Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

BIOLOGY **0610/41**

Paper 4 Theory (Extended) **May/June 2022**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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1 **(a)** Some students were studying the activity of yeast. They made a fact file, as shown in Fig. 1.1.

View solution

Organism: yeast

Scientific name: *Saccharomyces cerevisiae*

Structure: single cells

Main cell structures: cell wall, cell membrane, vacuole, nucleus, mitochondria, rough endoplasmic reticulum

Main energy source: sugars

Fig. 1.1

(i) State the kingdom in which yeast is classified.

..... [1]

(ii) State the process that occurs in mitochondria to provide energy for yeast cells. View solution

..... [1]

(b) Yeast cells make the enzyme sucrase. Sucrase catalyses the breakdown of sucrose to glucose and fructose.

View solution

Enzymes are made of protein.

Explain how the shape of a sucrase molecule is related to its function.

.....

.....

.....

.....

..... [2]

(c) The students made an extract of sucrase from yeast cells.

They investigated the activity of the sucrase extract at different pH values. They determined the rate of reaction at each pH.

They then calculated the rate of each reaction as a percentage of the fastest reaction, to give the percentage activity of sucrase.

View solution

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The results of this investigation are shown in Fig. 1.2.

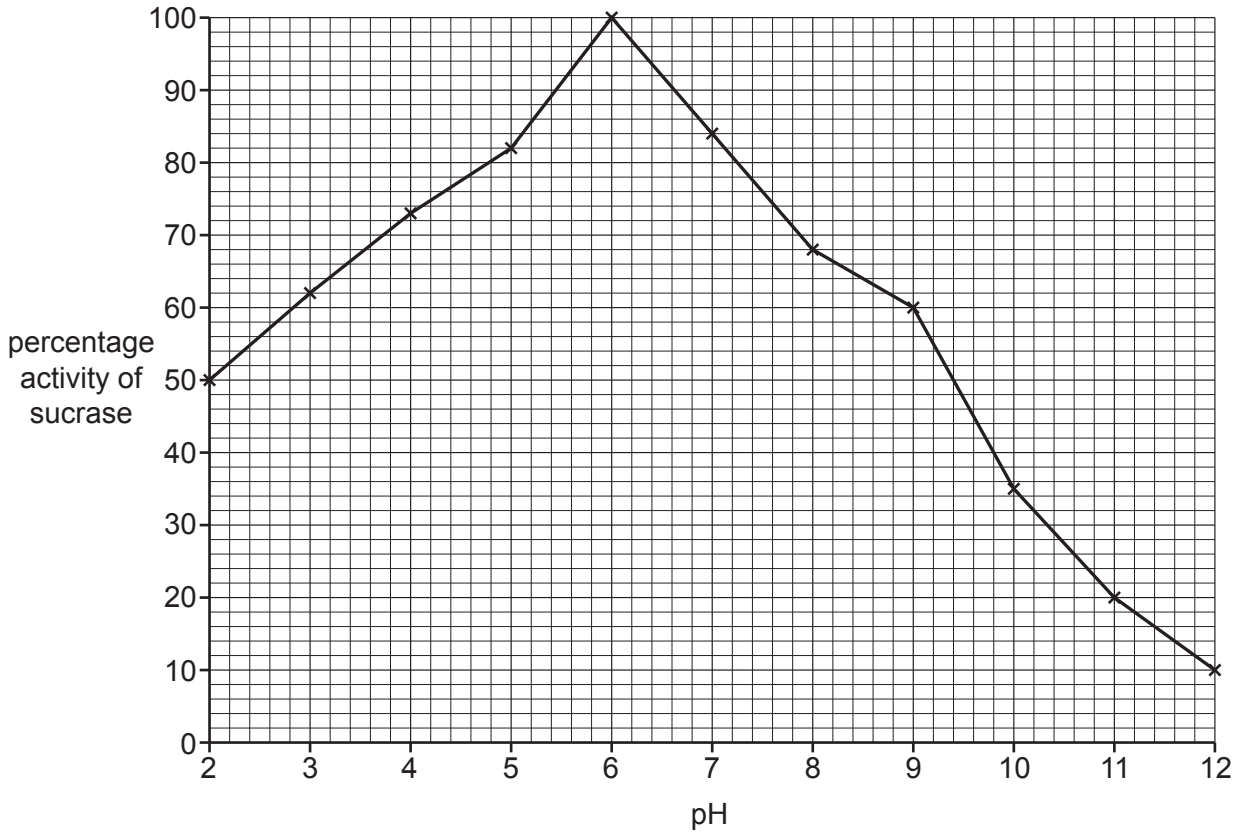

Fig. 1.2

Describe **and** explain the effect of pH on the activity of sucrase shown in Fig. 1.2.

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..... [6]

[Total: 10]

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2 Mammals have a double circulation.

Fig. 2.1 is a diagram of a section through the heart of a mammal. The arrows show the direction of blood flow through the heart and blood vessels.

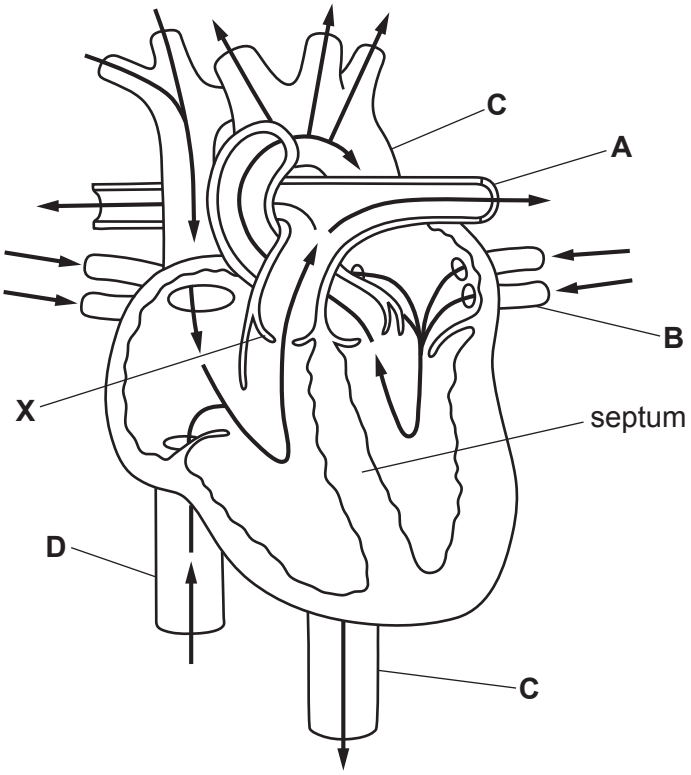

Fig. 2.1

(a) (i) State the name of the chamber of the heart with the thickest wall.

View solution

..... [1]

(ii) **D** is a vein. State the name of this vein and describe its structure.

View solution

name .....

description of structure .....

.....

.....

.....

.....

.....

[3]

(iii) Identify the structure labelled **X** in Fig. 2.1 **and** state its role in the heart.

.....

.....

.....

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..... [2]

View solution

(b) Fig. 2.2 is a diagram that shows the double circulation of a mammal. The arrows indicate the movement of oxygen and carbon dioxide in and out of the blood.

