4EX

SCIENCE (CHEMISTRY, BIOLOGY)

5088/04

Biology Component
Paper 4 [65 Marks]

PRELIMINARY EXAMINATION

Aug 2024
1 hour 15 minutes

<u>Additional Materials:</u>
Approved calculator

Instruction to Candidates

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.

This paper consists of two sections.

Section A will carry 55 marks and will contain a number of compulsory structured questions. The last question will carry 10 marks.

Section B will carry 10 marks and will contain two questions.

Candidates must answer only one out of these two questions.

FOR EXAMINER'S USE		
Paper		**Marks**
Paper 1 (MCQ)		/ 20
Paper 3		
A		/ 55
B	**8 / 9**	/ 10
Paper 5		/ 15
Total		**/ 100**

At the end of the examination, fasten all your work securely together.

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

This question paper consists of 16 printed pages.

Section A (55 marks)

Answer **all** the questions in the spaces provided.

1   Some students investigated the effect of immersing red blood cells in different concentrations of salt solutions.

They measured the diameters of samples of red blood cells and calculated the mean.

They then immersed the red blood cell samples in different concentrations of salt solutions.

After two minutes they measured and calculated the mean of the samples again.

Table 1.1 shows the results.

Table 1.1

percentage concentration of the salt solution / %	mean initial diameter of the red blood cells /µm	mean diameter of the red blood cells after two minutes / µm
0.4	7.5	Cells burst
0.8	7.5	8.2
0.9	7.5	7.5
1.8	7.5	6.0

(a)   Calculate the percentage increase in the mean diameter of red blood cells that were immersed in the 0.8% salt solution.

Give your answer to three significant figures.

Answer………………….. %   [2]

(b) (i)   Explain the results for the red blood cells that were immersed in 1.8% salt solution.

……………………………………………………………………………..

……………………………………………………………………………..

……………………………………………………………………………..

……………………………………………………………………………..   [2]

(ii)   State why there was no change in the mean diameter of the red blood cells immersed in 0.9% salt solution.

………………………………………………………………………….

……………………………………………………………………………..   [1]

[Total = 5]

2 An experiment was conducted to investigate the action of enzyme amylase in solutions of different pH.

Six test-tubes were set up where each test-tube was filled with buffer solutions of pH 4, 5, 6, 7, 8 and 9. 2 cm^3 of amylase and 8 cm^3 of starch were added into each test-tube in sequence.

The first set-up is shown in Fig 2.1.

- test-tube
- beaker
- water at 35^{0}C
- buffer solution of pH 4 + 2cm^3 of amylase + 8 cm^3 of starch
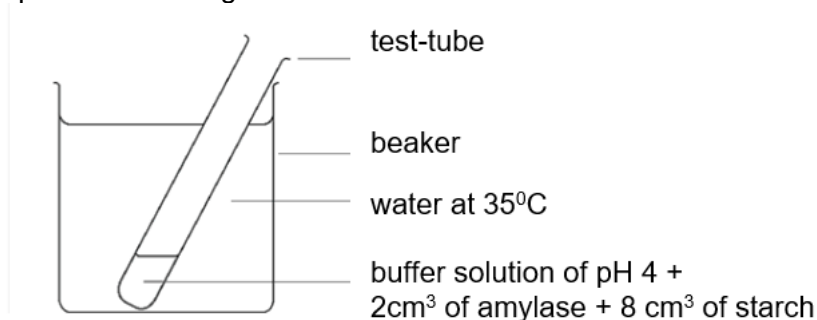
0.5 cm^3 of the mixture in the test-tube was taken out every 30 seconds and tested for starch, until it gave a negative test. The time taken for all the starch to be digested was recorded in Table 2.2.

Table 2.2

pH	time taken for starch to be digested / minutes
4	10.0
5	7.5
6	5.0
7	6.0
8	10.5
9	16.5

(a) Plot these results on the grid.

