St Mary's School
CAMBRIDGE

Lower Sixth Biology

Sample Entrance Examination

Time allowed: 60 minutes

Name: _____

INSTRUCTIONS :

- **Answer all questions**
- **Answers should be written in the spaces provided**
- **Dictionaries or reference materials are forbidden**

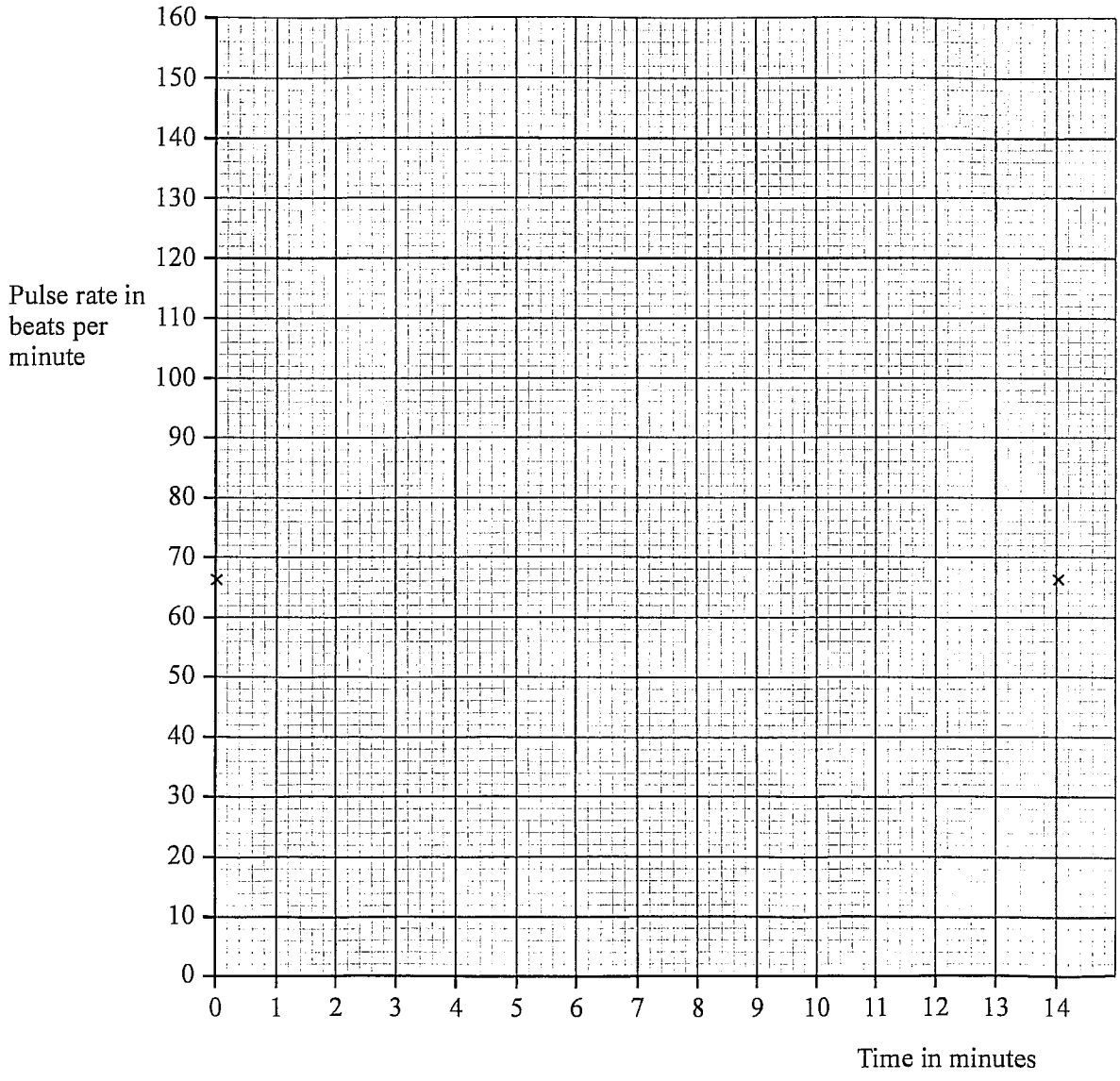
1. Kate's pulse rate was measured just before exercise, during the exercise and for a time afterwards.

