CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT

GCSE

Science

Session: 2000 June
Type: Question paper
Code: 1794

OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Secondary Education
former Midland Examining Group syllabus

SCIENCE: DOUBLE AWARD PAPER 1 **1794/1**
SCIENCE: BIOLOGY PAPER 1 **1780/1**
SCIENCE: BIOLOGY (NUFFIELD) PAPER 1 **1785/1**
FOUNDATION TIER

Tuesday **6 JUNE 2000** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials required:
Pencil,
Ruler (cm/mm).

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

FOR EXAMINER'S USE	
1	
2	
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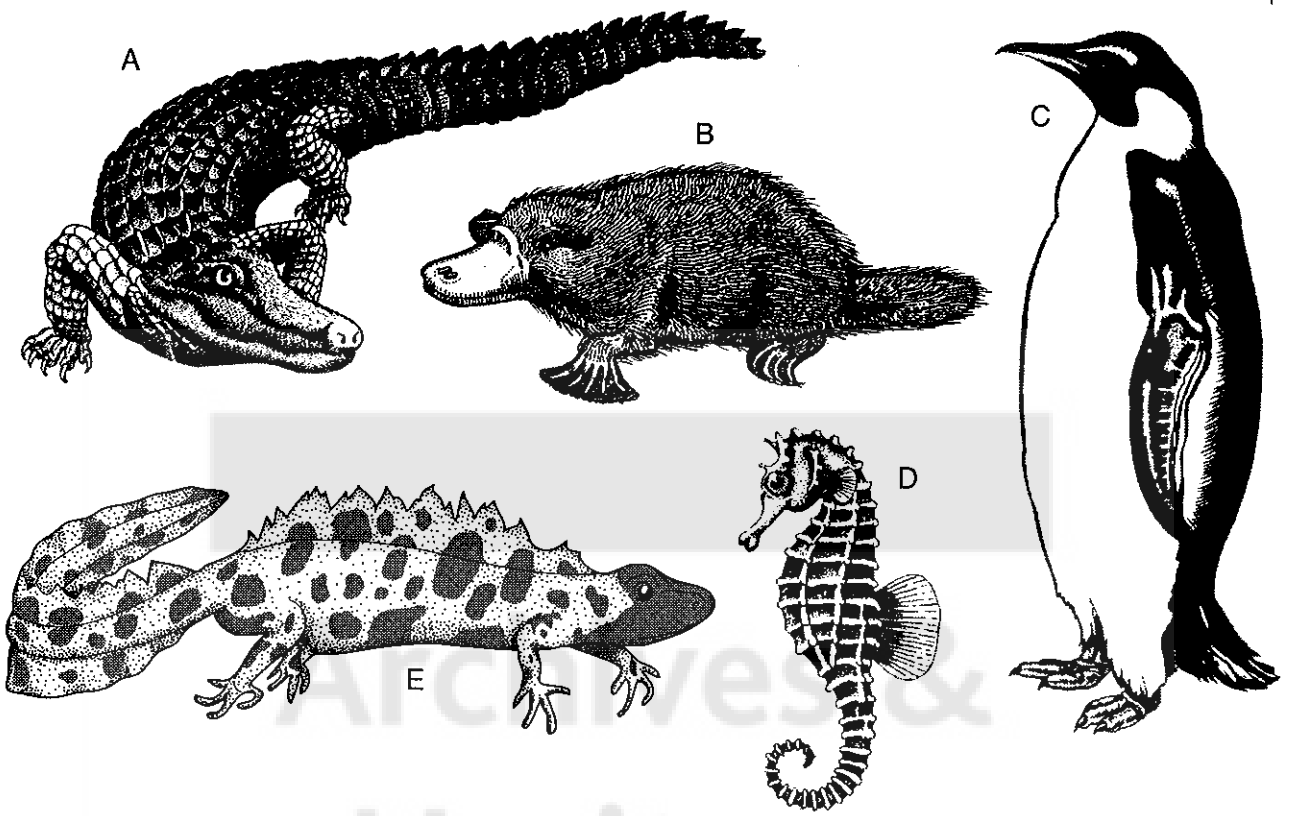
4	
5	
6	
7	
8	
9	
10	
11	
12	
TOTAL	

This question paper consists of 23 printed pages and 1 blank page.

[Turn over

1 Here are pictures of five vertebrate organisms.



Here is a key to identify the organisms.

1	legs	go to 2
	no legs	Fish
2	4 legs	go to 3
	2 legs	Bird
3	hair	Mammal
	no hair	go to 4
4	scales	Reptile
	no scales	Amphibian

Use the key to work out which vertebrate group each organism belongs to.
Write your answers in the table.

name of organism	vertebrate group
A	
B	
C	
D	
E	

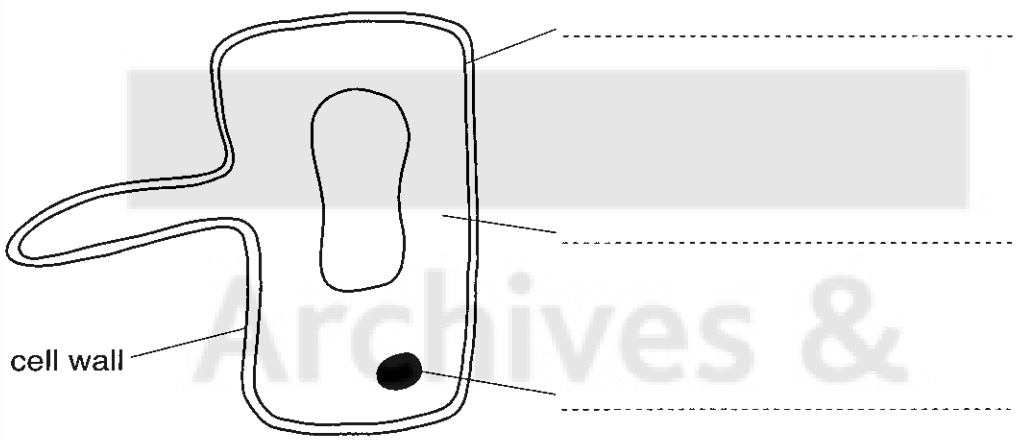
[4]

2 Ian used a microscope to look at some cells.

He drew a diagram of one cell.

(a) Finish labelling the diagram. Choose the **best** words from the list.

cell membrane
chloroplasts
cytoplasm
nucleus
vacuole



[3]

(b) The table shows the names of some cell parts and the jobs they do.

(i) Finish the table. There are **three** gaps.

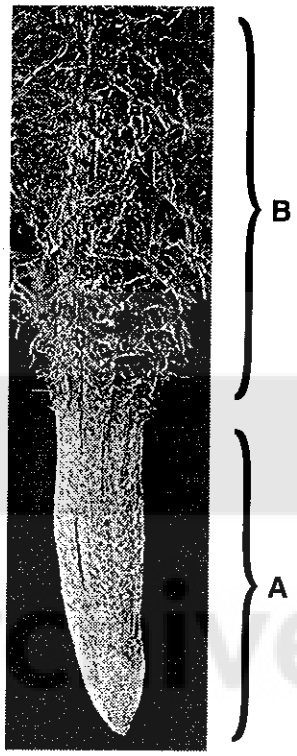
cell part	job
cell wall	provides support
	where most chemical reactions take place
	controls what goes into and out of the cell
nucleus	

[3]

(ii) Put a (ring) around the process that takes place in a mitochondrion.

excretion **respiration** **transpiration** [1]

This is a photograph of a root tip.
It shows a region with root hairs (**B**) and a region without root hairs (**A**).



(c) What is the job of root hairs?

_____ [1]

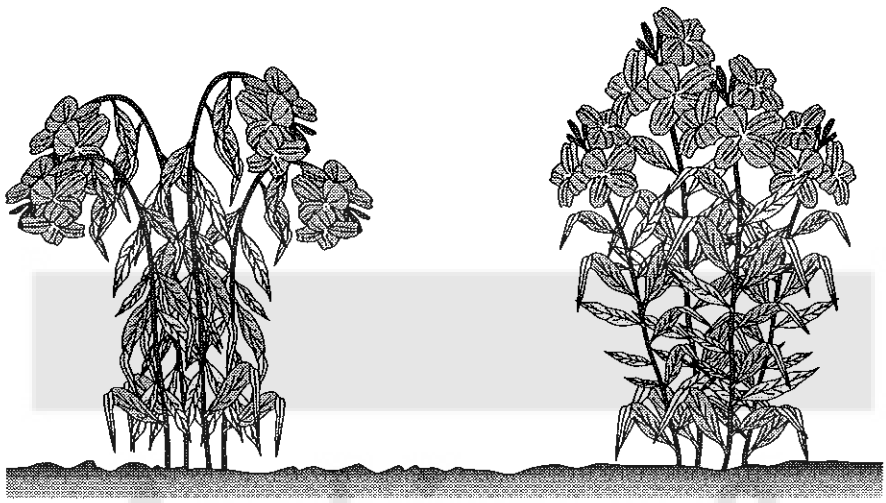
(d) The table shows information about this root and its root hairs.

surface area of the root (A and B) with the root hairs removed/ cm^2	surface area of all the root (A and B) with root hairs/ cm^2
6	24

Root hairs increase the surface area of the root.
How many times greater is the surface area of the root with root hairs than the surface area of the root without root hairs?
You **must** show how you work out your answer.

Answer _____ times greater [2]

(e) A gardener grows wallflower plants from seeds.
He pulls them up and replants them in his flower beds.
He waters these plants every day.
The plants wilt for several days after replanting.
Then they recover.



wilted recovered

Explain why the plants wilt and then recover.

_____

_____

_____

_____

_____ [3]

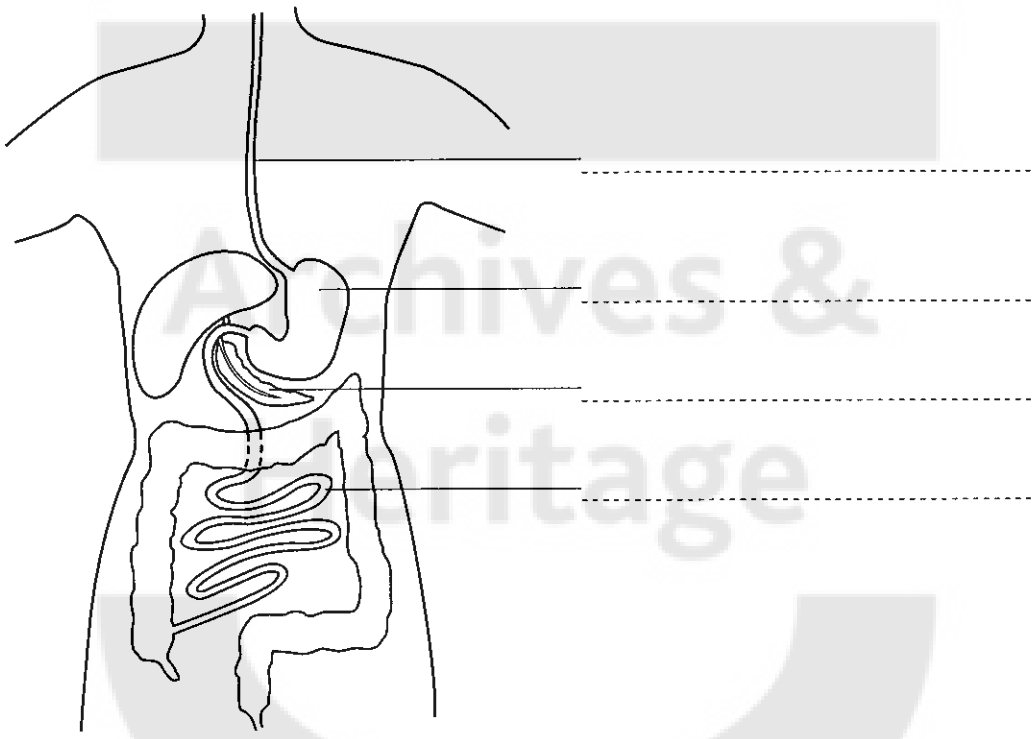
[Turn over

3 The diagram shows part of the human digestive system and some organs.

(a) Label the diagram.

Choose the **best** words from this list.

large intestine
liver
oesophagus
pancreas
small intestine
stomach



[4]

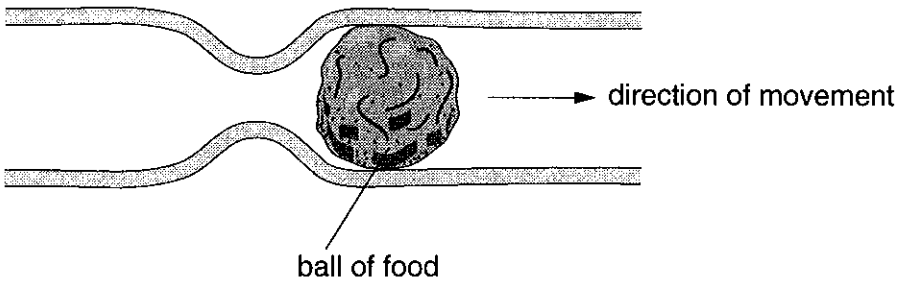
(b) Write **on the diagram**:

(i) an **A** to show where most of the digested food is absorbed into the blood stream.

(ii) a **D** to show where proteins are first digested.

(iii) an **E** to show where undigested food is egested. [3]

(c) The diagram shows food moving through the digestive system.



Describe how food is moved through the digestive system.

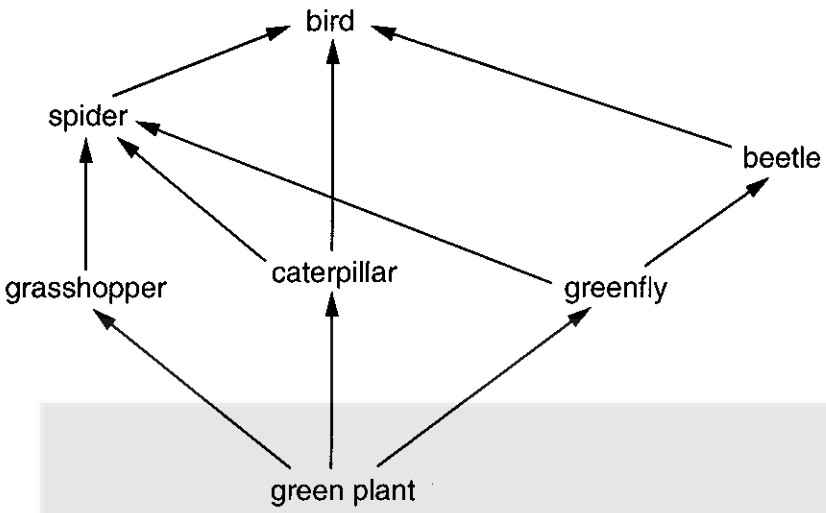
_____

_____

_____

_____ [2]

4 This question is about what animals eat.



(a) Choose words from the diagram to answer these questions.

(i) Write down the name of the producer.

_____ [1]

(ii) Write down the name of a primary consumer.

_____ [1]

(iii) Write down the name of a predator.

_____ [1]

(b) What name is given to this type of diagram?

Put a (ring) around the correct answer.

food chain **food pyramid** **food web** [1]

(c) Suggest what happens to the number of caterpillars if all the grasshoppers die. Explain your answer.

_____

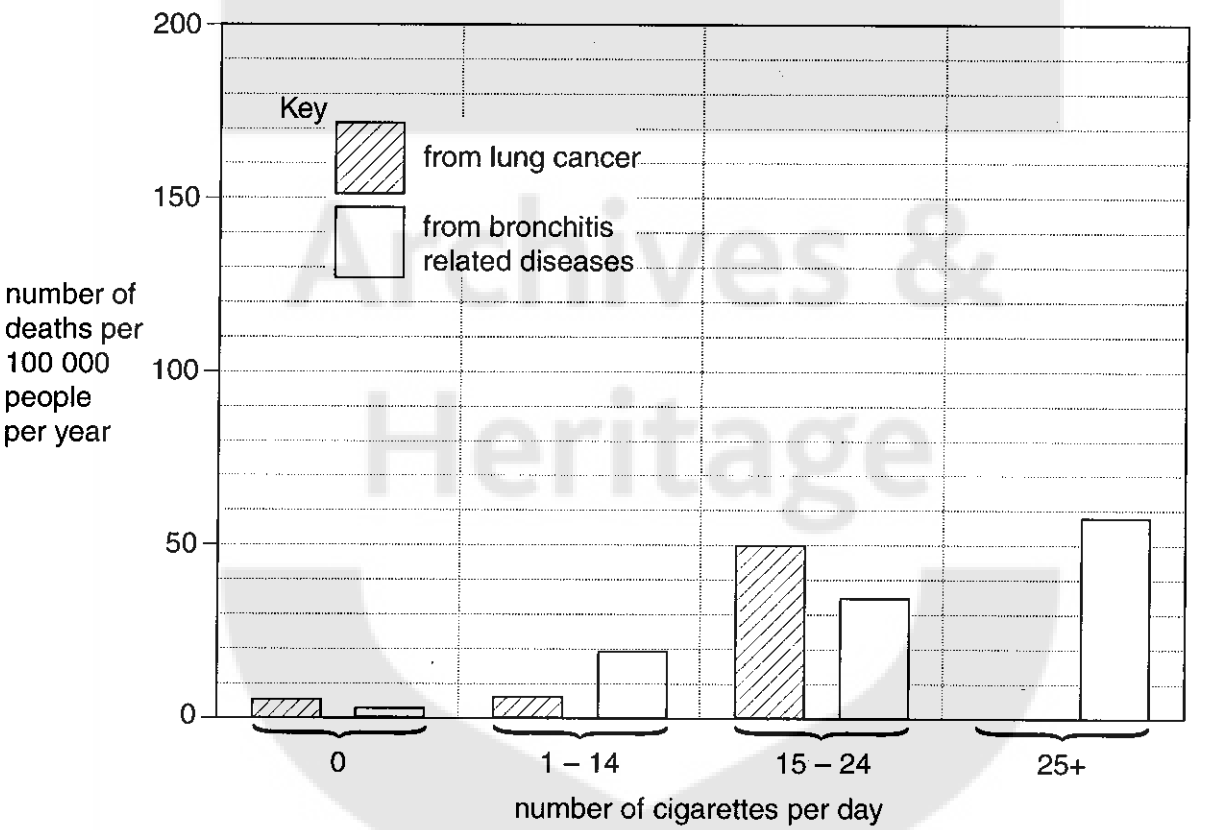
_____

_____ [2]

5 Doctors did a survey to investigate the effects of smoking on health.

The table and bar chart show some of the results of the survey.

number of cigarettes per day	number of deaths per 100 000 people per year	
	from lung cancer	from bronchitis related diseases
0	3	2
1-14	6	
15-24		35
25+	200	59



(a) Use the information provided to:

(i) finish the table. There are **two** gaps. [2]

(ii) draw the missing bar on the bar chart. [1]

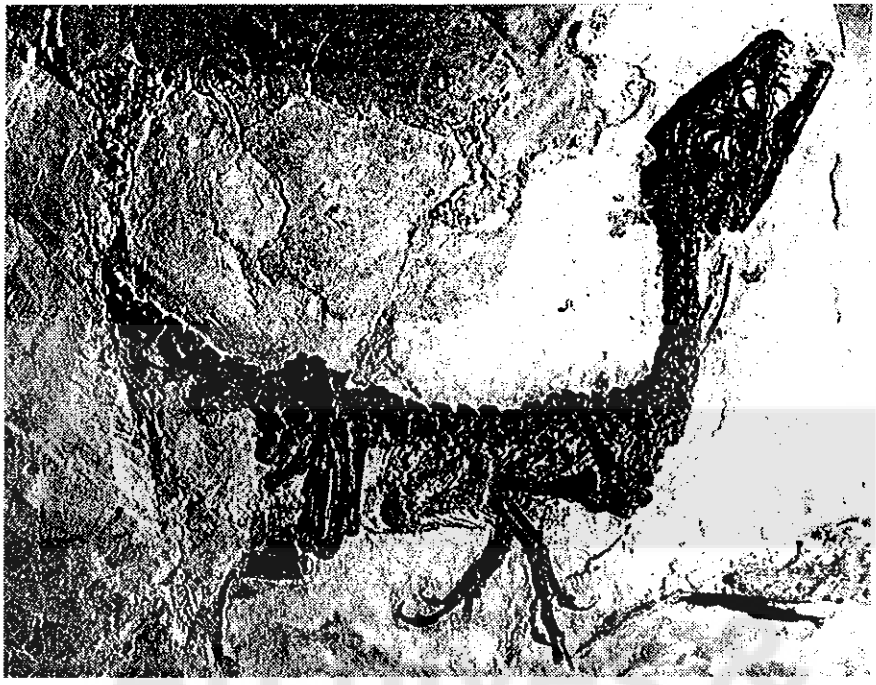
(b) Describe the patterns shown by the two sets of results in the survey.

_____

_____

_____ [3]

6 The fossil dinosaur was found in a piece of rock.



(a) Why is the dinosaur in the rock described as a fossil?

_____

_____ [1]

(b) Write down the name of a type of rock where fossils can be found.

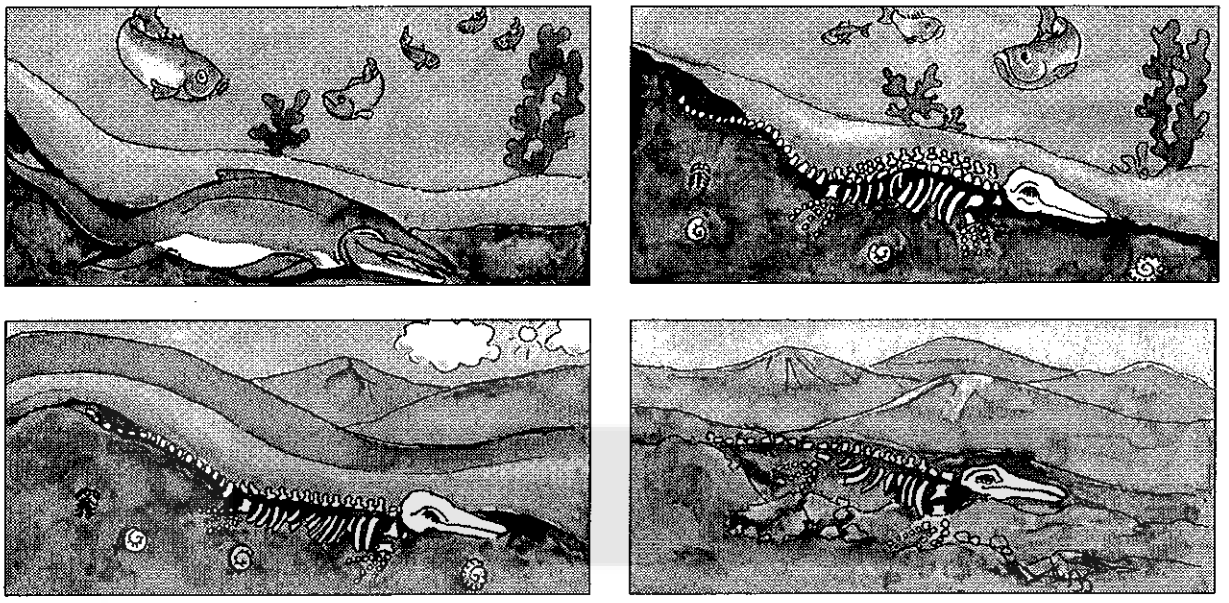
_____ [1]

(c) Why are fossils important to scientists?

_____

_____ [1]

(d) The diagrams show how an animal changes into a fossil.



Write about how fossils are formed.

Use the information in the diagrams and your biological knowledge to answer the question.

[2]

(e) This question is about fossil fish.
The diagram shows which fish were alive at different times in the past.

(i) Which type of fish is not alive today?

_____ [1]

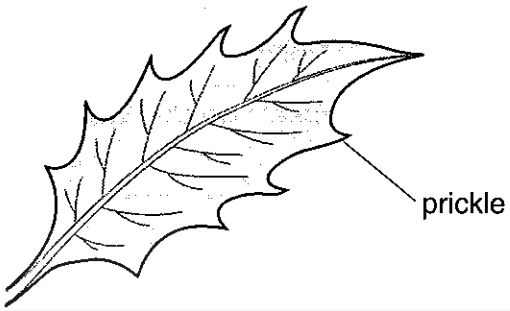
The diagram below shows the layers of rock in a cliff.
The bottom of layer **B** is 410 millions of years old.

(ii) In which layers of rock could fossil lung fishes be found?

_____ [1]

7 This question is about variation.

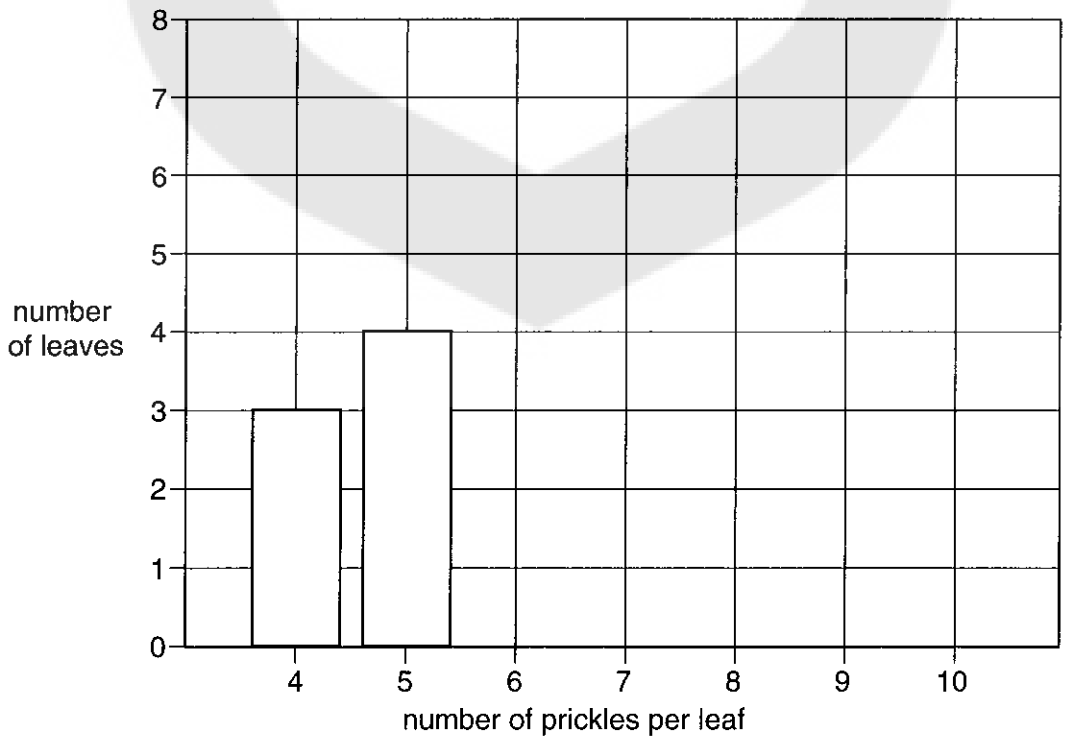
(a) Here is a diagram of a holly leaf.
A holly leaf has prickles around the edge.



