REDSPOT

IGCSE

(Syllabus 0610)

BIOLOGY

Paper 4 (Extended) - All Variants

Topical - Worked Solutions

period	2020 to 2024
contents	June & November, Paper 4 (P41, P42 & P43) Worked Solutions
form	Topic By Topic
compiled for	IGCSE

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CONTENTS

TOPIC 7

Human Nutrition

Diet, Digestive system, Physical & Chemical digestion, Absorption

1. ***[June 2020/P41/Q3]***

(a) Dialysis tubing is an artificial membrane, which is similar to the lining of the intestine.

A student investigated the diffusion of glucose through dialysis tubing by using the apparatus shown in Fig. 3.1.

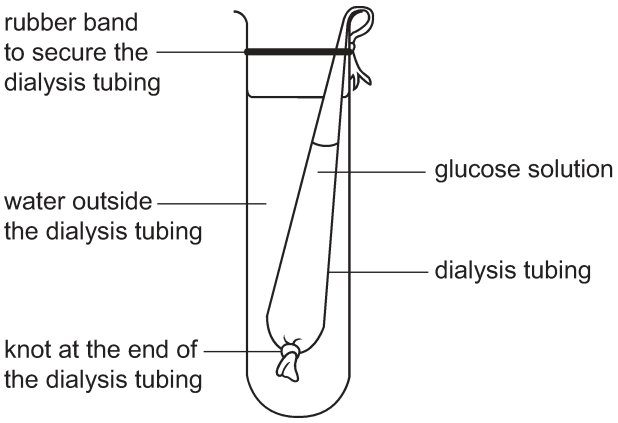

Fig. 3.1

The student took samples of the water outside the dialysis tubing at 5 minute intervals and tested the samples with Benedict's solution.

The results are shown in Table 3.1.

Table 3.1

time / minutes	results of the Benedict's tests on the water outside the dialysis tubing
0	blue
5	green
10	yellow
15	red

(i) Describe and explain the results shown in Table 3.1.

.....

.....

.....

.....

..... [3]

(ii) The student repeated the investigation with a higher concentration of glucose in the dialysis tubing. Predict the results that the student would observe.

.....

..... [1]

(b) Fig. 3.2 shows a drawing of a cell from the lining of the small intestine. The lumen is the space inside the intestine where food is digested.

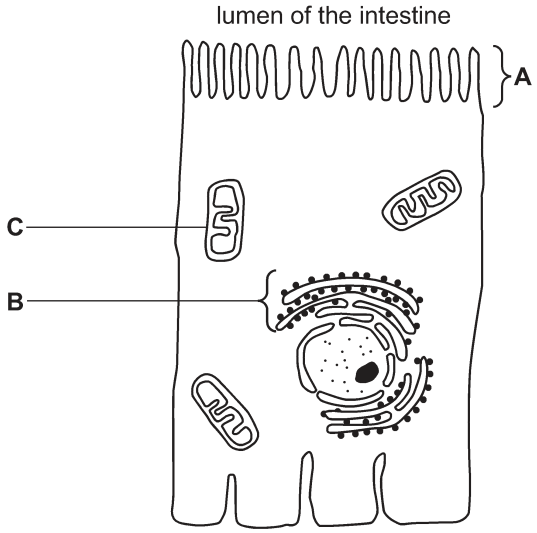

Fig. 3.2

State the names of the **three** labelled structures in Fig. 3.2 **and** describe the role of each structure in the intestinal cell.

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..... [6]

(c) The cholera bacterium can survive in the small intestine and the large intestine. The bacterium releases a toxin that interacts with receptors on the surface of cells.

Fig. 3.3 shows the effect of the toxin. The arrows indicate the direction of movement.

