ST EDWARD'S
OXFORD

13+ SCHOLARSHIP EXAMINATION
2013

SCIENCE

Candidate Name

1 Hour

BIO	CHE	PHY

INSTRUCTIONS TO CANDIDATES

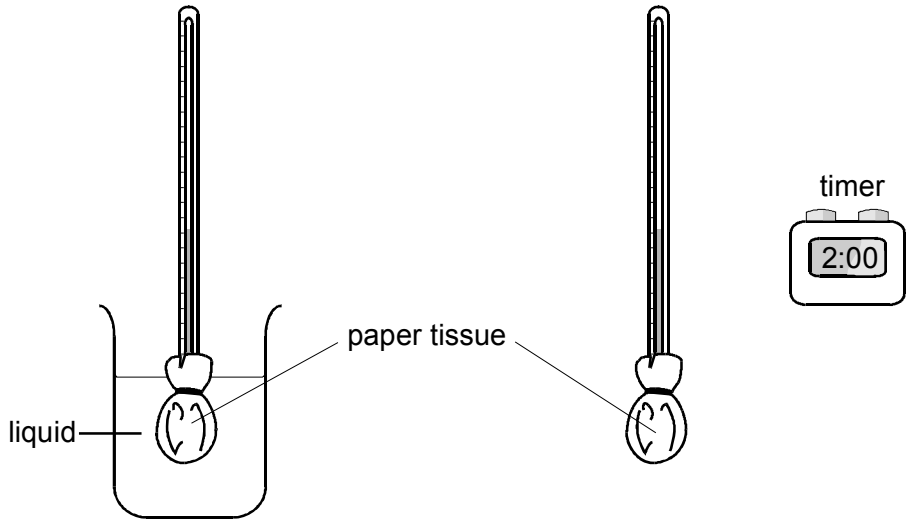
Write your name in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

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 calculator may be used.

1. A group of pupils carried out an experiment with four different liquids.

They wrapped paper tissues around the bulbs of four thermometers. They secured the tissues with rubber bands. Each thermometer was then dipped into a different liquid and removed. The temperature was recorded. The reading on each thermometer was then noted every two minutes.



The results are given in the table below.

time in min	reading, in °C, on the thermometer dipped in:			
	propanone	**ethanol**	**ether**	**water**
0	23	23	23	23
2	13	19	11	21
4	4	16	–2	20
6	2	14	–8	20
8	3	14	–1	20
10	4	14	8	20
12	6	14	17	20

(a) Suggest which liquid evaporated most rapidly.

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1 mark

(b) After six minutes, the reading went up on the thermometer dipped in ether. Explain why.

.....

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1 mark

(c) What is the likely temperature of the room in which they did the experiment?

.....…

1 mark

(d) The pupils carried out the experiment with propanone again. However, this time they did **not** wrap the thermometer in paper tissue but just dipped the glass bulb into the propanone and removed it. Suggest how their second set of results would be different.

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1 mark

Maximum 4 marks

2. The elements in group 7 of the periodic table are known as the halogens.

	melting point in °C	**boiling point in °C**	**relative atomic mass**	**colour of element at room temperature, 20°C**
fluorine	–220	–188	19	very pale yellow
chlorine	–101	–34	35.5	greenish yellow
bromine	–7	59	80	reddish brown
iodine	114	184	127	dark grey
astatine			210	

(a) (i) Predict the physical state of astatine at room temperature.

.....

1 mark

(ii) Predict the colour of astatine at room temperature.
Tick the correct box.

colourless ☐

yellow ☐

brown ☐

black ☐

1 mark

(b) The reactions of chlorine and bromine with some sodium salts are given below.

salt	colour of salt solution	colour after addition of chlorine solution, which is greenish yellow	colour after the addition of bromine solution which is orange
sodium chloride	colourless	pale greenish yellow	orange
sodium bromide	colourless	orange	orange
sodium iodide	colourless	dark brown	dark brown

(i) Use these observations to put the elements bromine, chlorine and iodine in order of reactivity.

least reactive .....

.....

most reactive .....

1 mark

(ii) A solution of iodine, which is dark brown, is added to a solution of sodium bromide. What will be the colour of the resulting solution?

1 mark

(c) Predict, with a reason, if there will be a reaction between:

(i) fluorine and sodium chloride solution.

.....