In an investigation, Shaheen counted the number of prickles on thirty holly leaves.
The table shows the results.

number of prickles per leaf	number of leaves
4	3
5	4
6	6
7	7
8	3
9	5
10	2

On the grid, finish the bar chart of these results.
Two bars have been drawn for you.



[2]

[Turn over

(b) Here is a list of human characteristics.

blood group
body mass
height
length of index finger
sex (gender)

(i) Write down **two** of these characteristics which show continuous variation.

1 _____

2 _____ [1]

(ii) Write down **two** of these characteristics which show discontinuous variation.

1 _____

2 _____ [1]

Human characteristics may be controlled by genes.
Some may be modified by the environment.
Some may be caused by the environment.
Here is another list of human characteristics.

blood group
body mass
natural eye colour
scar
sex (gender)
skin colour

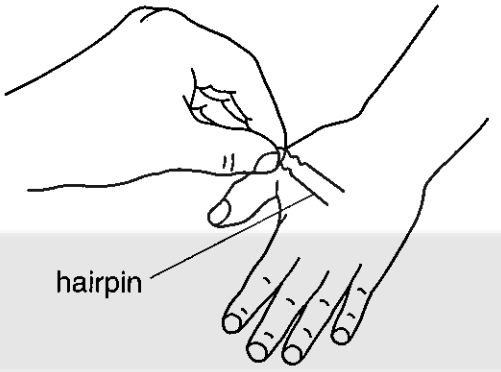
(c) Write **one** of these characteristics in each of the three boxes in the table.

method of control	characteristic
controlled by genes only	
controlled by genes and modified by the environment	
caused by the environment	

[3]

8 This question is about skin sensitivity.

(a) Peter presses Susan's skin with a hairpin.
He presses the skin on her wrist, fingertips and the back of her hand.
He tests each part ten times.
Sometimes he presses both points on to the skin and sometimes just one point.



Every time Peter presses her skin, Susan says the number of points she feels.

(i) What is the stimulus in this experiment?

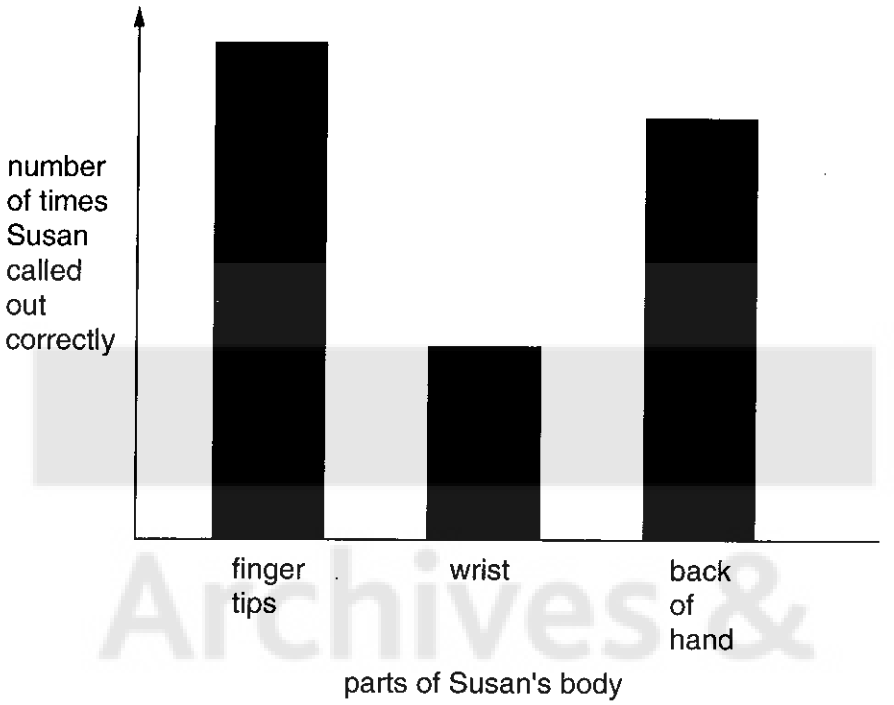
_____ [1]

(ii) Write down Susan's response in this experiment.

_____ [1]

Peter writes down how many times she calls out the correct number of points.

The chart shows the results for the skin on different parts of Susan's body.



(b) Write down the name of the part of Susan's body where her skin was most sensitive to the stimulus.

_____ [1]

(c) The skin on Susan's body was more sensitive in some parts than in others.
Suggest **two** causes of this difference in sensitivity.

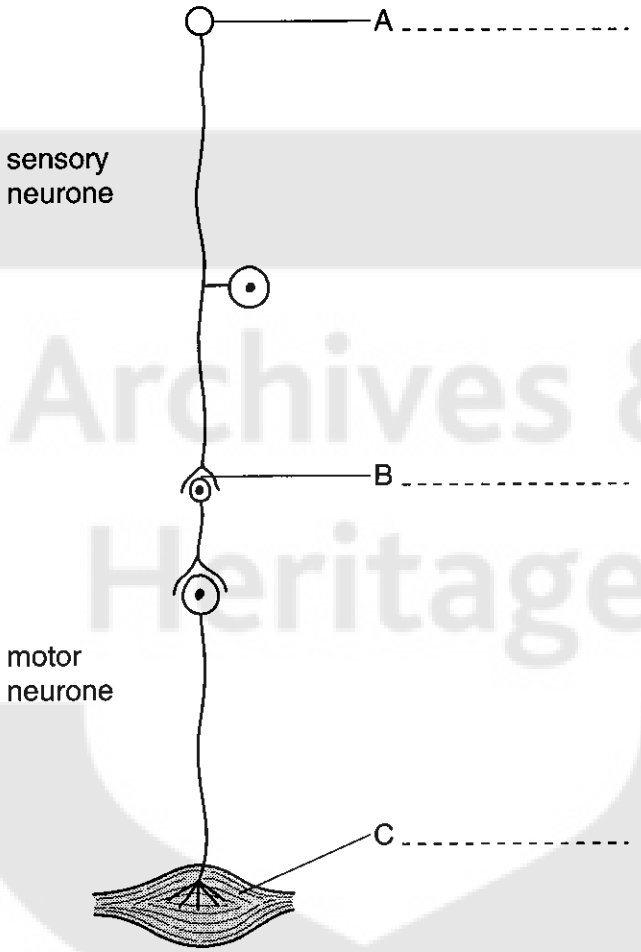
_____

_____

_____ [2]

(d) Peter's teacher gave him a diagram of a sensory and a motor neurone.
Finish labelling the diagram.
Choose the **best** words from this list.

axon
dendron
effector
receptor
synapse



[3]

9 This question is about liquids in the body.

(a) Some liquids are used to defend the body.

Put (rings) around **two** liquids that help to do this.

stomach acid

sweat

tears

urine [2]

(b) A boy falls off his bike and cuts his leg.
Microbes may get into the cut.
Microbes may cause an infection in the cut.

(i) Platelets and white blood cells are found in the blood.

Explain how these parts of the blood help to defend the body against infection.

_____

_____

_____

_____

_____

_____ [3]

(ii) Name **two** parts of our blood other than platelets and white blood cells.

Describe the jobs they do.

_____

_____

_____

_____ [2]

10 Plants make their own food.

(a) (i) Finish the **word** equation for this process.

water + _____ ⟶ glucose + _____ [2]

(ii) Write down the name of this process.

_____ [1]

(b) (i) Where does the energy to drive this process come from?

_____ [1]

(ii) Write down the name of the substance in leaves which traps this energy.

_____ [1]

(c) (i) Glucose can be broken down by cells to release energy.
Write down the name of this process.

_____ [1]

(ii) The glucose can also be built up into different substances.
These substances can then be used in many different ways.

Name **two** of these substances and explain how they are used in a plant.

Name _____

How used _____

_____

Name _____

How used _____

_____ [4]

11 The table shows information about four different drugs.

drug	type of action	habit-forming
amphetamine	stimulant	yes
barbiturate	depressant	yes
cocaine	stimulant	yes
paracetamol	analgesic	no

Use the information in the table and your biological knowledge to answer the following questions.

(a) Paracetamol is an analgesic.

What does **analgesic** mean?

_____

_____ [1]

(b) Write down the name of the drug shown in the table that will slow down the action of the nervous system.

Name of drug _____ [1]

(c) People who have taken cocaine find it difficult to stop taking it.

Suggest why cocaine can be habit-forming.

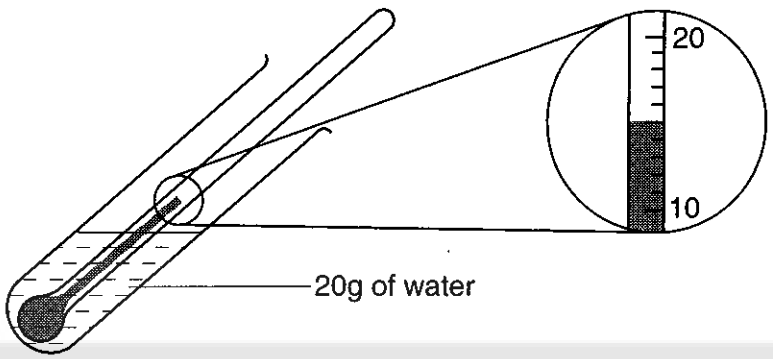
_____

_____

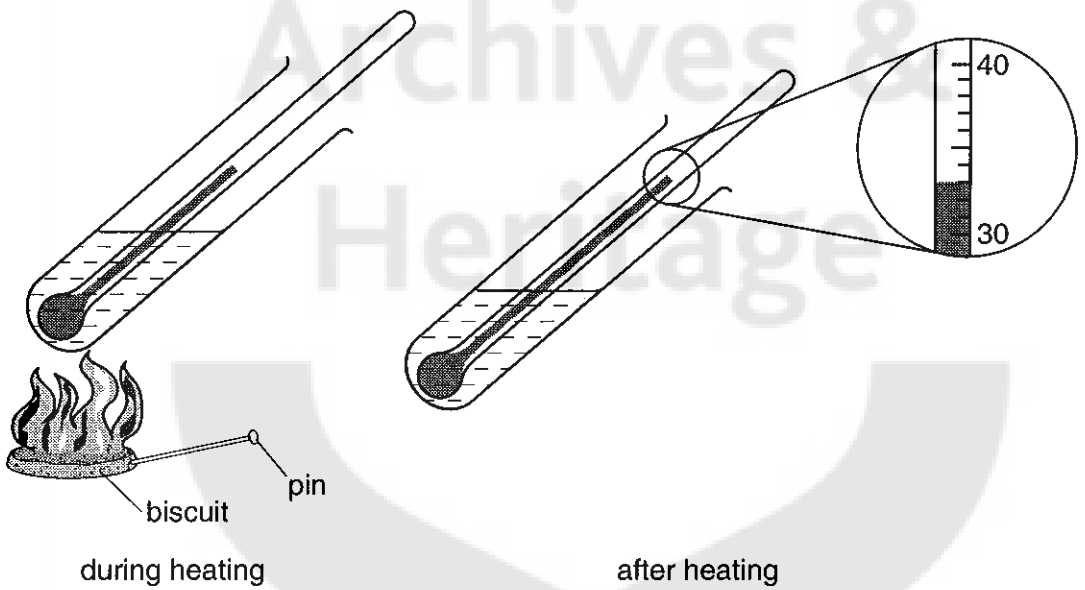
_____

_____ [2]

12 Henry wanted to estimate the energy content of a biscuit.
He placed 20g of water in a large test tube.
He then measured the temperature of the water.



Henry burned the biscuit under the large test tube and measured the temperature of the water again.



(a) (i) Use Henry's results to fill in the table.

temperature	°C
temperature before heating	
temperature after heating	
change in temperature	

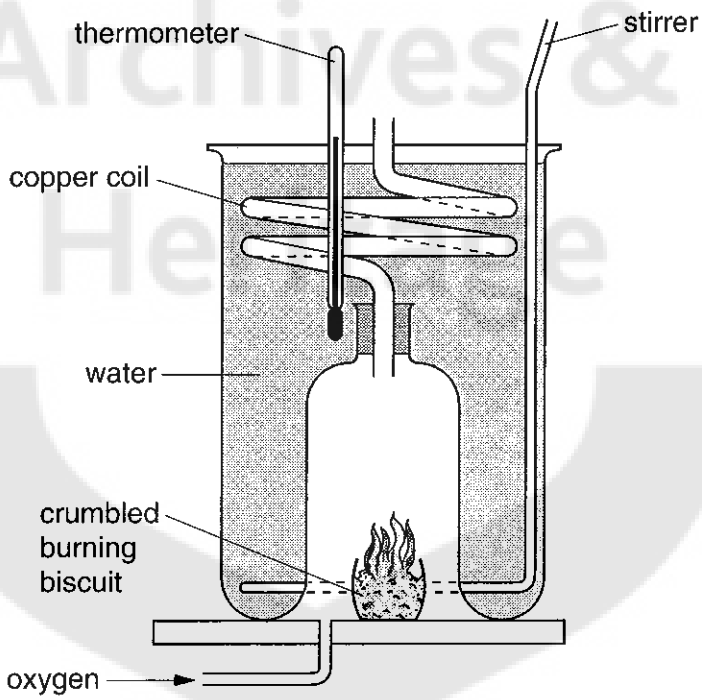
[2]

(ii) Henry knows that 1g of water needs 4.2 J of energy to increase its temperature by 1°C.
Calculate how much energy the water obtained from Henry's biscuit.

You **must** show how you work out your answer.

energy = _____ J [3]

(b) Henry repeated his experiment using the following apparatus.
He found that the water obtained more energy from the biscuit.



Write down **two** features of this apparatus which improved his result.
Explain how these features improved his result.

Feature 1 _____

Explanation _____

_____

Feature 2 _____

Explanation _____

_____ [4]

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OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Secondary Education
former Midland Examining Group syllabus

SCIENCE: DOUBLE AWARD	PAPER 2	**1794/2**
SCIENCE: BIOLOGY	PAPER 2	**1780/2**
SCIENCE: BIOLOGY (NUFFIELD)	PAPER 2	**1785/2**

HIGHER TIER

Tuesday **6 JUNE 2000** Afternoon 1 hour 45 minutes

Candidates answer on the question paper.
Additional materials required:
Ruler (cm/mm), Pencil.

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

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FOR EXAMINER'S USE	
1	
2	
3	
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7	
8	
9	
10	
11	
12	
13	
TOTAL	

This question paper consists of 27 printed pages and 1 blank page.

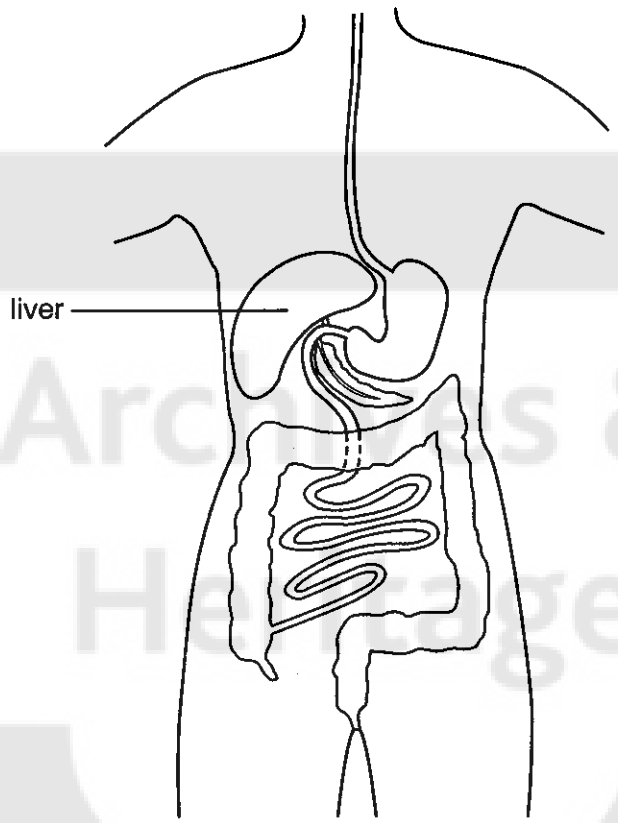
1 **(a)** The diagram shows part of the human digestive system and some organs.

Add labels to the diagram to show:

(i) oesophagus

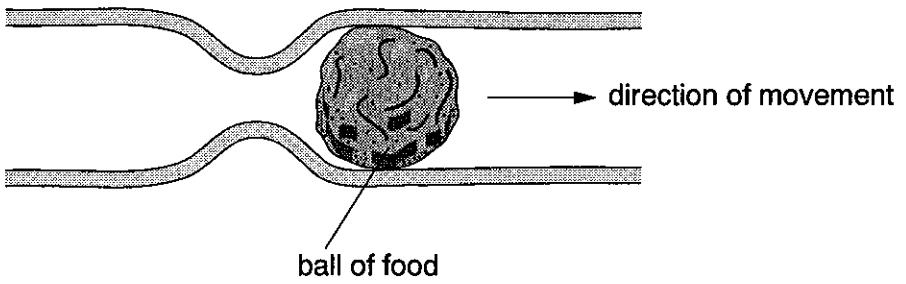
(ii) pancreas

(iii) large intestine



[3]

(b) The diagram shows food moving through the digestive system.



Describe how food is moved through the digestive system.

_____

_____

_____

_____ [2]

(c) The liver makes bile.
Bile is stored in the gall bladder.
It is released into the digestive system.

Describe **two** ways in which bile helps in the digestion of food.

1 _____

_____

2 _____

_____ [2]

[Turn over

2 The table shows information about four different drugs.

drug	type of action	habit-forming
amphetamine	stimulant	yes
barbiturate	depressant	yes
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Use the information in the table and your biological knowledge to answer the following questions.

(a) Paracetamol is an analgesic.

What does **analgesic** mean?

_____ [1]

(b) Write down the name of the drug shown in the table that will slow down the action of the nervous system.

Name of drug _____ [1]

(c) People who have taken cocaine, find it difficult to stop taking it.

Suggest why cocaine can be habit-forming.

_____

_____

_____

_____ [2]

3 **(a)** A boy falls off his bike and cuts his leg.
Microbes may get into the cut.
Microbes may cause an infection in the cut.

(i) Platelets and white blood cells are found in the blood.

Explain how these parts of the blood help to defend the body against infection.

[3]

(ii) Name **two** parts of our blood other than platelets and white blood cells.

Describe the jobs they do.

[2]

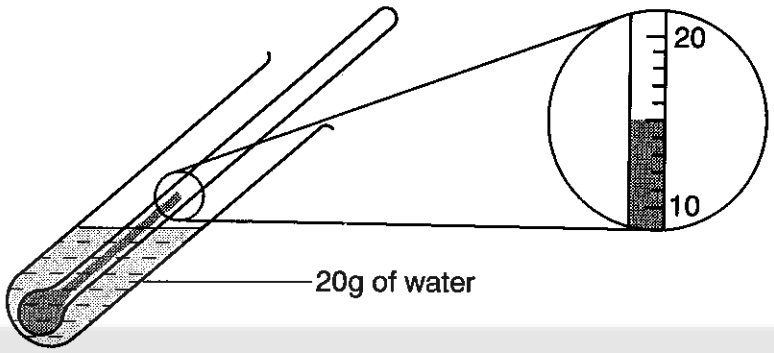
(b) Microbes also enter our bodies in the food we eat.

Explain how our digestive systems destroy these microbes.

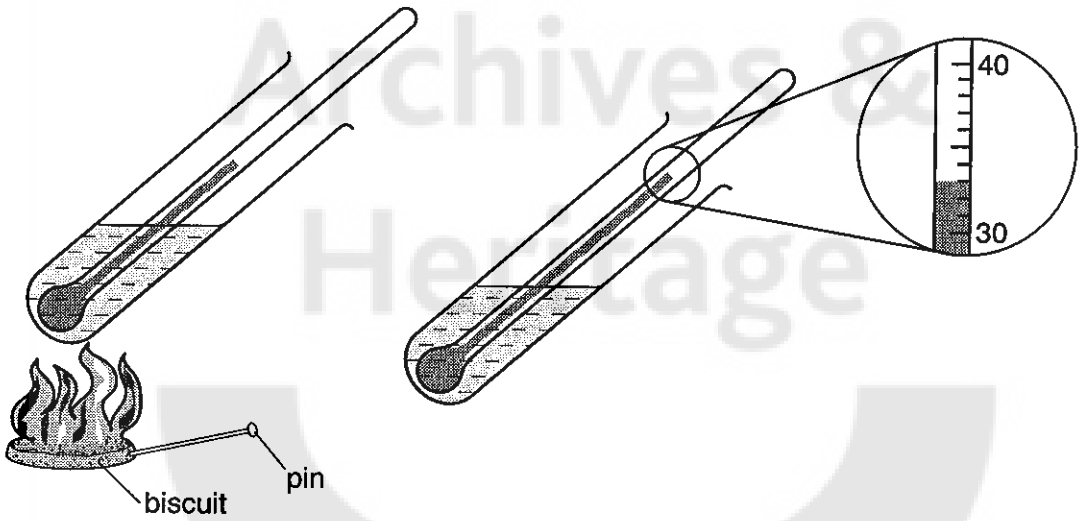
[2]

[Turn over

4 Henry wanted to estimate the energy content of a biscuit.
He placed 20 g of water in a large test tube.
He then measured the temperature of the water.



Henry burned the biscuit under the large test tube and measured the temperature of the water again.



(a) Henry knows that 1 g of water needs 4.2 J of energy to increase its temperature by 1° C.

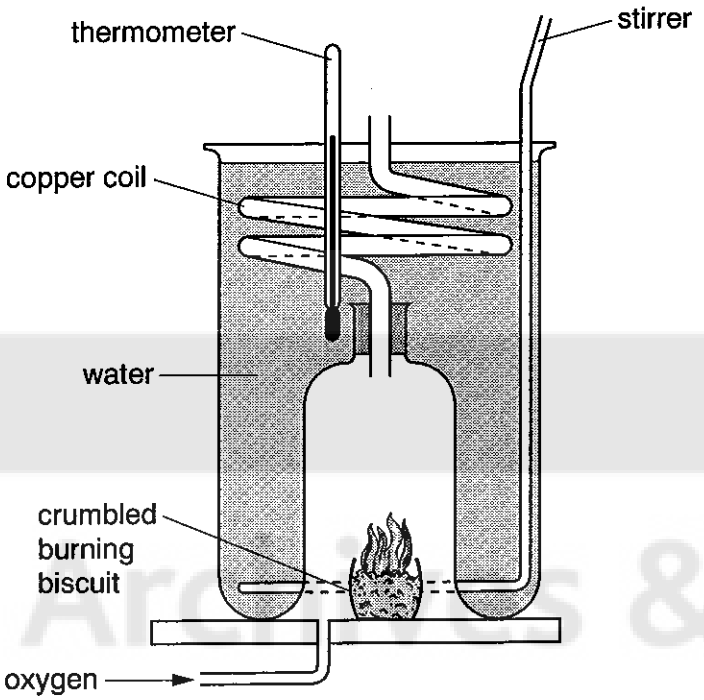
Calculate how much energy the water obtained from Henry's biscuit.

You **must** show how you work out your answer.

energy = _____ J [3]

(b) Henry repeated his experiment using the following apparatus.

He found that the water obtained more energy from the biscuit.



Write down **two** features of this apparatus which improved his result.

Explain how these features improved his result.

Feature 1 _____

Explanation _____

_____

Feature 2 _____

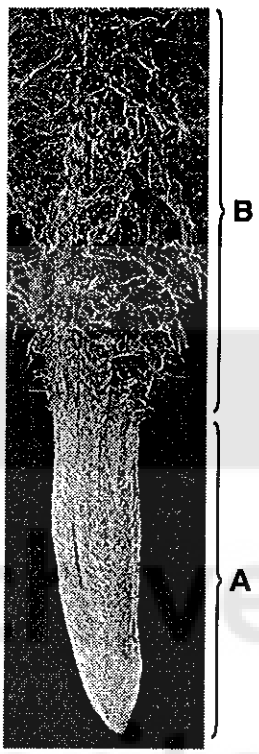
Explanation _____

_____

[4]

5 This is a photograph of a root tip.

It shows a region with root hairs (**B**) and a region without root hairs (**A**).



(a) What is the job of root hairs?

_____ [1]

(b) The table shows information about this root and its root hairs.

surface area of all the root (A and B) with the root hairs removed / cm^2	surface area of all the root (A and B) with root hairs / cm^2
6	24

Root hairs increase the surface area of the root.

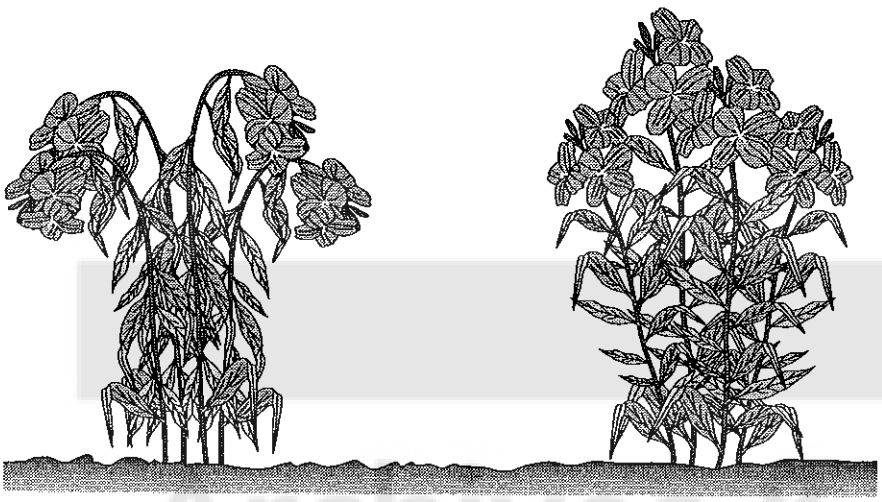
How many times greater is the surface area of the root with root hairs than the surface area of the root without root hairs?

You **must** show how you work out your answer.

Answer _____ times greater [1]

For Examiner's Use

(c) A gardener grows wallflower plants from seeds.
He pulls them up and replants them in his flower beds.
He waters these plants every day.
The plants wilt for several days after replanting.
They then recover.



wilted recovered

Explain why the plants wilt and then recover.

