

Gold Paper

Question Paper 4

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|------------|------------------|
| Level | A Level |
| Subject | Biology |
| Exam Board | OCR |
| Paper | Gold Paper |
| Booklet | Question Paper 4 |

Time allowed: 77 minutes

Score: /57

Percentage: /100

Grade Boundaries:

| A* | A | B | C | D | E |
|------|-----|-----|-----|-----|-----|
| >69% | 56% | 50% | 42% | 34% | 26% |

Question 1

This question is about the impact of potentially harmful chemicals and microorganisms.

- (a) (i) Salts that a plant needs, such as nitrates and phosphates, are taken into root hair cells by active transport.

For which macromolecule does a plant need both nitrogen **and** phosphorus?

[1]

- (ii) Flooding of fields by seawater can damage crops. Seawater contains dissolved salts, including sodium chloride.

How would flooding affect soil water potential?

[1]

- (iii) Sodium chloride in solution dissociates into Na^+ and Cl^- .

Explain how the Casparian strip prevents these ions from reaching the xylem of the plant by the apoplast pathway.

[2]

- (b) Plague is caused by the bacterium, *Yersinia pestis*.

- (i) The bacterium is a rod-shaped cell that is approximately 3 μm long.

Yersinia pestis is viewed using a light microscope with a magnification of 1250.

What would be the length of the cell in the image produced by this microscope?

[2]

- (ii) Photographs taken of the image obtained by the light microscope could be further enlarged using a projector.

Why might the enlarged image be unable to tell us more about the structure of *Yersinia pestis*?

[1]

- (iii) Outbreaks of plague still occur occasionally. Plague is transmitted by several methods including droplet infection, close contact between people and fleas moving between infected rats and people.

Suggest **two** ways to minimise the spread of an outbreak of plague.

[2]

- (c) Herbicides work in a number of different ways.

- (i) Some herbicides, known as phenoxy herbicides, mimic the action of the auxin, indoleacetic acid (IAA).

What is the normal action of IAA in plant cells?

[1]

- (ii) The herbicide atrazine works by disabling plastoquinone, one of the proton pumps in photosystem II.

Explain how atrazine would kill a susceptible plant.

[5]

[Total : 15]

Question 2

Kidney failure is a serious condition. Many kidney patients receive some form of renal replacement therapy (RRT) such as dialysis.

The UK Renal Registry collects national data about the causes and treatment of kidney failure.

- (a) Table 4.1 shows the number of adult patients who started RRT in the UK in 2011. The table also shows the estimated population of each country in the UK and the incidence rate of RRT in each country.

The incidence rate is the number of adult patients starting RRT in 2011 per million people.

| Country | Number of adults starting RRT in 2011 | Estimated population in 2011 (millions) | Incidence rate (per million people) |
|------------------|---------------------------------------|---|-------------------------------------|
| England | 5774 | 53.0 | 109 |
| Northern Ireland | 203 | 1.8 | 113 |
| Scotland | 495 | 5.3 | |
| Wales | 363 | 3.1 | 117 |
| UK | 6835 | 63.2 | 108 |

Table 4.1

Using the data in Table 4.1, calculate the missing value for the incidence rate of adult patients starting RRT in **Scotland** in 2011. **[2]**

(b) Fig. 4.1 shows the mean percentage of adult patients in the UK starting renal replacement therapy (RRT) in 2011 who were male and the age groups to which they belonged.

