggests four circuits which could be used to make the bulb brighter.



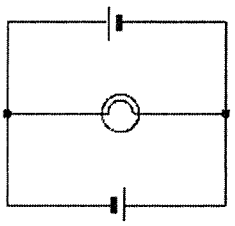
circuit A



circuit B



circuit D



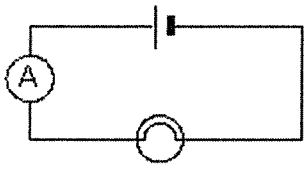
circuit C

(a) Which is the correct circuit to use: A, B, C or D?

_____

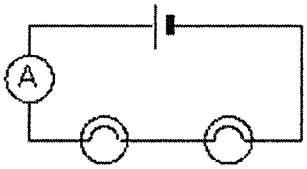
1 mark

Next John sets up circuit E and notes the reading on the ammeter.



circuit E

He then places another bulb in the circuit, to make circuit F. He notes the ammeter reading in circuit F.



circuit F

(b) How will the ammeter reading in circuit F compare with that in circuit E?

i) The reading in F is

_____

1 mark

ii) Explain you answer.

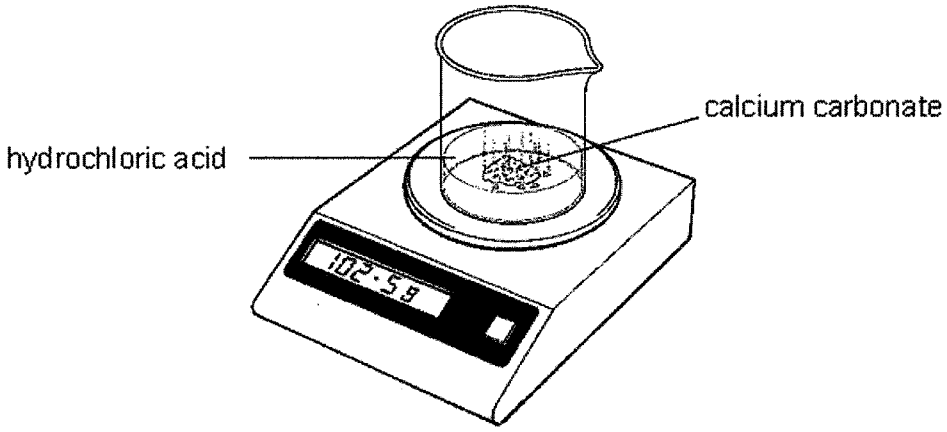
_____

1 mark

(c) Draw a circuit diagram in which **two** bulbs are lit as brightly as the bulb in circuit E, and the ammeter reading is the same as in circuit E.

2 mark
(Maximum 5 marks)

12. Ben put a beaker weighing 50 g on a balance. He added 50 g of dilute hydrochloric acid and 2.5 g of calcium carbonate to the beaker.
The total mass of the beaker and its contents was 102.5 g.



(a) The hydrochloric acid reacted with the calcium carbonate. How could Ben tell that a chemical reaction was taking place in the beaker?

_____

1 mark

(b) Write the word equation for the reaction which took place:

_____

2 marks

(c) When the reaction stopped, the total mass had decreased from 102.5 g to 101.4 g. Some water may have evaporated from the beaker.
What else caused the drop in mass?

_____

1 mark

(d) When the reaction stopped, Ben tested the contents of the beaker with universal indicator paper. The calcium carbonate had neutralised the acid. What is the colour of universal indicator paper in a neutral solution?

_____

1 mark

(e) Which **two** materials in the list below are mainly calcium carbonate? Tick the **two** correct **boxes.**

coal ☐

glass ☐

limestone ☐

marble ☐

sandstone ☐

2 marks

(f) Metals react with acids.
What gas is produced when a metal reacts with an acid?

_____.

1 mark

(g) Magnesium chloride is formed when magnesium reacts with an acid.

Complete the word equation for the reaction between magnesium and this acid.

magnesium + ...→ magnesium chloride + ...

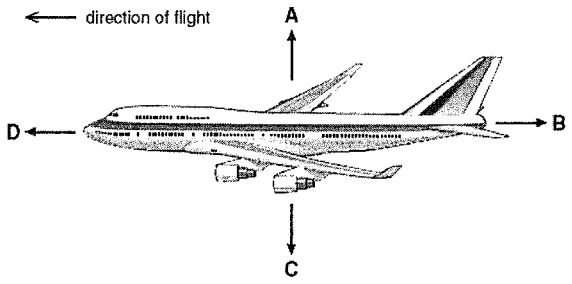
2 marks

(h) Complete the table below:

formula	name	Element or compound	Number of different types of atoms	Total number of atoms
Ca				
$MgCl_2$	Magnesium chloride			
$CuSO_4$				

4 marks
(Maximum 14 marks)

13. The diagram shows four forces acting on a plane in flight.



(a) What is responsible for the force labeled B?

_____

1 mark

(b) What is responsible for the force labeled C?