View solution

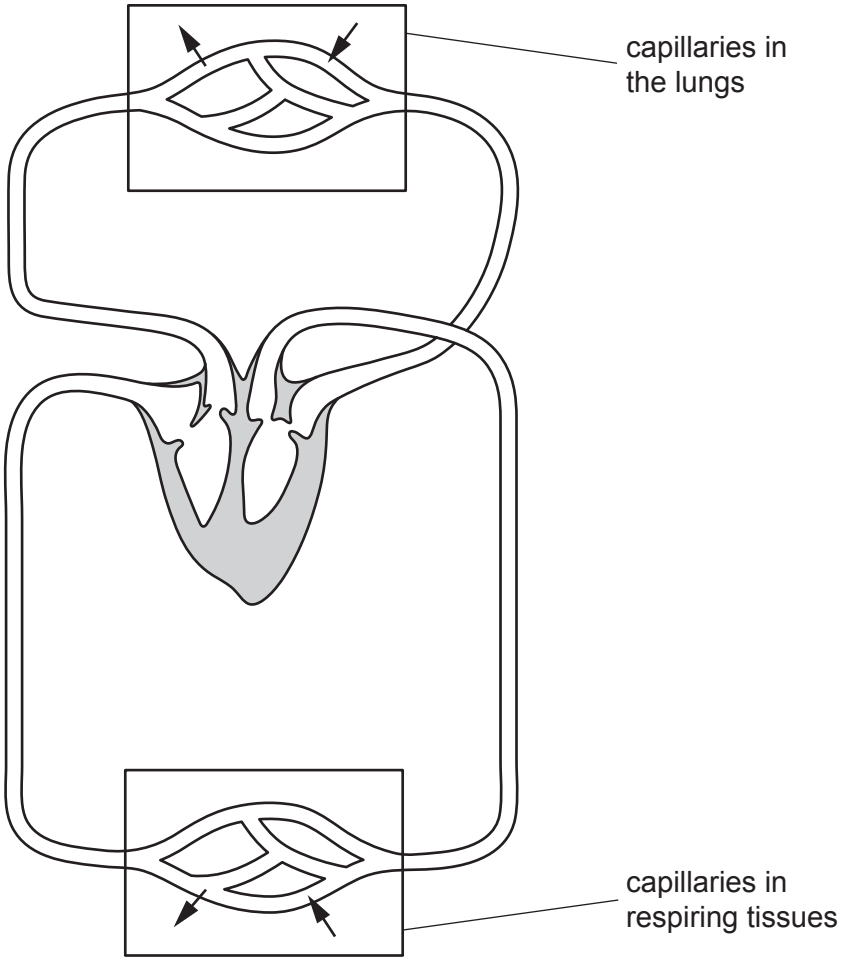

Fig. 2.2

(i) Shade the blood vessel in Fig. 2.2 that transports blood with the highest oxygen concentration. [1]

(ii) Describe the evidence shown in Fig. 2.2 that the mammal has a double circulatory system.

.....

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..... [2]

(iii) Explain the advantages of a double circulation.

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..... [4]

[Total: 13]

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3 The pancreas is an organ that has roles in the digestive and hormonal systems of humans.

Fig. 3.1 shows part of the alimentary canal and some of the associated organs.

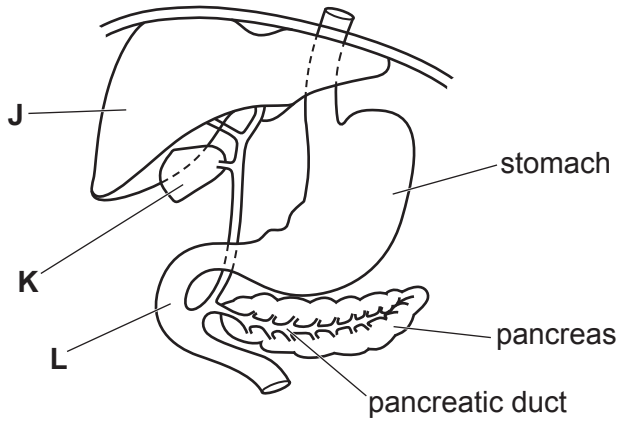

Fig. 3.1

(a) State the names of organs **J**, **K** and **L**.

View solution

J .....

K .....

L .....

[3]

(b) The pancreas secretes hormones into the blood and enzymes into the pancreatic duct. The enzymes are released into the alimentary canal.

Complete Table 3.1 by stating the hormones and enzymes that are secreted by the pancreas.

Table 3.1

hormones secreted by the pancreas	enzymes secreted by the pancreas
.....	.....
.....	.....
	.....