_____

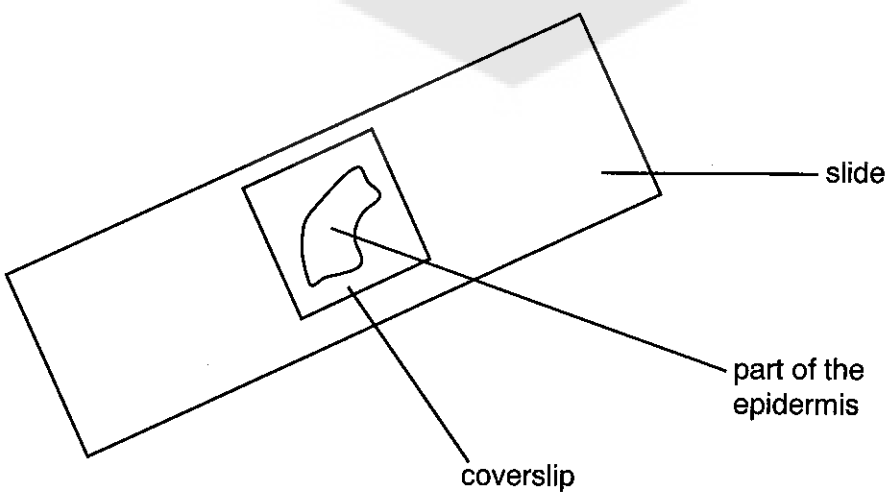
_____

_____

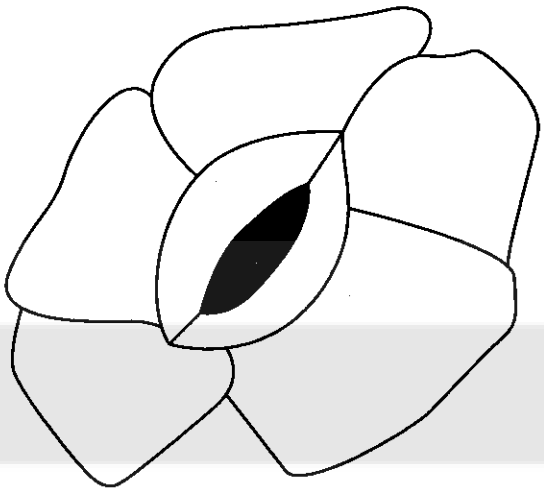
_____

_____ [3]

(d) Ian wants to look at stomata on a leaf from a plant that had recovered.
He puts part of the epidermis of a leaf on a slide.
This is shown in the diagram.



Ian looks at the epidermis with a microscope.
He draws what he sees.
Add a label to the diagram to show a guard cell.



[1]

(e) Cobalt chloride paper is blue when it is dry.
The paper turns pink when water vapour wets it.

Ian put a piece of dry cobalt chloride paper on the bottom surface of a wilted leaf and on the bottom surface of a recovered leaf.
He covered the pieces of cobalt chloride paper with clear sticky tape.
He left the pieces of cobalt chloride paper on the leaves for 30 minutes.

The table shows his results after 30 minutes.

leaf	colour of the cobalt chloride paper at the beginning	colour of the cobalt chloride paper after 30 minutes
wilted	blue	blue
recovered	blue	pink

Explain Ian's results.

_____

_____

_____ [2]

(f) Explain how a closed stoma opens.

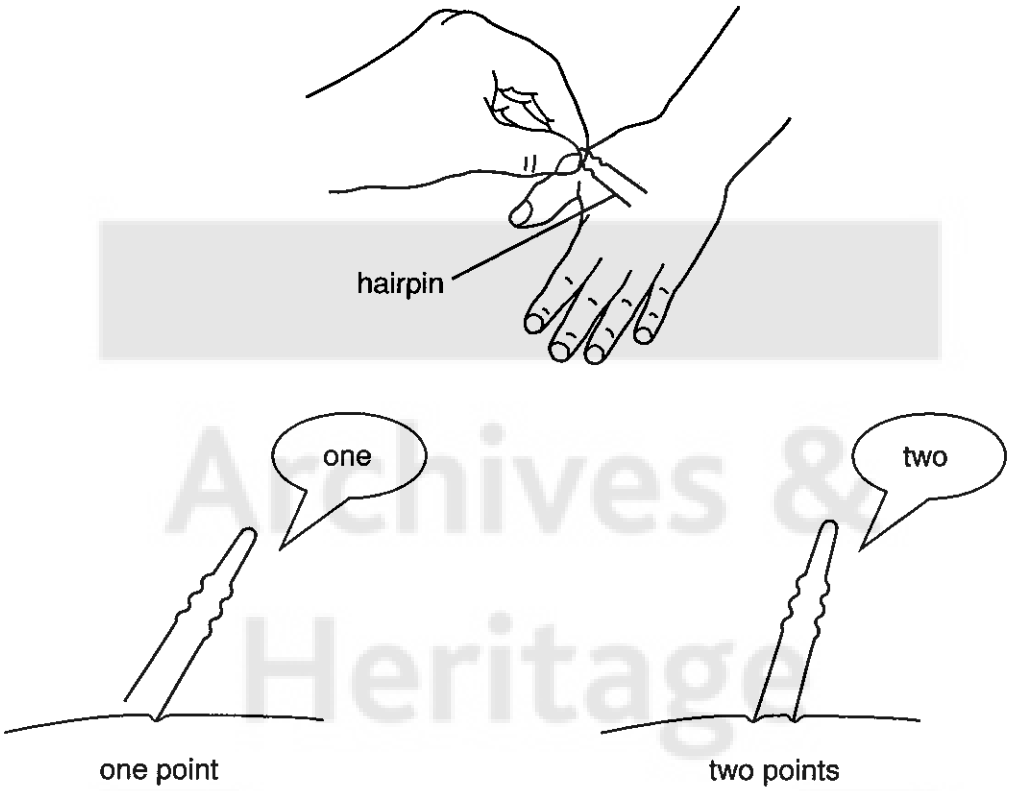
_____

_____

_____ [2]

6 This question is about skin sensitivity.

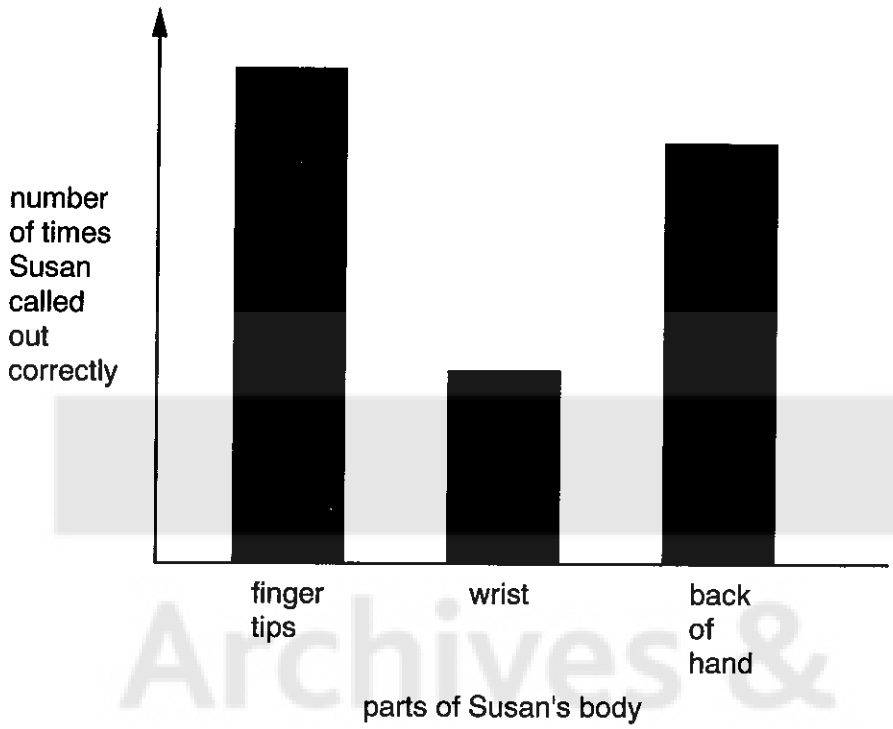
Peter presses Susan's skin with a hairpin.
He presses the skin on her wrist, fingertips and the back of her hand.
He tests each part ten times.
Sometimes he presses both points on to the skin and sometimes just one point.



Every time Peter presses her skin, Susan says the number of points she feels.

Peter writes down how many times she calls out the correct number of points.

The chart shows the results for the skin on different parts of Susan's body.



(a) The chart shows that the skin on Susan's body was more sensitive in some parts than in others.

Suggest **two** causes of this difference in sensitivity.

_____

_____

_____ [2]

(b) Explain how the energy from the stimulus reaches Susan's central nervous system.

_____

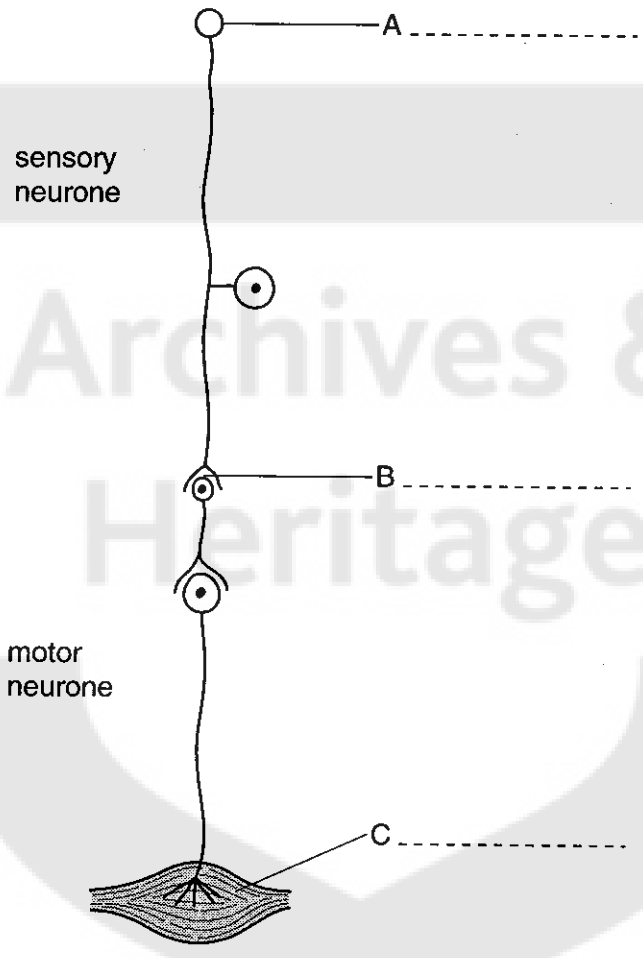
_____

_____

_____ [3]

(c) Peter's teacher gives him a diagram of a sensory and a motor neurone. Finish labelling the diagram and choose the **best** words from this list.

axon
effector
neurone
receptor
response
stimulus
synapse



[3]

(d) Explain how the structure of a neurone helps it to carry out its function.

_____

_____

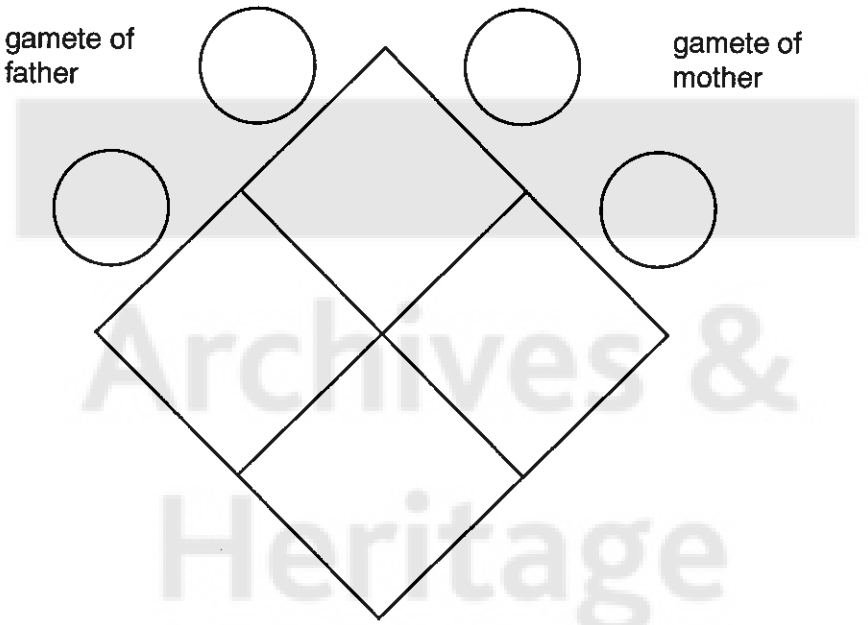
_____

_____ [2]

7 **(a)** Kezia helps to look after the gerbils at school.
A pair of gerbils with brown fur had babies.
Three of the baby gerbils had brown fur and one had white fur.

(i) Finish the genetic diagram to explain this cross.
Write the possible genotypes of the gametes of the parents in the circles.
Write the expected genotypes of the babies in the squares.

Use B for the dominant allele for brown fur.
Use b for the recessive allele for white fur.



[2]

(ii) Kezia wants only baby gerbils with white fur.

Write down the genotypes of the parents that she needs to cross to produce only gerbils with white fur.

_____ [1]

(b) One of the gerbils is born with two extra toes.

Kezia thinks this could be a mutation.

Suggest a possible environmental factor that may increase the probability of random gene mutation.

_____

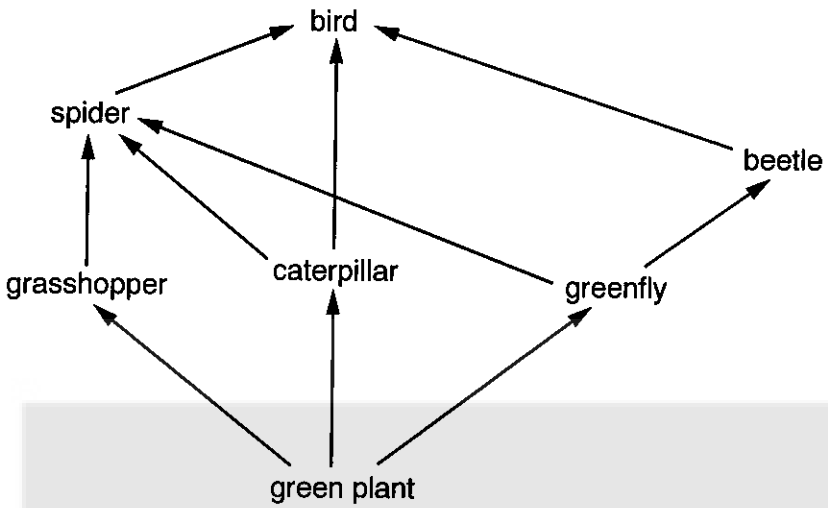
_____

_____ [1]

[Turn over

For Examiner's Use

8 This question is about what animals eat and energy flow.



(a) Suggest what happens to the number of caterpillars if all the grasshoppers die.

Explain your answer.

_____

_____

_____ [2]

(b) The grasshopper and the greenfly belong to the same trophic level.

(i) What is a '**trophic level**'?

_____

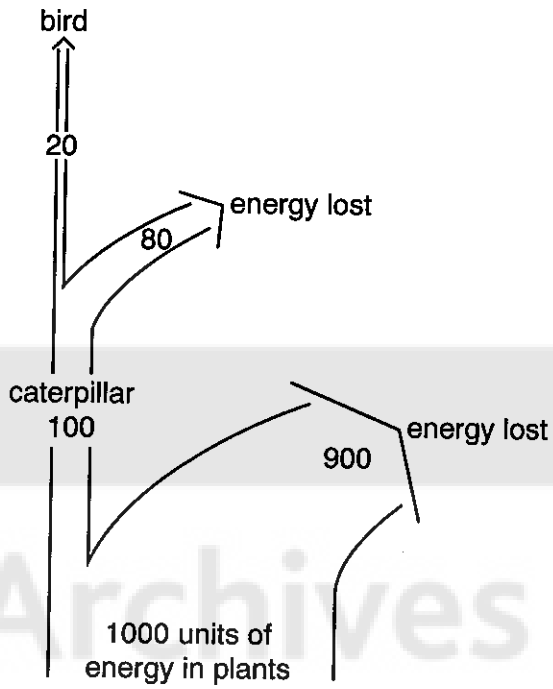
_____ [1]

(ii) Write down the name of the organism in the diagram which can be placed at two different trophic levels.

_____ [1]

(c) Energy enters the food web as the energy of sunlight.

The diagram shows the flow of energy through part of the food web.



A small percentage of the energy of sunlight is transferred to the plant.
Part of the energy in the plant is transferred to the caterpillar.
Part of the energy in the caterpillar is transferred to the bird.

(i) Calculate the percentage of energy in the plant that is transferred to the bird.
Use the numbers in the diagram.
You **must** show how you work out your answer.

Answer _____ % [2]

(ii) Energy moves through the food web in organic compounds.

Name **one** of these organic compounds.

_____ [1]

(iii) Write down **two** ways in which energy is 'lost' from the food web.

1 _____

2 _____

[2]

9 Plants make glucose by photosynthesis.

(a) Write down the balanced **symbol** equation for this process.

_____ [2]

(b) **(i)** Glucose can be broken down by cells to release energy.

Write down the name of this process.

_____ [1]

(ii) The glucose can also be built up into different substances.
These substances can then be used in many different ways.

Name **two** of these substances and explain how they are used in a plant.

Name _____

How used _____

_____

Name _____

How used _____

_____ [4]

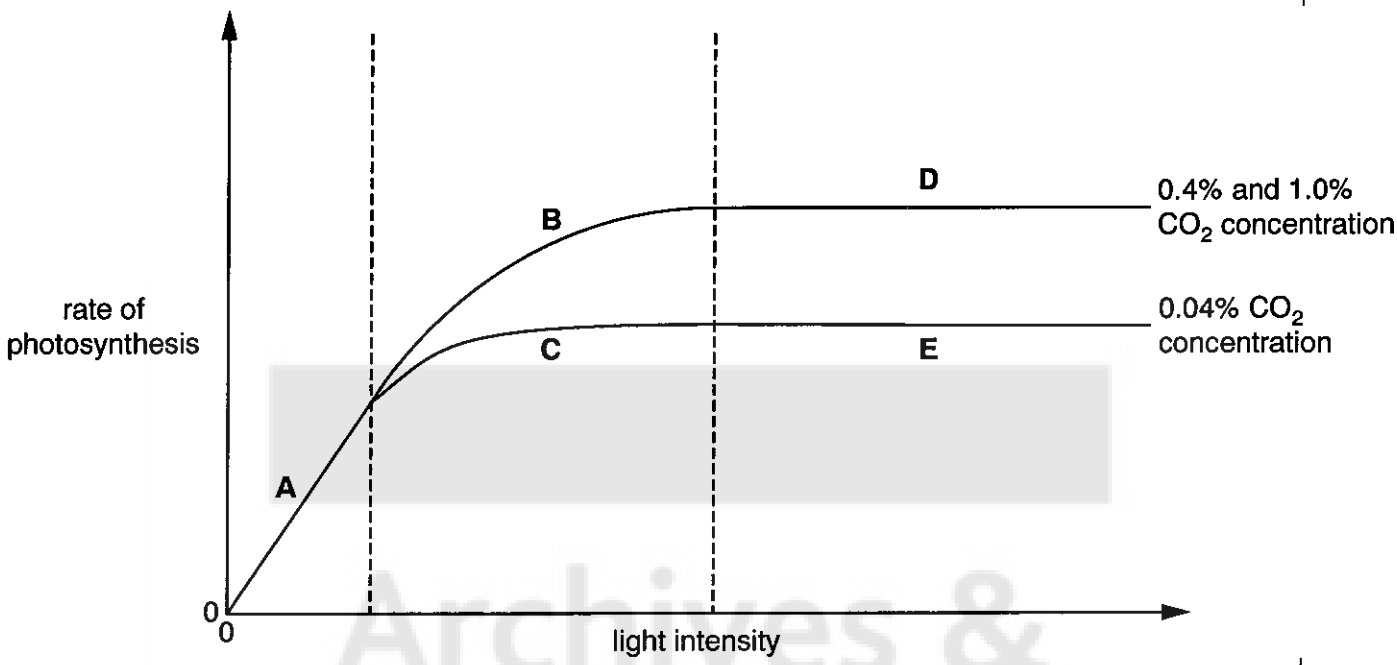
Light intensity, wavelength of light and concentration of carbon dioxide affect the rate of photosynthesis.

(c) Write down the name of another environmental factor that can affect the rate of photosynthesis.

_____ [1]

For Examiner's Use

(d) The graph shows the rate of photosynthesis as light intensity changes at three different concentrations of carbon dioxide.



(i) Write down the letter (**A**, **B**, **C**, **D** or **E**) which shows where light is the only limiting factor.

_____ [1]

(ii) Write down the letter (**A**, **B**, **C**, **D** or **E**) which shows where carbon dioxide is the only limiting factor.

_____

Explain your answer _____

_____ [2]

(e) Explain how different wavelengths (colours) of light can affect the rate of photosynthesis.

_____

_____

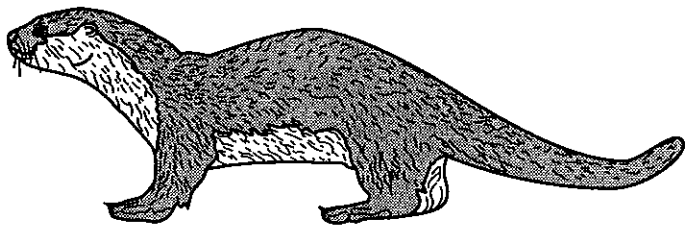
_____

_____

_____ [3]

[Turn over

10 Otters live on riverbanks and feed on fish.
They are successful predators.



(a) **(i)** Explain what is meant by the term **predator**.

_____

_____ [1]

(ii) Describe **two** adaptations shown by otters and explain how these adaptations make them successful predators of fish.

1 _____

_____

2 _____

_____

[2]

(b) Several years ago the otter population in the Midlands started to decline. Conservationists suggested that the decline could be because of the use of certain pesticides.

Suggest how the use of pesticides can cause a decline in the otter population over several years.

_____

_____

_____

_____

_____

_____ [3]

(c) In 1998 conservationists announced that the otter population in the Midlands had recovered and was on the increase.

A few months later, over 2,000 mink were released from a mink farm.

Conservationists predict that the release of the mink into the wild will cause another decline in the otter population.

Suggest **two** reasons why the release of the mink will affect the otter population.

1 _____

_____

_____

2 _____

_____

_____

[2]

For Examiner's Use

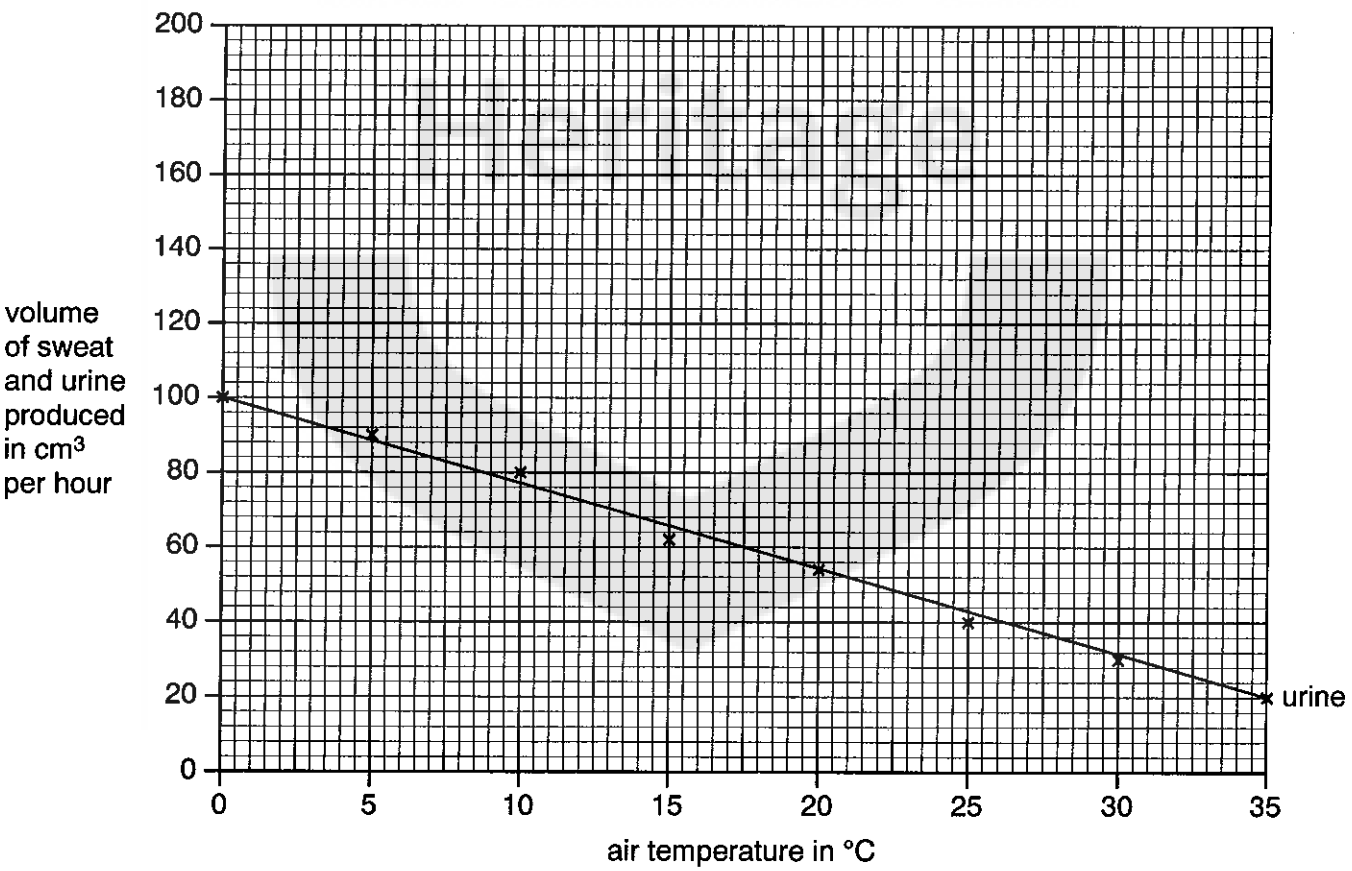
11 A scientist measured the volume of sweat and urine a student produced at different air temperatures.

air temperature in °C	sweat produced in cm^3 per hour	urine produced in cm^3 per hour
0	4	100
5	4	90
10	8	80
15	20	62
20	40	54
25	60	40
30	100	30
35	200	20

(a) The graph shows the student's urine production.

(i) Plot the points to show the student's sweat production at different temperatures. Use the same grid. [2]

(ii) Finish the graph by drawing the best curve through the points. [1]



(iii) Describe the changes in the volume of sweat and urine as the air temperature increases.

[2]

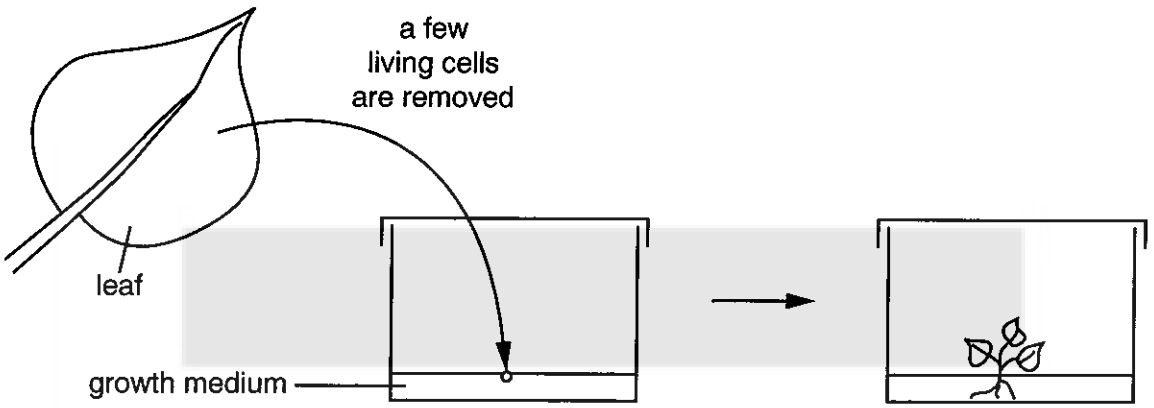
(b) Explain why the volumes of sweat and urine change with air temperature.