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1 mark

(ii) astatine and sodium iodide solution.

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1 mark

Maximum 6 marks

3. (a) Potassium nitrate (KNO_3) can be made by reacting 'potash' (K_2CO_3) with nitric acid (HNO_3).

(i) What is the chemical name for 'potash' (K_2CO_3)?

.....

1 mark

(ii) Write a balanced equation for the reaction of 'potash' with nitric acid.

.....

3 marks

(b) Potassium nitrate is used in airbags, which are part of the safety equipment of modern cars.
Inside an airbag, potassium nitrate is mixed with sodium azide.
When there is an accident, a spark makes the chemicals react.

(i) Firstly, the solid sodium azide (NaN_3) decomposes to produce sodium and nitrogen gas (N_2). Write a balanced symbol equation for this reaction.

.....

1 mark

(ii) Next, the sodium reacts with the potassium nitrate to form more nitrogen gas. The nitrogen inflates the nylon airbag.

Explain, in terms of molecules, why the formation of nitrogen gas makes the bag inflate.

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.....

2 marks

(iii) Why is it important that there is **no** sodium left after the reactions?

.....

.....

1 mark

(c) (i) As the driver is thrown forward against the bag, the gas pressure in the bag increases. Explain why it increases.

.....

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1 mark

(ii) There are tiny holes in the bag which allow a small volume of the gas to escape.

How does this prevent injury to the driver?

.....

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1 mark

Maximum 10 marks

4. The following is an extract from an anti-smoking pamphlet.

What about the risks for the passive smoker?



Cigarettes give off two types of smoke – 'mainstream smoke' is filtered by the cigarette and inhaled by the smoker. The other type is 'sidestream smoke' which goes directly into the air.

Children who are exposed to their parents' sidestream smoke are more prone than other children to many diseases.

(a) Give **two** diseases which children who inhale sidestream smoke are more likely to get than children whose parents do not smoke.

1 .....

2 .....

(2)

(b) Use information from the passage to suggest why mainstream smoke is less dangerous than sidestream smoke.

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(1)

(c) Explain, as fully as you can, why many people find it very difficult to give up smoking.

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(2)

(Total 5 marks)

5. The table shows the sources of some of the energy used in India between 1960 and 1970.

	Source of energy in millions of tonnes			
	Non-renewable fuels		**Renewable fuels**	
Year	**Coal**	**Oil**	**Cow dung**	**Vegetable waste**
1960	47	7	101	31
1965	64	10	112	34
1970	71	15	123	38

(a) The change in the use of renewable fuels differs from that of non-renewable fuels. Calculate the percentage of renewable fuels used in 1960 and in 1970. Show clearly how you work out your final answer.

1960 .....

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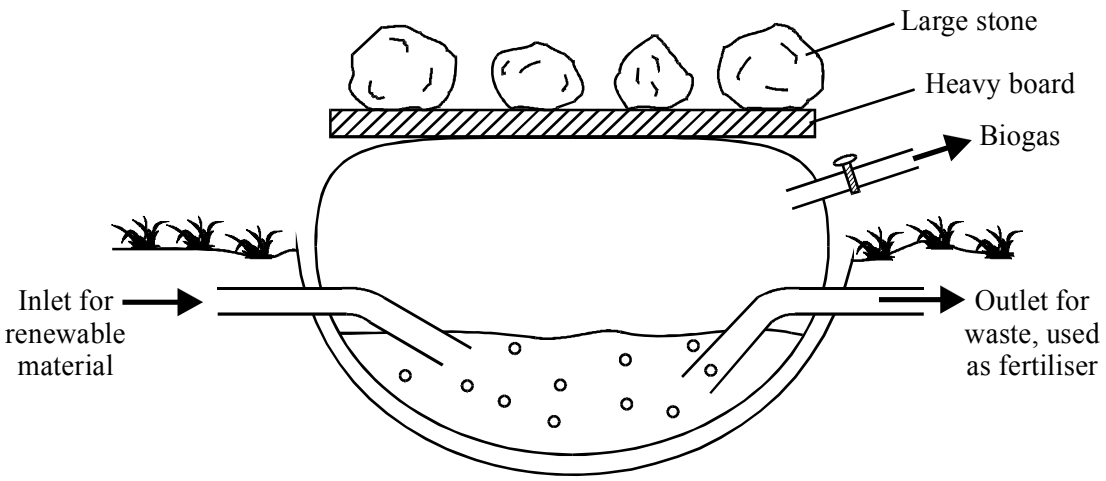
1970 .....