[5]

View solution

(c) Chloride ions also move along the pancreatic duct.

CFTR proteins in the cells lining the pancreatic duct move chloride ions out of the cells into the duct.

Fig. 3.2 is a diagram of a cell from the lining of the pancreatic duct showing the location and activity of CFTR proteins.

View solution

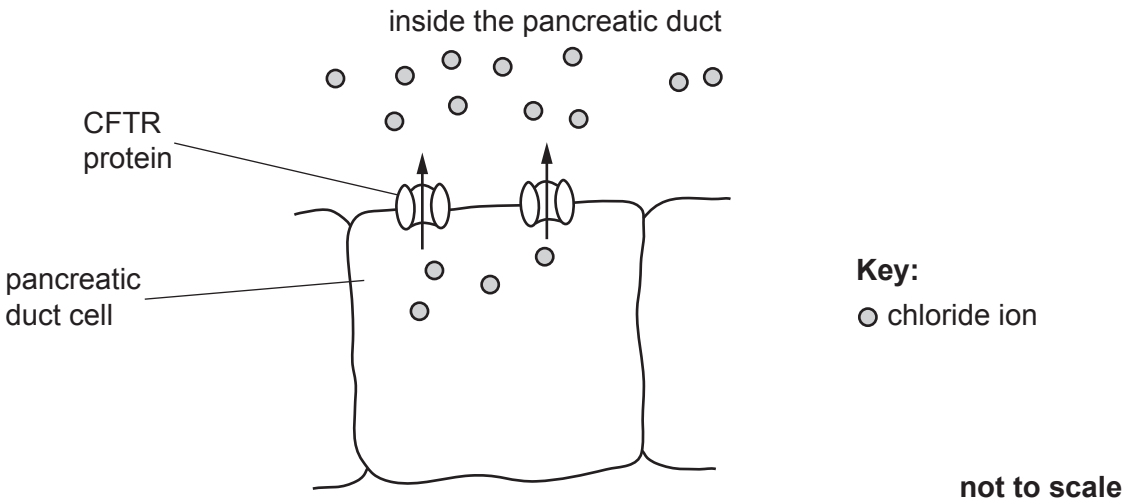

Fig. 3.2

Explain how CFTR proteins move chloride ions across the membrane of the cell shown in Fig. 3.2.

.....

.....

.....

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.....

..... [3]

(d) The movement of chloride ions into the pancreatic duct causes water to move from the cells into the duct to help the flow of liquid in the duct.

View solution

Explain how water moves from the cell shown in Fig. 3.2 into the pancreatic duct.

.....

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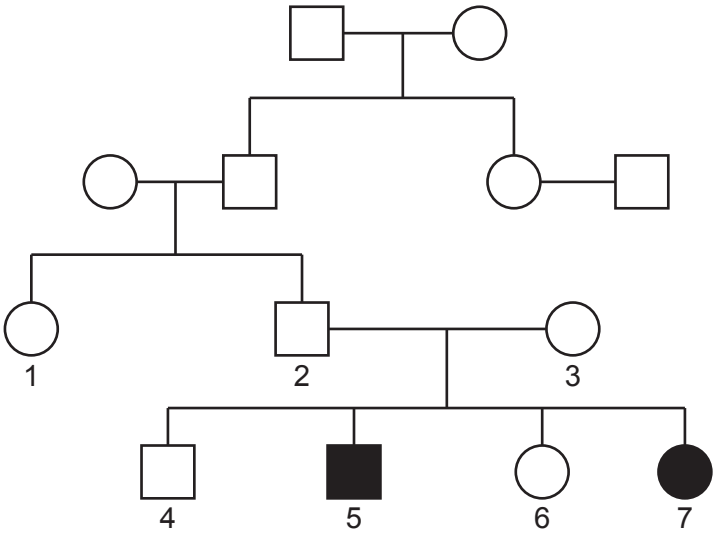
..... [3]

(e) If CFTR proteins do not move chloride ions, the liquid in the pancreatic duct becomes very sticky and the duct can become blocked.