Time taken to digest starch/ minutes
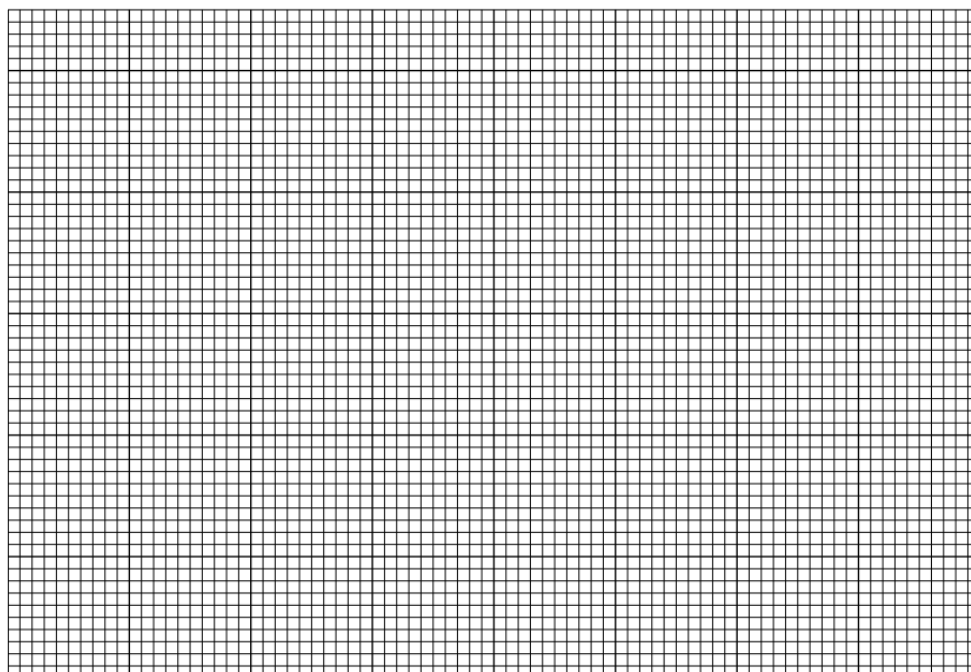
pH

[3]

[Turn over]

(b) Describe the test for starch and the expected results.

……………………………………………………………………………………………….

……………………………………………………………………………………………….

……………………………………………………………………………………………….

………………………………………………………………………………………………. [2]

(c) From your graph, state the optimum pH for amylase action.

optimum pH = ………………………… [1]

(d) Describe briefly how starch is digested in the alimentary canal.

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

[Total = 8]

3 A pulse oximeter is a device that fits on the end of a finger. It measures the heart rate (pulse rate) in beats per minute and the percentage of oxygen in the blood (%SpO$_2$)

Fig 3.1 shows a photograph of a pulse oximeter.

Fig 3.1

John, a non-smoker, used a pulse oximeter to investigate the effect of exercise on heart rate and the percentage of oxygen in the blood. He recorded readings from the pulse oximeter before exercise (0, 1, 2 minutes). He then exercised for 5 minutes. At the end of 5 minutes, he recorded four more readings at 7, 8, 9 and 10 minutes.

The results are shown in Table 3.1

Table 3.1

time / minutes	heart rate / beats per minute	percentage blood oxygen
0	66	98
1	65	99
2	66	99
7	110	96
8	96	97
9	85	98
10	68	98

(a) **(i)** Using the above data in Table 3.1, describe and explain any changes in John's heart rate during the investigation.

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………… [2]

(ii) Using the above data in Table 3.1, describe and explain any changes in the percentage of oxygen in his blood during the investigation.

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………… [2]

(iii) John thought the way he was breathing could have affected the percentage of oxygen in his blood during exercise.

What could he do to increase his percentage of oxygen in his blood?

……………………………………………………………………………… [1]

(b) A man is a heavy smoker and is suffering from emphysema.

Suggest how this person's normal pulse rate and percentage of oxygen in his blood may vary from those of John in **(a).**

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………… [2]

[Total=7 marks]

[Turn over]

4 Fig 4.1 shows the internal structure of the leaf.
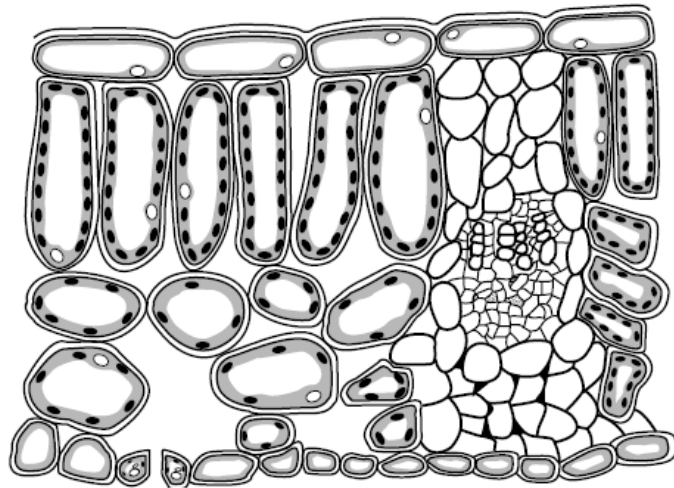
Fig 4.1

(a) **(i)** Label **X** and name the cell(s) where maximum photosynthesis takes place. [1]