.....

(3)

(b) The Indian government suggested that villagers should make better use of renewable resources.

They introduced biogas generators. The diagram shows one type of biogas generator.



The table shows the economic costs and benefits of using this type of generator.

Feature	**Cost or profit in £s**
Cost of generator and fitting	250
Annual maintenance costs	40
Annual profit from gas produced	30
Annual profit from fertiliser produced	40

Evaluate the advantages and disadvantages of using this type of generator.

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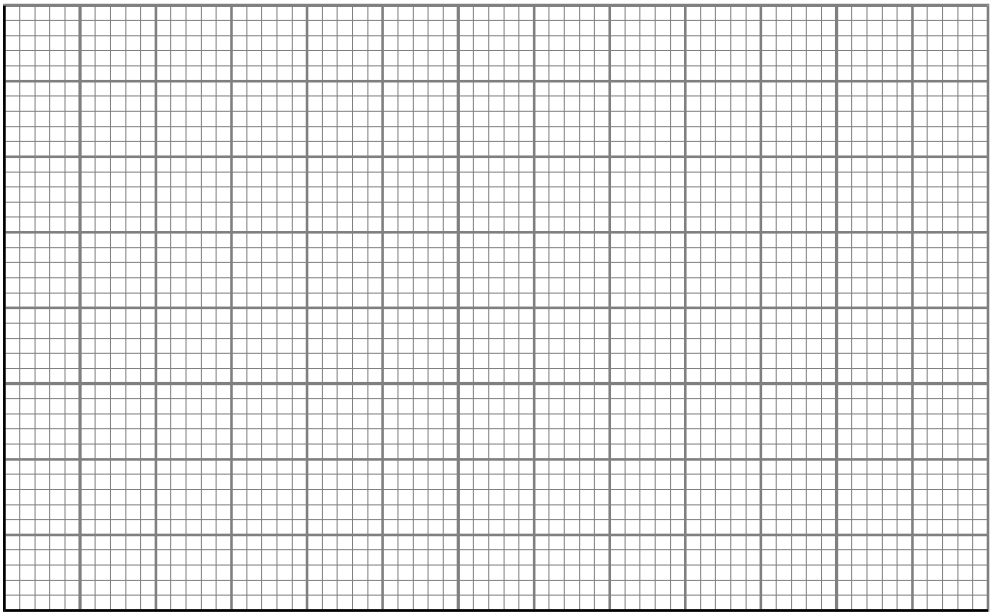
(4)

(c) The table shows how temperature affects the rate of biogas production in the generator.

Temperature in °C	10	15	20	25	30	35	40
Volume of biogas produced each day in m^3	0.50	0.55	1.50	1.70	3.00	3.45	3.30

(i) Use the grid to draw a graph to show how temperature affects the rate of biogas production.

Volume of biogas produced in m^3



Temperature in °C

(3)

(ii) Temperatures in India may reach over 35 °C. Explain the advantage of the generator being mainly underground.

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(2)

(Total 12 marks)

6. Each January, the RSPB (Royal Society for the Protection of Birds) organises the **Big Garden Birdwatch.** About 400 000 volunteers take part.

This is to find the most commonly seen garden birds. These are the instructions given to volunteers.

- Choose one hour over the weekend of 29-30 January to watch birds in your garden, local park or school.
- Then tell us the highest number that you see at any one time (not the total number that you see in one hour).
- You only need to record the birds that actually land (not the ones flying over).

The table shows what one volunteer recorded.

Bird	Most seen at one time
Blackbird	2
Blue tit [13]	2
Chaffinch	0
Coal tit	0
Collared dove	2
Goldfinch	0
Great tit	0
Greenfinch	0
House sparrow	6
Long-tailed tit	1
Magpie	2
Robin	1
Starling	8

(a) The volunteers were all asked to do the survey on the weekend of 29-30 January.

Explain why.

.....

.....

(1)

(b) The volunteers were told **not** to count the total number of birds seen in one hour.

Explain why.

.....

.....

(1)

(c) The volunteer said "My results show that starlings are the most common garden bird."

Was she correct?
Give the reason for your answer.