Blocked pancreatic ducts are one effect of cystic fibrosis, which is an inherited disease. Cystic fibrosis is caused by a mutation of the gene that codes for the CFTR protein.

Fig. 3.3 shows the pedigree diagram of a family that has two people who have cystic fibrosis.

View solution



Key:

female without cystic fibrosis

male without cystic fibrosis

female with cystic fibrosis

male with cystic fibrosis

Fig. 3.3

(i) The allele that causes cystic fibrosis is a recessive allele.

Describe **and** explain the evidence shown in Fig. 3.3 that cystic fibrosis is caused by a recessive allele.

.....

.....

.....

.....

..... [2]

(ii) Person 7 is expecting a child with a man who is heterozygous for cystic fibrosis.

Complete the genetic diagram to predict the probability of person 7 and the heterozygous man having a child with cystic fibrosis.

View solution

Use the symbol **A** for the dominant allele and **a** for the recessive allele.

parental genotypes ....

gametes  +

genotypes of offspring .....

phenotypes of offspring .....

probability of having a child with cystic fibrosis .....

[5]

[Total: 21]

4 Researchers investigated the effect of adding cattle manure (cattle faeces) to fields where snap bean plants, *Phaseolus vulgaris*, were grown. Cattle manure contains some protein.

(a) Explain how protein in the cattle manure is converted to the type of ions that plants can absorb.

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..... [5]

(b) Snap bean plants are legumes which have root nodules that contain nitrogen-fixing bacteria.

Fig. 4.1 shows some root nodules.

View solution

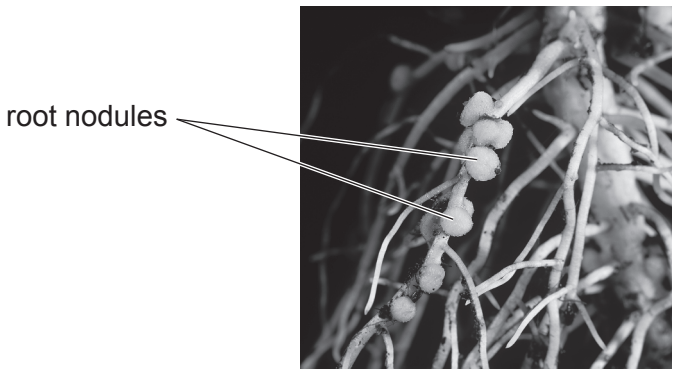

Fig. 4.1

(i) Suggest the advantage to farmers of having snap bean plants that have a large number of root nodules.

.....

.....

..... [1]

(ii) The researchers investigated the effect of adding cattle manure to fields of snap bean plants.

View solution

- Field 1 was treated with a small quantity of cattle manure.
- Field 2 was treated with a medium quantity of cattle manure.
- Field 3 was treated with a large quantity of cattle manure.
- Field 4 was not treated with any cattle manure.

The researchers counted the number of root nodules on samples of plants from each field when the snap beans were harvested.

The results of the investigation are shown in Fig. 4.2.