The results are shown below.

Time (minutes)	0	2	4	6	8	10	12	14
Pulse rate (beats per min)	66	97	131	152	116	80	66	66

The points for 0 and 14 minutes are shown on the grid.

(a) (i) Plot the rest of Kate's results and complete the graph.



(3)

(ii) Kate stopped exercising after 6 minutes.
Use the graph to find her recovery time.

.....

(1)

(b) Kate trained intensively for one month.

(i) After each training session she measured her recovery time.
Why did she do this?

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(1)

(ii) At the end of the month, she again plotted her pulse rate against time.
In what TWO ways would the new graph be different from the original?

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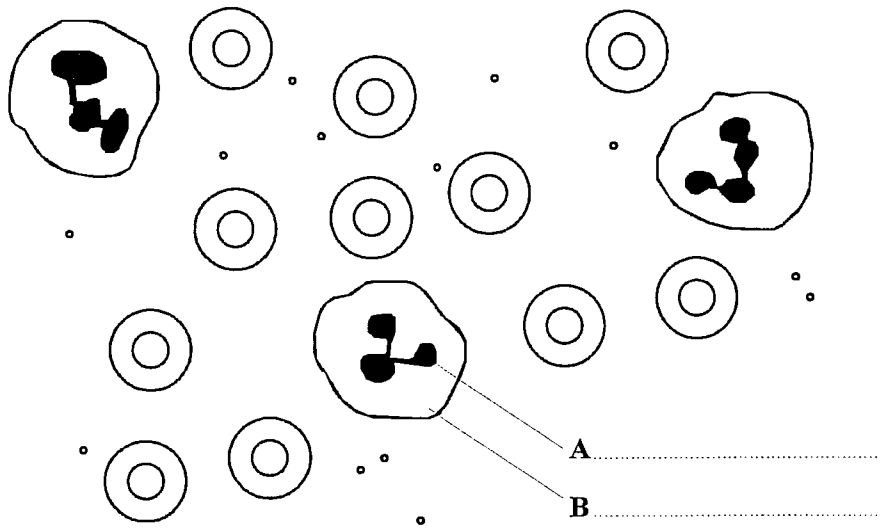
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(2)
(Total 7 marks)

2 Blood is a mixture of plasma, white blood cells, red blood cells and platelets.
The diagram shows a sample of blood,



(a) How many white blood cells are shown?

.....

(1)

(b) Use words from the box to label parts **A** and **B** on the diagram.

cytoplasm	**haemoglobin**	**membrane**	**nucleus**

(2)

(c) White blood cells make antibodies.
What do antibodies do?

.....

(1)

3 (a) Tick **two** statements which are true about insulin.

Insulin is a hormone	
Insulin is carried in blood plasma	
Insulin is an enzyme	
Insulin is produced in the liver	

(2)

(b) Insulin was discovered in 1922 by two scientists, Frederick Banting and Charles Best.



Banting



Best

Read this passage about their work. The lines have been numbered.

Late in the 19th century, scientists had realised that there was a connection between the pancreas and diabetes.

From 1910 to 1920 several scientists tried to extract the chemical that we now call insulin from the pancreas. No one managed to do so. Banting read a scientific paper in 1920 from which he developed a new idea which helped him to successfully extract insulin. Banting used dogs for his experiments. He was helped by his assistant Charles Best.

Six weeks after the experiments on dogs, insulin was injected into a 14 year old boy who was dying of diabetes. The injection changed his blood sugar level. A test on his urine showed that his health had improved

(i) Explain the phrase **Banting read a scientific paper**. (line 5)

.....

.....

(1)

(ii) Banting and Best tried their newly discovered insulin on dogs.

Suggest **one** reason why some people would think that this was:

a good idea

.....

(1)

a bad idea

.....

(1)

(iii) Banting and Best were awarded the Nobel Prize for their discovery of insulin.

How did the work of other scientists help them to make the discovery?

.....

.....

.....

(2)

(iv) How would the boy's blood sugar level have changed after he was given insulin? (lines 10 and 11)

.....