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(1)

(d) The RSPB have collected questionnaires from 400 000 people.

Suggest the best method of storing this data so that it could be analysed quickly.

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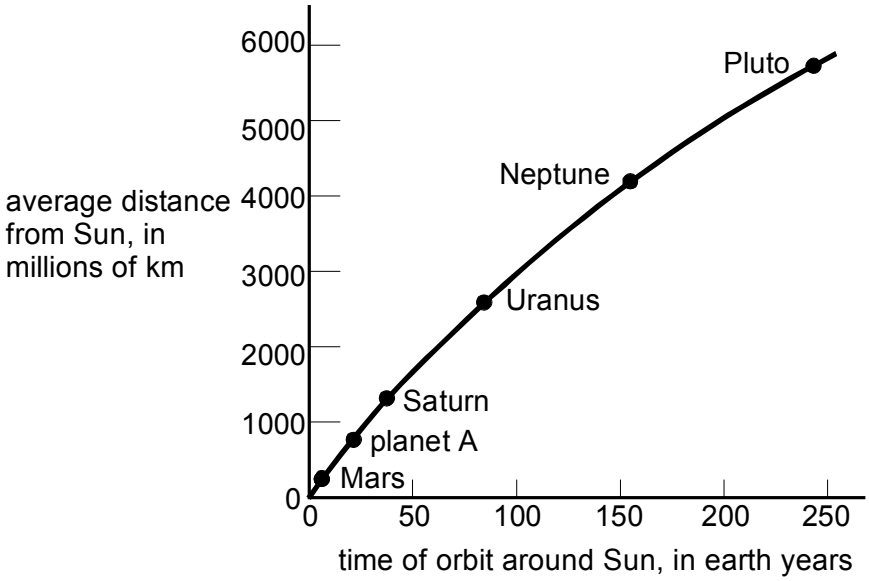
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(2)

(Total 5 marks)

7. The graph below gives information about some of the planets in the Solar System.

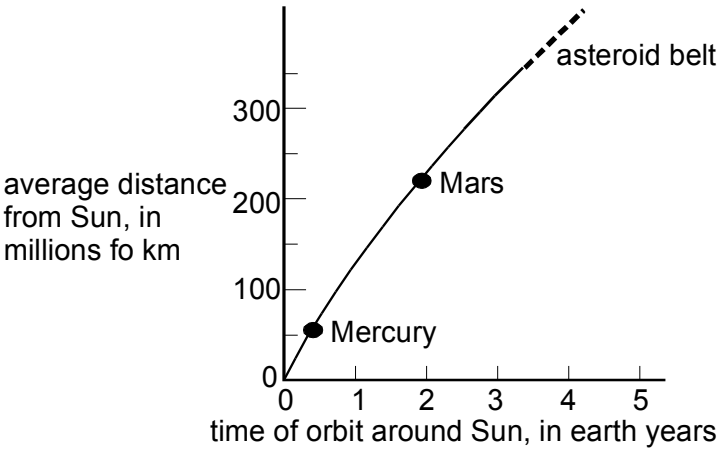


(a) Planet A is shown on the graph above.
The orbit of planet A is between Saturn and Mars.
What is the name of planet A?

.....

1 mark

(b) Part of the graph opposite is shown in more detail below.



(i) Use a dot (●) to mark the position of the Earth **carefully** on the graph above. Label the dot 'Earth'. Explain why you put the dot at this position.

.....

.....

2 marks

(ii) On the same graph, mark with a cross (**X**) the approximate position of Venus and label it 'Venus'.

1 mark

(c) Asteroids orbit the Sun just like the planets. Information about five asteroids is given in the table below.

name of asteroid	Eugenia	Hestia	Iris	Melpomene	Psyche
time of orbit in Earth years	4.49	4.01	5.51	3.48	5.00

Which asteroid is the greatest distance from the Sun? Give the reason for your answer.