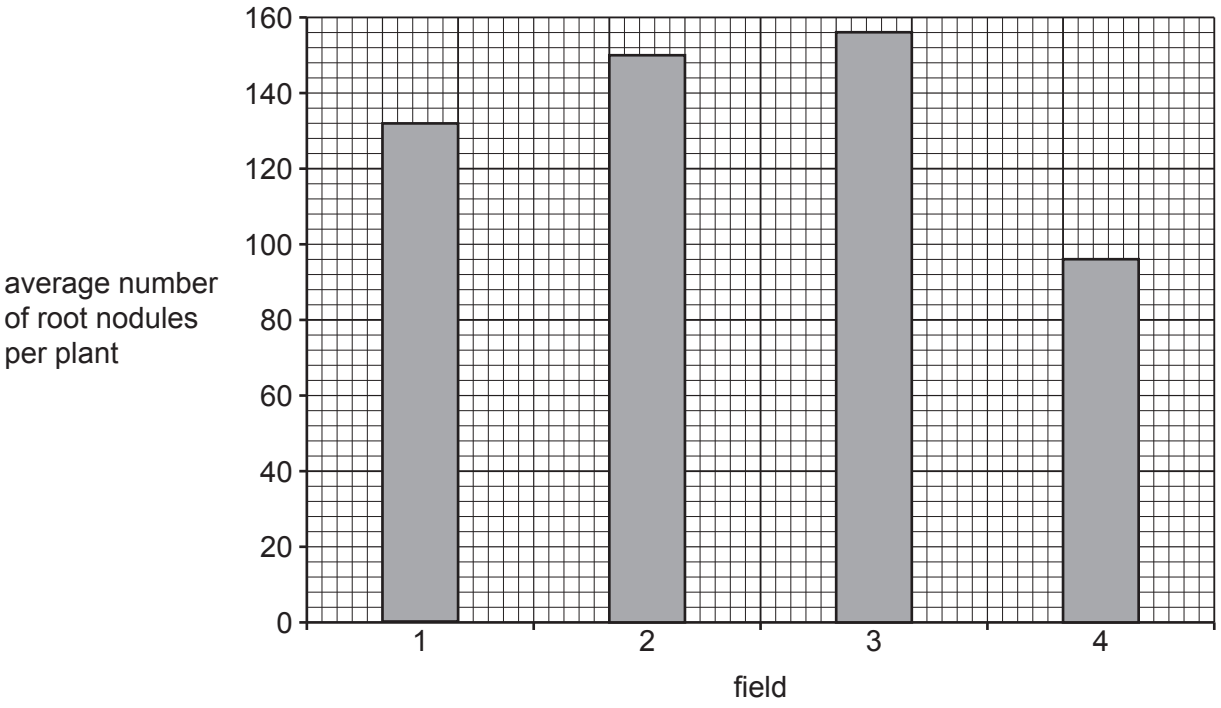

Fig. 4.2

Calculate the percentage increase in the average number of root nodules per plant when snap bean plants were grown with a large quantity of cattle manure (field 3) compared with no cattle manure (field 4).

Give your answer to **two** significant figures.

Space for working.

.....%
[3]

(iii) When large quantities of manure are put on fields it can lead to eutrophication of streams and rivers. This can lead to the death of fish.

View solution

Describe how eutrophication of streams and rivers can lead to the death of fish.

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..... [4]

[Total: 13]

5 The Mulanje cedar, *Widdringtonia whytei*, is the national tree of Malawi. This species of tree grows naturally only on Mount Mulanje in Malawi. Many of the trees have been overharvested or destroyed by wildfires, resulting in deforestation, as shown in Fig. 5.1.



Fig. 5.1

(a) State the genus name of the Mulanje cedar tree.

View solution

..... [1]

(b) Explain the undesirable effects of deforestation on habitats that are on mountains, such as Mount Mulanje.

.....

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..... [3]

(c) Scientists in Malawi are working to prevent the extinction of the Mulanje cedar tree in its natural habitat.

Explain the benefits to other organisms on Mount Mulanje of conserving the Mulanje cedar tree in its natural habitat.

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..... [2]

(d) The seeds of many endangered tree species are kept in seed banks.

Suggest why it is important to collect seeds from many individual trees of each species rather than just one tree.

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..... [2]

[Total: 8]

View solution

6 **(a)** Fig. 6.1 is a flow diagram showing the events that occur to form a human fetus.