(ii) Label **Y** and name the cell(s) which transport water to the cells. [1]

The figure shows three plants **A**, **B** and **C**, growing in pots.

Each plant was treated in the following ways:

- An equal volume of water was given to each plant at start of experiment.
- Plastic bags were placed around the pots of plants A and C.
- The whole of plant B was enclosed within a plastic bag.
- The plants were placed in a sunny position by a window.

Plant **A**   Plant **B**   Plant **C**
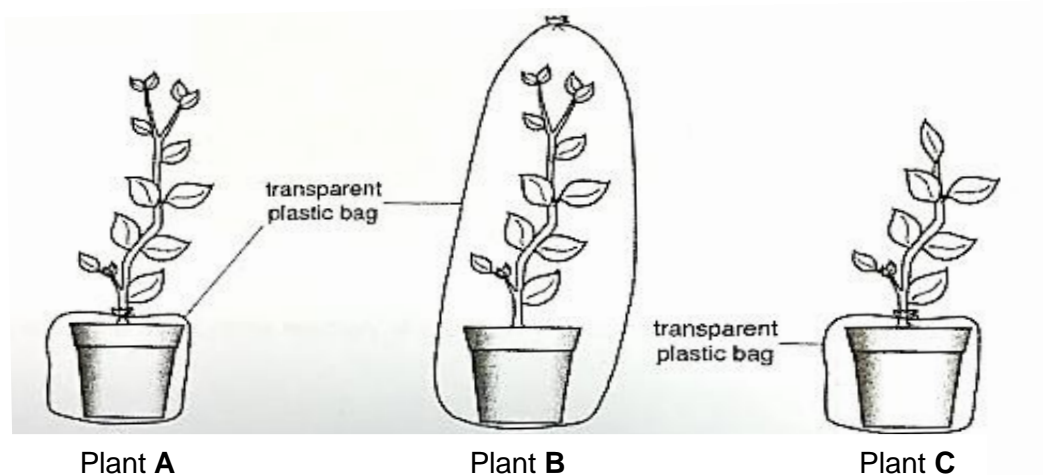
The change in mass of each plant was calculated each day for a period of 5 days, and the percentage loss over the 5 days was then calculated.

(b) **(i)** Name the process responsible for any loss of mass by the plants.

………………………………………………………………………………….. [1]

(ii) Suggest why the pots of plants **A** and **C** were enclosed in plastic bags.

……………………………………………………………………………………….

……………………………………………………………………………………. [1]

(iii) The bar chart below shows the percentage mass loss by the three plants over the 5 days.

Plant …… Plant …… Plant ……
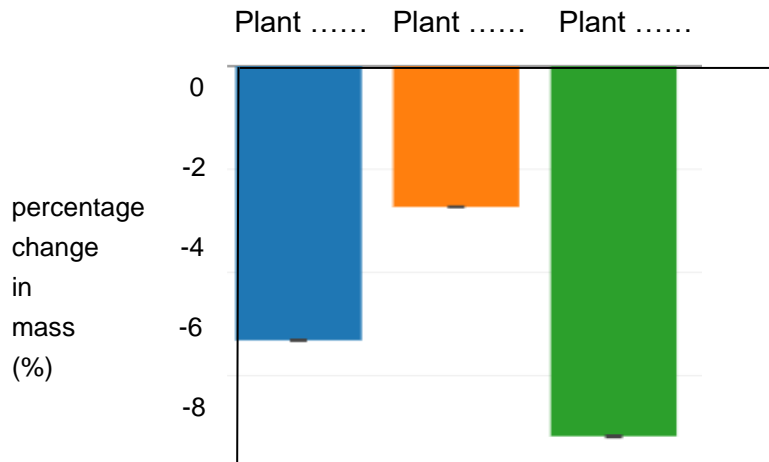
Identify the three plants (**A**, **B** and **C**) in the above bar chart. [1]

(iv) State which of the plants wilted the most and explain why.