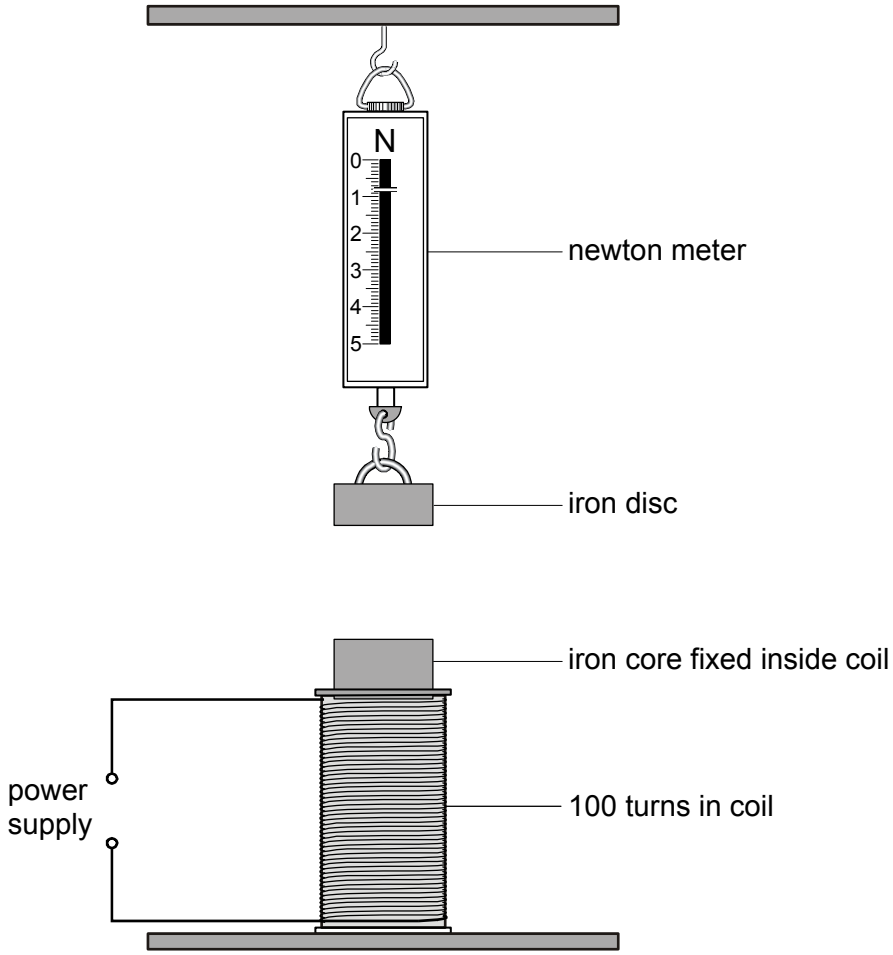
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1 mark

Maximum 5 marks

8. Mary used the apparatus below to test the strength of an electromagnet.
She used the reading on the newton meter to measure the force of the magnet on the iron disc.



(a) Explain why the reading on the newton meter increases when a current passes through the coil.