(1)

(v) What substance was his urine tested for? (line 11)

.....

(1)

(c) Suggest why the insulin was injected rather than being taken by mouth.

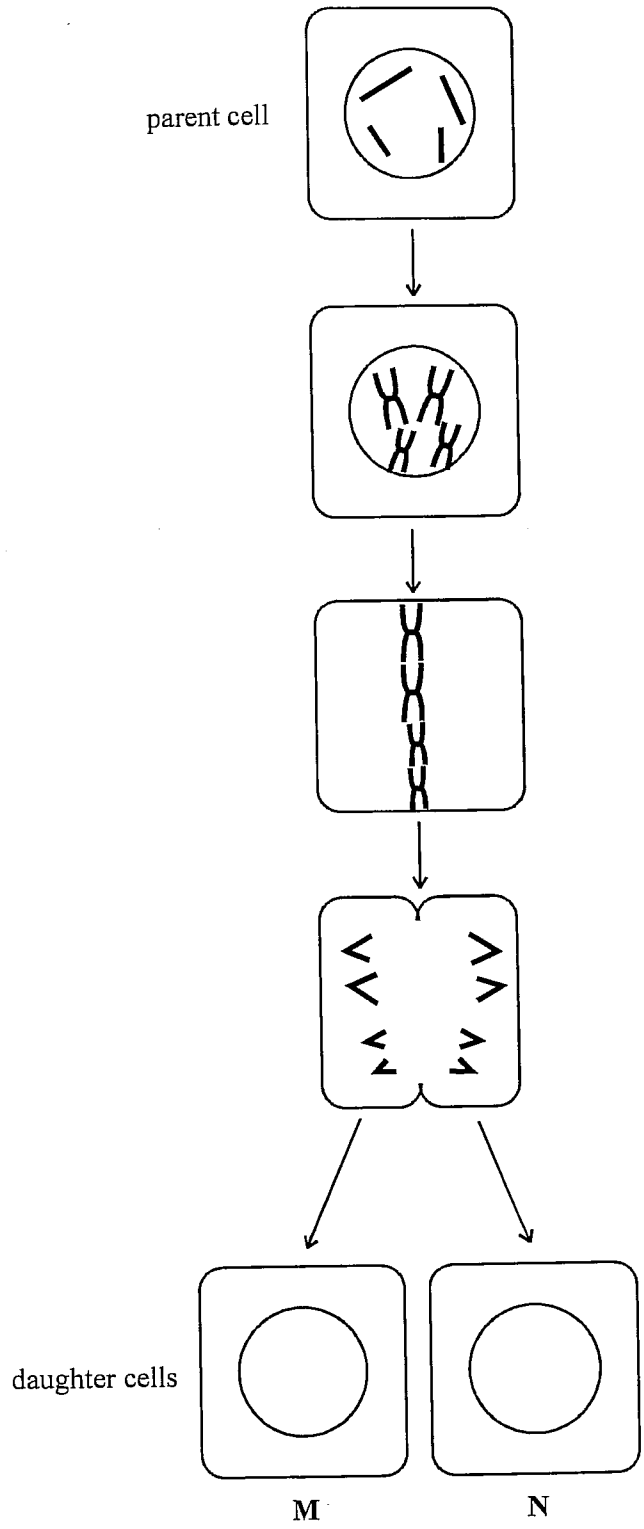
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(1)

(Total 10 marks)

4 The diagram shows the stages in mitosis in a cell with four chromosomes.



(a) Complete cells **M** and **N** by accurately drawing in the chromosomes present. **(2)**

(b) Meiosis is another type of cell division. It is used to produce gametes.

Give **two** other ways in which meiosis differs from mitosis.

1 .....

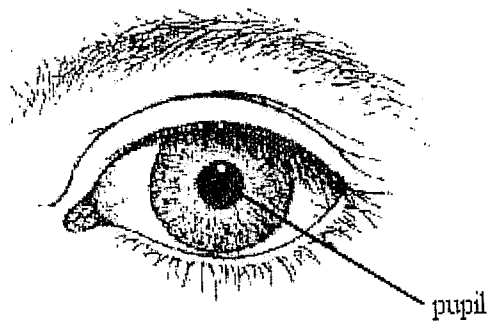
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2 .....