[5]

12 A company grows plants that are sold to the public.
The company needs to produce many thousands of young plants at the same time.

One way of doing this is by micropropagation.

The diagrams show one method of micropropagation.



(a) (i) Explain why only a few cells are needed.

_____

_____

_____

_____ [2]

(ii) Explain why this process is carried out in sterile conditions.

_____

_____ [1]

(iii) The growth medium contains sucrose, amino acids, vitamins, nitrates and phosphates.
It also contains hormones such as auxins.

Explain why the following substances are needed in the growth medium.

sucrose _____

_____

amino acids _____

_____

auxins _____

_____

[3]

(b) There are economic and biological advantages of micropropagation for the commercial production of plants.

List **four** of these advantages.

1 _____

_____

2 _____

_____

3 _____

_____

4 _____

_____

[4]

13 This question is about controlling the rate of breathing.

The table shows how a person's breathing rate can vary.

activity	carbon dioxide production in cm^3 per minute	rate of breathing in breaths per minute
resting in bed	197	16
walking slowly	922	18
walking fast	2000	20
walking very fast	2400	21

(a) Explain why the amount of carbon dioxide produced changes.

[2]

(b) Explain how the carbon dioxide concentration of the blood results in the change of breathing rate shown in the table.

[3]

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OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Secondary Education
former Midland Examining Group syllabus

SCIENCE: DOUBLE AWARD	PAPER 3	**1794/3**
SCIENCE: CHEMISTRY	PAPER 1	**1781/1**
SCIENCE: CHEMISTRY (NUFFIELD)	PAPER 1	**1786/1**

FOUNDATION TIER

Monday **12 JUNE 2000** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials required:
Pencil,
Ruler (cm/mm).

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

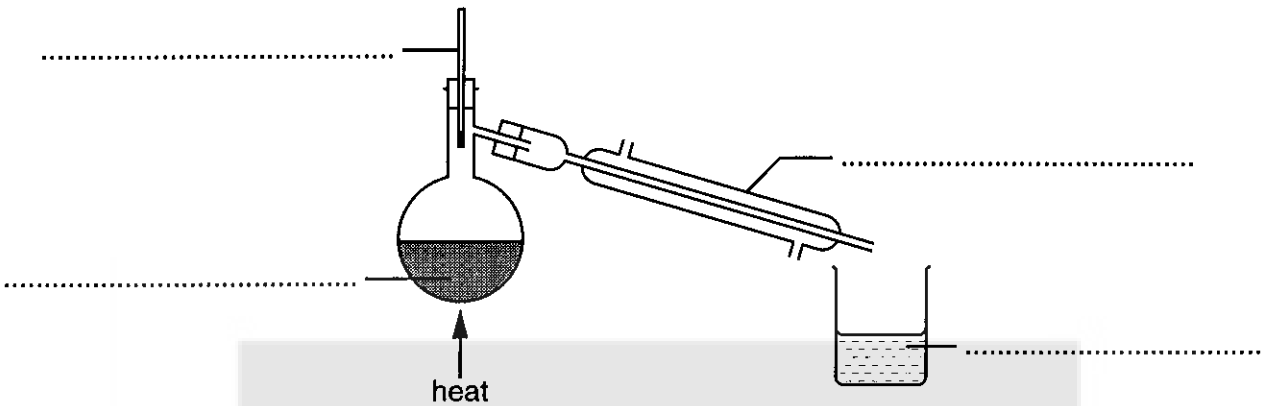
A copy of the Periodic Table is printed on the back page.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
TOTAL	

This question paper consists of 18 printed pages and 2 blank pages.

1 **(a)** Mrs. Brown is showing her class how to get some pure water from salty water.

She uses this apparatus.



Add labels to the diagram. Choose the **best** words from this list.

condenser

filter funnel

pure water

salty water

thermometer [4]

(b) You can use Universal Indicator solution to show if a liquid is an acid, neutral or an alkali.

pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	acid						neutral	alkali						
colour of Indicator	red			orange			green	blue				purple		

Pure water is neutral and has a pH value of 7.

How would you **use** the Universal Indicator solution to show this?
Describe what you would **see**.

_____

_____

_____ [2]

2 This question is about crude oil.

Which **three** useful substances do we get from crude oil?

Put (rings) around the **three** substances.

aircraft fuel	**aluminium foil**	**limestone chips**
paper	**propane gas**	**road tar**

[3]

3 Here are some statements about metals.

Only **three** of them are correct.

Put a tick (✓) in the box next to each correct statement.

Metals conduct electricity. ☐

Metals are always liquid. ☐

Helium is a metal. ☐

Metals conduct heat. ☐

The halogens are metals. ☐

Some metals react with water. ☐ [3]

4 Ranjan finds out how three metals react with some solutions.

Her results are shown in the table.

	metal added		
name of solution	magnesium	copper	iron
copper(II) sulphate	blue colour fades red-brown solid appears	no change	blue colour fades red-brown solid appears
iron(II) sulphate	pale green colour fades dark grey solid appears	no change	no change
magnesium sulphate	no change	no change	no change

(a) (i) Which metal does **not** react with any of the solutions?

_____ [1]

(ii) Which metal reacts with two solutions?

_____ [1]

(iii) Put the metals copper, iron and magnesium in order of reactivity.

most reactive _____

_____

least reactive _____ [1]

(b) Here is the equation for the reaction between magnesium and copper(II) sulphate.

magnesium + copper(II) sulphate ⟶ copper + magnesium sulphate

Ranjan sees a red-brown solid appear in this reaction.

She also sees that the blue colour fades.

(i) Which is the red-brown solid?

Put a tick (✓) in the correct box.

copper ☐

copper(II) sulphate ☐

magnesium ☐

magnesium sulphate ☐ [1]

(ii) Which substance has the blue colour that fades?

Put a tick (✓) in **one** box.

copper	☐
copper(II) sulphate	☐
magnesium	☐
magnesium sulphate	☐

[1]

(c) Ranjan's teacher tells her that the reaction between magnesium and copper(II) sulphate solution is **exothermic**.

Describe an experiment that Ranjan could do to see if this is correct.

_____

_____

_____ [2]

(d) **(i)** Two of the metals that Ranjan used in the experiment are **transition** metals.

Put a (ring) around each of the **two** transition metals.

copper **iron** **magnesium** [1]

(ii) Choose one of these metals.

Write down a use for this metal and explain why it is suitable for this use.

metal chosen = _____

_____

_____

_____ [2]

(e) Zinc is more reactive than copper.

Describe what you would **see** when some zinc is added to copper(II) sulphate solution.

_____

_____ [2]

5 **(a)** The exhaust gases from older cars are tested each year.

These exhaust gases contain carbon monoxide, unburned hydrocarbons and smoke.

If the amount of one of these is too high, the car will fail its test.

Look at these results from an exhaust test.

Use these results to answer the questions.

item	test result	maximum limit
carbon monoxide	4.0 %	3.5 %
unburned hydrocarbons	197 ppm	1200 ppm
idle speed	pass	
smoke level	pass	

(i) What is the maximum limit of carbon monoxide allowed?

_____ [1]

(ii) This car failed its test. Why?

Put a tick (✓) in the correct box.

There is too much carbon monoxide. ☐

There is too much unburned hydrocarbon. ☐

There is too much smoke. ☐ [1]

(b) Why is carbon monoxide dangerous?

_____

_____ [1]

(c) As well as carbon monoxide, unburned hydrocarbons, smoke and water, car exhausts contain other gases.

One of these gases may cause a change in the Earth's weather.
Explain this.

_____

_____

_____

_____ [3]

6 Polythene and PVC are polymers.

The table shows some of the properties of these polymers.

polymer	Does it melt easily?	Does it catch fire easily?	Does it conduct electricity?	Can it be coloured easily?	Can it be bent easily?
polythene	yes	yes	no	no	yes
PVC	yes	no	no	yes	no

Use **only** the information in the table to answer these questions.

(a) Polythene is not used to make saucepans.

Suggest **two** reasons.

1. _____

2. _____ [2]

(b) A polymer is used to make the covering for electrical wires.

Explain why PVC is better than polythene for the covering on electrical wires.

_____

_____

_____ [2]

(c) PVC is better than polythene for making window frames.

Which property of PVC is the most important for this use?

_____ [1]

(d) Write down the name of a household item that is made from polythene.

_____ [1]

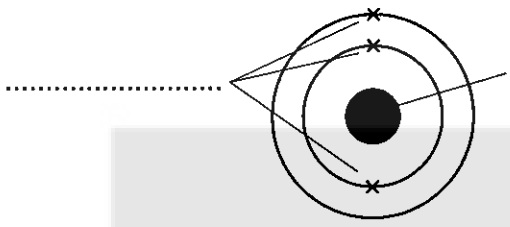
7 **(a)** **(i)** The diagram represents an atom of lithium.

Add labels to the diagram. Use **all** of the words from this list.

electrons

neutrons

protons



..... and .....

[2]

(ii) What name is given to the central part of the atom?

_____ [1]

(b) Fill in the gaps in the sentences.

Use the Periodic Table to help you.

(i) Lithium is in Group _____ of the Periodic Table. [1]

(ii) Lithium is in Period _____ of the Periodic Table. [1]

(c) Write down the symbol of an element which has an atomic number smaller than lithium.

_____ [1]

(d) Mr. Green is a science teacher.

He shows his class how lithium, sodium and potassium react with water.

What safety precautions should Mr. Green take?

_____

_____

_____

_____

_____ [3]

8 We can represent chemical reactions using equations.

(a) Look at these word equations.

A methane + oxygen ⟶ carbon dioxide + water

B sodium hydroxide + nitric acid ⟶ sodium nitrate + water

C hydrogen peroxide ⟶ oxygen + water

D sodium + water ⟶ sodium hydroxide + hydrogen

Answer the following questions by choosing from **A**, **B**, **C** or **D**.

Each letter may be used once, more than once or not at all.

(i) Which equation represents a neutralisation reaction? ☐

(ii) Which equation represents a combustion reaction? ☐

(iii) Which equation shows the formation of an alkali? ☐

[3]

(b) Finish the symbol equation for **C**.

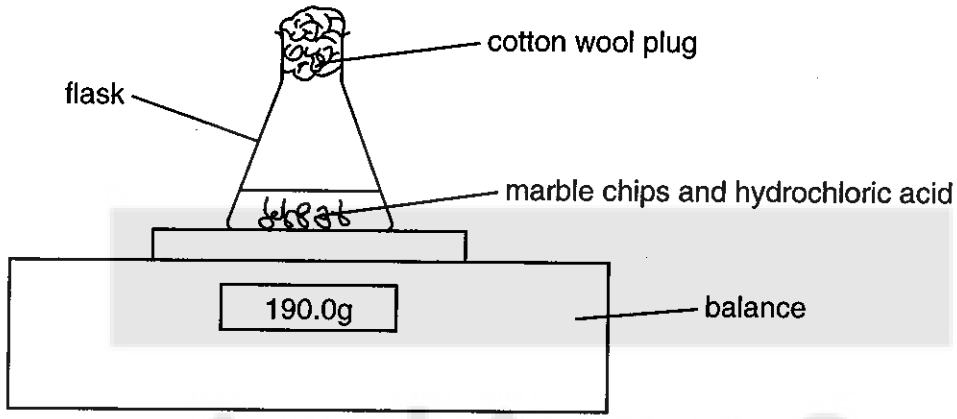
..... H_2O_2 ⟶ ..... H_2O + O_2 [1]

9 Jo and Andy are finding out about rates of reaction.

They react hydrochloric acid with marble chips (calcium carbonate).

hydrochloric acid + calcium carbonate ⟶ calcium chloride + carbon dioxide + water

They use this apparatus.



(a) The mass of the flask and its contents decreases during the experiment.

Suggest why this happens.

_____

_____ [1]

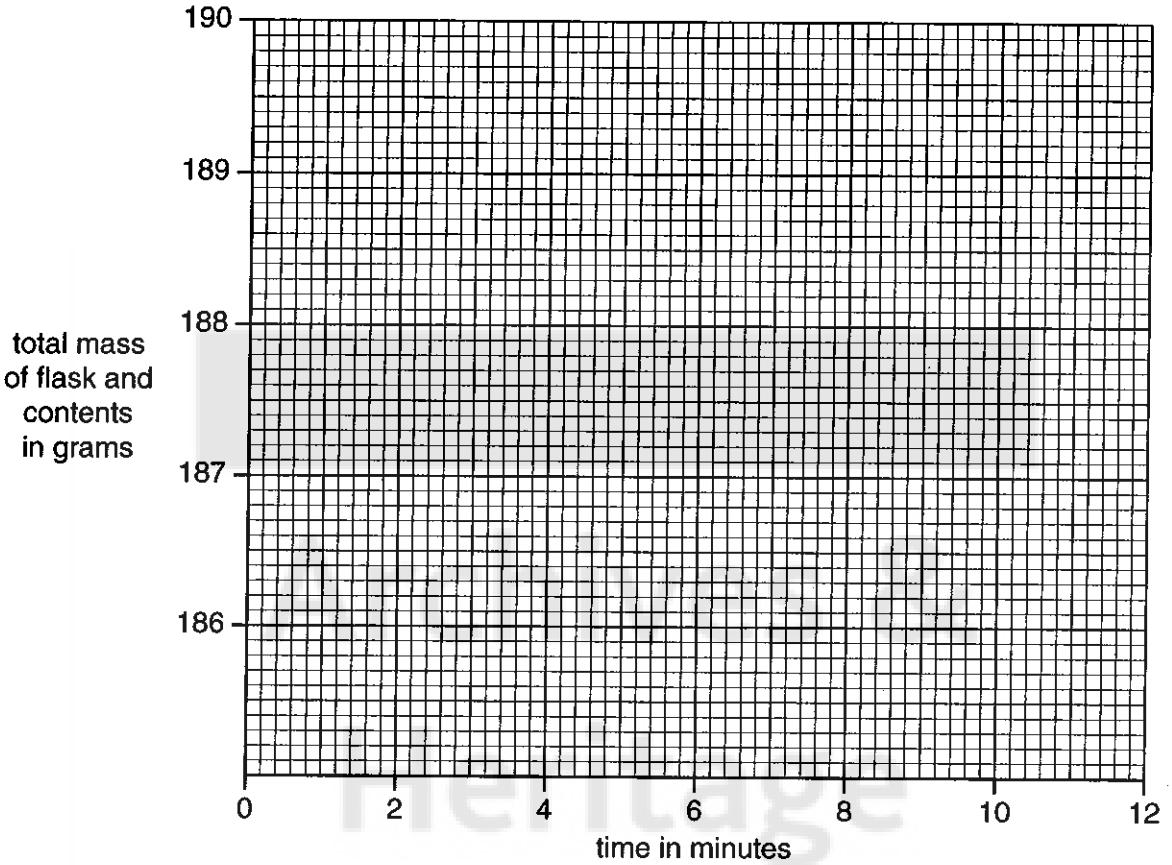
(b) Jo and Andy measure the total mass of the flask and its contents as the reaction takes place.

The table shows their results.

time in minutes	mass of flask and contents in grams
0	190.0
2	188.0
4	187.0
6	186.3
8	186.1
10	186.0
12	186.0

(i) Plot their results on the grid. [2]

(ii) Finish the graph by drawing the best curve through the points. [1]



(iii) Jo says that the reaction was faster between 0 and 2 minutes than between 2 and 4 minutes.

How do the results show this?

_____

_____ [2]

(c) In the first experiment the hydrochloric acid was at room temperature.

Jo and Andy repeat the experiment.

The only difference is that the hydrochloric acid is at a higher temperature.

Sketch a curve on the grid to show the results they get. [2]

For Examiner's Use

10 The table shows information about some compounds.

formula	name	type of structure	melting point in °C
CaO	calcium oxide	giant	2900
H_2O	water	molecular	0
NaCl		giant	808
SO_2		molecular	–75

(a) Finish the table by writing in the names for NaCl and SO_2. [2]

(b) What links the melting point and the type of structure?

Use the information in the table to help you.

_____

_____ [2]

(c) Put a (ring) around the word which **best** finishes this sentence.

The forces holding the particles together in calcium oxide are called

chemical _____ .

atoms **bonds** **magnets** **molecules** [1]

(d) Calcium and oxygen react together to form calcium oxide.

During the reaction two electrons move from a calcium atom to an oxygen atom.

Calcium ions, Ca^{2+}, and oxide ions, O^{2-}, are formed.

Finish the table. There are **two** spaces.

element	number of electrons in an atom	arrangement of electrons
calcium Ca	20	2.8.8.2
oxygen O	8	2.6
ion	number of electrons in an ion	arrangement of electrons
calcium Ca^{2+}	18	
oxide O^{2-}	10	

[2]

(e) Calculate the relative formula mass of calcium oxide, CaO.

Use the Periodic Table to help you.

[2]

(f) Strontium, Sr, reacts with oxygen in a similar way to calcium.

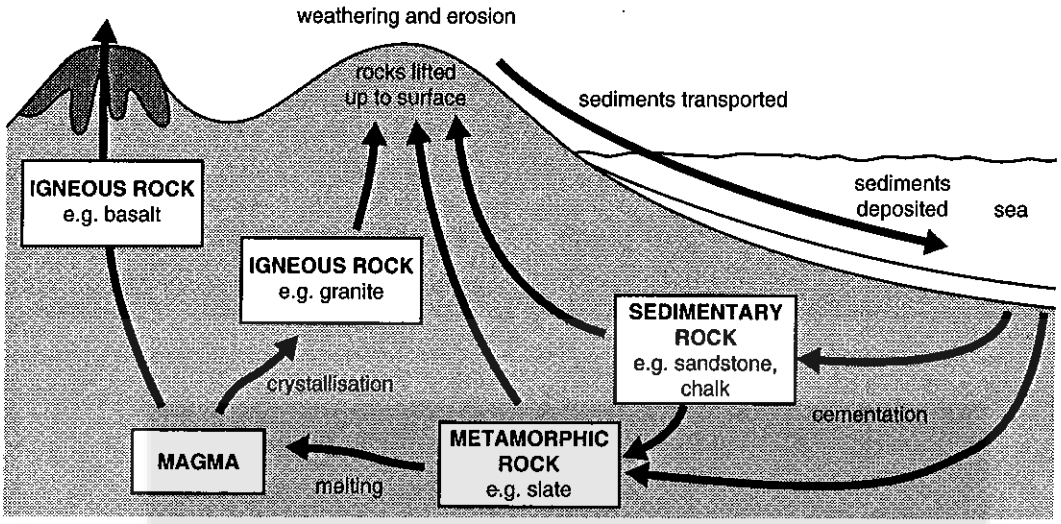
It forms a compound, strontium oxide, SrO.

Explain these facts.

Use your Periodic Table and your knowledge of the structure of atoms to help you.

[3]

11 The diagram shows how rocks are broken down and new rocks formed in the rock cycle.



(a) These are four processes involved in forming **sedimentary** rocks.

They are in the wrong order.

A depositing sediments

B cementation

C transporting sediments

D weathering and erosion

Fill in the boxes to show the correct order. Use the diagram to help you.

☐ → ☐ → ☐ → ☐ [3]

(b) Write down **two** processes taking place when **metamorphic** rocks turn into **igneous** rocks.

1 _____

2 _____ [2]

(c) What conditions of temperature and pressure are needed to turn **sedimentary** rocks into **metamorphic** rocks?

_____

_____ [2]

(d) This table shows some information about slate, chalk and granite.

rock	Is the rock crystalline?	Can the rock contain fossils?
slate	no	yes
chalk		
granite		

Finish the table by putting '*yes*' or '*no*' in each of the four spaces.

The diagram may help you. [2]

12 Nitrogen and hydrogen react to form ammonia.

The equation for the reaction is

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(a) Finish the sentence by choosing the **best** word from this list.

fertiliser **neutralisation** **reversible**

The reaction between nitrogen and hydrogen to form ammonia is a

_____ reaction. [1]

(b) Large quantities of nitrogen and hydrogen are used to make ammonia.

(i) Which raw material is used to get nitrogen?

Put a (ring) around the correct answer.

air **limestone** **sea water** [1]

(ii) Which raw material is used to get hydrogen?

Put a (ring) around the correct answer.

air **crude oil** **limestone** [1]

(c) Using too much fertiliser can cause pollution in rivers and can kill fish.

(i) Here are five sentences describing how this happens. They are in the wrong order.

Fill in the boxes to show the right order. The first one has been done for you.

A Algae grow well on the fertiliser and cover the river.

B Excess fertiliser dissolves in rain and drains into rivers.

C There is little oxygen left for the fish and they die.

D The algae die and bacteria decompose them.

E The bacteria use up most of the oxygen in the water.

B				

[3]

(ii) What word is used to describe this process?

Put a (ring) around the correct answer.

distillation **eutrophication** **fertilisation** **neutralisation** [1]

13 The table shows the approximate composition of the atmosphere.

name of gas	percentage of gas in the atmosphere
argon	1
carbon dioxide	0.03
nitrogen	78
oxygen	20

Use the names of gases from the table to answer the questions.

Each name may be used once, more than once or not at all.

(a) Which gas makes up most of the atmosphere?

_____ [1]

(b) Which gas makes up about 1/5th of the atmosphere?

_____ [1]

(c) Which gas is made when animals respire?

_____ [1]

(d) Which gas do plants use in photosynthesis?

_____ [1]

(e) Which gas is in Group 0 of the Periodic Table?

_____ [1]

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DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
																	4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulphur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Secondary Education
former Midland Examining Group syllabus

SCIENCE: DOUBLE AWARD PAPER 4 **1794/4**
SCIENCE: CHEMISTRY PAPER 2 **1781/2**
SCIENCE: CHEMISTRY (NUFFIELD) PAPER 2 **1786/2**
HIGHER TIER

Monday **12 JUNE 2000** Morning 1 hour 45 minutes

Candidates answer on the question paper.
Additional materials required:
Pencil,
Ruler (cm/mm).

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

A copy of the Periodic Table is printed on the back page.

FOR EXAMINER'S USE	
1	
2	
3	
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9	
10	
11	
TOTAL	

This question paper consists of 19 printed pages and 1 blank page.

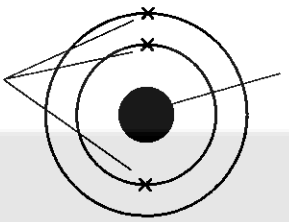
1 **(a)** **(i)** The diagram shows an atom of lithium.

Add labels to the diagram. Use **all** of the words from this list.

electrons

neutrons

protons



..... and .....

[2]

(ii) What name is given to the central part of the atom?

_____ [1]

(b) Fill in the gaps in the sentences.

Use the Periodic Table to help you.

(i) Lithium is in Group _____ of the Periodic Table. [1]

(ii) Lithium is in Period _____ of the Periodic Table. [1]

(c) Write down the symbol of an element which has an atomic number smaller than lithium.

_____ [1]

(d) Mr. Green is a science teacher.

He shows his class how lithium, sodium and potassium react with water.

What safety precautions should Mr. Green take?

_____

_____

_____

_____

_____ [3]

(e) Finish and balance the symbol equation for the reaction of sodium and cold water.

$$Na + H_2O \rightarrow \_\_\_\_\_ + H_2$$ [2]

(f) Describe the trend in reactivity of alkali metals.

Use your knowledge of electron arrangement to explain this trend.

[4]

2 The table shows information about some compounds.

formula	name	type of structure	melting point in °C
CaO	calcium oxide	giant	2900
H_2O	water	molecular	0
NaCl	sodium chloride	giant	808
SO_2	sulphur dioxide	molecular	–75

(a) What links the melting point and the type of structure?

Use the information in the table to help you.

_____

_____ [2]

(b) Calcium and oxygen react together to form calcium oxide.

During the reaction two electrons move from a calcium atom to an oxygen atom.

Calcium ions, Ca^{2+}, and oxide ions, O^{2-}, are formed.

Finish the table. There are **two** spaces.

element	number of electrons in an atom	arrangement of electrons
calcium Ca	20	2.8.8.2
oxygen O	8	2.6
ion	number of electrons in an ion	arrangement of electrons
calcium Ca^{2+}	18	
oxide O^{2-}	10	

[2]

(c) Calculate the relative formula mass of calcium oxide, CaO.

Use the Periodic Table to help you.

_____

_____ [2]

(d) Strontium, Sr, reacts with oxygen in a similar way to calcium.

It forms a compound, strontium oxide, SrO.

Explain these facts.

Use your Periodic Table and your knowledge of the structure of atoms to help you.

_____

_____

_____

_____ [3]

3 We can represent chemical reactions using equations.

(a) Look at these word equations.

A methane + oxygen ⟶ carbon dioxide + water

B sodium hydroxide + nitric acid ⟶ sodium nitrate + water

C hydrogen peroxide ⟶ oxygen + water

D sodium + water ⟶ sodium hydroxide + hydrogen

Answer the following questions by choosing from **A**, **B**, **C** or **D**.

Each letter may be used once, more than once or not at all.

(i) Which equation represents a neutralisation reaction? ☐

(ii) Which equation represents a combustion reaction? ☐

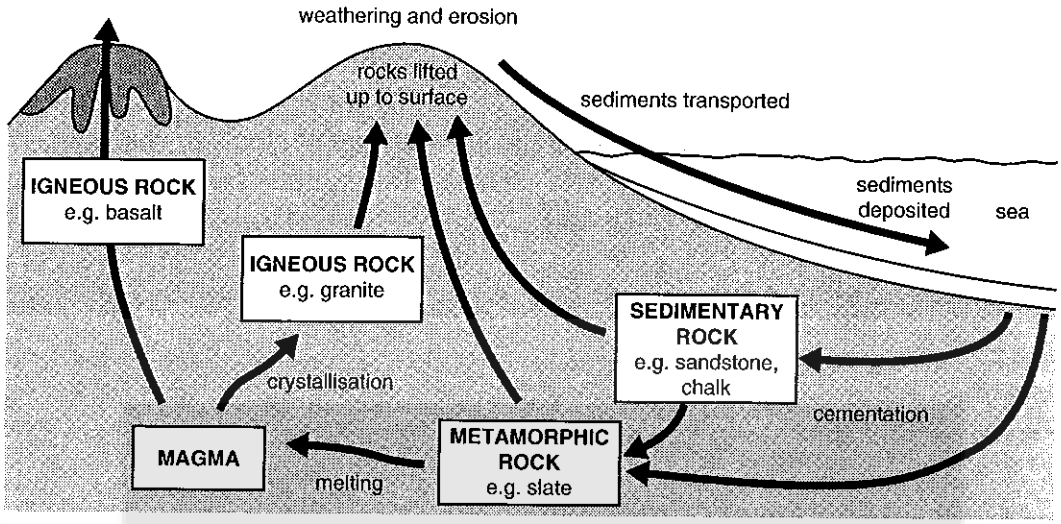
(iii) Which equation shows the formation of an alkali? ☐

[3]

(b) Finish the symbol equation for **C**.