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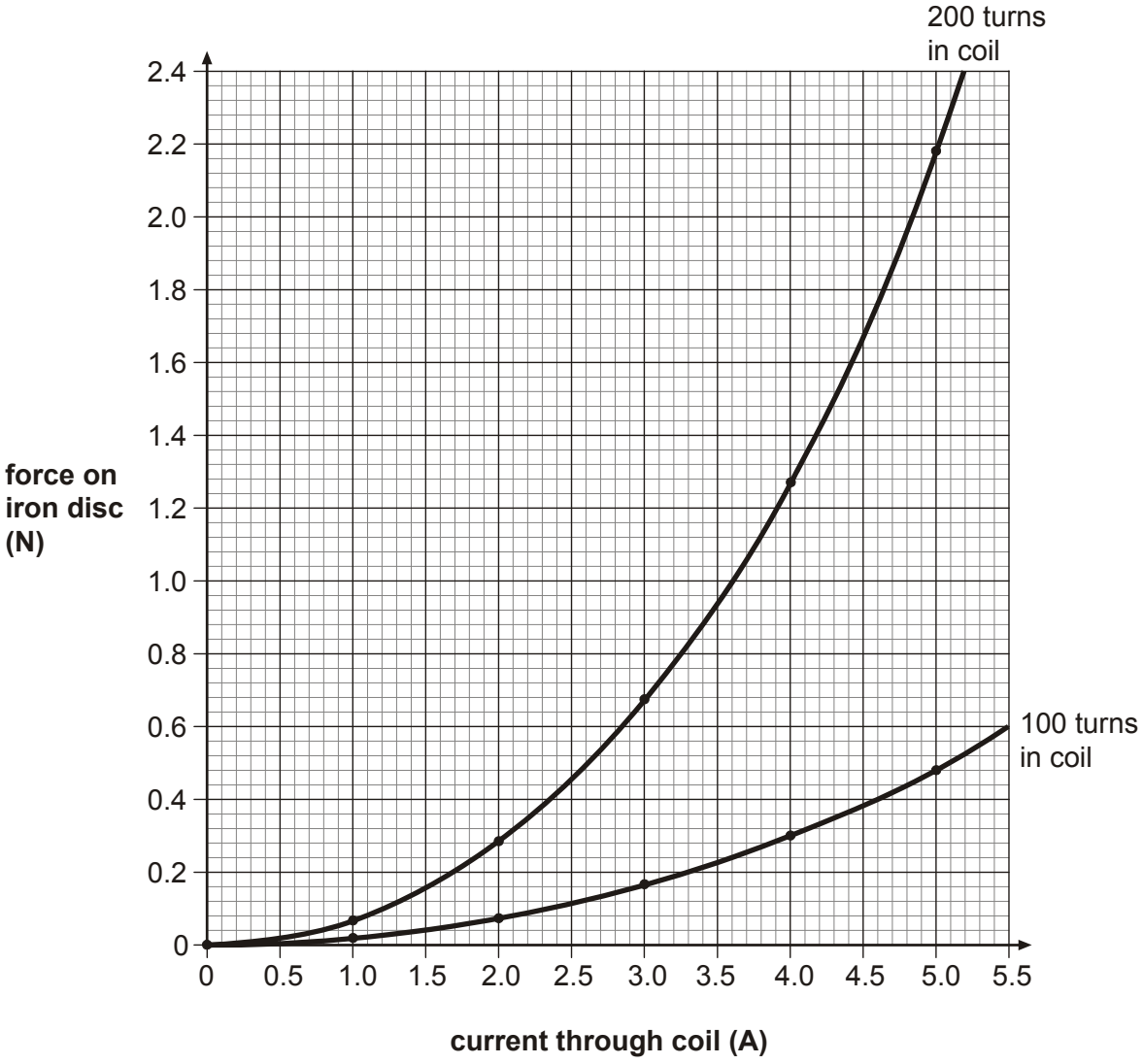
2 marks

(b) When a current passes through the coil, some of the electrical energy is changed to thermal energy.
What would happen to the coil if the current passing through it was too large?

.....

1 mark

(c) Mary made two electromagnets, one with 100 turns of wire in the coil and one with 200 turns.
She varied the current through the coil of each electromagnet.
She measured the force of each electromagnet on the iron disc.
The graph shows her results.



Write **two** conclusions that Mary could make from these results.

1. .....

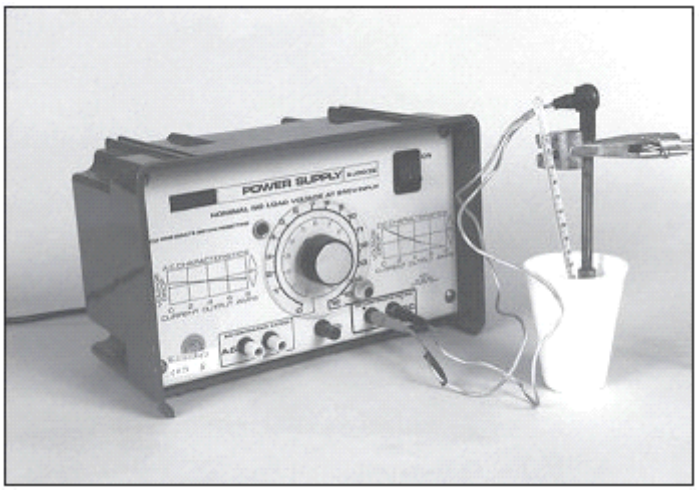
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2. .....

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2 marks
maximum 5 marks

9. John used an electrical heater to heat a cup of water. He kept stirring the water. When the temperature reached 20°C, he started his stopwatch and measured the temperature of the water every half minute.