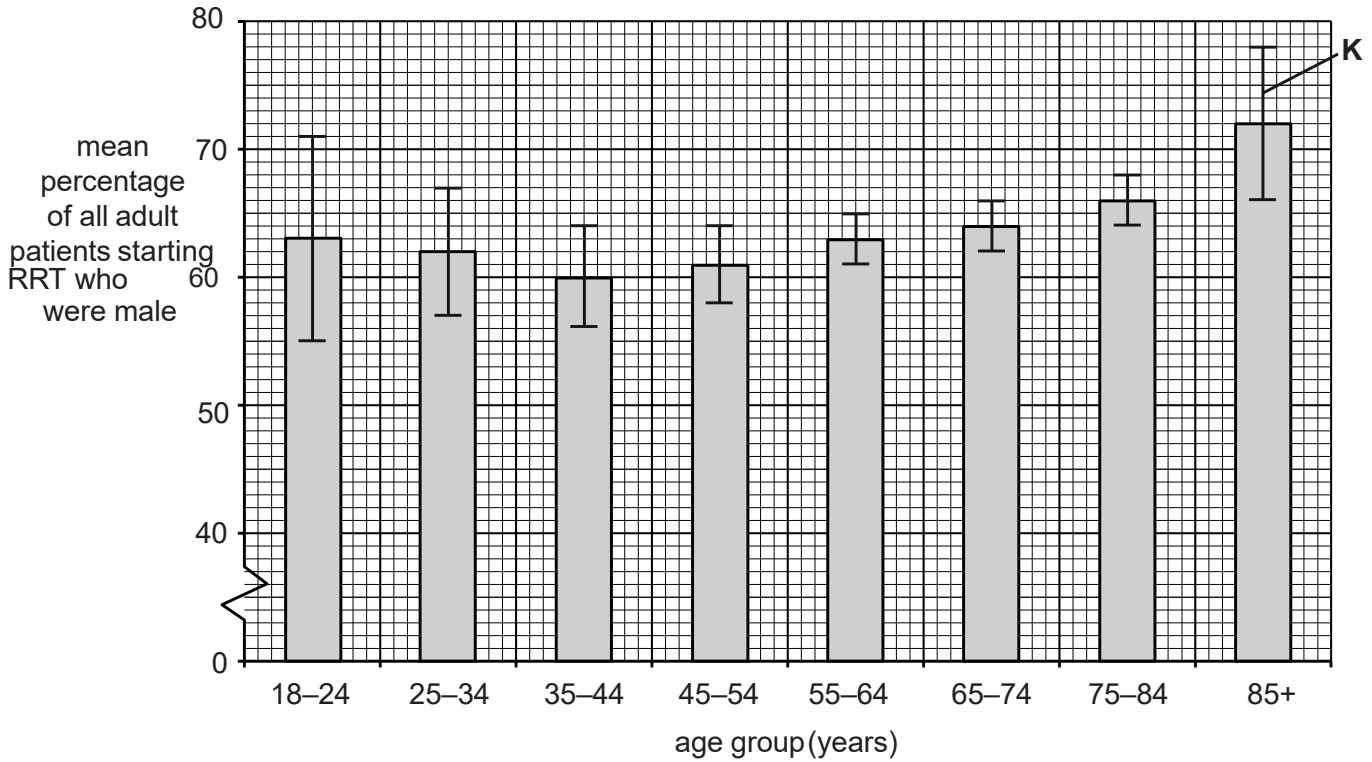


Fig. 4.1

(i) State the name given to the feature indicated by the letter **K** on Fig. 4.1. **[1]**

(ii) What information can be deduced from the data in Fig. 4.1 about the gender of adult patients starting RRT in 2011? **[2]**

(c) Many causes of kidney failure can be diagnosed.

Table 4.2 shows the percentage of patients starting RRT in 2011 who were diagnosed with different causes of kidney failure. The percentages are given for patients belonging to two different age groups, and for patients of all age groups.

| Cause of kidney failure | Patients with kidney failure (%) | | |
|-------------------------|----------------------------------|----------------|----------------|
| | Aged below 65 years | Aged 65+ years | All age groups |
| Diabetes | 27.2 | 22.4 | 24.80 |
| Glomerulonephritis | 17.4 | 9.2 | 13.30 |
| Pyelonephritis | 7.8 | 6.5 | 7.15 |
| Hypertension | 6.7 | 7.4 | 7.05 |
| Polycystic kidney | 10.6 | 3.8 | 7.20 |
| Renal vascular disease | 2.3 | 11.5 | 6.90 |
| Other causes | 16.0 | 16.6 | 16.30 |
| Uncertain diagnosis | 12.0 | 22.6 | 17.30 |

Table 4.2

(i) Suggest why 'uncertain diagnosis' occurs more often in the group of patients aged 65+ years compared with the group below 65 years of age. [1]

(ii) Identify the cause of kidney failure with the **most significant** increase in the group of patients aged 65+ years compared with the group below 65 years of age.

Justify your answer.

[1]

- (d) The main forms of RRT use dialysis. Most patients receiving dialysis have haemodialysis using a dialysis machine. However, the number of people receiving another form of dialysis, peritoneal dialysis, is increasing.

Fig. 4.2 represents the procedure of peritoneal dialysis. Some of the key points of this procedure are listed below.