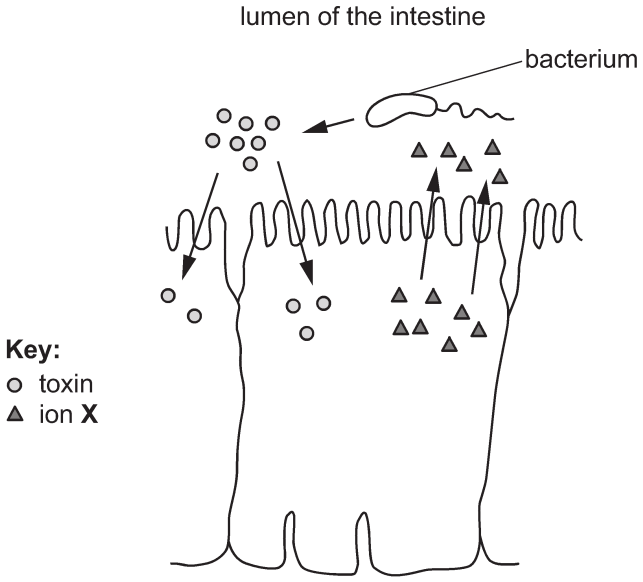

Fig. 3.3

The toxin stimulates the secretion of ion **X** out of the intestinal cell.

(i) State the name of ion **X**.

..... [1]

(ii) Describe the effects on the body of the secretion of ion **X** into the lumen of the intestine.

.....

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.....

.....

.....

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.....

.....

..... [4]

2. ***[June 2020/P43/Q1 a,b]***

(a) State **three** uses of energy in the human body.

1 .....

2 .....

3 .....

[3]

(b) Fig. 1.1 shows part of the digestive system of a human.

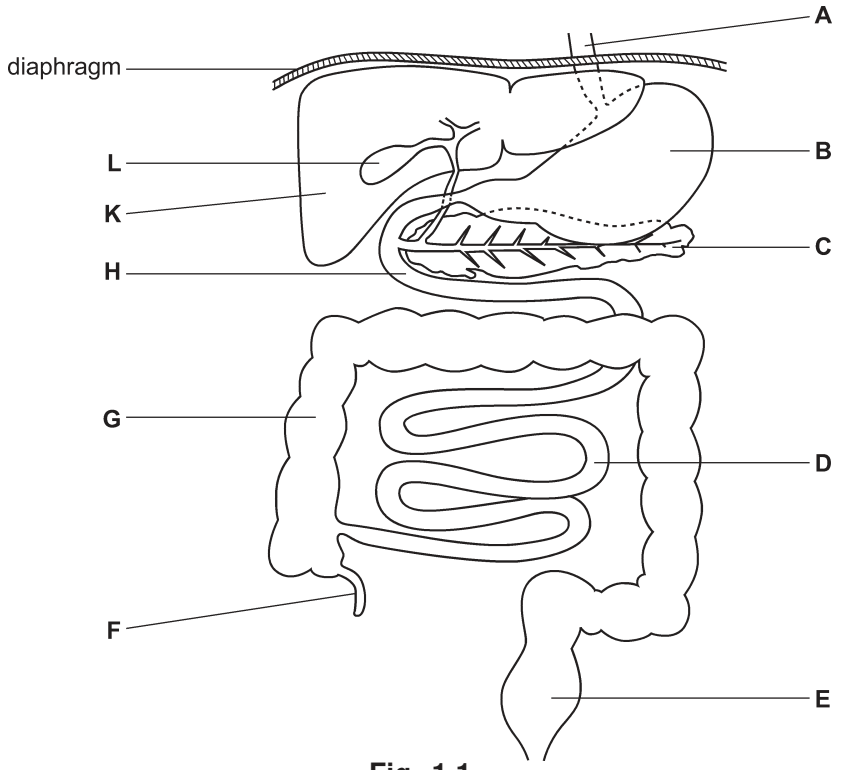

Fig. 1.1

Complete Table 1.1. One row has been done for you. [6]

Table 1.1

function	name of structure	letter from Fig. 1.1
pushes food to the stomach	oesophagus	**A**
assimilation of amino acids to produce plasma proteins		
storage of bile		
secretion of insulin		
absorption of fatty acids and glycerol		
secretion of pepsin		
digestion of starch		

3. ***[Nov 2020/P41/Q3 b]***

Urea is a toxin that is excreted by the kidneys in humans.

Describe how **and** where in the body urea is formed.

.....

.....

.....

.....

.....

..... [3]

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4. ***[Nov 2020/P41/Q5 a,b]***

Milk is a source of some of the nutrients that are part of a balanced diet.