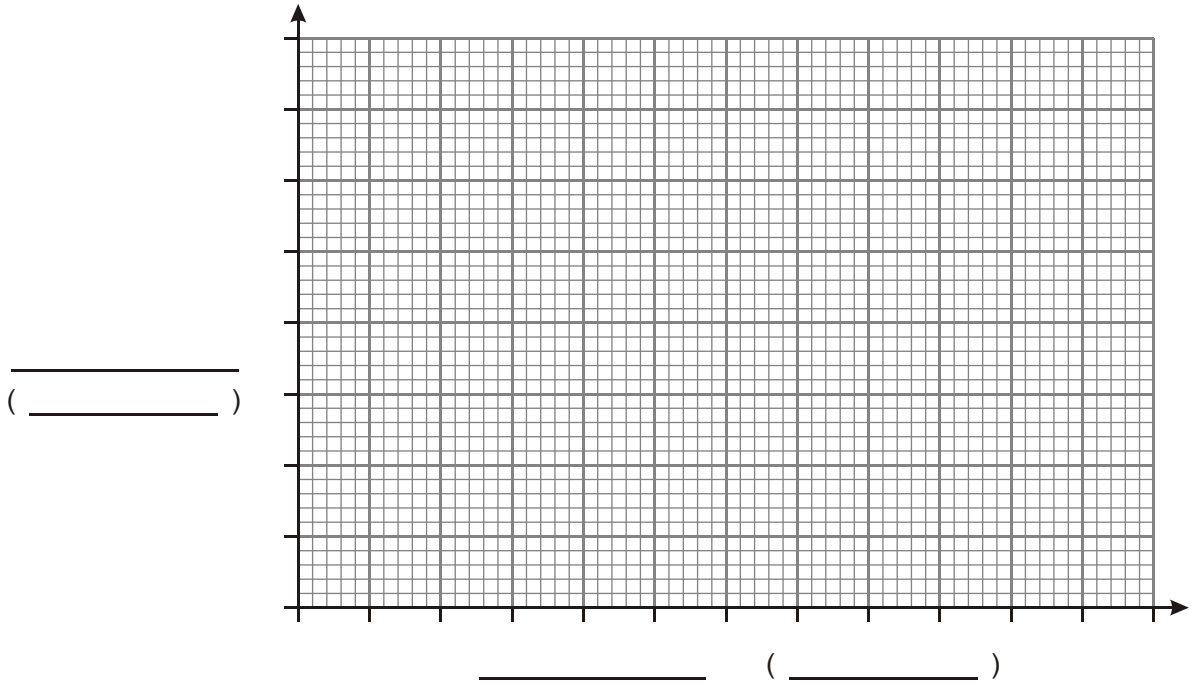


He switched off the heater after 4 minutes, but continued to record the temperature. His results are shown in the table.

One measurement is missing and another appears to be wrong.

Time (minutes)	**Temperature (°C)**
0.0	20
0.5	26
1.0	31
1.5	36
2.0	41
2.5	46
3.0	
3.5	57
4.0	56
4.5	58
5.0	59
5.5	59

(a) Use the results in the table to draw a graph on the grid.
Label the axes.
Plot the points and draw a smooth curve of best fit.



4 marks

(b) From your curve, estimate the temperature of the water after **three** minutes.