..... H_2O_2 ⟶ ..... H_2O + O_2 [1]

4 The diagram shows how rocks are broken down and new rocks formed in the rock cycle.



(a) These are four processes involved in forming **sedimentary** rocks.

They are in the wrong order.

A depositing sediments

B cementation

C transporting sediments

D weathering and erosion

Fill in the boxes to show the correct order. Use the diagram to help you.

☐ → ☐ → ☐ → ☐ [3]

(b) Write down **two** processes taking place when **metamorphic** rocks turn into **igneous** rocks.

1 _____

2 _____ [2]

(c) What conditions of temperature and pressure are needed to turn **sedimentary** rocks into **metamorphic** rocks?

_____

_____ [2]

(d) This table shows some information about slate, chalk and granite.

rock	is the rock crystalline?	can the rock contain fossils?
slate	no	yes
chalk		
granite		

Finish the table by putting 'yes' or 'no' in each of the four spaces.

The diagram may help you. [2]

(e) Igneous rocks can be described as **extrusive** or **intrusive.**

Basalt is an extrusive rock.

Granite is an intrusive rock.

Describe how extrusive rocks and intrusive rocks are formed from magma.

_____

_____

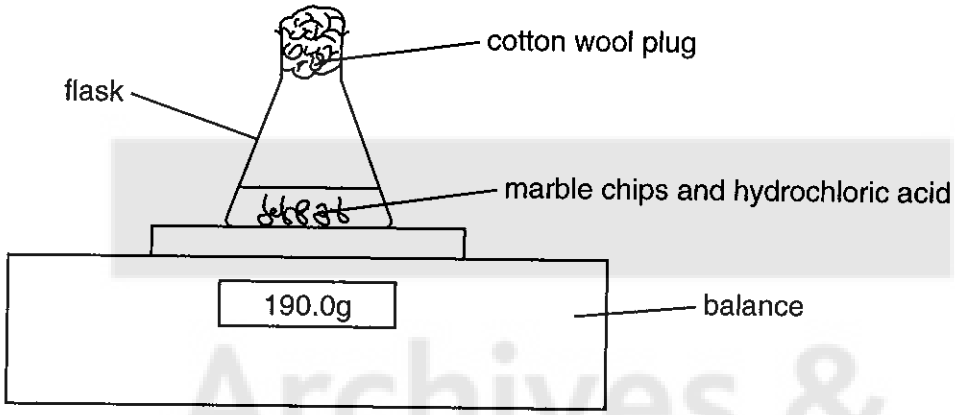
_____ [2]

5 Jo and Andy are finding out about rates of reaction.

They react hydrochloric acid with marble chips (calcium carbonate).

hydrochloric acid + calcium carbonate ⟶ calcium chloride + carbon dioxide + water

They use this apparatus.



(a) The mass of the flask and its contents decreases during the experiment.

Suggest why this happens.

_____

_____ [1]

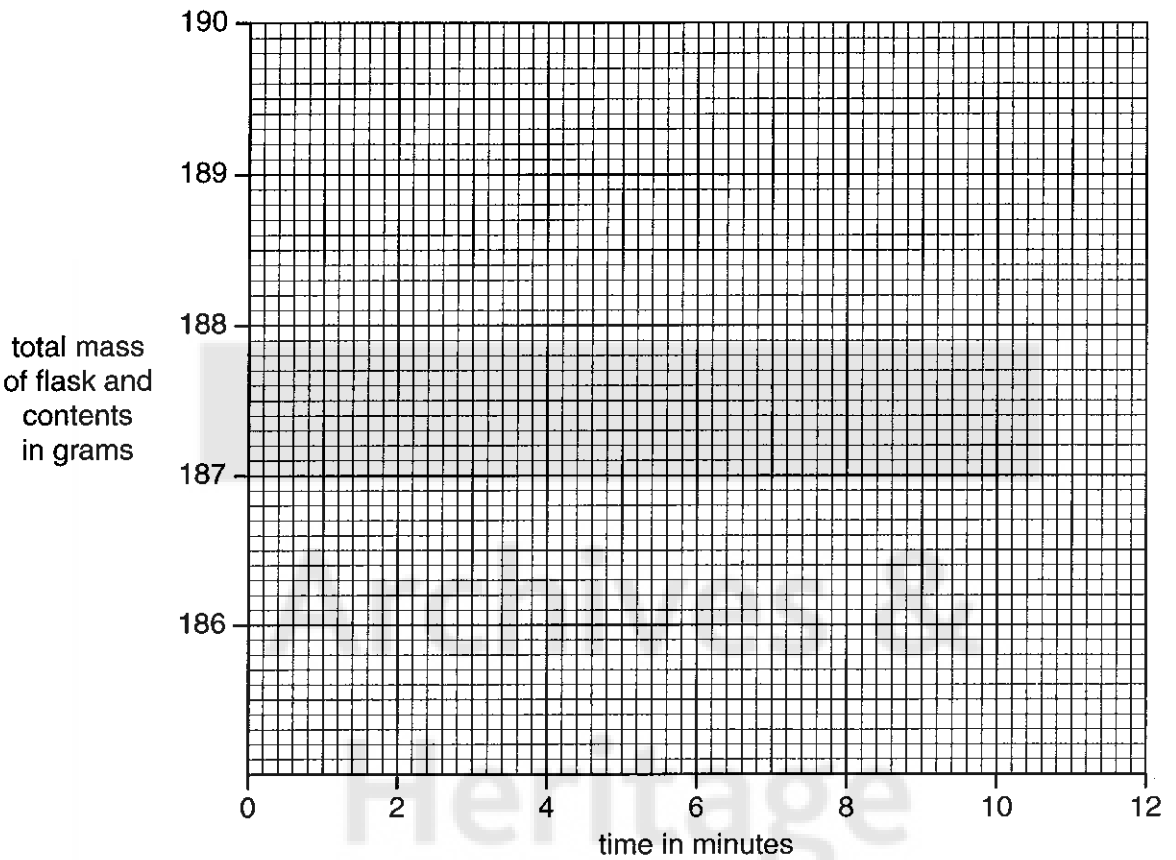
(b) Jo and Andy measure the total mass of the flask and its contents as the reaction takes place.

The table shows their results.

time in minutes	mass of flask and contents in grams
0	190.0
2	188.0
4	187.0
6	186.3
8	186.1
10	186.0
12	186.0

(i) Plot their results on the grid. [2]

(ii) Finish the graph by drawing the best curve through the points. [1]



(iii) Jo says that the reaction was faster between 0 and 2 minutes than between 2 and 4 minutes.

How do the results show this?

_____

_____ [2]

(c) In the first experiment the hydrochloric acid was at room temperature.

Jo and Andy repeat the experiment.

The only difference is that the hydrochloric acid is at a higher temperature.

Sketch a curve on the grid to show the results they get. [2]

(d) Jo and Andy do the original experiment at room temperature again.

This time they add an equal volume of water to the hydrochloric acid before adding the marble chips.

How would the rate of reaction be different from the first experiment?

Use your knowledge of particles to explain your answer.

_____

_____

_____

_____ [3]

6 This question is about fertilisers and chemicals used to make them.

(a) Using too much fertiliser can cause pollution in rivers and can kill fish.

(i) Here are five sentences describing how this happens. They are in the wrong order.

Fill in the boxes to show the right order. The first one has been done for you.

A Algae grow well on the fertiliser and cover the river.

B Excess fertiliser dissolves in rain and drains into rivers.

C There is little oxygen left for the fish and they die.

D The algae die and bacteria decompose them.

E The bacteria use up most of the oxygen in the water.

B				

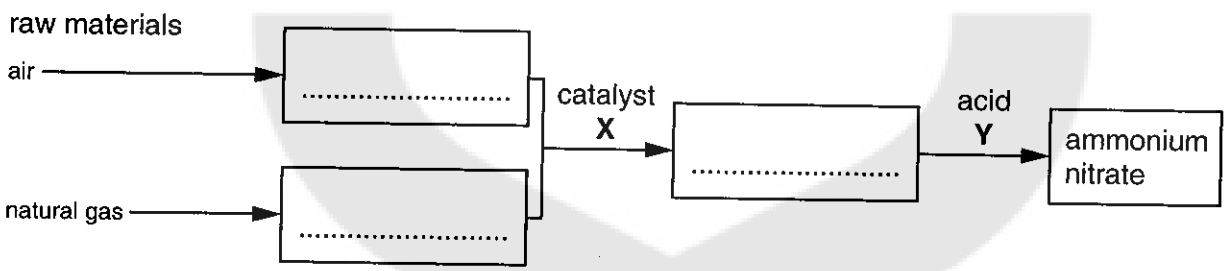
[3]

(ii) What word is used to describe this process?

Put a (ring) around the correct answer.

distillation **eutrophication** **fertilisation** **neutralisation** [1]

(b) Ammonium nitrate, NH_4NO_3, can be used as a fertiliser.
The flow chart shows how ammonium nitrate can be made.



(i) Finish the flow chart by adding the three missing labels. [2]

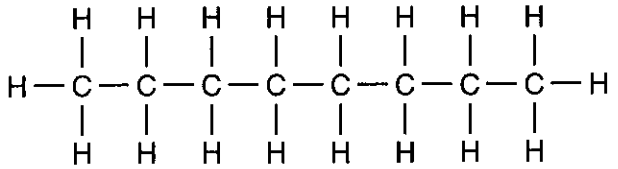
(ii) Write down the name of catalyst **X**.

_____ [1]

(iii) Write down the name of acid **Y**.

_____ [1]

7 Octane is a saturated hydrocarbon.
Its graphical (displayed) formula is



(a) Put a (ring) around the family to which octane belongs.

alkanes **alkenes** **carbohydrates** **carbonates** [1]

(b) The products formed when octane burns in air depend upon the amount of air.
Explain this statement.

_____

_____

_____

_____

_____ [4]

(c) When octane vapour is passed over a heated catalyst a reaction takes place.
Ethene and hydrogen are the only products.

(i) What type of reaction is taking place?

_____ [1]

(ii) Finish and balance the symbol equation for this reaction.

octane → ethene + hydrogen

C_8H_{18} → .....C_2H_4 + ... [2]

(iii) Excess ethene is bubbled through bromine water.
What colour change would you see?

From _____ to _____ [2]

(d) Ethene is used as the raw material for making poly(ethene).

(i) Draw the graphical (displayed) formula of ethene and of poly(ethene).

ethene poly(ethene) [3]

(ii) Poly(ethene) has replaced paper and cardboard for many packaging uses.

Suggest one advantage and one disadvantage of poly(ethene) compared to paper and cardboard. Do not consider the relative costs of the materials.

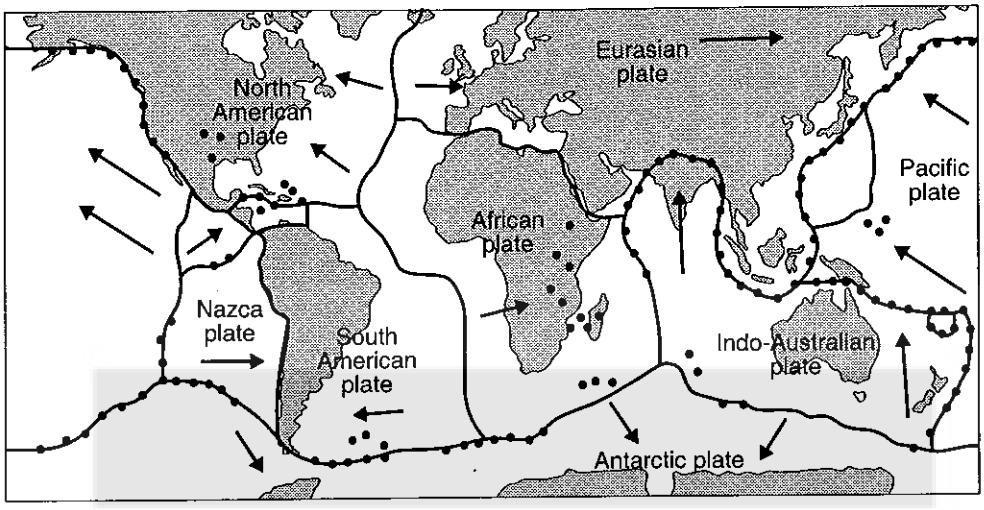
Advantage of poly(ethene) _____

_____

Disadvantage of poly(ethene) _____

_____ [2]

8 The Earth's crust is broken up into large plates.
The diagram shows some of these plates and the sites of major earthquakes.



Key: — plate boundary
→ movement boundary
• earthquake site

(a) Look at the pattern of earthquakes.

Look at the boundaries of the plates.

What is the connection between the pattern of earthquakes and the plate boundaries?

_____

_____ [2]

(b) Draw on the diagram a line to show where you would expect there to be another plate boundary. [1]

(c) What causes a major earthquake?

_____ [1]

(d) The city of San Francisco is built along the San Andreas Fault.
It is an area where earthquakes occur.
The buildings in San Francisco are designed and built of materials to reduce the effects of earthquakes.

Suggest what else can be done to reduce the social, economic and environmental effects of a future earthquake.

_____

_____

_____ [2]

9 This question is about phosphine.

Phosphine is a compound of phosphorus and hydrogen.

A sample of phosphine of mass 100 g contains 91.2 g of phosphorus.

(a) Work out the simplest formula of phosphine.
(Relative atomic masses: H = 1, P = 31)
You **must** show how you work out your answer.

formula _____ [3]

(b) Calculate the relative formula mass of phosphine.

relative formula mass _____ [1]

(c) Draw a 'dot and cross' diagram to show the arrangement of electrons in a phosphine molecule. You need only show electrons in outer shells.

[2]

10 A waste solution from a factory contains copper(II) sulphate.

Copper is recovered from this solution.

After further treatment the water goes into a local river.

(a) Suggest **one** reason why copper is recovered from the solution.

_____ [1]

(b) To recover the copper, excess iron filings are added to the solution containing copper(II) sulphate.

The reaction taking place is shown in the equation.

$$Fe(s) + CuSO_4(aq) \rightarrow Cu(s) + FeSO_4(aq)$$

(i) How is solid copper removed from the solution?

_____ [1]

(ii) Suggest why iron filings react faster than lumps of iron.

_____

_____ [1]

(iii) Calculate the maximum mass of copper that could be recovered using 1 tonne of iron. (Relative atomic masses: Fe = 56,Cu = 64)

You **must** show how you work out your answer.

maximum mass _____ tonnes [2]

11 This question is about the halogen elements in Group 7 of the Periodic Table.

The reactivity of the elements in Group 7 decreases down the group.

(a) Write down the name and symbol of the **most** reactive halogen in Group 7.

Element _____ Symbol _____ [1]

(b) The table gives information about three halogens.

halogen	colour	melting point in °C	boiling point in °C	state at room temperature and pressure
chlorine	greenish-yellow	–101	–34	gas
bromine	red	–7	60	liquid
iodine	dark grey	114	185	solid

Astatine is in Group 7 of the Periodic Table. It is below iodine.
Use the information in the table and your knowledge to answer the following.

(i) Predict the state of astatine at room temperature and pressure.

_____ [1]

(ii) Suggest a melting point for astatine. Use the data to explain your choice.

Melting point _____

Explanation _____

_____ [2]

(iii) Predict the colour of astatine.

_____ [1]

(iv) What are the name and formula of the compound formed by sodium and astatine?

Name _____ Formula _____ [2]

(c) The table summarises the results of reactions when halogens are added to solutions of sodium halides.

(i) Finish the table by adding a tick (✓) if a reaction takes place and a cross(✘) if a reaction does not take place. Some have been done for you. [3]

halogen added	solutions of		
	sodium chloride	sodium bromide	sodium iodide
bromine	✘	✘	✓
chlorine	✘		
iodine			✘

(ii) Finish the sentence by choosing the **best** word from the list.

decomposition

displacement

neutralisation

The reaction of bromine with sodium iodide is an example of

a _____ reaction. [1]

(iii) Write an equation for the reaction taking place when bromine, Br_2, is added to potassium iodide solution, KI.

_____ [2]

(d) Sodium chloride is used as a raw material for producing other sodium compounds.

These include

sodium carbonate

sodium hydrogencarbonate

sodium hydroxide

Choose **two** of these. For each one, write down a use of the sodium compound.

sodium compound	**use**
_____	_____
_____	_____ [2]

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DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
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232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Secondary Education
former Midland Examining Group syllabus

SCIENCE: DOUBLE AWARD	PAPER 5	**1794/5**
SCIENCE: PHYSICS	PAPER 1	**1782/1**
SCIENCE: PHYSICS (NUFFIELD)	PAPER 1	**1787/1**

FOUNDATION TIER

Friday **16 JUNE 2000** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials required:
Pencil
Ruler (cm/mm)

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

FOR EXAMINER'S USE	
1	
2	
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7	
8	
9	
TOTAL	

This question paper consists of 19 printed pages and 1 blank page.

1 This question is about light.

(a) Stars are luminous objects.

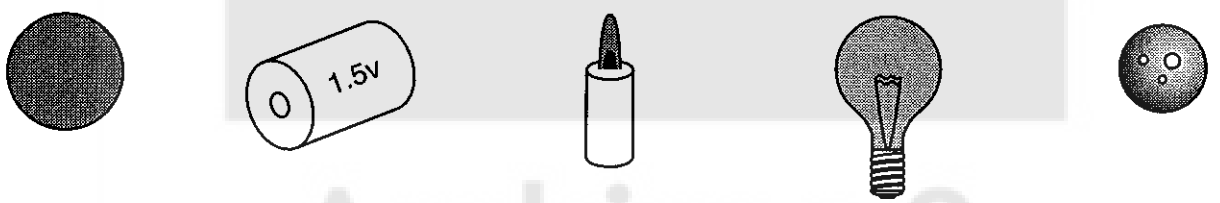
They give **out** light.

Look at the **five** pictures below.

Two of the objects are **not** luminous. They can only **reflect** light.

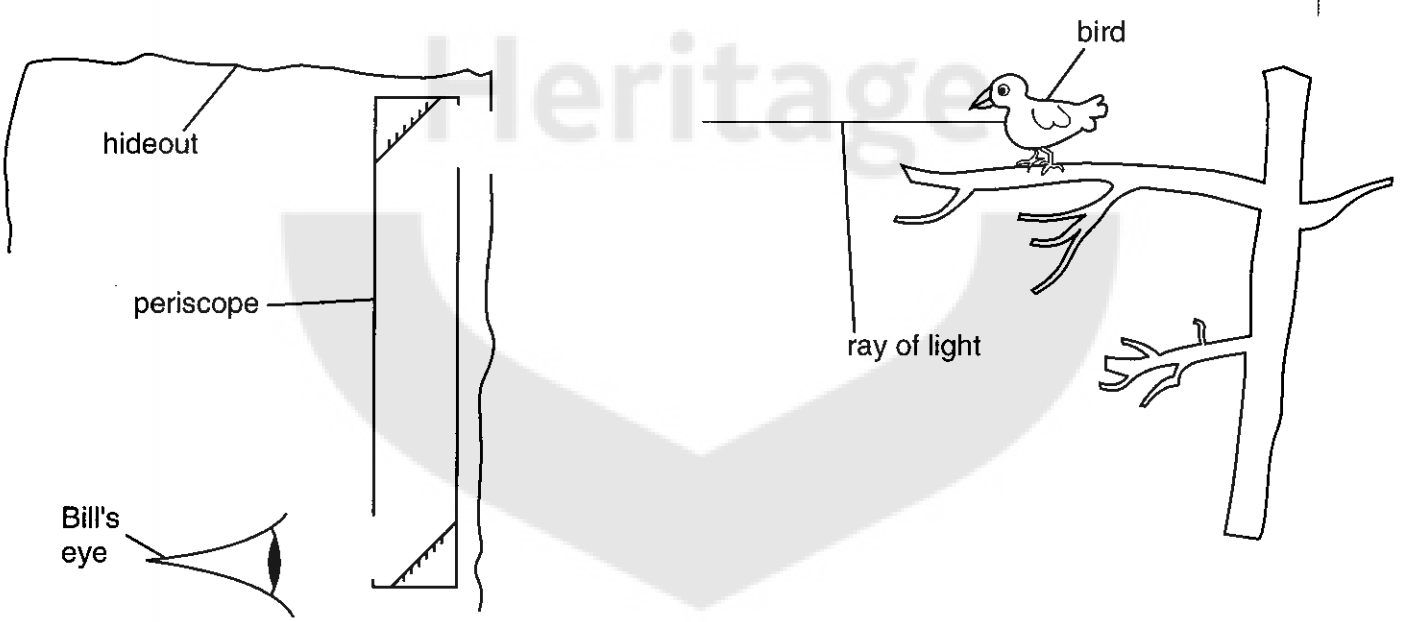
Put (rings) around the **two** objects which are **not** luminous.

1 Sun | 2 cell | 3 candle flame | 4 glowing bulb | 5 Moon



[2]

(b) Bill uses a periscope to watch a bird from a hideout in the woods.



(i) Finish the diagram to show how light from the bird reaches Bill's eye.

The ray has been started for you. [3]

(ii) The periscope produces an image of the bird.

Describe this image that Bill sees in the periscope.

Put ticks (✓) in the **three** boxes next to the correct statements.

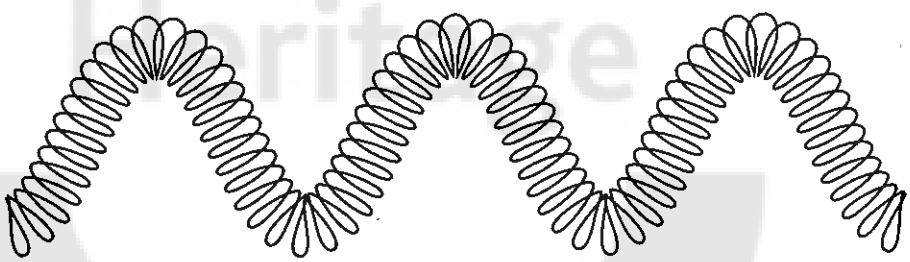
The image is larger than the bird.	☐
The image is real.	☐
The image is the right way up.	☐
The image is the same size as the bird.	☐
The image is smaller than the bird.	☐
The image is upside down.	☐
The image is virtual.	☐

[3]

(c) Bill sees the bird by light waves and hears it by sound waves.

A teacher shows Bill models of light waves and sound waves using a slinky spring.

model of light wave (transverse)



model of sound wave (longitudinal)

Describe how the transverse wave is different from the longitudinal wave.

_____

_____

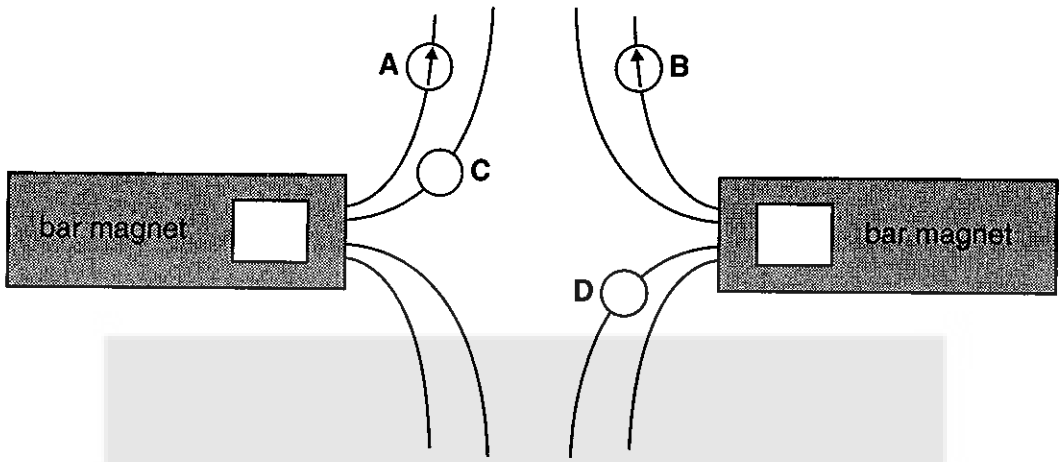
_____

_____

_____ [2]

2 This question is about magnetism.

(a) The diagram shows the magnetic field between the ends of two bar magnets.



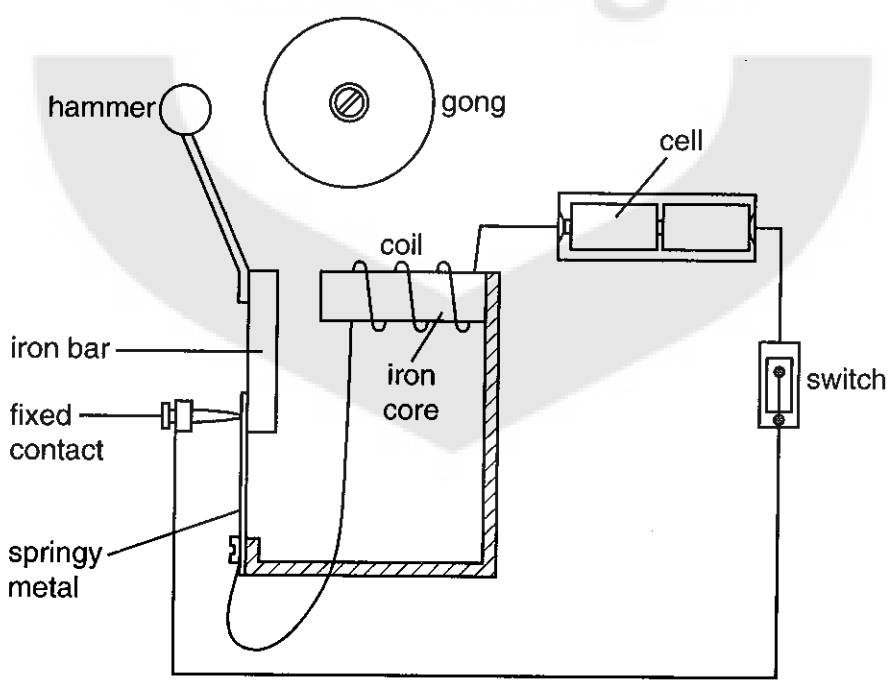
A, **B**, **C** and **D** are plotting compasses.

The needles of **A** and **B** point in the directions shown.

(i) Draw arrows in the circles **C** and **D** to show the directions of the needles. [2]

(ii) Label the two poles of the magnets nearest each other in the boxes shown. [2]

(b) Graham makes a simple electric bell.



He closes the switch.

(i) The hammer moves to the right and hits the gong.

Explain why.

_____

_____

_____[2]

(ii) The hammer now moves back to the left.

Explain why.

_____

_____

_____[2]

(c) Graham wants the hammer to hit the gong harder.

Alex says 'Why not replace the iron core with a permanent bar magnet?'

(i) Why is this **not** a good idea?

_____

_____

_____[1]

(ii) Suggest **two** ways Graham could make the hammer hit the gong harder.