(a) Calcium and protein are two nutrients found in milk.

Describe the importance of calcium and protein in the diet.

calcium .....

.....

.....

protein .....

.....

.....

[4]

(b) Lactose is found in cows' milk. Some people do not have the enzyme to digest lactose.

State the names of **two** organs, associated with the alimentary canal, that produce enzymes.

1 .....

2 .....

[2]

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5. ***[Nov 2020/P42/Q2]***

Fig. 2.1 is a vertical section of a human molar tooth and surrounding structures.

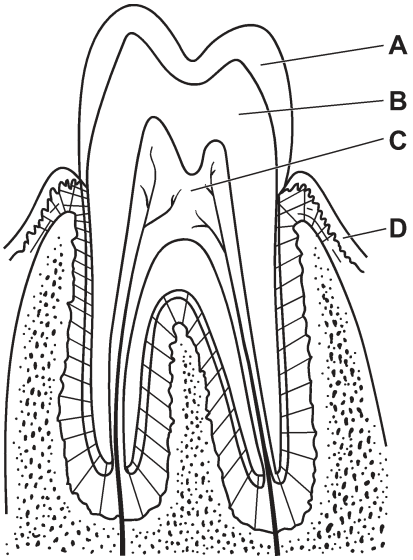

Fig. 2.1

(a) State the names of the parts labelled **A** to **D** on Fig. 2.1.

A .....

B .....

C .....

D .....

[4]

(b) Describe **and** explain the function of molar teeth.

.....

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.....

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..... [3]

(c) Fig. 2.2 is an X-ray of decay in a molar tooth.

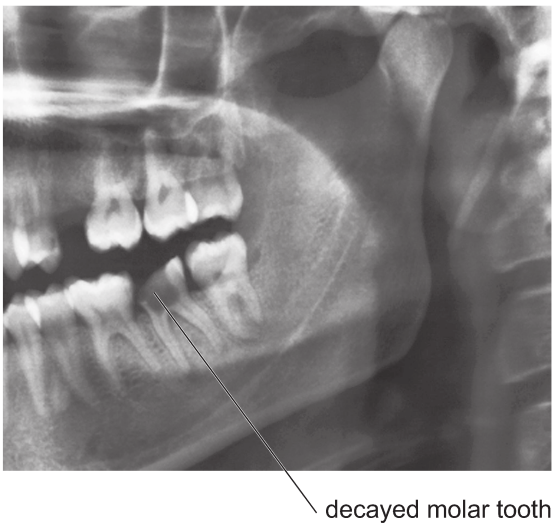

Fig. 2.2

Explain how tooth decay occurs.

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.....

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.....

.....

.....

.....

..... [4]

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6. ***[Nov 2020/P43/Q2]***

(a) A person ate a meal containing starch and fat.

Fig. 2.1 shows some events that occurred after ingesting this meal.

P	absorption of nutrients in the villi
Q	assimilation of fatty acids in the liver
R	breakdown of large food particles by the teeth
S	movement of small food particles through the oesophagus
T	secretion of amylase from the salivary glands

Fig. 2.1

SOLUTIONS

Topic - 7

1. **(a)** **(i)** At 0 minutes blue colour indicates the absence of glucose which ensures that glucose is not present on the outer surface of tubing. Green, yellow and red colour at 5, 10, 15 minutes indicate the presence of glucose. Glucose diffuses out of the permeable dialysis tubing from high concentration to low concentration.

(ii) The colour change will be quicker and more intense.

(b) **A** represents microvilli which increases the surface area for absorption and allows movement of substances into the cell.

B is rough endoplasmic reticulum. It is the site of protein synthesis.

C is mitochondrion. It is the power house of the cell and performs aerobic respiration.

(c) **(i)** Chloride.

(ii) The secretion of chloride ions into the lumen of the intestine causes a loss of water by osmosis, as water moves down a water potential gradient into the intestinal lumen. This results in a large volume of water accumulating in the intestine, leading to diarrhoea. The excessive loss of water from the body can cause dehydration.