Plant ………………………

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

………………………………………………………………………………………….. [3]

[Total = 8]

[Turn over]

5 Fig 5.1 represents the liver and its blood supply.
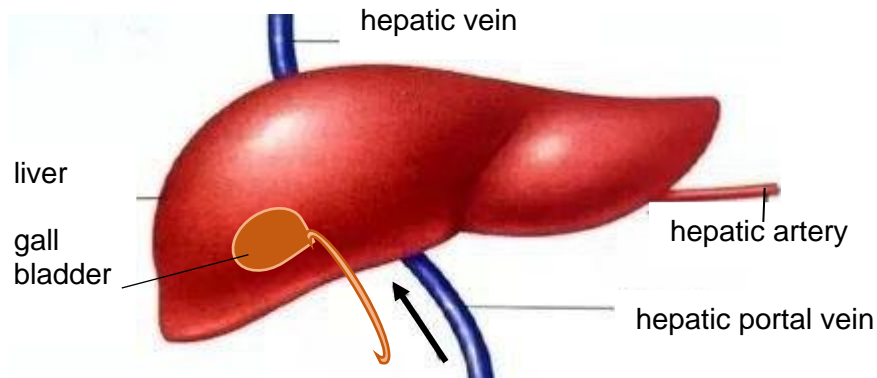
Fig 5.1

(a) **(i)** On Fig 5.1, draw an arrow next to the blood vessels to show the direction in which blood flows (one has been drawn for you). [1]

(ii) State which blood vessel shown in Fig 5.1 contains the highest concentration of urea.

.... [1]

(iii) State the function of the gall bladder.

....

.... [1]

(b) Long term alcohol consumption can lead to serious liver disease.

Fig 5.2 shows alcohol consumption and liver cirrhosis mortality in men in Country X from 1970 to 2004.
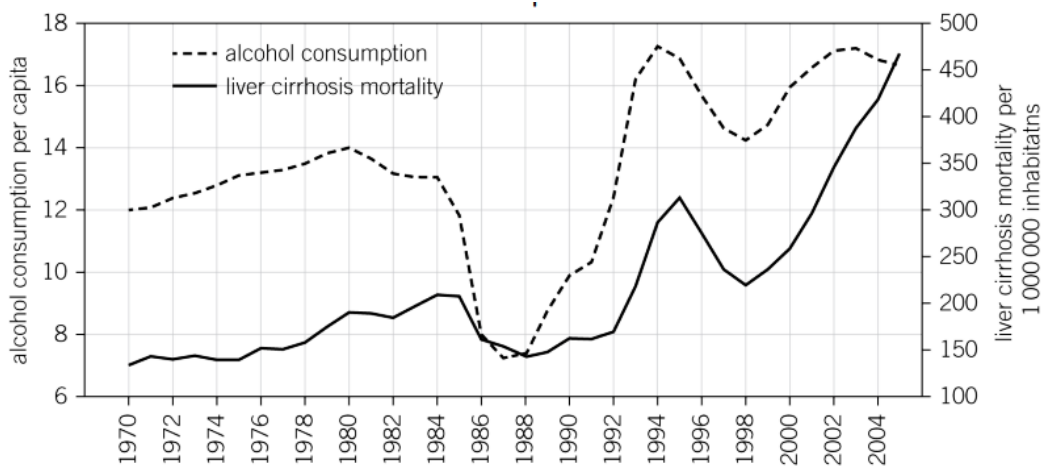
Fig 5.2

(i) Describe the relationship between alcohol consumption and deaths from liver cirrhosis in the years 1970 to 1984.

....

.... [1]

(ii) Alcohol consumption fell sharply in 1984. Describe the trend in deaths from liver cirrhosis in this year.

....

.... [1]

(iii) Does the data show any correlation between alcohol as a main risk factor and deaths from liver cirrhosis? Explain your answer.

....

....

.... [1]

[Total = 6]

6 (a) Sickle-cell anaemia is a condition caused by gene mutation.

(i) Define the term mutation.

....

.... [1]

(ii) Describe the relationship between gene and chromosome.

....

....

....

.... [2]

(iii) State one factor that can cause mutation.