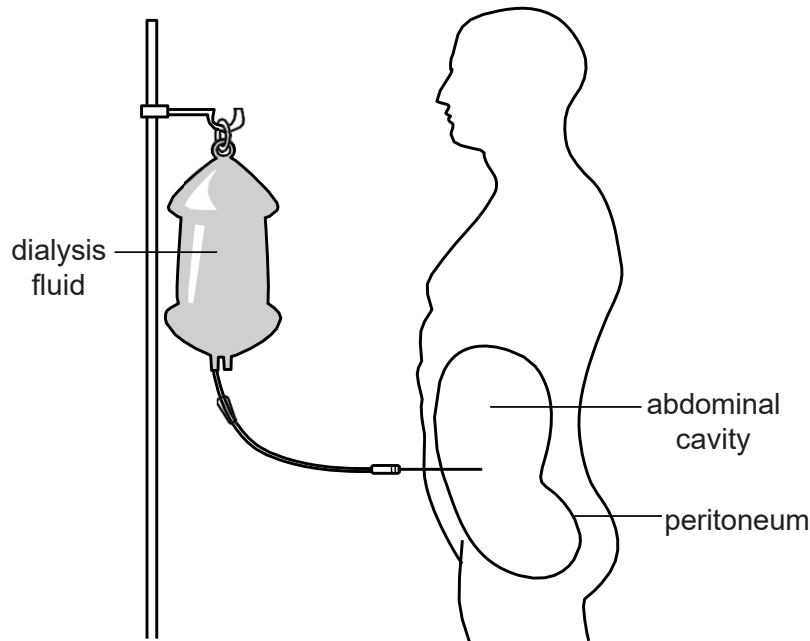


Fig. 4.2

- The peritoneum is a membrane that lines the abdominal cavity and is well supplied with blood capillaries.
- The peritoneum acts as a surface across which waste can be removed.
- The dialysis fluid, containing the sugar dextrose, fills the abdominal cavity.
- The fluid remains in the abdominal cavity for 4 to 6 hours.
- The fluid is then drained from the abdominal cavity and thrown away.
- The procedure usually needs to be done four times each day.

- (i) How might the peritoneum differ in its **function** from the artificial membrane in a dialysis machine used in haemodialysis?

[1]

(ii) Why does the dialysis fluid used in peritoneal dialysis contain dextrose solution rather than water alone? [2]

(iii) Suggest why patients receiving peritoneal dialysis usually need to have the peritoneal dialysis fluid replaced four times a day, but those receiving haemodialysis only need treatment three times a week. [2]

(e) One function of healthy kidneys is to make the hormone erythropoietin (EPO), which stimulates the production of red blood cells. Patients with kidney failure may need to be given supplements of EPO.

State the type of cell from which red blood cells are formed **and** where this type of cell is located. [1]

[Total : 13]

Question 3

(a) The rate of photosynthesis is affected by different factors.

An experiment was carried out to investigate the effect of temperature and carbon dioxide concentration on the rate of photosynthesis.

- Plants were supplied with air (0.04% CO₂) and with air enriched with carbon dioxide (0.19% CO₂).
- The rate of photosynthesis was measured at different leaf temperatures.

The results are shown in Table 4.1.

| Leaf temperature (°C) | Rate of photosynthesis (a.u) | |
|-----------------------|-----------------------------------|-----------------------------------|
| | in air with 0.04% CO ₂ | in air with 0.19% CO ₂ |
| 10 | 8.0 | 8.0 |
| 15 | 12.3 | 16.8 |
| 20 | 15.0 | 24.4 |
| 25 | 16.2 | 30.0 |
| 30 | 14.3 | 34.7 |
| 35 | 8.3 | 38.2 |
| 40 | — | 29.3 |
| 45 | — | 13.2 |

Table 4.1

- (i) Describe the effect on the rate of photosynthesis of increasing leaf temperature. [3]
- (ii) Calculate the percentage increase in the rate of photosynthesis at 30 °C as the carbon dioxide concentration is increased from 0.04% to 0.19%.
Show your working and give your answer to 3 significant figures. [2]
- (iii) Use the information in Table 4.1 to state **one other** effect of an increased concentration of carbon dioxide on the rate of photosynthesis. [1]

(iv) Suggest why there are no results for 0.04% CO₂ at 40 °C and 45 °C.

[2]

(b) As a leaf ages, the ribulose biphosphate carboxylase (rubisco) content of the leaf changes.

Fig. 4.1 represents the amount of rubisco present, the synthesis of rubisco and the breakdown of rubisco as the leaf ages.