1. _____

_____

2. _____

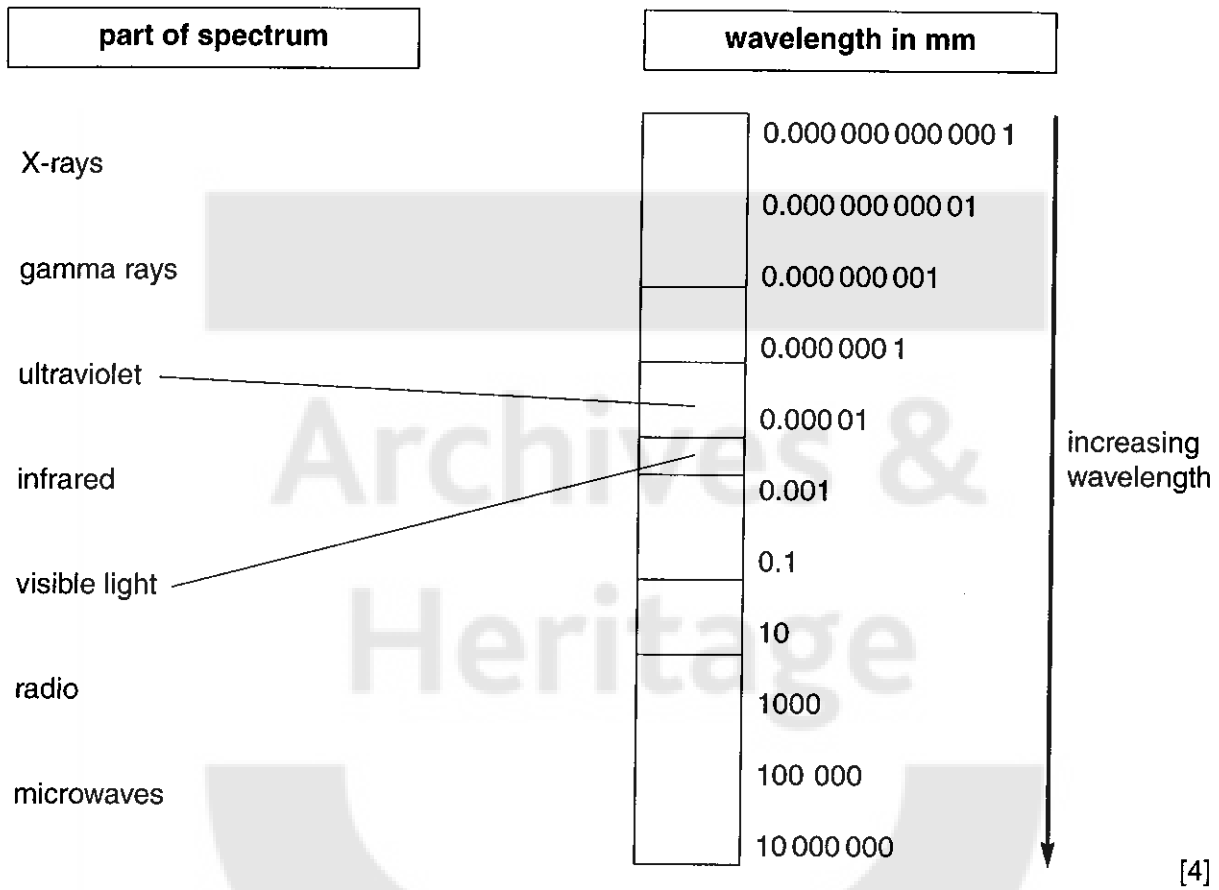
_____[2]

3 This question is about the electromagnetic spectrum.

(a) The diagram shows the parts of the electromagnetic spectrum and their wavelength ranges.

Draw a **straight** line from each part of the spectrum to the correct range.

Each part must be joined to a different range. Two have been done for you.



[4]

(b) Finish the sentences by choosing the **best** words from this list.

Each word may be used once, more than once, or not at all.

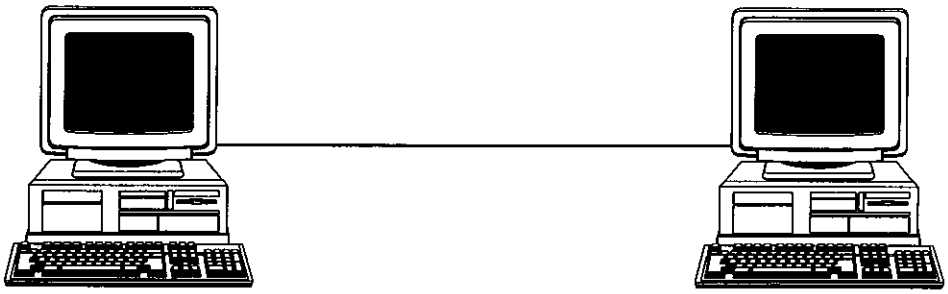
gamma rays
infrared
microwaves
radio
ultraviolet
X-rays

The Sun's rays contain _____ which can cause sunburn and _____ which can cause skin cancer.

Cancer can be treated with _____ .

Night photography uses _____ . [4]

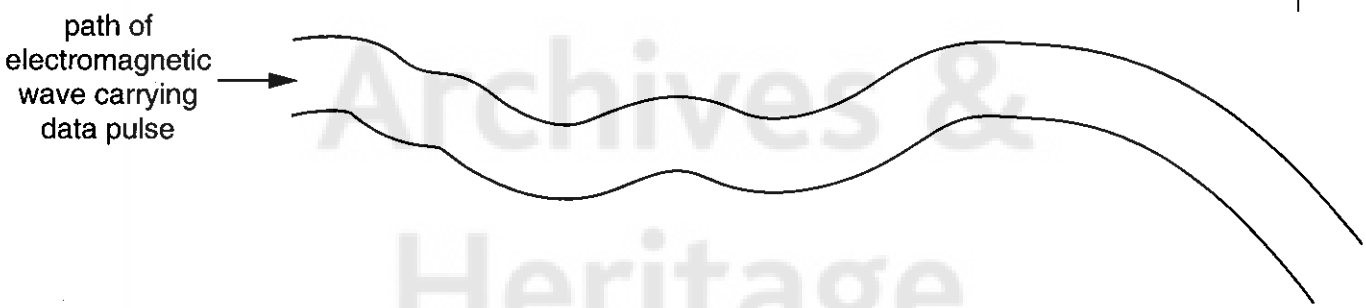
(c) Two computers are linked by optical fibre. Data pulses are sent between them.



(i) Write down the name of a part of the electromagnetic spectrum which is used to transmit the data pulses.

_____ [1]

(ii) The diagram shows part of an optical fibre.



Describe and explain the path of the electromagnetic wave passing along the fibre.

You may add to the diagram or draw other diagrams to help your answer.

_____

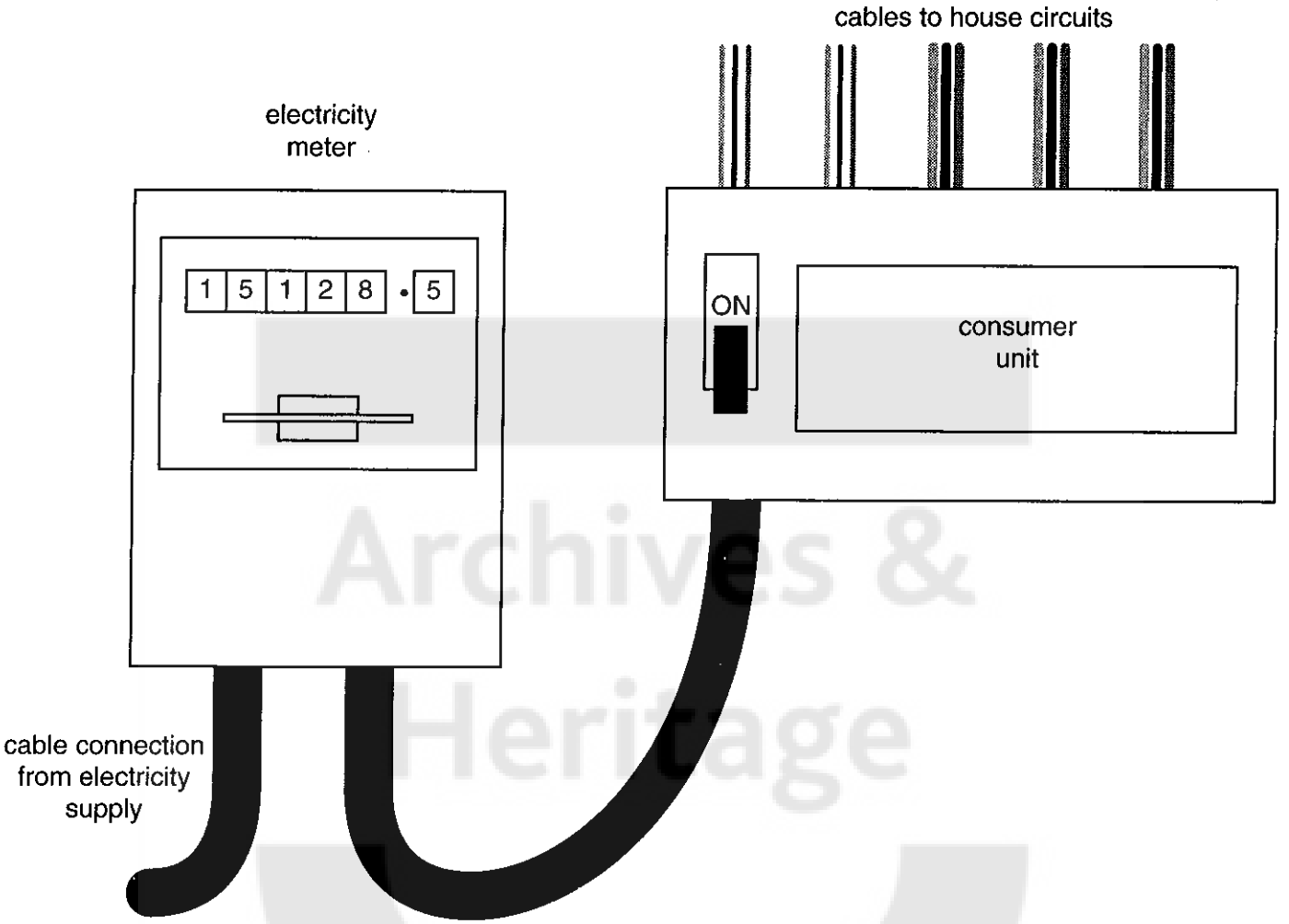
_____

_____

_____ [3]

4 This question is about the supply of electricity to the home.

The diagram shows how the electricity supply is connected to the house circuits.



(a) Finish the sentence by choosing the **best** word from this list.

charge

current

energy

voltage

The electricity meter measures the amount of _____ transferred. [1]

(b) **(i)** Each cable in a house circuit has three wires in it.

Two of these are called the **live** wire and **neutral** wire.

Write down the **name** of the third wire. _____ [1]

(ii) Which of these three wires carries no current when appliances are working properly?

_____ [1]

(iii) A fault occurs in a house circuit.

The current in the live wire is now too big.

What happens in the consumer unit?

_____ [1]

(c) The circuit to the immersion heater has thicker wires than the lighting circuit.

Suggest why.

_____

_____

_____ [2]

(d) James writes down information about the appliances used in his home between 6 p.m. and 7 p.m.

This is what he wrote.

appliance	power rating in kW	time switched on in hours	energy used in kWh
fan heater	1.0	1.0	1.0
TV and video	0.1	1.0	
kettle	2.0	0.1	
water heater	3.5	0.2	
all lights	0.5	1.0	

(i) Finish the table by calculating the energy used by each appliance.

The first one has been done for you. [2]

(ii) Which appliance has cost the **most** to use between 6 p.m. and 7 p.m.?

_____ [1]

(iii) The meter reading was **15128.5** kWh at 6 p.m.

What is the new meter reading at 7 p.m.?

You **must** show how you work out your answer.

new meter reading _____ [2]

5 This question is about radioactivity and its uses.

Americium-241 ($^{241}_{95}$Am) is a radioactive material which emits gamma radiation.

(a) Put ticks (✓) in the boxes next to the **two** correct statements about gamma radiation.

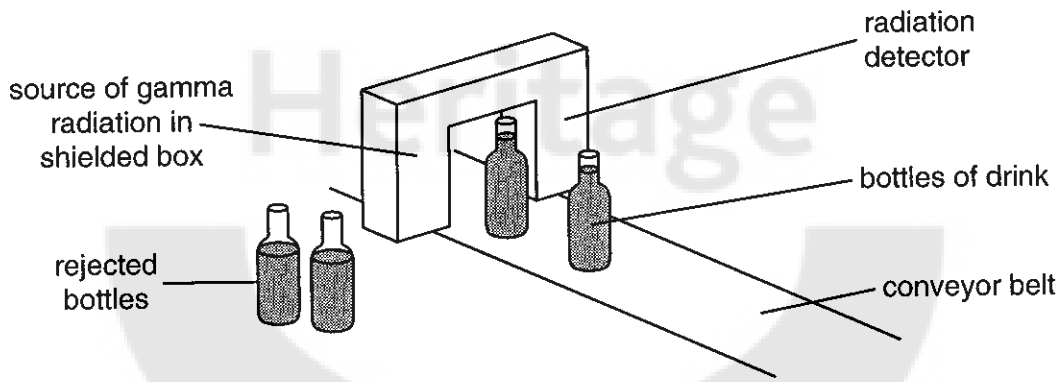
Gamma radiation is harmless.	☐
Gamma radiation travels as a wave.	☐
Gamma radiation has a range of only a few centimetres in air.	☐
Gamma radiation will penetrate several centimetres of lead.	☐

[2]

(b) A brewery uses Americium-241 in its bottling plant.

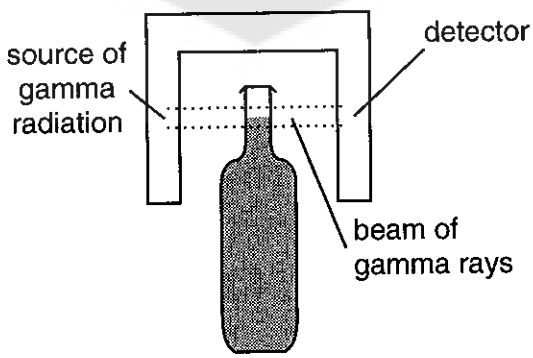
The diagram shows bottles of drink passing through a liquid level detector.

If the bottle is not full enough, the bottle is rejected.

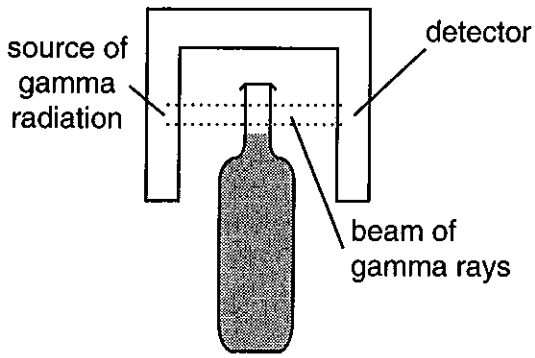


The gamma radiation passes through the bottle and its contents.

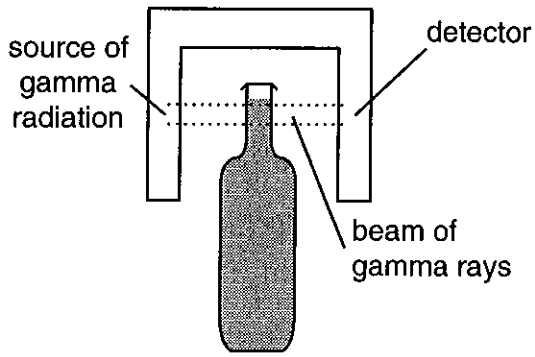
The radiation is detected on the other side.



bottle filled to correct level



bottle not full enough



bottle too full

(i) What happens to the amount of radiation detected if the bottle is not full enough?

_____ [1]

(ii) What happens to the amount of radiation detected if the bottle is too full?

_____ [1]

(iii) For this process to work, all of the bottles must be accurately made to be the same thickness.

Suggest why.

_____

_____

_____

_____ [2]

(iv) Why is gamma radiation used instead of alpha radiation?

_____ [1]

(v) Some modern bottling machines use ultrasound instead of gamma radiation to check the liquid level.

Suggest why ultrasound is used instead of gamma radiation.

_____

_____ [2]

6 This question is about satellites.

More than 8000 objects orbit the Earth.

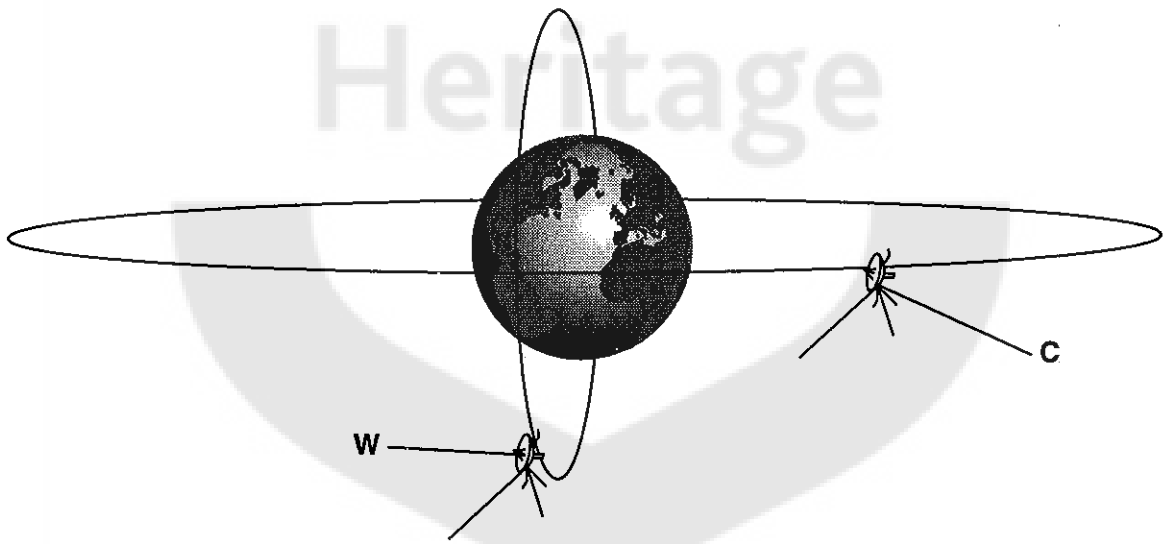
(a) Which of the following are **satellites** orbiting the Earth?

Put ticks (✓) in the **three** correct boxes.

the comet Hale-Bopp	☐
the Hubble space telescope	☐
the Mir space station	☐
the Moon	☐
the planet Pluto	☐
the star Alpha Centauri	☐

[3]

The diagram shows two satellites orbiting the Earth.



not to scale

W is a weather satellite which takes 102 minutes to orbit the Earth.

C is a communications satellite which takes 24 hours to orbit the Earth.

(b) The weather satellite take less time than the communications satellite to orbit the Earth.

Explain why.

_____

_____

_____ [2]

(c) Write down the name of the force which keeps the satellites in orbit.

_____ [1]

(d) Asif, in London, telephones his friend, Miguel, in New York.

The microwave signal goes to the communications satellite and back to Earth, a total distance of 90 000 km.

The time delay between when Miguel starts speaking and when Asif hears his voice is 0.3 s.

Calculate the speed of the signal.

You **must** show how you work out your answer.

speed _____ km/s [3]

7 This question is about transferring energy.

Energy can be transferred by **conduction**, **convection**, **evaporation** and **radiation**.

(a) Finish these sentences.

The Sun transfers energy to the Earth by _____ .

Air rises above hot areas of the land. This transfers energy by _____ .

[2]

This marathon runner has been running for more than 23 miles.

He is very hot and sweaty.

(b) Sweating helps the runner to lose energy.

Use your ideas about energy transfer to explain how this happens.

_____

_____

_____

_____

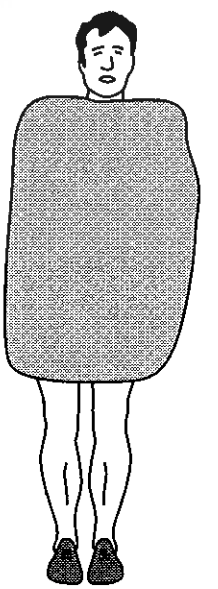
_____

_____

_____

_____[3]

(c) After the race, the runner is given a **shiny** foil blanket.



This stops him cooling down too quickly.

Use your ideas about energy transfer to explain **two** ways in which this happens.

1. _____

_____

_____

2. _____

_____

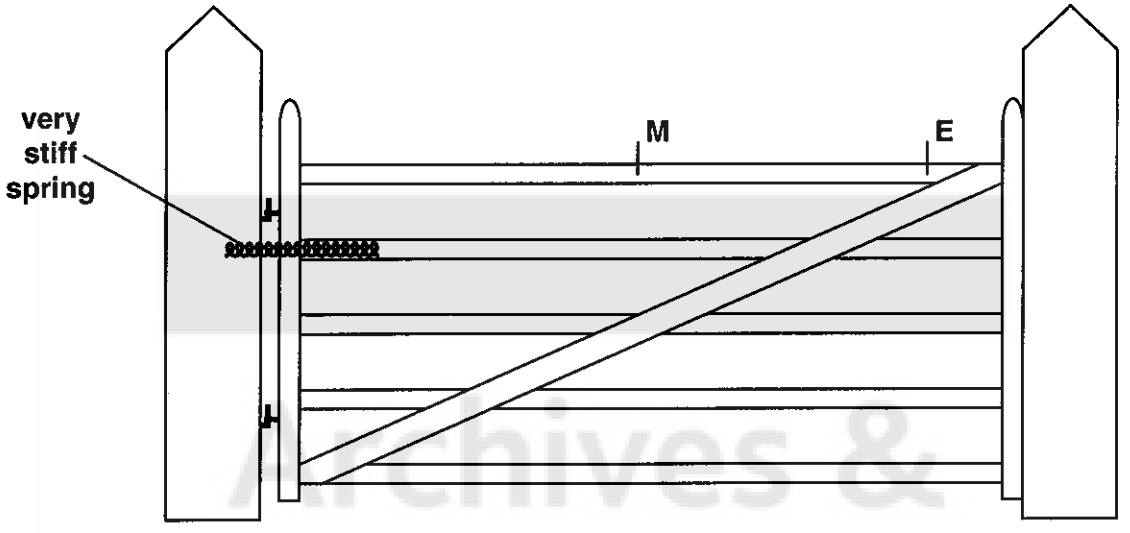
_____[4]

8 This question is about forces.

Phil lives on a farm.

One of the farm gates has a **very stiff spring** attached between the gate and the gate post.

This **spring** keeps the gate closed.



Phil can open the gate if he pushes it at the end **E**.

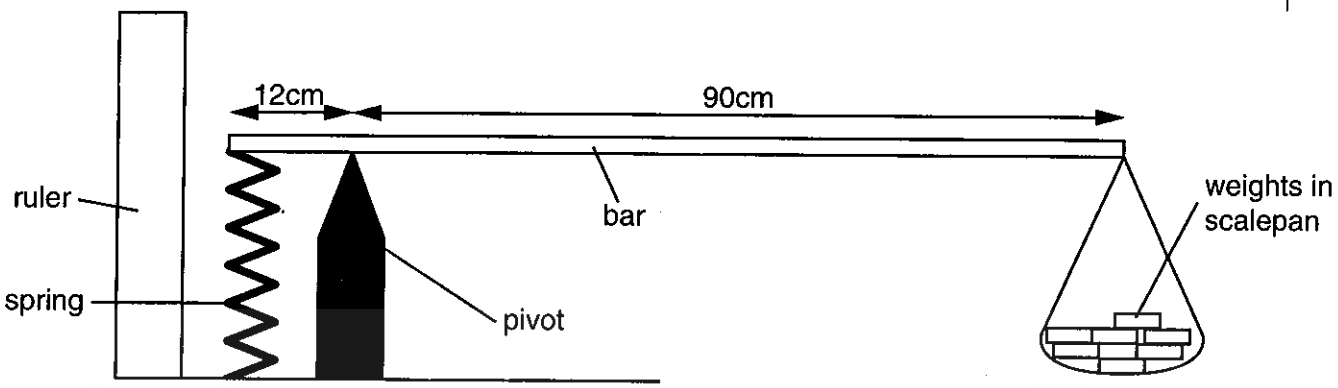
He cannot open the gate if he pushes it in the middle **M**.

(a) Use your knowledge of moments to explain this.

_____

_____ [1]

At school, Phil stretches a similar spring using this equipment.



not to scale

(b) He measures the length of the spring as he adds weights to the **scalepan**.

The table shows his results.

load on scalepan in N	length of spring in mm	extension of spring in mm
0	200	0
10	212	12
20	225	25
30	234	34
40	248	48
50	262	
60	270	
70	285	
80	294	
90	307	

(i) Phil has not worked out all the extensions.

Finish the table by writing in the shaded boxes. [2]

(ii) Plot the points for load and extension on the grid opposite.

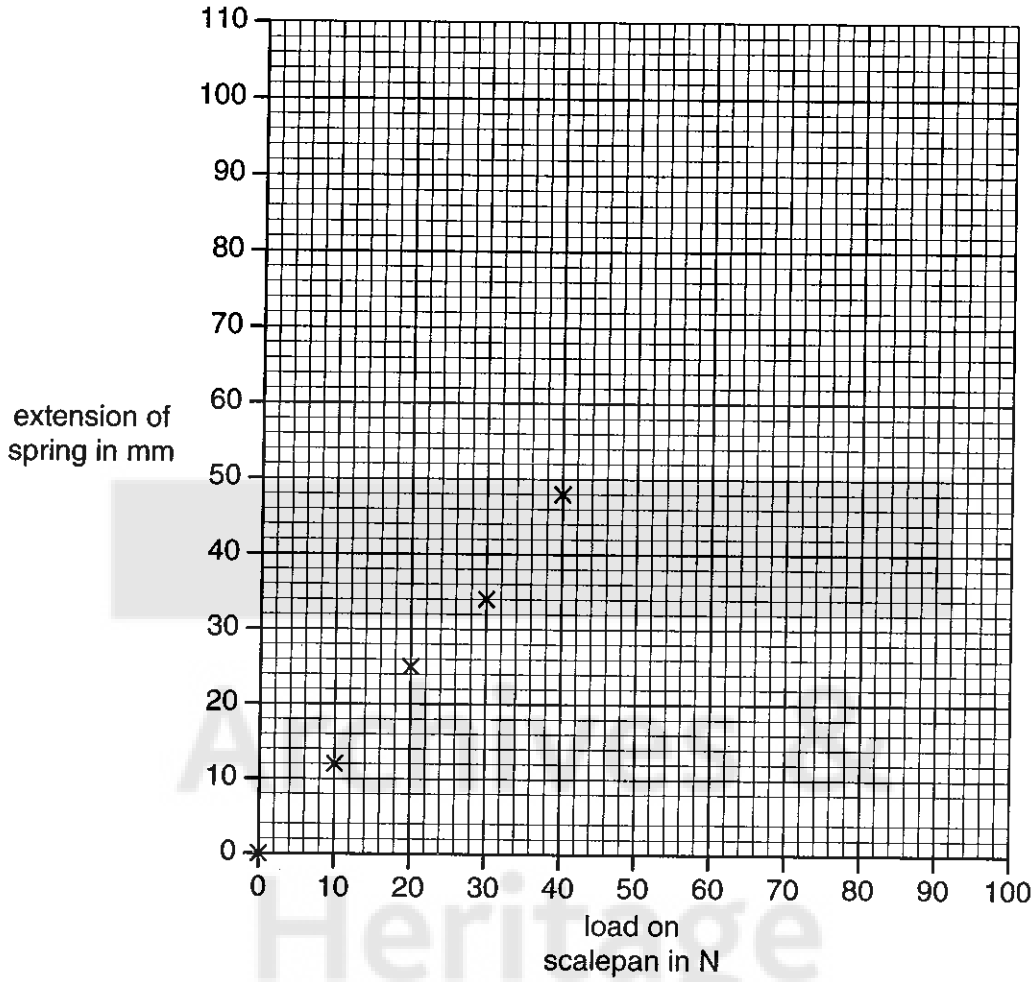
The first five have been done for you. [1]

(iii) Finish the graph by drawing the **best** straight line. [1]

(iv) Use your graph to find the load needed to stretch the spring by 65 mm.