.... [1]

[Turn over]

(b) Sickle-cell anaemia is an inherited disease. Individuals who are homozygous recessive suffer from the disease.

Fig 6.1 show how sickle-cell anaemia is inherited in one family.

Fig 6.1

key

☐ unaffected male

▨ carrier male

■ affected male

○ unaffected female

◍ carrier female

● affected female
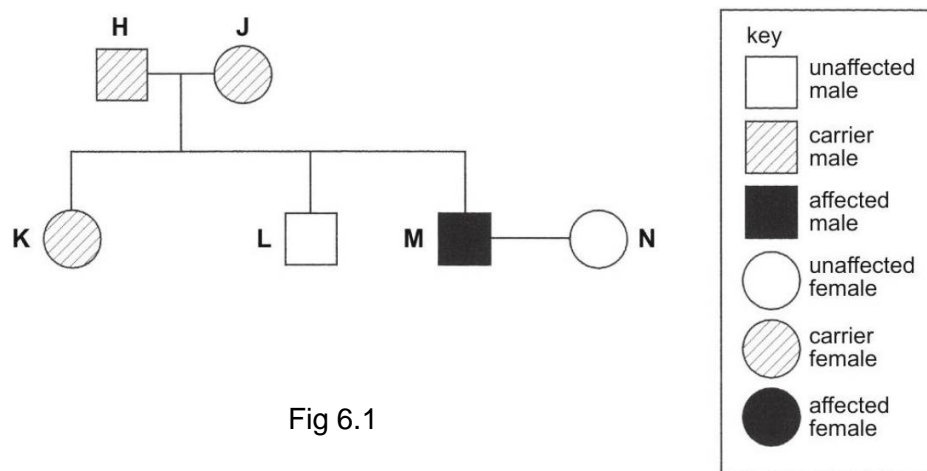
(i) Using the letters, **A** and **a**, state the genotype of parent **H.**

………………………………. [1]

(ii) State which of the individuals in Fig 6.1 is/are homozygous.

………………………………… [1]

(iii) Use letters **A** and **a**, to draw a genetic diagram to show the possible genotypes of any children produced by parents **M** and **N**.

[4]

(iv) State the chances of a child born to parents **M** and **N** suffering from sickle-cell anaemia.

……………………………………… [1]

[Total = 11]

7   White blood cells protect the body against pathogens such as bacteria and viruses.

   (a)   Describe how white blood cells protect us against pathogens.

   ....

   ....

   ....

   ....

   ....

   ....   [3]

   (b)   The transmission of the measles virus is like the influenza virus.
         Describe 2 methods of transmission of the measles virus to cause a measles
         infection.

   ....

   ....

   ....

   ....   [2]

   A doctor injects a child with a measles vaccine. A few weeks after the
   vaccination, the child becomes infected with measles from another person.

   Figure 7.1 shows the number of measles antibodies in the child's blood from
   before the vaccination until after the infection.
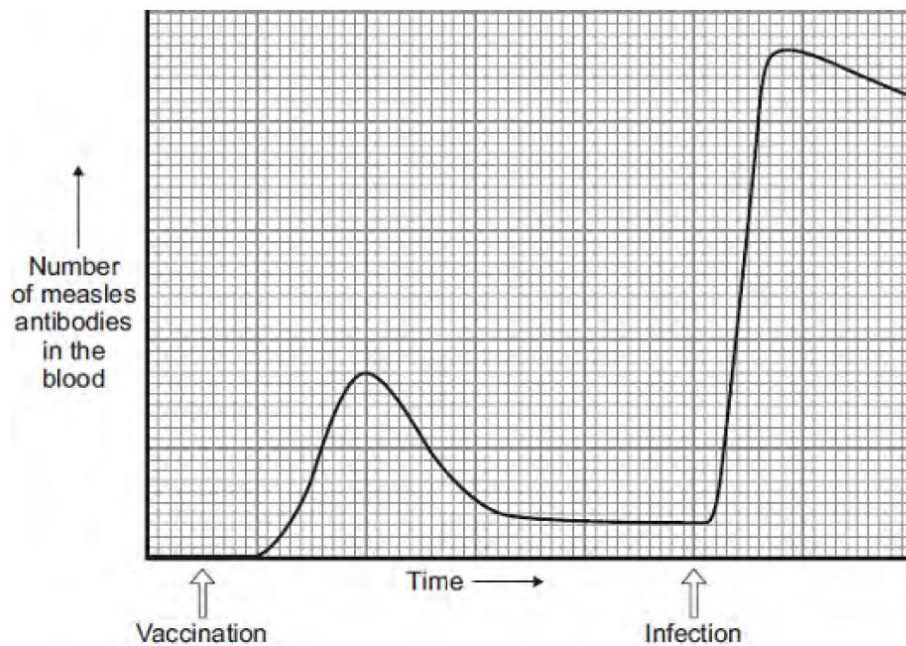
Fig 7.1