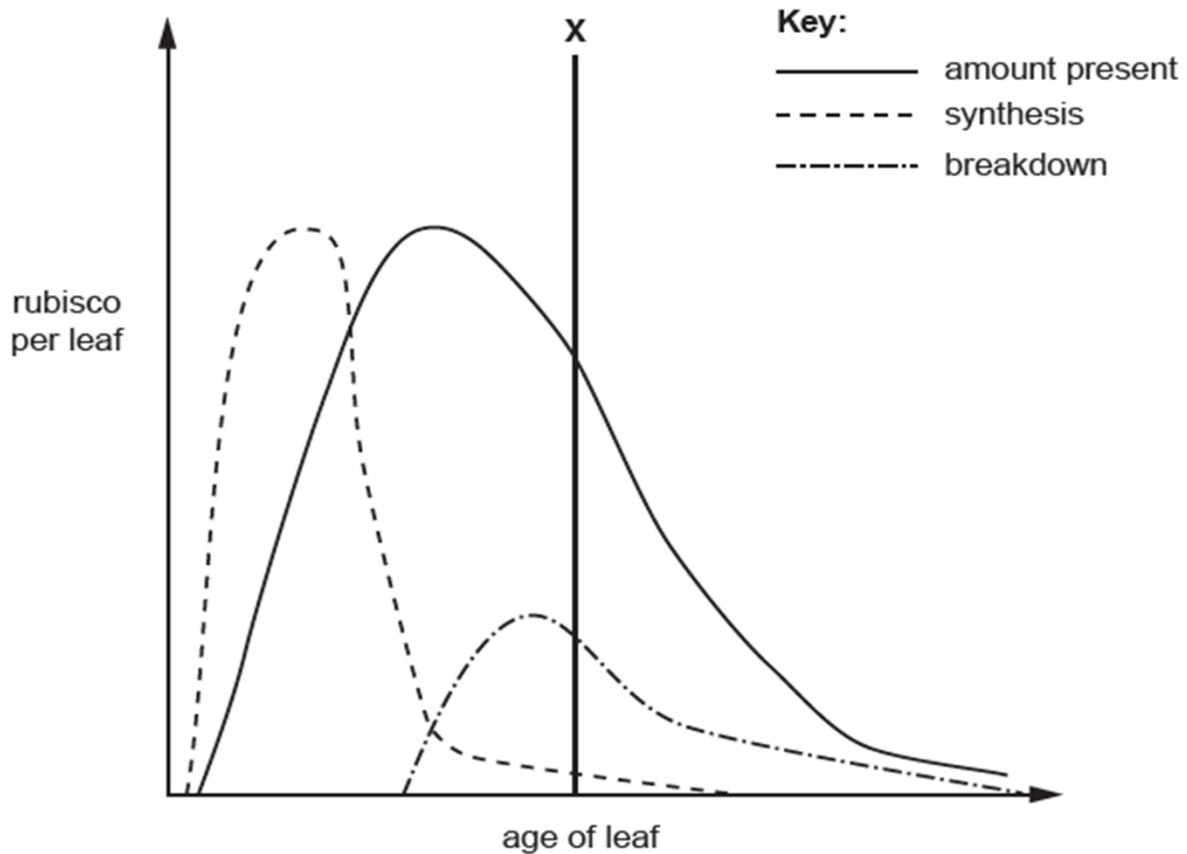


Fig. 4.1

Explain the effect that the levels of rubisco would have **on the rate of photosynthesis** as the age of the leaf increases beyond the line labelled X.

[3]

[Total : 11]

Question 4

- (a) The greater blue-ringed octopus, *Hapalochlaena lunulata*, is one of the most venomous of all animals.

Its bite contains tetrodotoxin (TTX), a neurotoxin that can cause paralysis and death within minutes.

- (i) The following information has been discovered about the effects of TTX on nerve cells:
- TTX binds to the external surface of the voltage-gated sodium ion channels in the axon membrane.
 - Binding of TTX changes the tertiary structure of the channel.
 - This means the channel cannot open.

Using the information provided, explain how TTX affects the activity of neurones. **[4]**

- (ii) A common cause of death from TTX poisoning is suffocation (not getting enough oxygen) as a result of paralysis of the diaphragm.

Explain how paralysis of the diaphragm could lead to suffocation. [2]

- (iii) TTX is also known to reduce the speed of conduction in the Purkyne fibres of the heart.

Suggest and explain what effect this would have on the heart rate. [3]

- (b) Molluscs such as *H. lunulata* have unmyelinated neurones. Saltatory conduction cannot occur in these neurones.

Why is transmission of action potentials along the axon slower in the absence of saltatory conduction?

[1]

[Total : 10]

Question 5

A teacher was reviewing some common mistakes in a variety of students' answers to biological questions.

Some of the answers given by the students are written below.

- (a) "When investigating the effect of temperature on enzyme activity it is important to keep the amount of substrate the same."

Suggest a more suitable word than 'amount'. [1]

- (b) "Productivity of domestic animals can be improved by selective breeding. However, inbreeding can be a problem as it causes mutations which can lead to genetic diseases in the animals."

State and explain the incorrect biology in this answer. [2]

- (c) "The Simpson's Index of Diversity for the area of woodland is very high. This means that the habitat is stable and so the electricity company's application to build a power station is likely to be approved after the Environmental Impact Assessment has been carried out."

Explain the incorrect biology in this answer. [2]

- (d) In response to the question "Explain why some types of food are stored in a freezer", a student wrote:

"Food does not decay when frozen because the very low temperature denatures the bacterial enzymes so the enzymes cannot bind to the substrate molecules in the food."

Suggest a better answer to the question. [3]

[Total: 8]