View solution

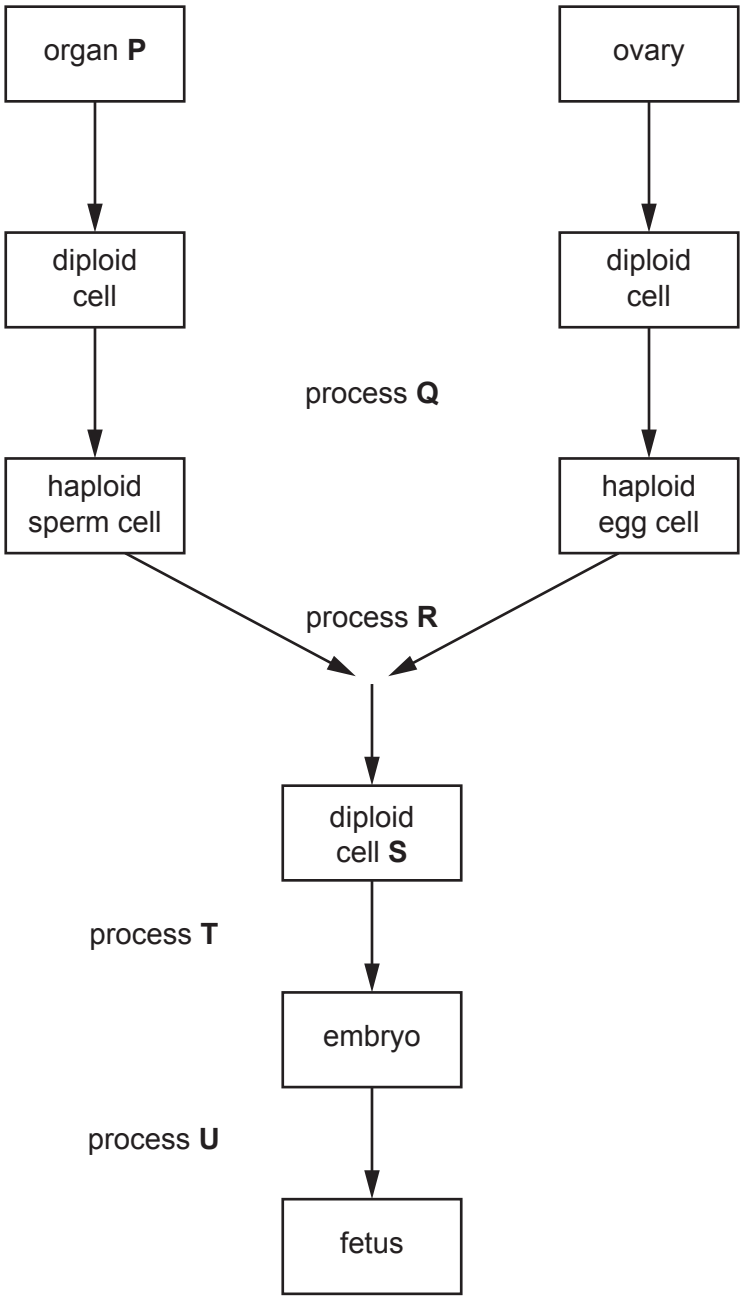

Fig. 6.1

Complete Table 6.1 by using the information in the flow diagram to identify the cell, the organ and the processes shown in Fig. 6.1.

Table 6.1

cell, organ or process	name of the cell, organ or process
organ **P**	
cell **S**	
process **Q** produces haploid sperm and eggs	
process **R** produces diploid cell **S**	
process **T** occurs so that cell **S** can grow into an embryo	
process **U** occurs so that the embryo can gain oxygen and nutrients from the mother's blood	

[6]

(b) **(i)** State why it is important that sperm and egg cells are haploid and not diploid. View solution

.....

.....

..... [1]

(ii) State the function of the jelly coat that surrounds egg cells.

.....

.....

..... [1]

View solution

(c) Complete the sentences with the appropriate words.

View solution

The placenta provides a large surface area for the ..... of oxygen and carbon dioxide between maternal and fetal blood. Dissolved nutrients also pass across the placenta. Examples of dissolved nutrients are: ..... acids, ... and ..... .

Antibodies pass from the maternal blood giving natural ..... immunity to the baby for some infections that the mother has had or has been vaccinated against. Each different type of vaccine contains one or more ..... taken from the ..... that causes the disease.

[7]

[Total: 15]

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