(c) Using Fig 7.1, explain why the child experienced a milder form of measles and took a shorter time to recover from measles.

....

....

....

.... [2]

(d) **(i)** The use of antibiotics is ineffective against measles. Explain why this is so.

....

....

....

.... [2]

(ii) What is the advantage of vaccinating a large proportion of the population against measles?

....

.... [1]

[Total = 10]

---End of Section A---

Section B (10 marks)

Answer any **1** questions in this section. Write your answers in the spaces provided.

8 **(a)** Fig 8.1 shows a pyramid of numbers and biomass for a sycamore tree.

pyramid of numbers   pyramid of biomass

birds of prey

birds

insects

tree
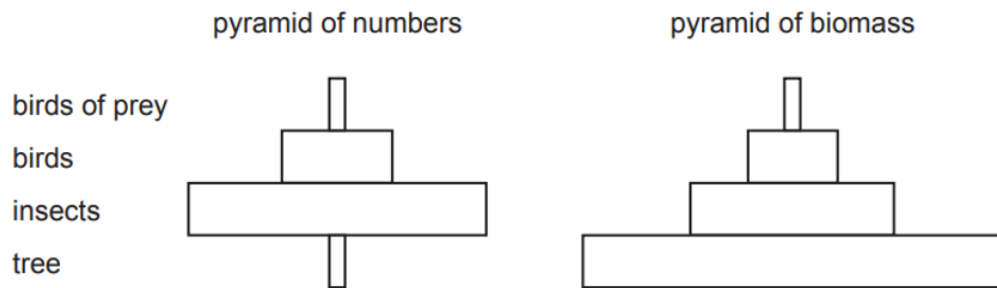
Fig 8.1

Using Fig 8.1, describe and explain the different shapes of the two pyramids.

…………………………………………………………………………………………..

…………………………………………………………………………………………..

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……………………………………………………………………………………… [4]

(b) The concentration of atmospheric carbon dioxide has increased considerably in recent years.

Describe the possible causes of increased atmospheric carbon dioxide.

…………………………………………………………………………………………..

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…………………………………………………………………………………………..

…………………………………………………………………………………………..

……………………………………………………………………………………… [2]

(c) Soybean plants, *Glycine max*, were grown in two separate plots.

Each plot used a carbon dioxide enrichment system to control the atmospheric carbon dioxide concentration.

The atmospheric carbon dioxide concentrations in the two plots were kept at:

- 370ppm, which is similar to the current atmospheric carbon dioxide concentration.

- 550ppm, which is a possible future atmospheric carbon dioxide concentration.

When the soybean plants were fully grown, scientists calculated the average rates of photosynthesis at regular intervals from 04:00 to 22:00 for both plots.

The results are shown in Fig. 8.2.
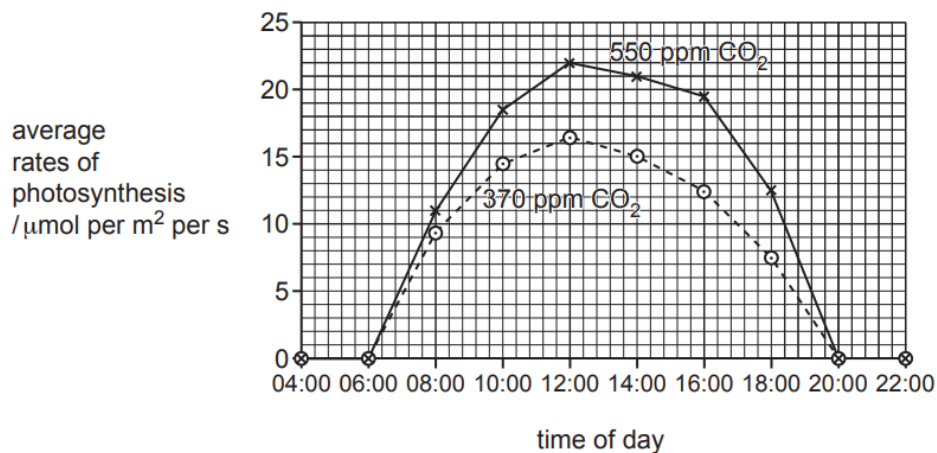
Fig. 8.2

Describe and explain the effect of carbon dioxide concentration on the average rates of photosynthesis of the soybean plants from 06:00 to 20:00.