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(2)
(Total 4 marks)

5 The amount of light which reaches an eye changes the size of the pupil.



Mike switches the light on in a dark room.

These changes take place in his eye. They are not in the correct order.

A muscles in the iris contract which makes the pupil small

B less light reaches the retina

C electrical impulses are sent to the iris from the brain

D electrical impulses are sent through the optic nerve to the brain

E light reaches the retina

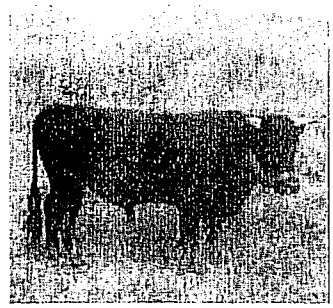
F bright light enters his eye

Write **one** letter in each box to show the correct order.

number	1	2	3	4	5	6
letter						

(Total 5 marks)

6 Dexter cattle are a small short-legged breed. They have the genotype **Dd**.
Kerry cattle have normal long legs, and have the genotype **DD**.
There is a third genotype **dd**. Calves with this genotype are always born dead.



(a) (i) Complete a genetic diagram for crossing a Dexter bull with a Kerry cow.

	Dexter		Kerry	
genotype	.....	×	.....	
gametes	.....	.....	.....	.....
offspring	.....	.....	.....	.....

(2)

(ii) What is the ratio of calf phenotypes from this cross?

.....

(1)

(b) (i) Complete a genetic diagram for crossing a Dexter bull with a Dexter cow.

	Dexter		Dexter	
genotype	.....	×	.....	
gametes	.....	.....	.....	.....
offspring	.....	.....	.....	.....

(2)

(ii) What is the ratio of calf genotypes from this cross?

.....

(1)

(iii) If twelve calves developed, how many would you expect to be born dead?

.....

(1)

(c) Which cross would you recommend to farmers who want Dexter calves?
Explain your answer.

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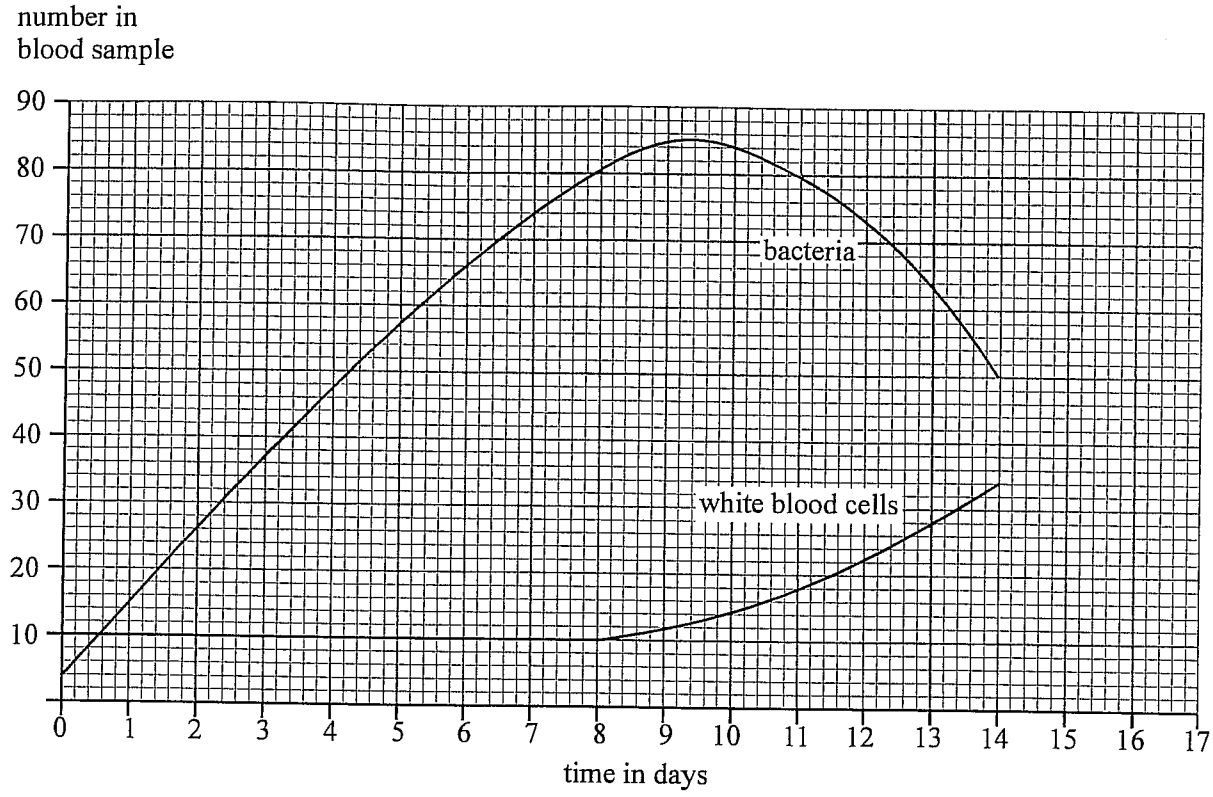
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(2)
(Total 9 marks)