2. **(a)** *Any three from,*

1. Protein synthesis.
2. Active transport.
3. Muscle contraction.
4. Cell division
5. Growth
6. Nerve impulses

(b)

function	name of structure	letter from Fig. 1.1
pushes food to the stomach	oesophagus	**A**
assimilation of amino acids to produce plasma proteins	**liver**	**K**
storage of bile	**gall bladder**	**L**
secretion of insulin	**pancreas**	**C**
absorption of fatty acids and glycerol	**small intestine**	**H / D**
secretion of pepsin	**stomach**	**B**
digestion of starch	**small intestine**	**H / D**

3. Urea is formed in the liver by deamination of excess amino acids,which involves removing the nitrogen-containing part of the amino acid.

4. **(a)** *Calcium*: Calcium is necessary for the formation of bones and teeth. It also prevents rickets.

Protein: Protein is essential for the growth of an organism. It is used to make muscle and prevents marasmus.

(b) 1. Salivary glands.
2. Stomach
3. Pancreas

5. **(a)** **A**: Enamel.

B: Dentine.

C: Pulp.

D: Gum.

(b) Molar teeth crushes the food into smaller pieces which increases the surface area of food for amylase (enzyme) action.

(c) Tooth decay can be due to multiple factors. Food particles stuck in the teeth promotes bacterial growth. Bacteria respires and produces acid. This acid can dissolve the enamel which exposes the dentine. Dentine is the soft layer and can be destroyed easily by the acid and this exposes the nerve endings and so the whole tooth is decayed.

6. (a)

R	T	S	P	Q

(b) (i) Any two from,

1. Nucleus.
2. Ribosomes.
3. Rough endoplasmic reticulum
4. Vesicles
5. Cell membrane

(ii) Gastric juice have multiple components one of which is pepsin a protease enzyme that functions for the chemical digestion of protein molecules and convert these molecules into amino acids to be absorbed by the body. Pepsin also digest bacteria or pathogen.

(iii) Mucus.

(c) (i) Emulsification of fats occurs in the small intestine, where fats are mixed with bile. Bile breaks up large fat globules into smaller fat droplets, which increases the surface area of fat globules for enzyme action. This helps lipase digest the fats more efficiently.

(ii) Small Intestine.

(iii) Lacteal.

7. (a) (i) Water.

(ii)

nutrient	elements	enzyme	products of digestion
protein	**C, H, O, N**	**protease / pepsin**	**amino acids**
fat	**C, H, O**	**lipase**	**fatty acids and glycerol**
lactose (milk sugar)	C, H, O	**lactase**	galactose and glucose (simple sugars)

(b) (i) Vitamin D is required for the development and strengthening of bones and teeth. It also prevents rickets.

(ii) Iron is required to make haemoglobin in red blood cells which is used for the transportation of oxygen. Iron deficiency may cause anaemia.

8. (a) Duodenum.

(b) (i) Active transport involves movement of substances through a membrane using chemical energy which comes from cellular respiration. Substances are moved against the concentration gradient using carrier proteins in the membrane.

(ii) Microvilli increases the surface area for the absorption of nutrients.

(c) (i) Mucus.

(ii) Protective substance in the intestine is necessary to prevent the intestine from any bacteria or toxins. It also provides protection against protease enzymes and extreme pH.

(d) Lacteals absorb fatty acids and glycerol and transport them into lymph vessels.

(e)

structure	level of organisation
gall bladder	**organ**
endoplasmic reticulum	**cell structure**
intestinal epithelium	**tissue**
ileum	**organ**

(f) (i) Fungal extract contains both amylase and pectinase. But the concentration of amylase is higher than pectinase and it can also be concluded that the concentration of amylase is more than 1% as the clear area in the **D** is larger than the clear area of **A**. It can also be concluded that the concentration of pectinase is lower than 1% because the cleared area is smaller in **D** as compared to **B**. These enzymes diffuse through the area and greater their concentration greater will be the cleared area. There is no change in the area around **C**.

(ii) Pattern will be same but smaller due to less effective collisions between enzymes and substrate.