Predict how the projected atmospheric carbon dioxide concentrations will affect plant growth.

Use the data from Fig. 8.2 in your answer.

....

....

....

....

....

....

....

.... [4]

[Total = 10]

9 (a) Fig 9.1 shows the thickness of the uterine lining of a woman for the first 8 days of a 40-day assessment period.

Thickness of uterine
lining (arbitrary units)

Fig 9.1

(i) Using the information from Table 9.2, complete Fig 9.1 of the thickness of the remaining period of the assessment.

Table 9.2

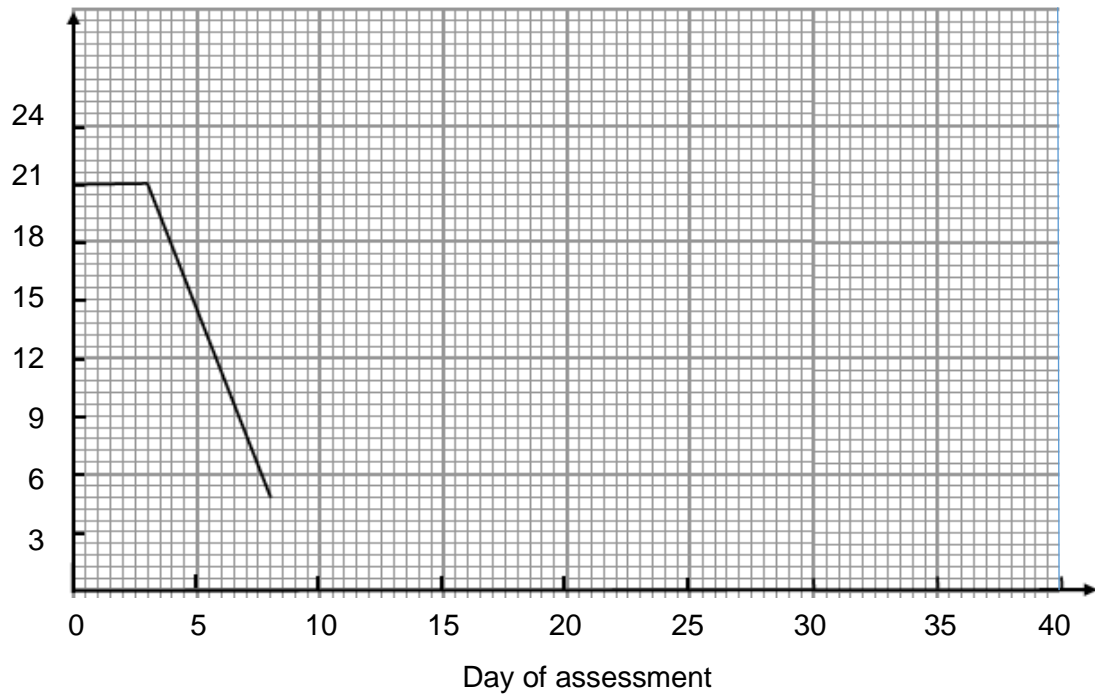| Time (day of assessment)	Thickness of uterine lining (arbitrary units)
10	3
16	9
20	21
24	21
28	21
32	24
36	24
40	24

[2]

[Turn over]

(ii) The woman's menstrual cycle lasts an average of 28 days.

With reference to the graph, outline the key events that would have taken place in the female reproductive system and the hormones responsible, for the following periods of time.

Day 8 to Day 16 of assessment

....

....

....

....

....

.... [3]

Day 17 to Day 40 of assessment

....

....

....

....

....

.... [3]

(b) If the woman was to get pregnant, describe the events that will take place from the moment of fertilisation till implantation.

....

....

....

.... [2]

[10 marks]

End of Section B

End of Paper