You **must** show clearly, **on the graph**, how you get your answer.

load needed = _____ N [2]



(c) Look back at the diagram of the equipment Phil used.

The distance from the pivot to where the **spring** is attached is 12 cm.

The distance from the pivot to where the **scalepan** is attached is 90 cm.

Calculate the force on the **spring** caused by a load of 80 N in the scalepan.

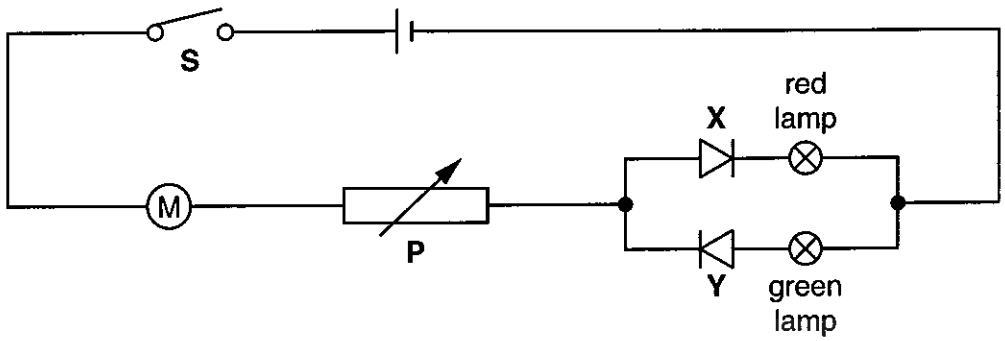
Use the equations below. You **must** show how you work out your answer.

moment of a force = force x perpendicular distance to pivot

sum of clockwise moments = sum of anticlockwise moments

force on spring = _____ N [3]

9 Karen wires up this circuit.



(M) is the symbol for an electric motor.

(a) Finish the table by writing the names of components **S**, **P** and **X**.

Choose your answers from this list.

diode

LED

LDR

resistor

switch

variable resistor

component	name
S	
P	
X	

[3]

(b) Karen wants to make the motor spin faster.

(i) Which component must she adjust? _____

(ii) Explain why this works.

_____

_____ [2]

(c) Karen closes **S**. She writes this down.

	• Motor spins
	• Red lamp is on
	• Green lamp is off

Use your ideas about current in circuits to explain her observations.

_____

_____

_____

_____ [3]

(d) Karen reverses the cell. The motor spins in the opposite direction.

What happens to the lamps? Finish the sentences.

The red lamp _____ .

The green lamp _____ . [1]

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OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Secondary Education
former Midland Examining Group syllabus

SCIENCE: DOUBLE AWARD	PAPER 6	**1794/6**
SCIENCE: PHYSICS	PAPER 2	**1782/2**
SCIENCE: PHYSICS (NUFFIELD)	PAPER 2	**1787/2**

HIGHER TIER

Friday **16 JUNE 2000** Afternoon 1 hour 45 minutes

Candidates answer on the question paper.
Additional materials required:
Pencil
Ruler (cm/mm)

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

This question paper consists of 23 printed pages and 1 blank page.

[Turn over

1 This question is about transferring energy.

Energy can be transferred by **conduction**, **convection**, **evaporation** and **radiation**.

(a) The Sun transfers energy to the Earth.
Before reaching the Earth only one process is involved in this transfer.

State the process and give a reason for your answer.

Process _____

Reason _____

_____ [2]

This marathon runner has been running for more than 23 miles.
He is very hot and sweaty.

(b) Sweating helps the runner to lose energy.
Use your ideas about energy transfer to explain how this happens.

_____

_____

_____

_____

_____

_____

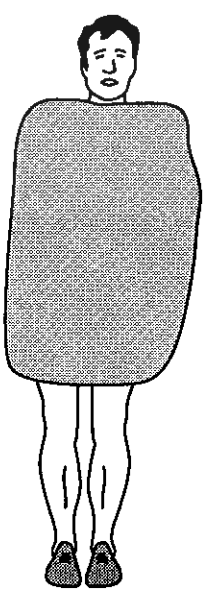
_____

_____ [3]

(c) After the race, the runner is given a **shiny** foil blanket.

This stops him cooling down too quickly.

Use your ideas about energy transfer to explain **two** ways in which this happens.



1. _____

_____

_____

2. _____

_____

[4]

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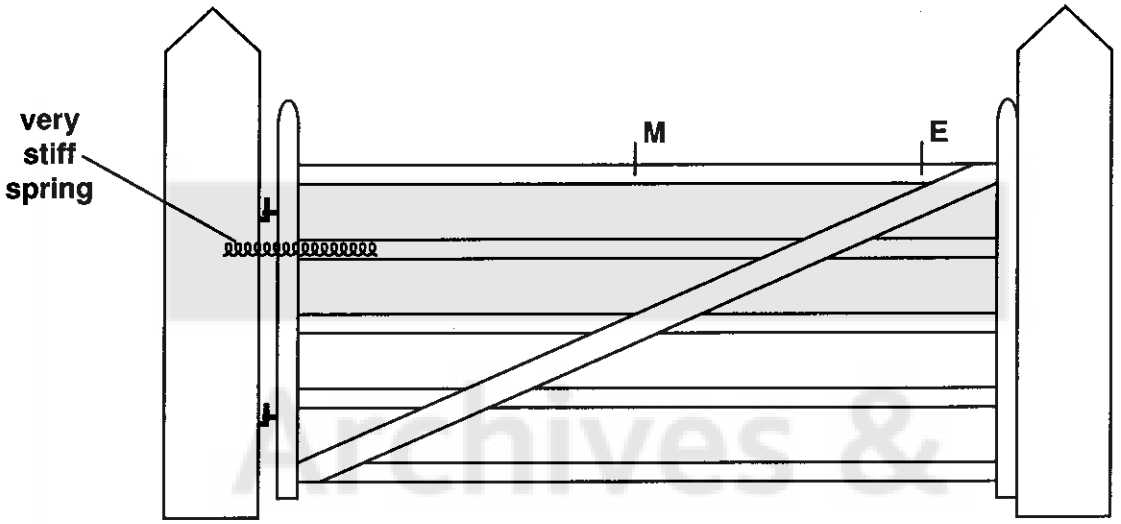


Phil can open the gate if he pushes it at the end **E**.

He cannot open the gate if he pushes it in the middle **M**.

(a) Use your knowledge of moments to explain this.

_____

_____ [1]

(b) Phil holds open the gate. Ruth starts to drive the tractor through.

The mass of the tractor is 3000 kg.

The force causing the tractor to accelerate is 1500 N.

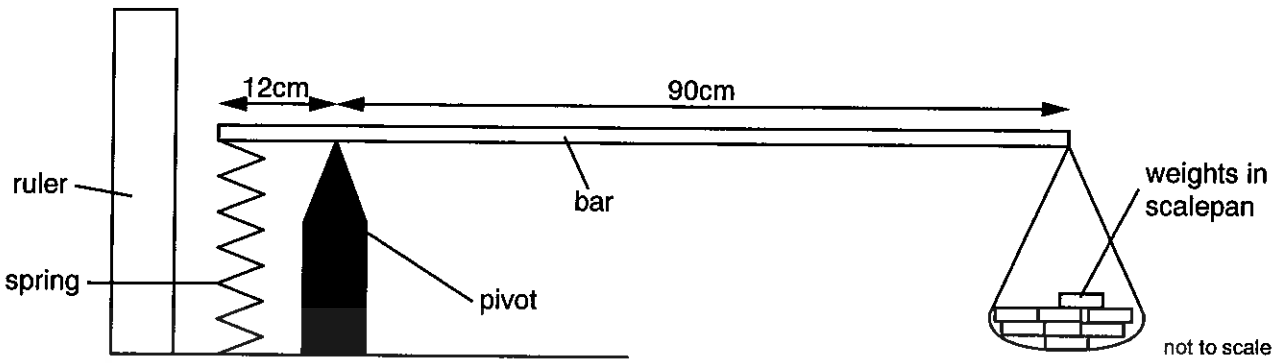
Calculate the acceleration of the tractor.

You **must** show how you work out your answer.

acceleration = _____ unit _____ [4]

[Turn over

At school, Phil stretches a similar spring using this equipment.



(c) He measures the length of the spring as he adds weights to the **scalepan**.

The table shows his results.

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30	234	34
40	248	48
50	262	62
60	270	70
70	285	85
80	294	94
90	307	107

(i) Plot the points for load and extension on the grid opposite.

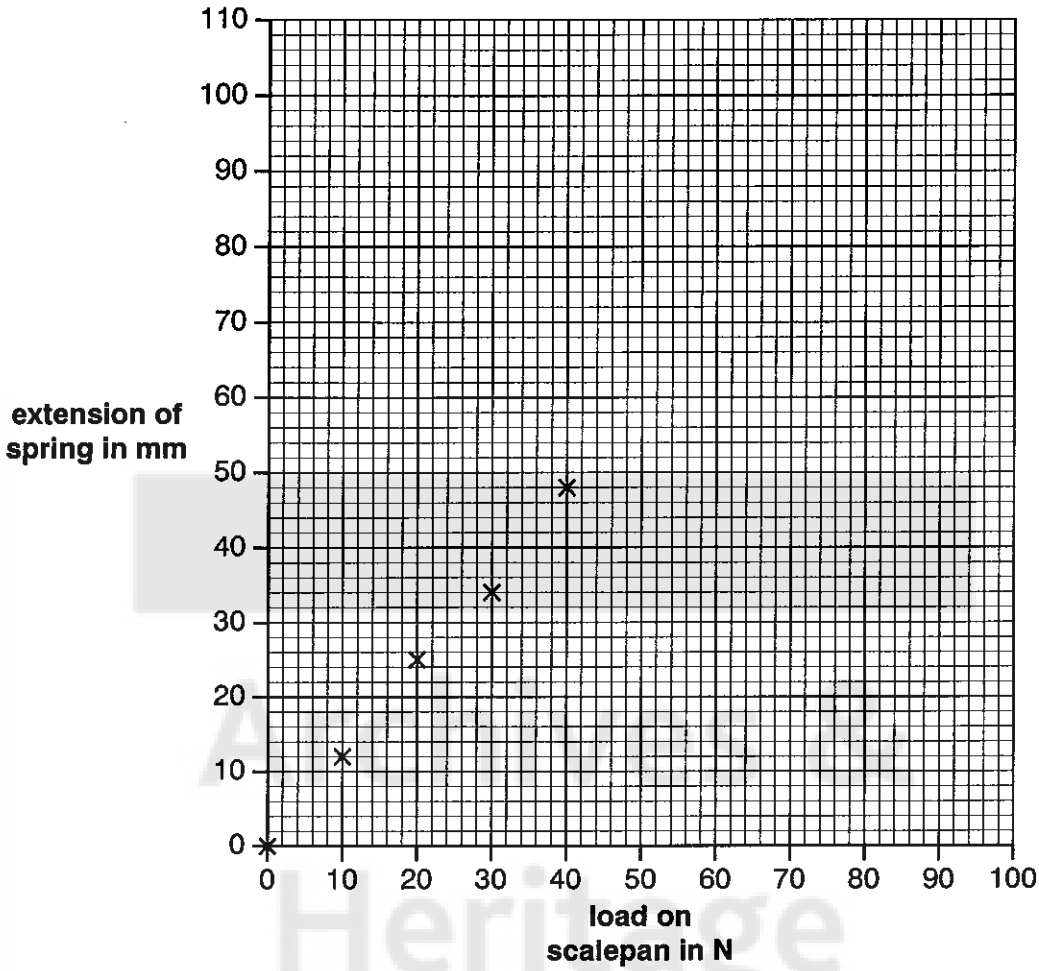
The first five have been done for you. [1]

(ii) Finish the graph by drawing the **best** straight line. [1]

(iii) Use your graph to find the load needed to stretch the spring by 65 mm.

You **must** show clearly, **on the graph**, how you get your answer.

load needed = _____ N [2]



(d) Look back at the diagram of the equipment Phil used.

The distance from the pivot to where the **spring** is attached is 12 cm.

The distance from the pivot to where the **scalepan** is attached is 90 cm.

Calculate the force on the **spring** caused by a load of 80 N in the scalepan.

Use the two equations below. You **must** show how you work out your answer.

moment of a force = force x perpendicular distance to pivot

sum of clockwise moments = sum of anticlockwise moments

force on spring = _____ N [3]

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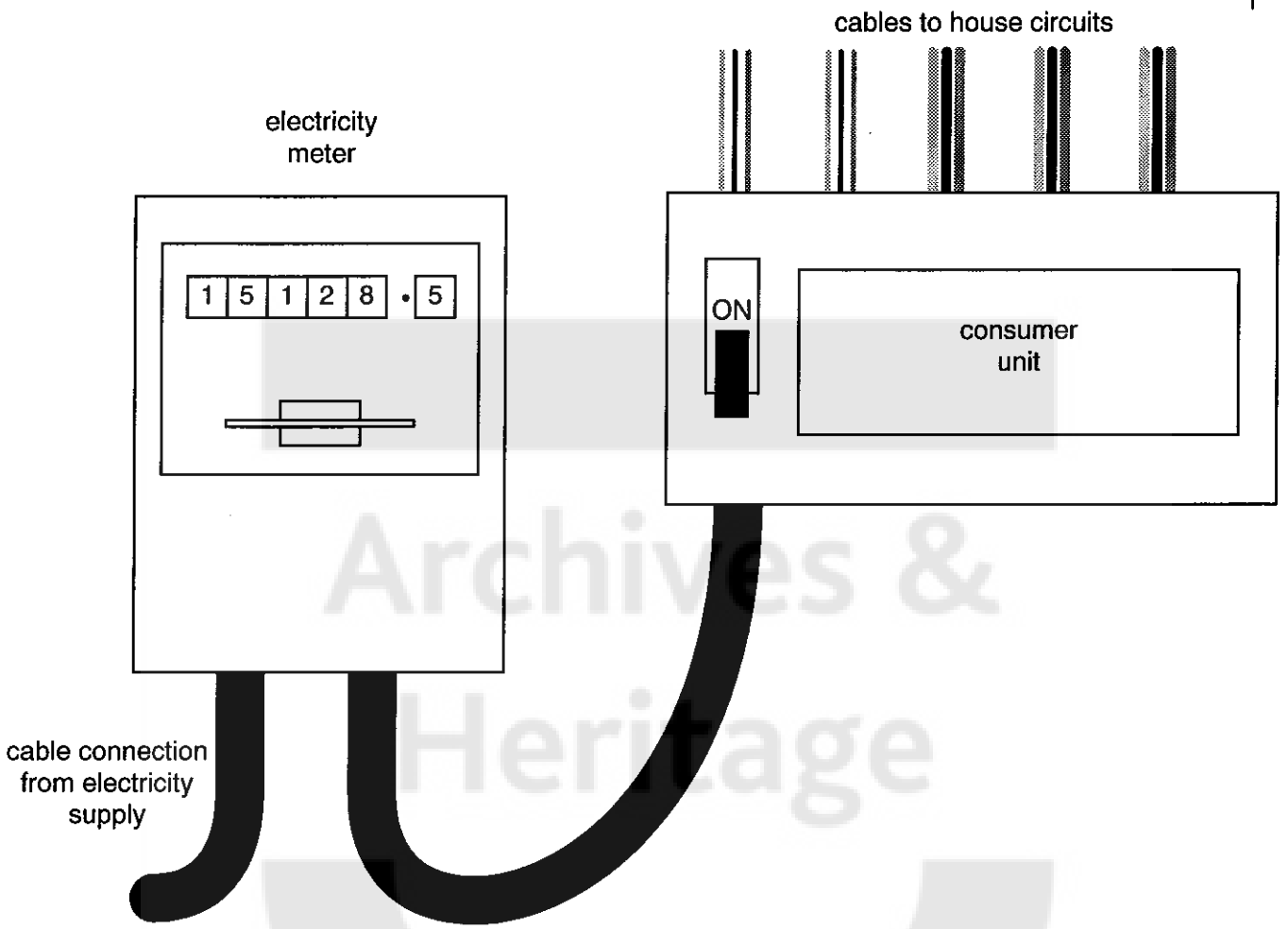
The diagram shows how the electricity supply is connected to the house circuits.



(a) An **alternating** current passes through the cables.

Use your knowledge of particles and how they move to describe this current.

1. Name of particles _____

2. How they move _____

_____ [2]

(b) The circuit to the immersion heater has thicker wires than the lighting circuit.

Suggest why.

_____

_____

_____ [2]

(c) James writes down information about the appliances used in his home between 6 p.m. and 7 p.m.

This is what he wrote.

appliance	power rating in kW	time switched on in hours	energy used in kWh
fan heater	1.0	1.0	1.0
TV and video	0.1	1.0	
kettle	2.0	0.1	
water heater	3.5	0.2	
all lights	0.5	1.0	

(i) Finish the table by calculating the energy used by each appliance.

The first one has been done for you. [2]

(ii) Which appliance has cost the **most** to use between 6 p.m. and 7 p.m.?

_____ [1]

(iii) The meter reading was **15128.5** kWh at 6 p.m.

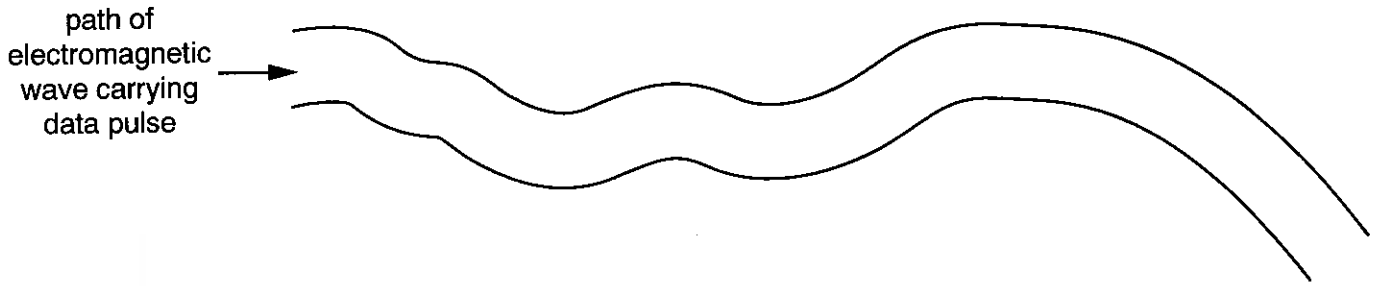
What is the new meter reading at 7 p.m.?

You **must** show how you work out your answer.

new meter reading _____ [2]

4 This question is about optical fibres.

(a) The diagram shows part of an optical fibre.



Describe and explain the path of the electromagnetic wave passing along the fibre.

You may add to the diagram or draw other diagrams to help your answer.

_____

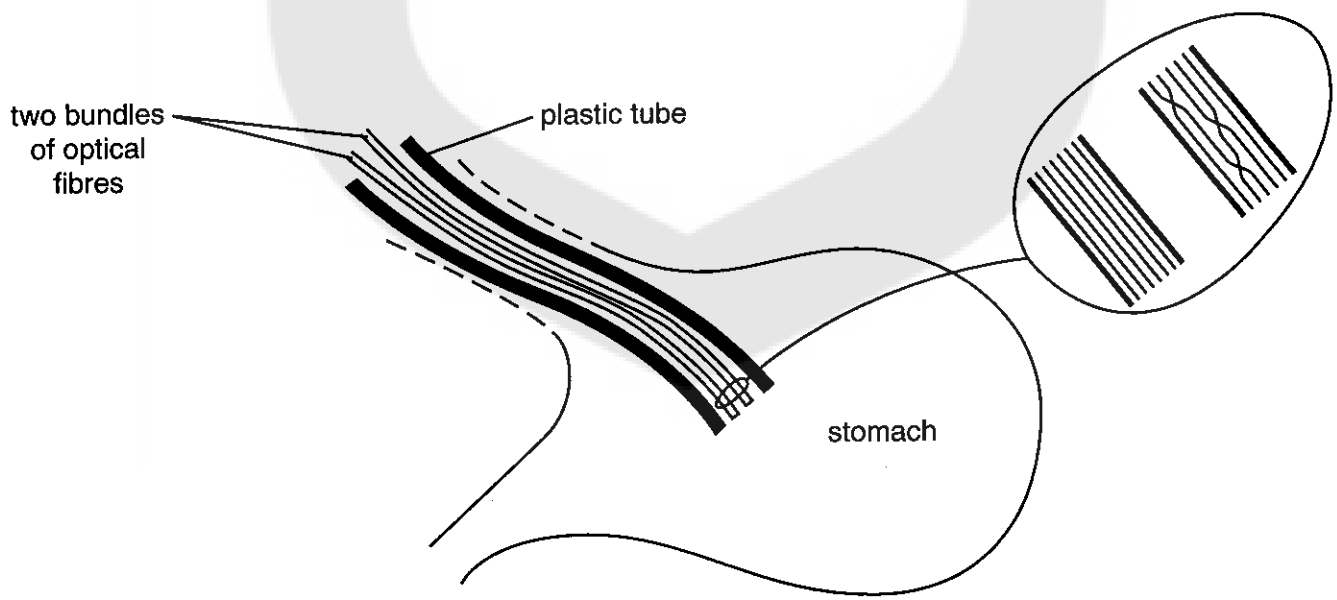
_____

_____

_____ [3]

(b) Doctors use endoscopes (fibrescopes) to see inside a patient's stomach.

The diagram shows part of the endoscope. It shows **two** bundles of optical fibres inside a plastic tube.



(i) Explain why endoscopes must have **two** bundles of optical fibres.

_____

_____

_____ [2]

(ii) The fibres in one of the bundles must be arranged in the same pattern at both ends. Explain why.

_____

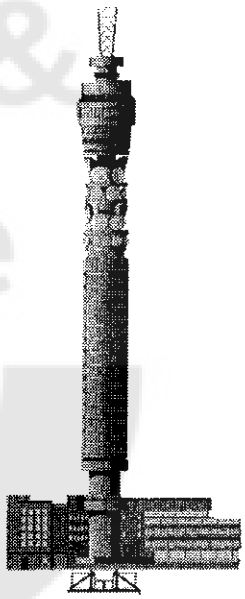
_____ [1]

(iii) How does using an endoscope help a doctor to study a patient's stomach?

_____

_____ [1]

5 This question is about telecommunications.



The BT (Telecom) Tower in London has many dishes which receive and transmit signals using microwaves.

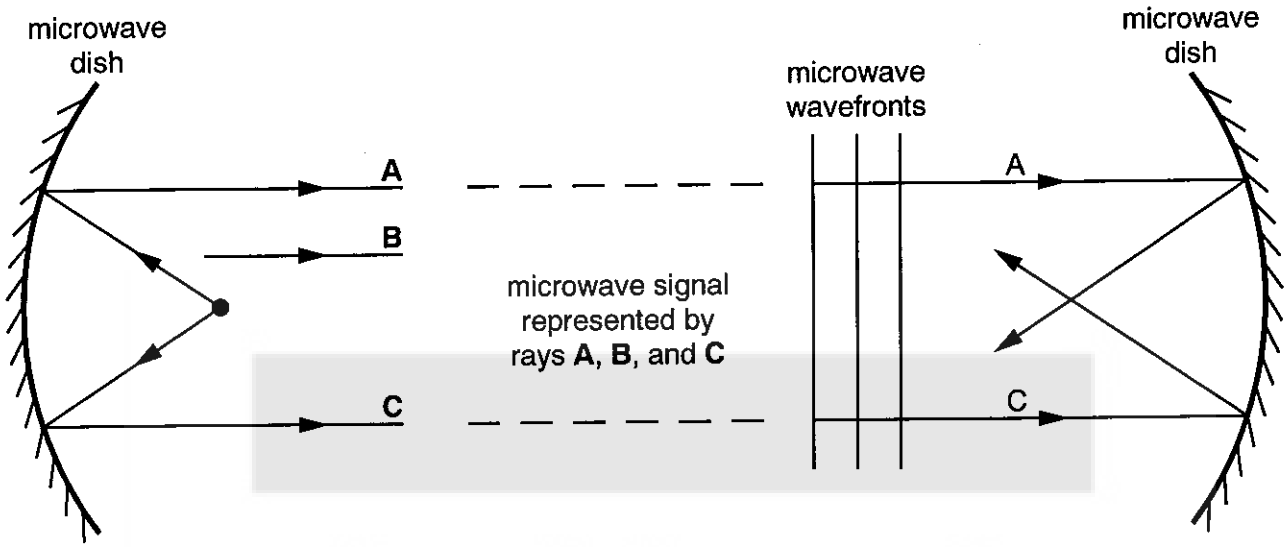
(a) The signal received from another transmitter is very weak.

Suggest a way of overcoming this problem.

_____

_____ [1]

(b) The diagram shows how two concave microwave dishes transmit and receive signals. The microwave signal is represented by rays **A**, **B** and **C**.



(i) Write a **T** on the diagram to show the **exact** position of the transmitter. [1]

(ii) Write an **R** on the diagram to show the **exact** position of the receiver. [1]

(iii) The paths taken by the rays **A** and **C** from the transmitter to the receiver are shown.

Part of the path of ray **B** is shown on the diagram.

Complete the path of ray **B** from the transmitter to the receiver. [2]

(iv) Three microwave wavefronts are shown on the diagram.