.....°C

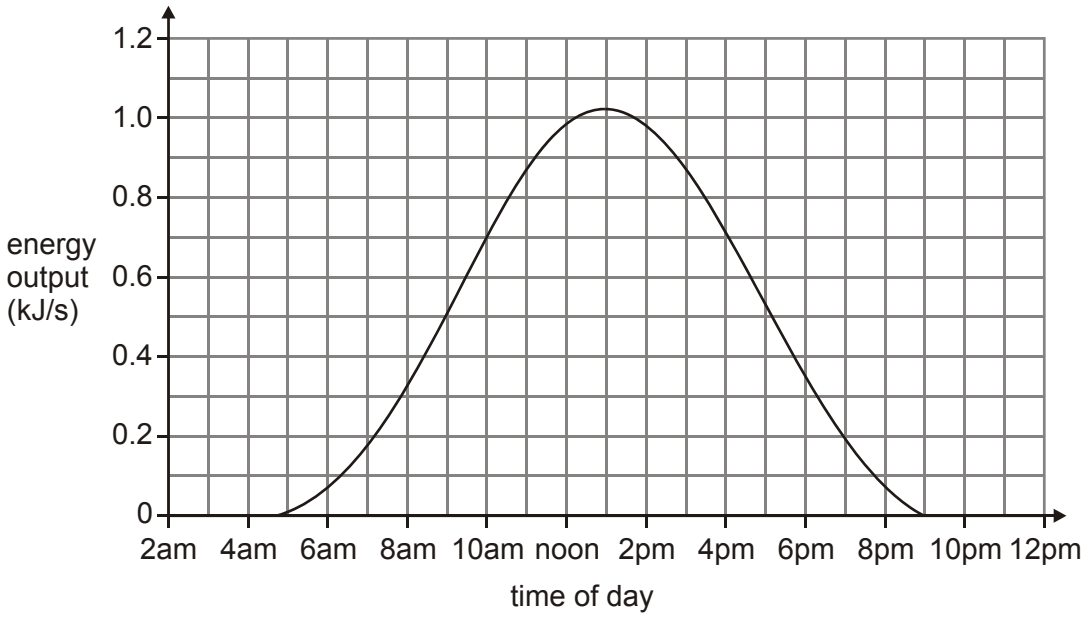
1 mark

maximum 5 marks

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



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



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

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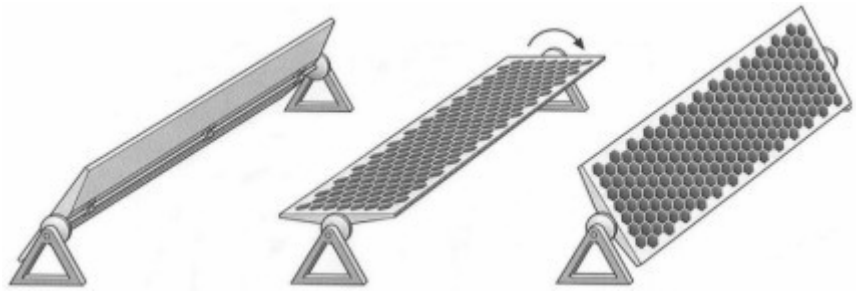
1 mark

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

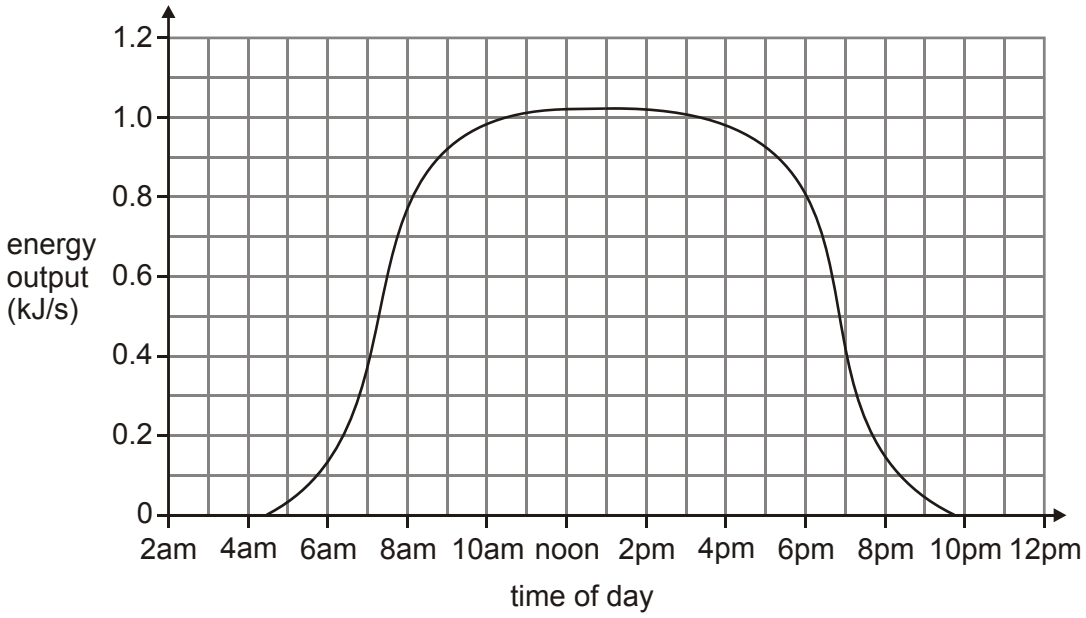
..... hours

1 mark

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



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



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

2 marks

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

.....

.....degrees

1 mark

maximum 5 marks