9. **(i)** Vitamin C helps in tissue repair and also reduces the risk of some infections, e.g. flu, pneumonia. It also forms collagen and improves mineral ions absorption in the body. Iron on the other hand is involved in the production of haemoglobin for the transport of oxygen. It also prevents anaemia.

(ii) $$\text{Percentage decrease} = \frac{4291-897}{4291}\times 100$$
$$= 79\%$$

(iii) We can observe that there is an increase in the lymphocytes in the treatment group per microgram blood after 3 months, but there is no change in the lymphocytes in control group. No specific conclusion can be made because of a smaller sample size. More information and data is required to come to a conclusion.

10. **(a)** **J**: Liver.
K: Gall bladder.
L: Duodenum.

(b)

hormones secreted by the pancreas	enzymes secreted by the pancreas
insulin	amylase
glucagon	trypsin
	lipase

11. **(a)**

number from Fig. 4.1	name of the organ	letter or letters of all the processes that occur in the organ
1	**mouth**	**I, C, M**
2	**stomach**	**C, M, A**
3	**duodenum**	**A, C, M**
4	**ileum**	**A, C**
5	**colon**	**A**
6	**anus**	**E**

(b) **P** is lacteal which absorbs fatty acids and glycerols. Structure **T** is a lymphatic vessel and structure **Q** is an epithelial cell which has microvilli. Epithelial cell is one cell thick and is the site for breakdown of maltose to glucose. The microvilli present in structure **Q** increases the surface area for maximum absorption. Structure **R** is a capillary which has thin walls and transports blood and nutrients to **S** that is a vein.

12. **(i)** Mechanical (or physical) digestion.

(ii) Enamel.

(iii) Tooth decay initiates when food particle is left on the teeth and bacteria respires on it. Bacteria produces lactic acid which dissolves enamel as a result tooth decays.

13. **(a)** **(i)** So that these molecules can become soluble and small enough for diffusion and absorption.

(ii) Water.

(b) Proteins are converted to amino acids by the protease enzymes. All enzymes are specific and have a specific pH at which they work. Enzyme **A** is pepsin which works at an optimum pH of 2 and shows no activity at pH 5. Enzyme **B** is trypsin which works at an optimum pH of 10 and is denatured from pH 3. It is present in small intestine and works in alkaline condition.

(c) Membrane of Epithelium.

14. **(a)**

enzyme	organ that secretes the enzyme	number identifying the organ on Fig. 2.1	substrate	product or products
amylase	**salivary glands**	1	**starch**	**maltose**
pepsin	**stomach**	3	protein	**amino acids**
lipase	**pancreas**	4	**fat** / **lipid**	**fatty acids and glycerol**
maltase	**small intestine**	**5**	**maltose**	**glucose**

(b) Hydrochloric acid present in stomach kill bacteria and provides a suitable pH for protease enzyme. It also activates pepsinogen.

(c) It absorbs water.

Topic 16 Reproduction

TOPIC 16.1

Reproduction in Plants

1. ***[June 2020/P41/Q4]***

Johnson grass, *Sorghum halepense*, is wind-pollinated.

(a) Fig. 4.1 shows some Johnson grass flowers.