Draw on the diagram these three wavefronts after they have been reflected by the concave microwave dish. [3]

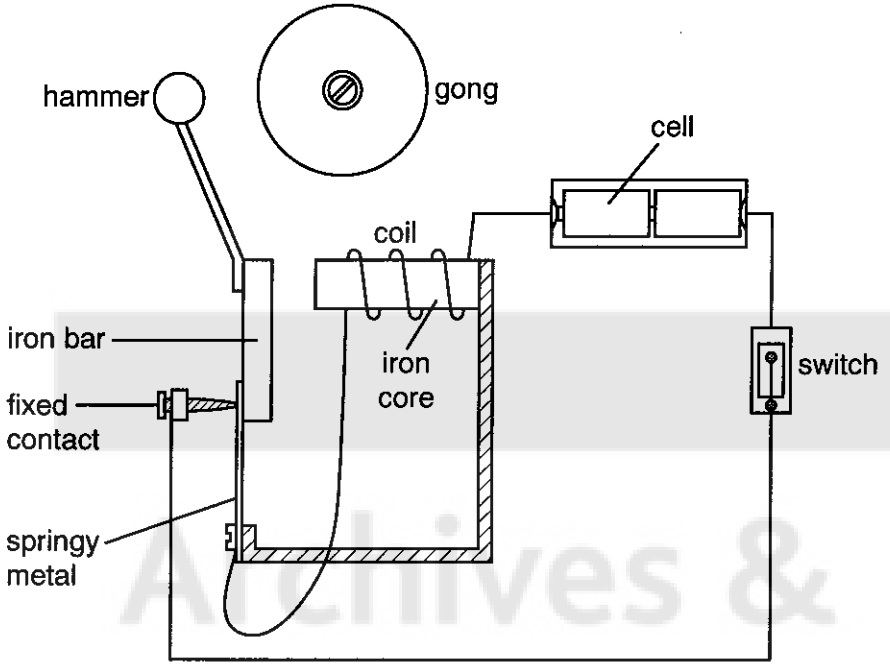
(c) Why are microwaves preferred to radiowaves for transmitting signals in **narrow beams**?

_____

_____ [2]

6 This question is about electromagnetism.

(a) Graham makes a simple electric bell.



He closes the switch.

(i) The hammer moves to the right and hits the gong.

Explain why.

_____

_____

_____ [2]

(ii) The hammer now moves back to the left.

Explain why.

_____

_____

_____ [2]

(b) Graham wants the hammer to hit the gong harder.

Alex says 'Why not replace the iron core with a permanent bar magnet?'

(i) Why is this **not** a good idea?

_____

_____

_____ [1]

(ii) Suggest **two** ways Graham could make the hammer hit the gong harder.

1. _____

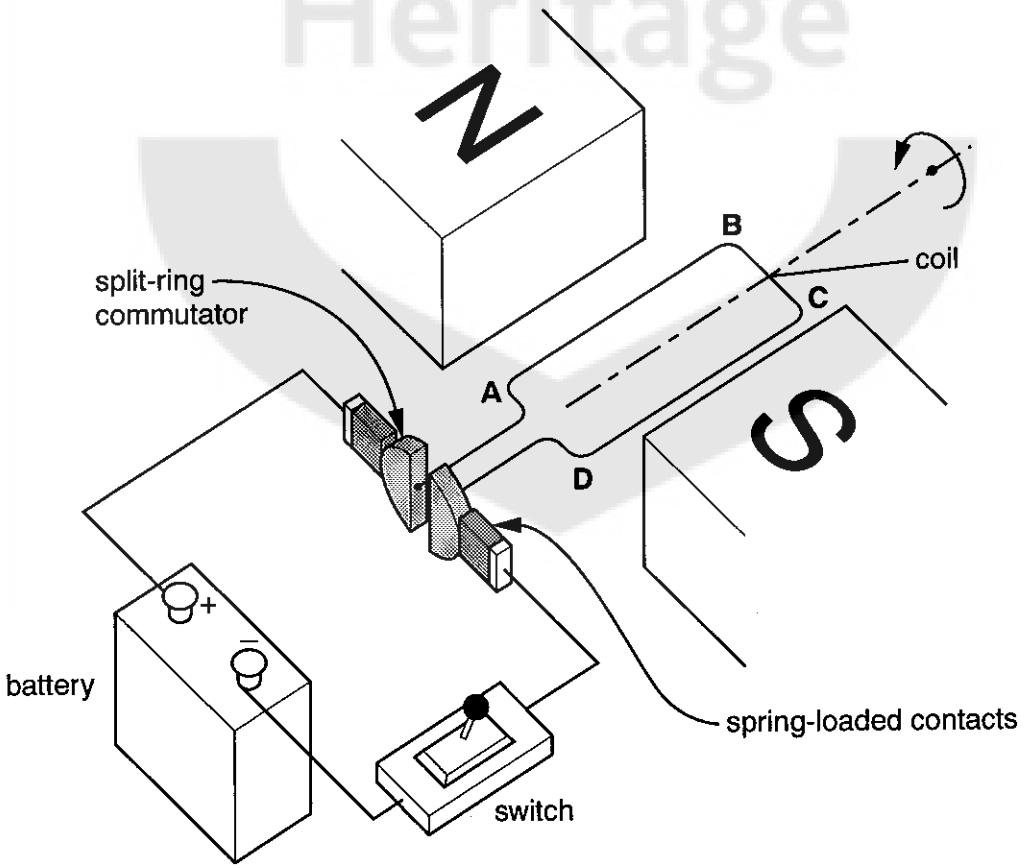
_____

2. _____

_____ [2]

(c) The diagram shows a simplified view of a model electric motor.

The coil is between the poles of a permanent magnet.



When the switch is closed the coil **ABCD** starts to spin.

(i) Use your ideas about forces on conductors in magnetic fields to explain why it **starts** to spin.

Drawing on the diagram may help your answer.

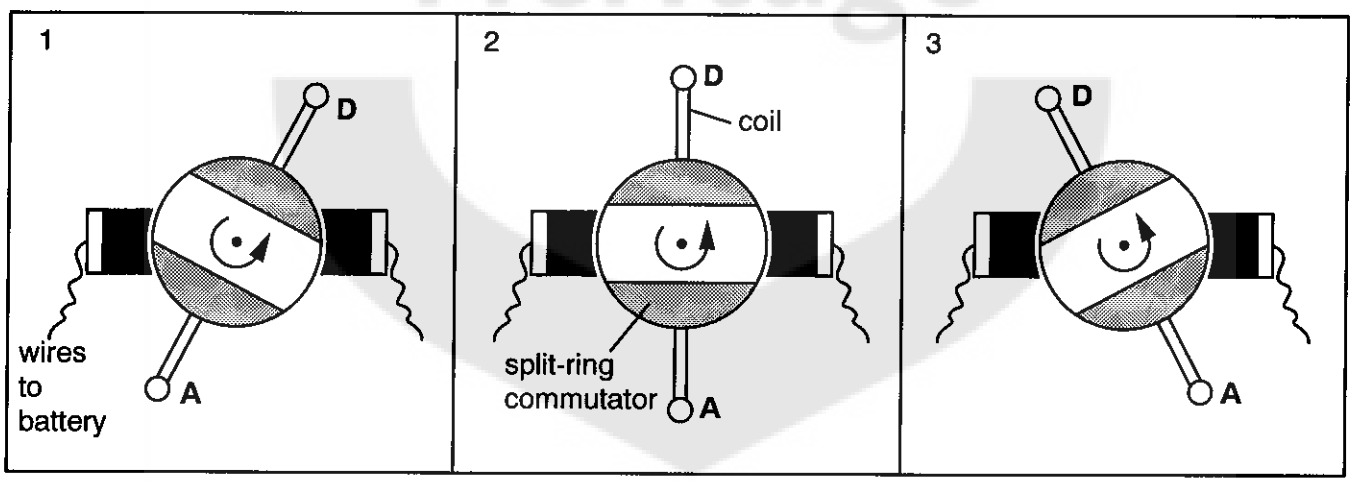
[3]

(ii) What will happen if the battery terminals are reversed?

Explain why.

[2]

(iii) The diagrams show the split-ring commutator as the coil of the motor spins through the vertical position.

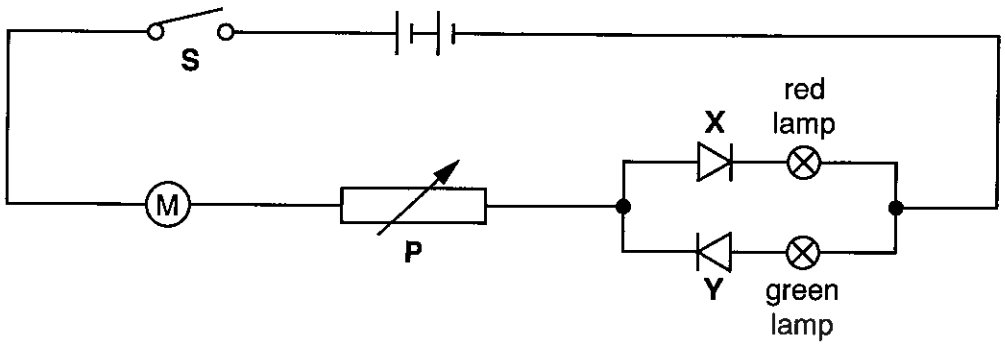


Explain how the split-ring commutator allows the motor to **continue** to spin.

Drawing forces on the diagram may help your answer.

[2]

7 Karen wires up this circuit.



(M) is the symbol for an electric motor.

(a) Karen closes **S**. She writes this down.

	• Motor spins
	• Red lamp is on
	• Green lamp is off

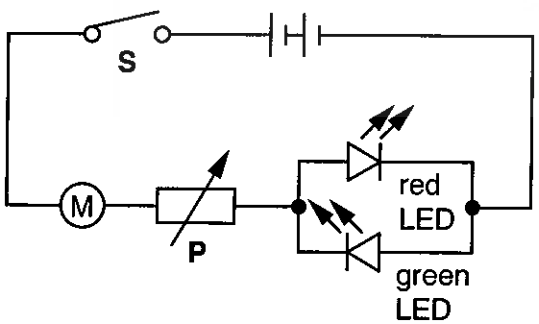
She now reduces the resistance of **P**. What observations will she make about the motor and the lamps now?

motor _____

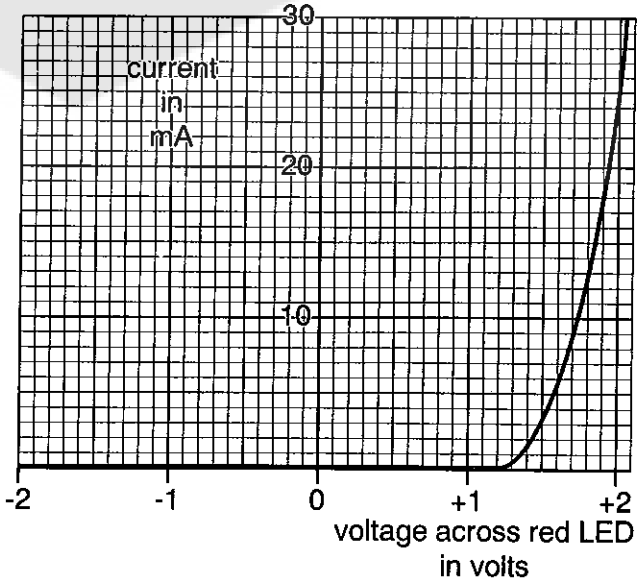
red lamp _____

green lamp _____ [3]

(b) She replaces **X** , **Y** and the lamps with red and green LEDs.



current-voltage graph for a red LED



The graph shows how current varies with voltage across a red LED.

The graph for a green LED is very similar.

(i) Use the graph to find the current through the red LED when the voltage across it is 1.6 V.

You **must** show clearly on the graph how you get your answer.

current = _____ mA [2]

(ii) Calculate the resistance of the red LED when the voltage across it is 1.6 V.

You **must** show how you work out your answer.

resistance = _____ unit _____ [4]

(iii) Use information from the graph to explain how the resistance changes as the voltage increases from zero to 2.0 V.

_____

_____

_____ [2]

(iv) When the voltage across the green LED is 2.0 V, the current through the motor is 25 mA.

Use the graph and your ideas about circuits to explain why.

_____

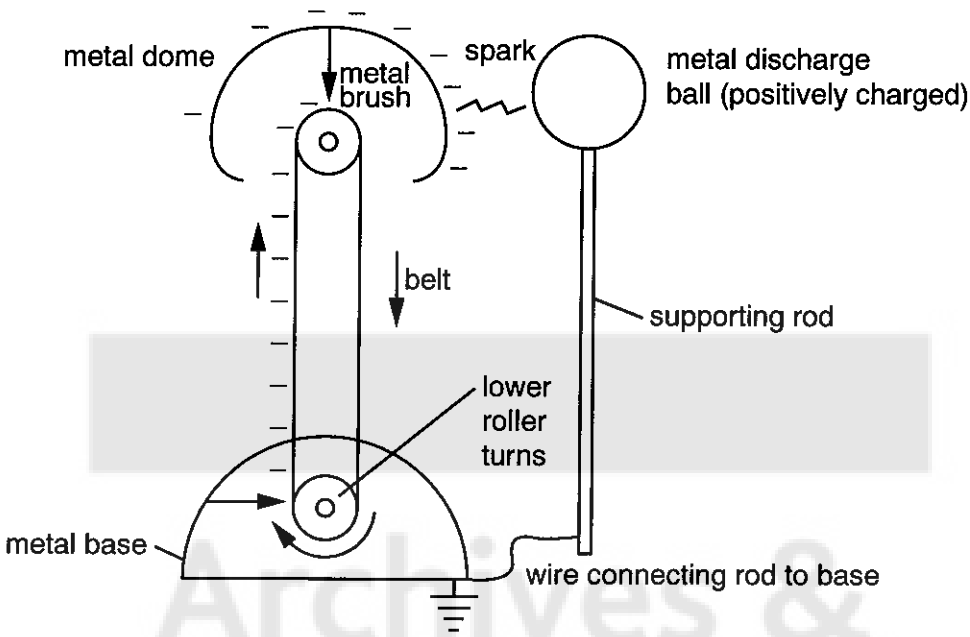
_____

_____

_____ [3]

8 This question is about static electricity.

Frances is using a Van de Graaff generator to make sparks.



The lower roller is turned.

Negative charge is carried by the belt up to the upper roller.

The negative charge is transferred by the brush to the metal dome.

(a) **(i)** The discharge ball becomes positively charged.

The supporting rod must be conducting for this to happen. Explain why.

_____

_____

_____ [2]

(ii) Write an **X** on the metal discharge ball to show where there is **most** positive charge. [1]

(b) A spark occurs when enough negative charge collects on the metal dome.

The air becomes conducting.

(i) Use your knowledge of particles and how they move to describe the current between the dome and the ball.

_____

_____

_____ [2]

(ii) 0.001 mC of charge is transferred in a spark. 90 mJ of energy is released.

Calculate the voltage between the dome and the ball which causes this transfer.

You **must** show how you work out your answer.

voltage = _____ V [3]

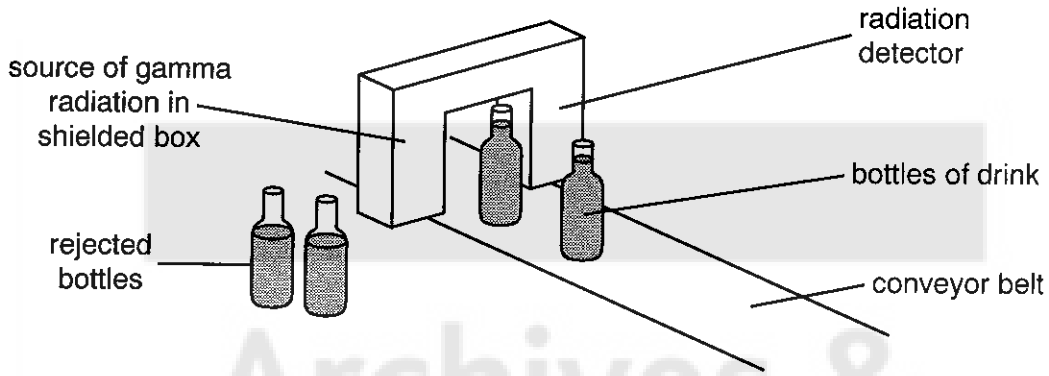
9 This question is about radioactivity and its uses.

Americium-241 ($^{241}_{95}$Am) is a radioactive material which emits gamma radiation.

A brewery uses Americium-241 in its bottling plant.

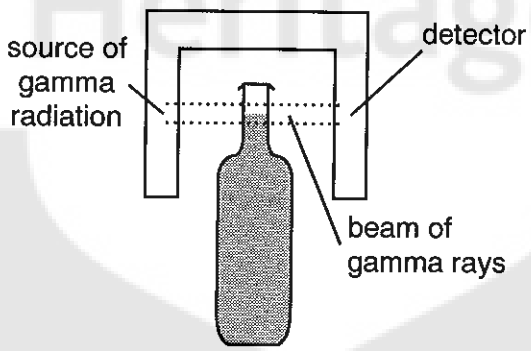
The diagram shows bottles of drink passing through a liquid level detector.

If the bottle is not full enough, the bottle is rejected.

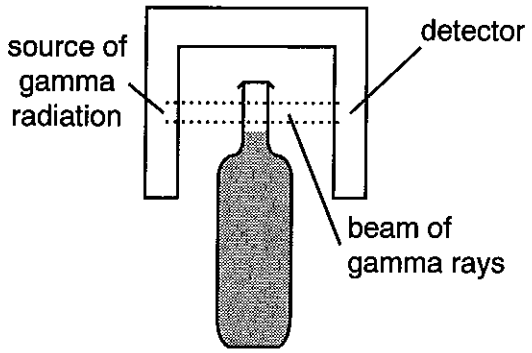


The gamma radiation passes through the bottle and its contents.

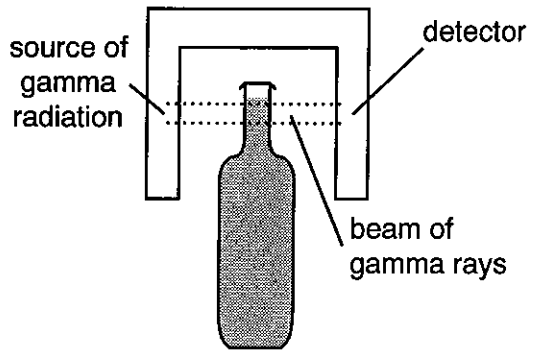
The radiation is detected on the other side.



bottle filled to correct level



bottle not full enough



bottle too full

(a) **(i)** For this process to work, all of the bottles must be accurately made to be the same thickness.

Suggest why.

_____

_____

_____

_____ [2]

(ii) Why is gamma radiation used instead of alpha radiation?

_____ [1]

(iii) Some modern bottling machines use ultrasound instead of gamma radiation to check the liquid level.

Suggest why ultrasound is used instead of gamma radiation.

_____

_____ [2]

(b) Americium-241 has a half-life of 460 years.

(i) Explain what is meant by the term **half-life**.

_____

_____

_____ [1]

(ii) The machinery at the bottling plant is designed to last for twenty years.

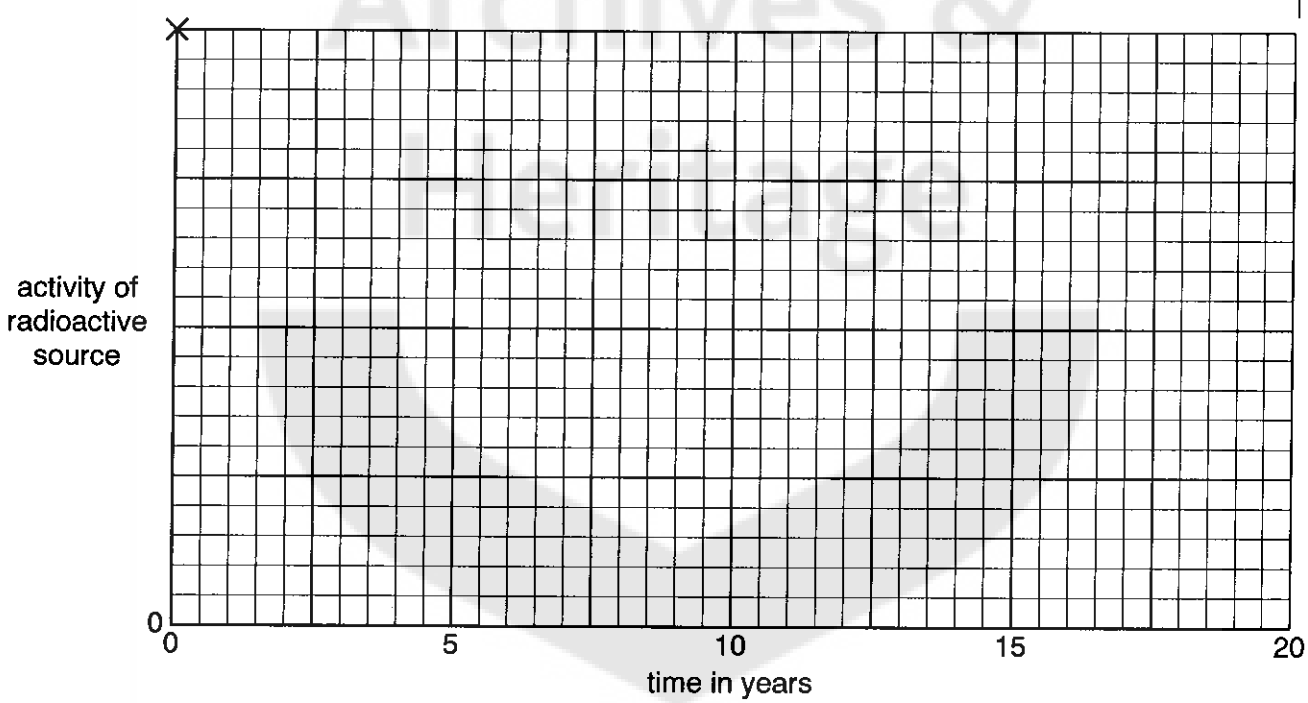
Cobalt-60 is another radioactive material used in industry which emits gamma radiation.

It has a half-life of 5 years.

Plot accurately on the grid the activity of the Cobalt-60 after 5, 10, 15 and 20 years.

The activity at the start has been marked for you (X).

Finish the graph by drawing the best line through the points. [3]



(iii) **Sketch** on the grid how the activity of the Americium-241 (half-life 460 years) changes during the twenty years.
Use the same starting point (X) as before.
Label your line **A**. [1]

(iv) Use your graph to explain why Cobalt-60 is not a suitable radioactive source to use in the bottling plant.

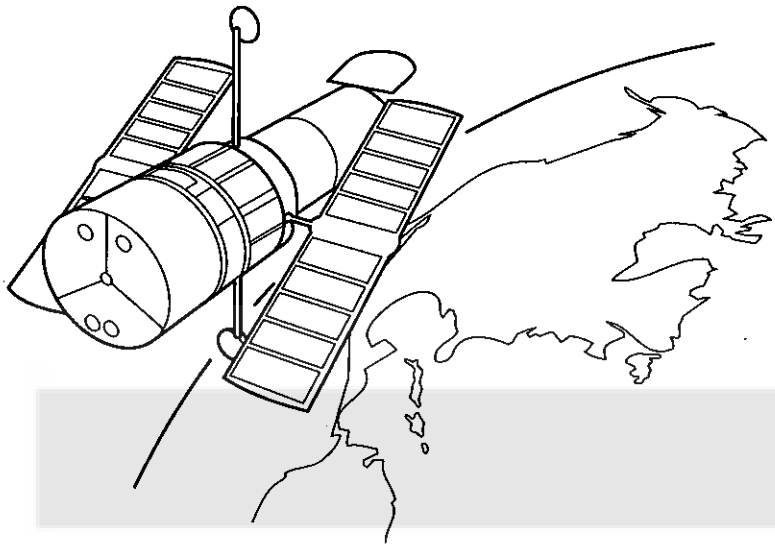
_____

_____

_____ [2]

For Examiner's Use

10 The Hubble Space Telescope orbits the Earth at a height of 600 km.



(a) Calculate the time it takes for a microwave signal to reach Earth from the satellite.

The speed of the microwave signal is 300 000 km/s.

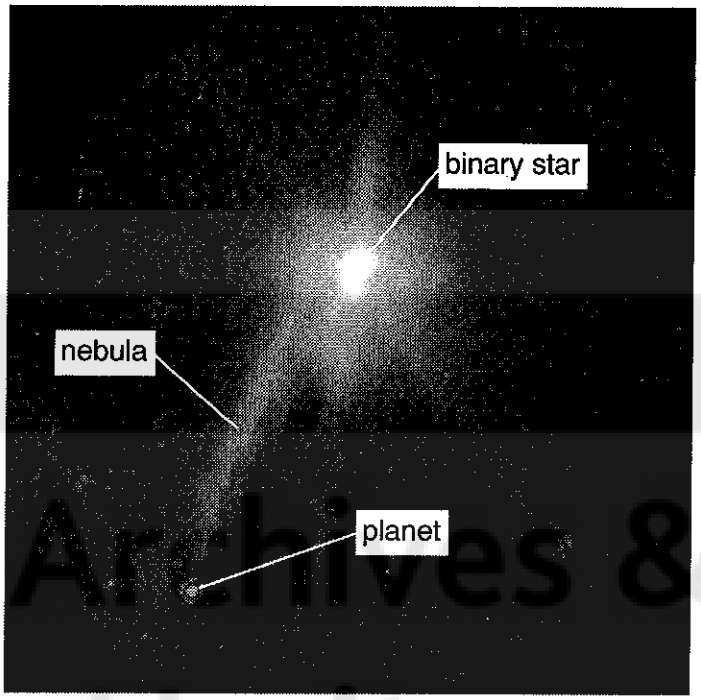
You **must** show how you work out your answer.

time = _____ s [3]

For Examiner's Use

(b) This picture was taken by the Hubble Space Telescope in August 1997.

It shows the birth of binary stars. These are a pair of stars which orbit around each other.



Read the following sentences from the NASA press release.

Then use them to help you answer the questions.

HUBBLE'S FIRST DIRECT LOOK AT POSSIBLE PLANET AROUND ANOTHER STAR

This NASA Hubble Telescope infra-red picture of new-born binary stars shows a long thin nebula pointing towards a faint object. This could be the first planet outside our solar system to be pictured directly.

The brightest objects in the picture are the binary stars. These illuminate a large cloud of gas and dust from which the stars formed. So much dust surrounds these stars that they are almost invisible at optical wavelengths. However, infra-red light penetrates the dust, revealing the new-born stars.

At the bottom left of the picture, there is a point of light many times fainter than the stars. Calculations show that this object is much too dim to be an ordinary star. The brightness of this object suggests it could be a hot planet several times the mass of Jupiter. The planet is 200 billion kilometres from the star (1400 times the Earth's distance from the Sun). A bright streak (nebula) stretches from the star towards the planet. This may suggest that the planet was ejected from the star system.

Present ideas predict that very young giant planets are still warm from being formed by gravitational contraction. Temperatures can be as high as a few thousand degrees Celsius. This makes them relatively bright in infra-red light compared with old giant planets such as Jupiter.

(i) The picture of the star system has been formed using infra-red light rather than visible light.

Use your knowledge of waves to explain the difference between infra-red light and visible light.

_____

_____ [1]

(ii) Why was visible light not used?

_____

_____ [1]

(c) Stars form from clouds of gas and dust. Explain how.

_____

_____ [1]

(d) Calculations show that the object referred to in line 9 is a planet rather than a star.

(i) What information about the planet in the passage supports this?

_____ [1]

(ii) Suggest what process **cannot** be occurring in the planet's core.

_____ [1]

(e) Why would you expect the acceleration due to gravity at the surface of the planet to be much greater than that on the surface of Jupiter?

_____ [1]

(f) What information in the passage suggests it will take many Earth years for the planet to orbit the binary stars?

_____ [1]

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