7 The graph shows the numbers of white blood cells and bacteria in the blood of an infected person. The person was **not** being treated for the infection.



Use the information in the graph and your own knowledge to answer the questions below.

(a) (i) On which day did the number of white blood cells begin to increase?

.....

(1)

(ii) On which day did the number of bacteria begin to decrease?

.....

(1)

(b) Explain why the number of bacteria decreased.

.....

.....

.....

(2)

(c) Use the graph to predict when there would be no bacteria in the blood.

.....

(1)

(Total 5 marks)

9 Soil contains aluminium compounds. Acid rain washes these aluminium compounds out of the soil and into rivers and lakes.

(a) Explain how acid rain is formed.

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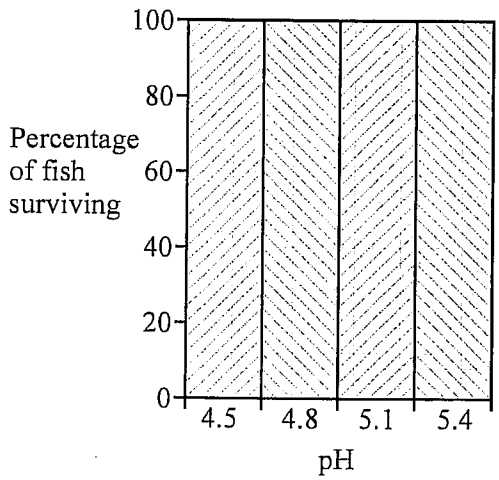
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(3)

(b) Graphs **X** and **Y** show the survival of fish in water at different pH values, with and without aluminium compounds.

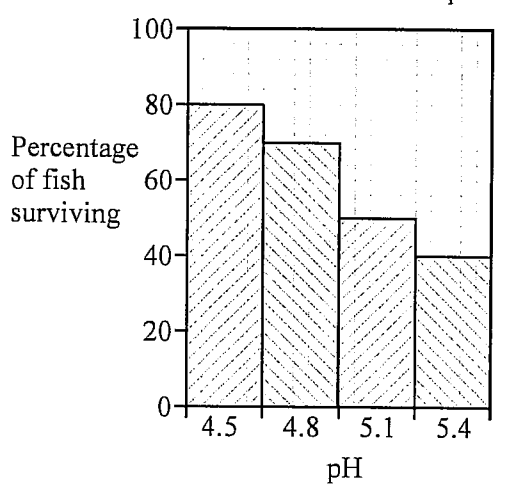
Graph X

Water without aluminium compounds



Graph Y

Water with aluminium compounds



(i) What percentage of fish survive at pH 4.8 in water containing aluminium compounds?

.....

(1)

(ii) What percentage of fish survive in the most acidic water containing aluminium compounds?

.....

(1)

(iii) What evidence from the graphs shows that aluminium compounds have a greater effect than pH on fish survival?

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(1)

(c) Describe an experiment you could do to find out if aluminium compounds cause fish to grow slowly.