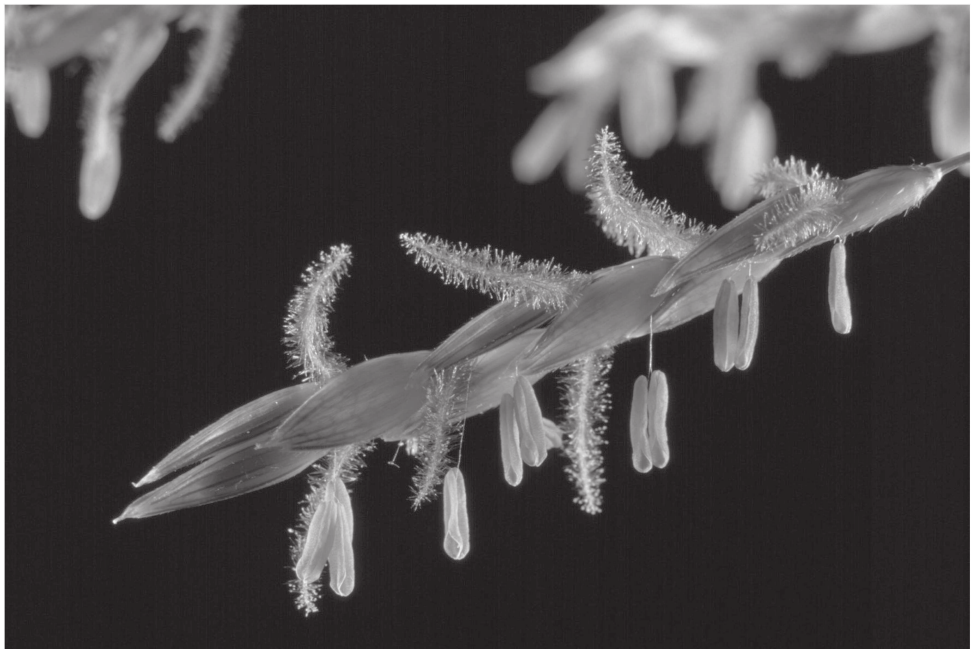

Fig. 4.1

(i) State the genus of Johnson grass.

..... [1]

(ii) Describe **two** features **visible in Fig. 4.1** that show that Johnson grass flowers are adapted for wind-pollination.

1 .....

.....

2 .....

.....

[2]

(b) Fig. 4.2 shows a section through a carpel shortly after pollination.

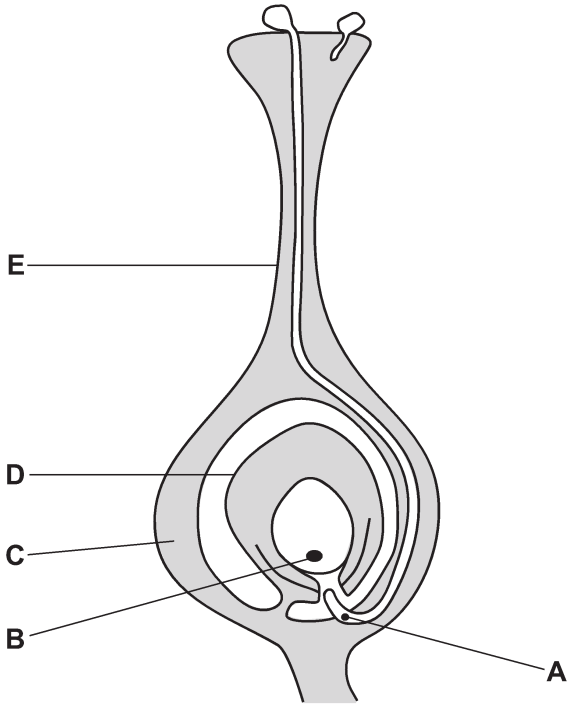

Fig. 4.2

(i) State the names of the parts of the carpel labelled **C**, **D** and **E**.

C .....

D .....

E .....

[3]

(ii) Complete the sentences:

Pollen grains are formed in anthers. During their formation the number of chromosomes in the nuclei is halved by the process of ..... . This means the male nucleus **A** in the pollen tube is described as a ..... nucleus.

When nucleus **A** ..... with nucleus **B**, the chromosome number doubles to form a ..... nucleus. The name of this process is ..... .

Then the ..... divides by the process of ..... to form an embryo.

[7]

(c) Discuss the advantages of sexual reproduction to a wild population of flowering plants such as Johnson grass.

.....

.....

.....

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.....

.....

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.....

.....

..... [5]

(d) Sexual reproduction requires energy.

State **three** uses of energy in organisms **other than in reproduction**.

1 .....

2 .....

3 .....

[3]

2. ***[June 2020/P42/Q6]***

(a) Fig. 6.1 is a diagram showing some parts of a plant. The circle shows a magnified cross-section of part of the stem.