_____

1 mark

(c) (i) When the plane is flying at a constant speed. Which statement about the size of the forces is true?
Tick the correct box.

Force B is zero. ☐

Force B is greater than force D. ☐

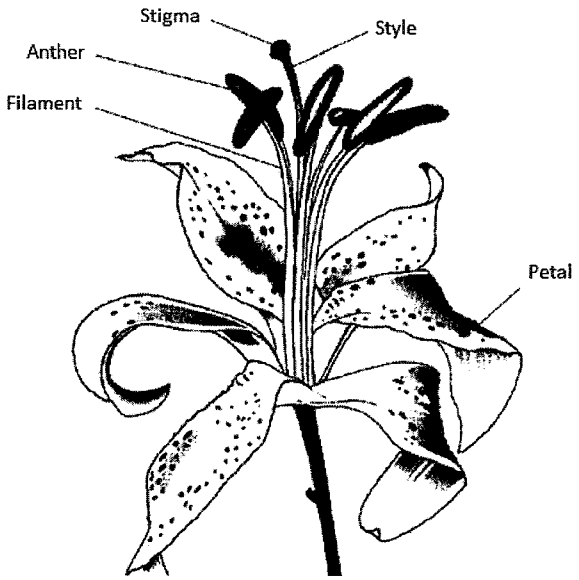
Force D is equal to force B. ☐

Force D is greater than force B. ☐

1 mark

(Maximum 3 marks)

14. The diagram below shows a flower. Five parts are labelled.



(a) Complete the sentences below by filling in the missing words.

Flowers are a plant's _____ organs. The _____ produces pollen, which is the male sex cell (the equivalent of sperm). Some plants have brightly coloured _____ to attract insects.

3 marks

(b) Suggest why the stigma is sticky.

_____

_____

_____

2 marks

(c) Describe what happens during pollination of an insect pollinated plant.

_____

_____

_____

2 marks

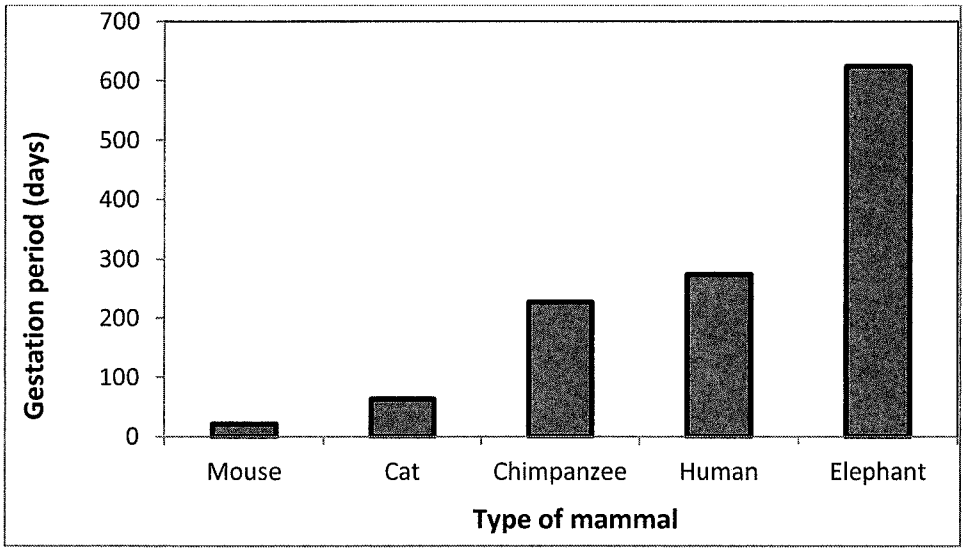
(d) Bright colours attract insects to the flower of a plant. Suggest two **other** features that would attract insects.

1. _____

2. _____

2 marks

(e)The graph below shows the gestation period for 5 different mammals:



(i) What is a gestation period?

_____

_____

1 mark

(ii) State the gestation period for a human in months.

_____ months

1 mark

(iii) What is the relationship between size and length of gestation period?

_____

_____

1 mark

(f) A scientist stated "the maximum volume of a human infant's brain is directly related to the size of their mother's pelvis".

Explain why this is statement might be true

_____

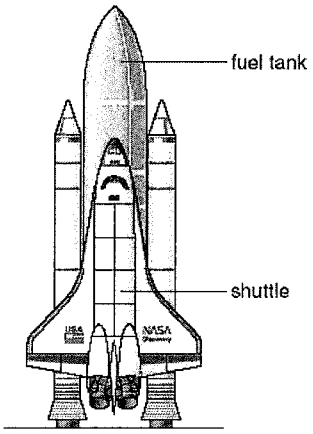
_____

_____

_____

2 marks
(Maximum 14 marks)

15. The shuttle is a spacecraft which is used to take satellites into space.
The drawing below shows the shuttle just about to take off.



(a) The shuttle has a separate fuel tank containing liquid hydrogen and liquid oxygen.

Explain why hydrogen and oxygen are transported as liquids rather than as gases.