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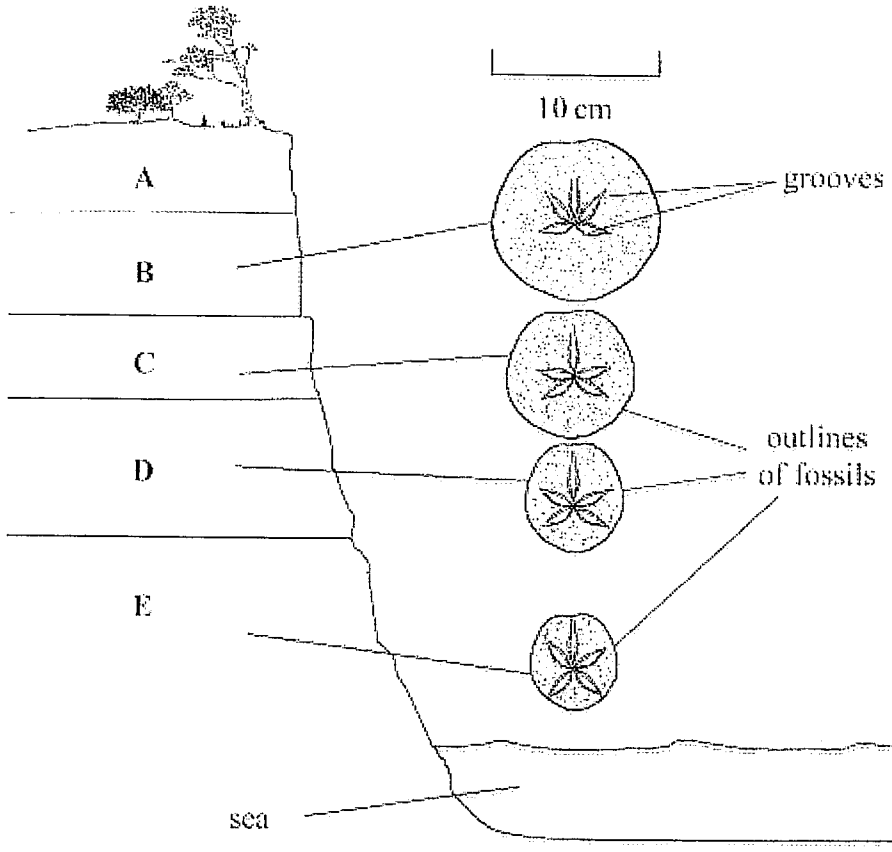
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(4)
(Total 10 marks)

9 Fossils found in different layers of a cliff are shown below.



The fossils are the remains of organisms called sea urchins that evolved over many years.

(a) Describe two ways in which these fossils show that the sea urchins have evolved.

1. .....

.....

(1)

2. .....

.....

(1)

(b) Suggest **one** reason why there are no fossils of sea urchins in layer A at the top of the cliff.

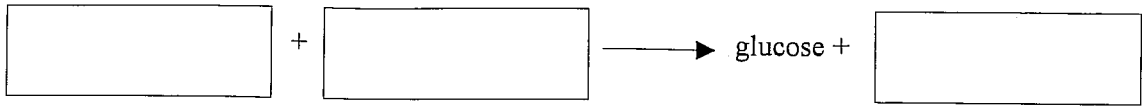
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(1)

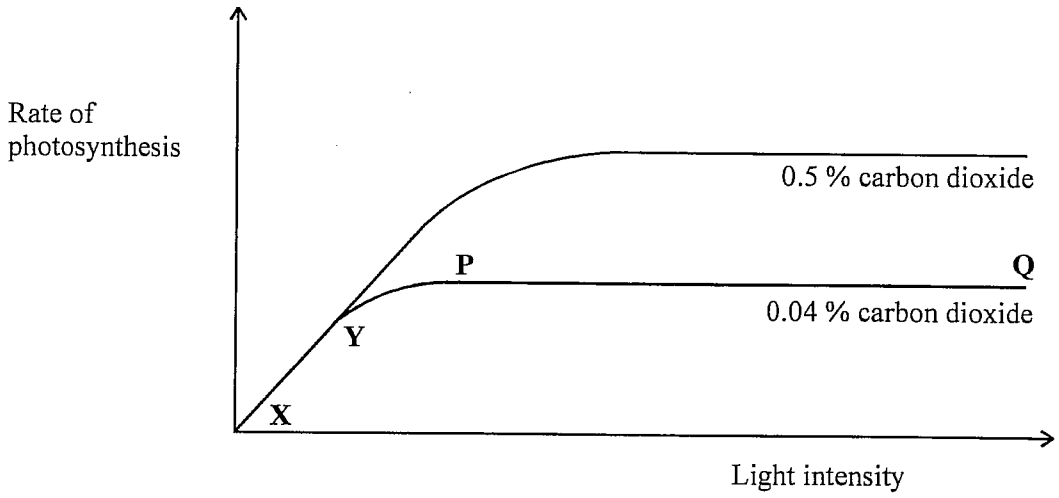
(Total 3 marks)