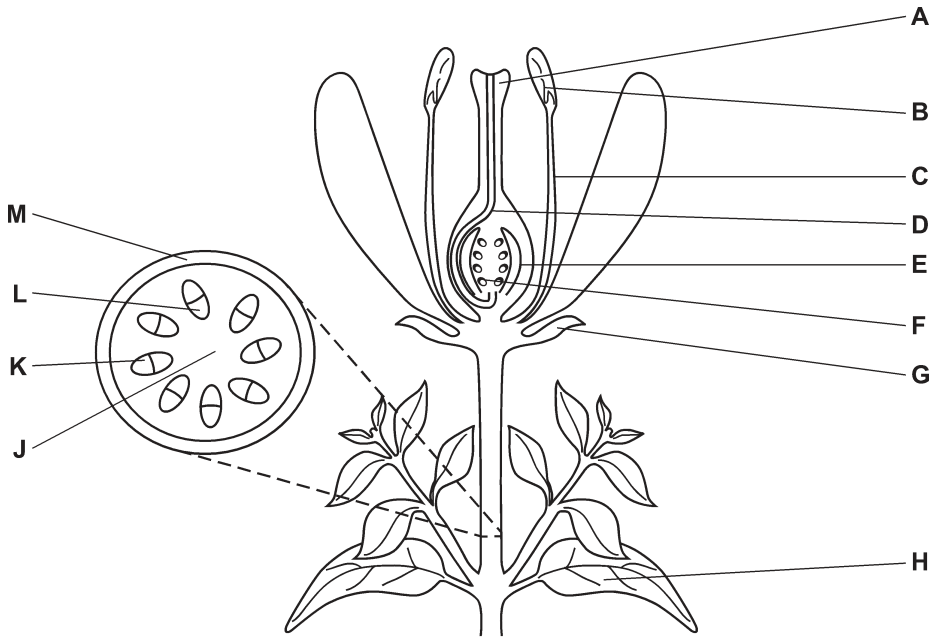

Fig. 6.1

(i) Table 6.1 contains statements about the functions of some of the structures in Fig. 6.1.

Complete the table by:

- stating the name of the structure
- identifying the letter that labels that structure.

Table 6.1

function	name of structure	letter from Fig. 6.1
provides support to the stem		
protects flower bud		
produces glucose		
produces pollen		
delivers male nuclei to the site of fertilisation		

[5]

(ii) State **one** letter from Fig. 6.1 that identifies a structure that contains a **haploid** nucleus.

..... [1]

(iii) State the name of the process that describes the transport of sucrose in a plant.

..... [1]

(iv) State **one** letter from Fig. 6.1 that is a structure that is an example of a source for sucrose transport.

..... [1]

(b) In addition to sucrose, amino acids are also transported in plants.

(i) State the name of a mineral ion that becomes part of an amino acid.

..... [1]

(ii) State the name of the structures inside cells that assemble amino acids into proteins.

..... [1]

(iii) State the name of the group of molecules that are made of proteins and act as catalysts.

..... [1]

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3. ***[Nov 2020/P41/Q4 a,b]***

(a) Fig. 4.1 shows a bee with pollen on its legs.

Fig. 4.1

Bees are insects that pollinate some flowering plants. They are attracted to the flowers by their colour, scent and nectar.

(i) Describe other ways in which flowers and pollen grains are adapted for insect pollination.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State where pollen is produced in a flower.

..... [1]

(iii) State the name of the process that produces haploid pollen nuclei.

..... [1]

(iv) Explain why it is important that the pollen nuclei are haploid.

.....

..... [1]

(b) (i) Describe how the pollen that is carried by an insect to another flower results in the formation of a plant embryo.

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.....

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.....

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.....

.....

..... [5]

SOLUTIONS

Topic - 16.1

1. **(a)** **(i)** *Sorghum*.

(ii) 1. The stigma is feathery and has large surface area.

2. Anthers hang outside the flowers.

(b) **(i)** **C**: Ovary.

D: Ovule.

E: Style.

(ii) Pollen grains are formed in anthers. During their formation the number of chromosomes in the nuclei is halved by the process of meiosis. This means the male nucleus **A** in the pollen tube is described as a haploid nucleus.

When nucleus **A** fuses with nucleus **B**, the chromosome number doubles to form a diploid nucleus. The name of this process is fertilisation. Then the zygote divides by the process of mitosis to form an embryo.