_____

_____

1 mark

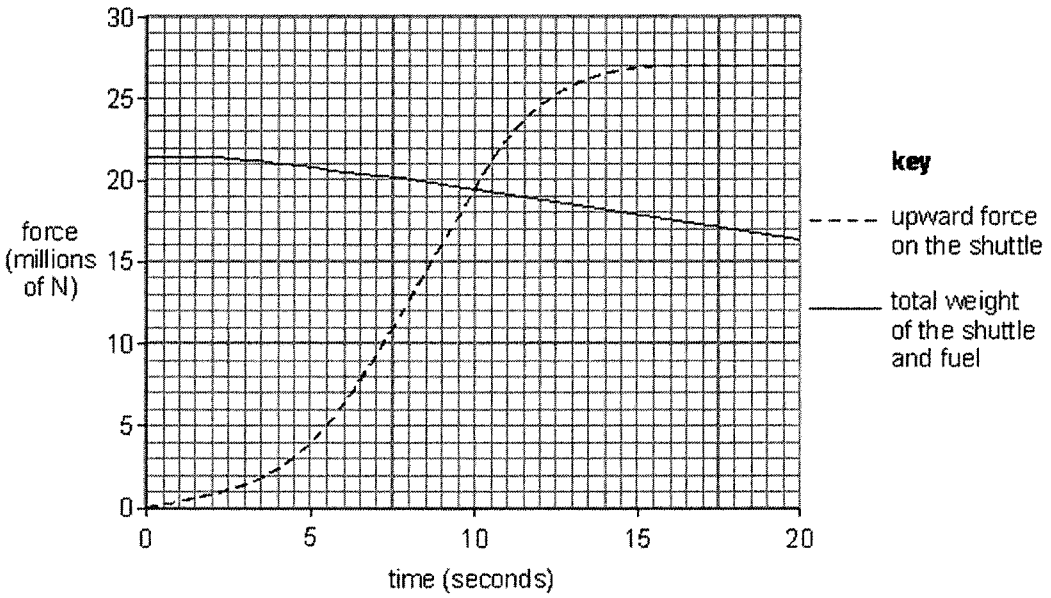
(b) Oxygen is needed to burn the fuel in the shuttle's engines.
Vehicles on Earth do **not** need a tank containing oxygen.

Why does the shuttle need to have a tank containing oxygen?

_____

1 mark

(c) The graph below shows how the upward force and the weight of the shuttle, including fuel, change during the first 20 seconds, after the fuel is ignited.



Why does the total weight of the shuttle **decrease** during the first 20 seconds?

_____

1 mark

(d) (i) Look at the graph. At 20 seconds, what is the value of:

the upward force on the shuttle? _____ millions of N

the total weight of the shuttle and fuel _____ millions of N

1 mark

(ii) At 20 seconds, what is the **resultant** force on the shuttle? _____ millions of N

1 mark

(iii) Use the graph to explain why the shuttle **cannot** take off before 10 seconds.

_____

1 mark

(iv) The fuel tank will eventually separate from the shuttle and fall back down to Earth. What force will keep the shuttle in its orbit around the Earth?

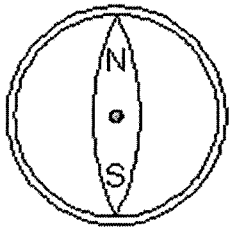
_____

1 mark

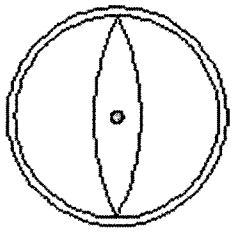
(Maximum 9 marks)

16. (a) Sam has two small compasses. When he puts them a long way apart, they both point North.

Label the North and South magnetic poles on compass B.



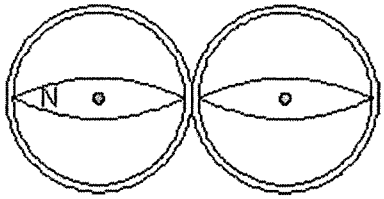
compass A


compass B

1 mark

(b) Sam puts the compasses side by side.

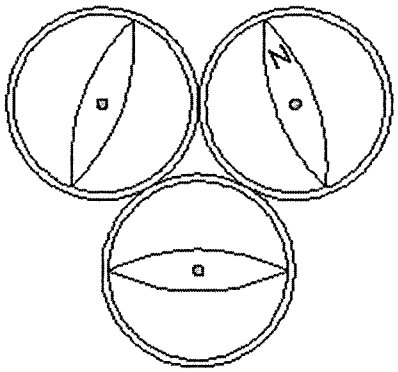
Label the North and South magnetic poles on **both** compasses.
One pole has been done for you.



1 mark

(c) Sam then puts three compasses close together.

Label the North and South magnetic poles on each of the **three** compasses.
One pole has been done for you.



1 mark

(d) What metal are compass needles made from?

_____

1 mark
(Maximum 4 marks)

END OF QUESTIONS
Total 100 marks