10 (a) Complete the equation for photosynethesis.



(2)

(b) The graph shows the results of experiments on the factors that affect the rate of photosynthesis in a well watered plant. Throughout the experiments the temperature was kept at the optimum for the enzymes in the plant.



(i) Which factor is limiting the rate of photosynthesis between points **X** and **Y**?

Explain your answer.

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(2)

(ii) Account for the shape of the graph between points **P** and **Q.**

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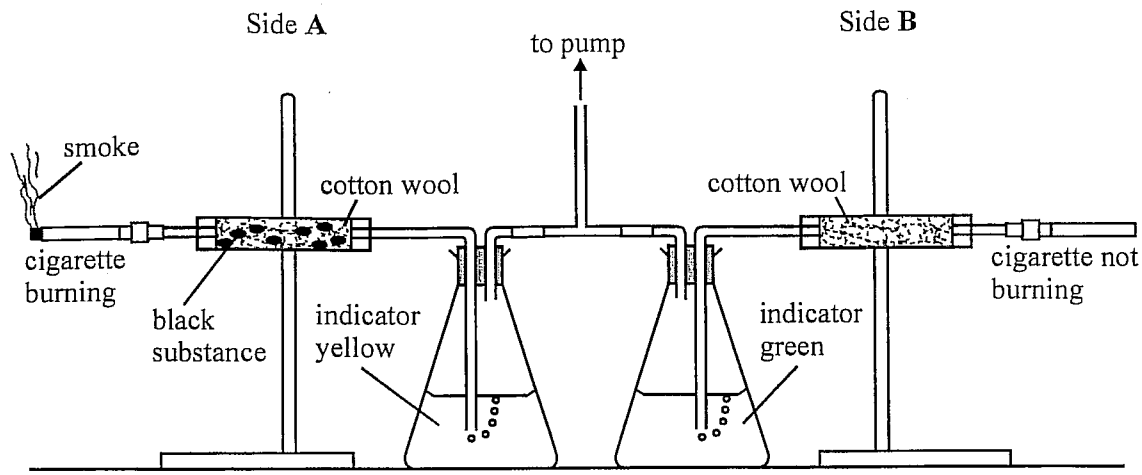
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(2)

(Total 6 marks)

11 A smoking machine was used to investigate the substances which enter the lungs when a person smokes a cigarette. The diagram shows the results.



(a) The smoking machine was used in a fume cupboard.

Why was this important?

.....

.....

(1)

(b) Draw an arrow on the diagram to show the direction of air flow on side **B** of the smoking machine.

(1)

The table shows the colour of the indicator at different pH values.

colour of indicator	yellow	yellowy green	light green	green	dark green	blue
pH	4	5	6	7	8	9

(c) The cigarette smoke changed the indicator to a yellow colour.

What does this show about the smoke?

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(2)

(d) Describe **two** pieces of evidence, shown in the diagram, which suggest that cigarettes produce pollutants.

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(2)

(e) Give **one** reason why the cigarette on side **B** was part of the investigation.

.....

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(1)

(f) Suggest **two** ways in which this investigation was a fair test.

.....

.....

.....

.....

(2)

(g) People who smoke cigarettes can become addicted to them.

Which substance in the tobacco causes addiction?

.....

(1)

(h) Name **two** diseases which can be caused by smoking cigarettes.

1 .....

2 .....

(2)

(Total 12 marks)