(c) Sexual reproduction gives genetic variation because offspring inherit different combinations of alleles from two parents. This gives rise to genetic diversity. This allows mutation to occur and organisms adapt to their changing environment. Mutation may also give rise to new species. The seed dispersal also colonize new areas with less competition.

(d) 1. Active transport.

2. Protein synthesis.

3. Muscle contraction.

4. Transport in the phloem

5. Cell division (mitosis, meiosis).

2. **(a)** **(i)**

function	name of structure	letter from Fig. 6.1
provides support to the stem	**xylem**	**L**
protects flower bud	**sepal**	**G**
produces glucose	**leaf**	**H**
produces pollen	**anther**	**B**
delivers male nuclei to the site of fertilisation	**pollen tube**	**D**

(ii) **B** / **D** / **F**

(iii) Translocation.

(iv) **H**

(b) **(i)** Nitrate ions.

(ii) Ribosomes.

(iii) Enzymes.

3. **(a)** **(i)** Flowers and pollen grains have various adaptations for insect pollination. They have large petals and often have bright colors and distinct patterns to attract insects. They emit strong scents to lure pollinators. The shape of flowers facilitates easy access for insects to the nectar while ensuring contact with reproductive parts. Pollen grains are sticky or spiky, aiding in their attachment to insects, which helps in transferring pollen between flowers. Additionally, some flowers have nectar guides to direct insects to the nectar source, ensuring efficient pollination.

(ii) Anther.

(iii) Meiosis.

(iv) So that after fertilization diploid number is restored.

(b) (i) Pollen carried by an insect is transferred to stigma which then forms a pollen tube which grows down style and enters the ovule in the ovary. Pollen fuses with the female nucleus and fertilization occurs and forms a zygote. Zygote undergoes mitosis to form an embryo.

(ii) Cross-pollination allows genetic variation, making plants more resistant to disease and environmental changes. The evolved organisms will be more fit to survive the changing environment.

4. (i)

1(a)	two petals visible	go to 2	
(b)	three petals visible	go to 4	
2(a)	one stigma per flower	go to 3	
(b)	more than one stigma per flower	*Pyrus communis*	**D**
3(a)	stigma higher than anther	*Prunus domestica*	**A**
(b)	stigma at same level or lower than anther	Prunus salicina	**B**
4(a)	two ovules visible	go to 5	
(b)	more than two ovules visible	*Punica granatum*	**E**
5(a)	anther smaller than carpel	*Prunus amygdalus*	**C**
(b)	anther larger than carpel	*Olea europaea*	**F**

(ii) 1. Nectar.
2. Sticky stigma.
3. Anther.
4. Colorful petals.
5. Sticky pollen

5. (a) (i)

structure in Fig. 1.1	name	function
A	stigma	trap pollen
B	petal	attracts insects
F	sepal	protect flower bud

(ii) 1. Filament
2. Anther

(b) (i) Self-pollination occurs within the same plant or flower, where pollen is transferred from the anther **C** to stigma **A**. The pollen grain grows a tube down through the style and ovary, guided by enzymes. The male nucleus travels down the pollen tube through the micropyle into the ovule **E**, where it fuses with the female nucleus. This forms a diploid zygote, and fertilisation takes place in the ovule.

(ii) *Advantages:*

- Self pollination has higher chance of successful pollination and fertilisation.
- Less pollen is wasted.
- Pollination can still occur even if the plant is isolated.
- Helps maintain selected varieties with less genetic variation, which is useful for farmers.

Disadvantages:

- Less genetic variation.
- Higher risk of inherited genetic diseases.
- Fewer individuals may survive new diseases.
- Increased competition between plants with similar traits.

6. (a) (i)

- Strap-shaped
- Long narrow leaves
- Parallel (not branched) veins.

(ii) Asexual reproduction is comparatively fast and does not require pollination. Offsprings are adapted to parent's environment. Asexual reproduction gives low genetic variation and is more susceptible to new diseases. Due to this offsprings have a close competition with each other.

(b) (i) It increases the chances of reaching a stigma.

(ii) Stigma is large, long, feathery and hangs outside the flower which helps it catch pollen.

(c) Cross-pollination is the transfer of pollen grains from the anther to the stigma on a different plant of the same species.