REDSPOT

O LEVEL

CLASSIFIED WORKED SOLUTIONS

BIOLOGY

Paper 2 (Theory) - All Variants

(Syllabus 5090)

period	2014 to J-2024
contents	June & November, Paper 2 (P21 & P22), Worked Solutions
form	Topic By Topic
compiled for	O Levels

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TOPIC 6

Plant Nutrition

Photosynthesis, Leaf Structure, Mineral Nutrition

1. ***[June 2014/P21/Q8]***

(a) Explain how humans are dependent upon the process of photosynthesis.

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..... [6]

(b) State and explain the appearance of a plant that lacks each of the following ions.

magnesium

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nitrate

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[4]

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2. ***[Nov 2014/P21/Q9]***

(a) Describe the path taken by a molecule of carbon dioxide, and the processes in which it is involved, from the moment it leaves the atmosphere until it forms part of a starch molecule in a leaf.

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..... [7]

(b) Explain how a lack of magnesium in the soil in which a plant is growing may reduce the formation of starch in a leaf.

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..... [3]

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3. ***[Nov 2014/P22/Q3]***

Pitcher plants, similar to the one shown in Fig. 3.1, trap insects in their pitchers and digest them to supplement their nutritional requirements.

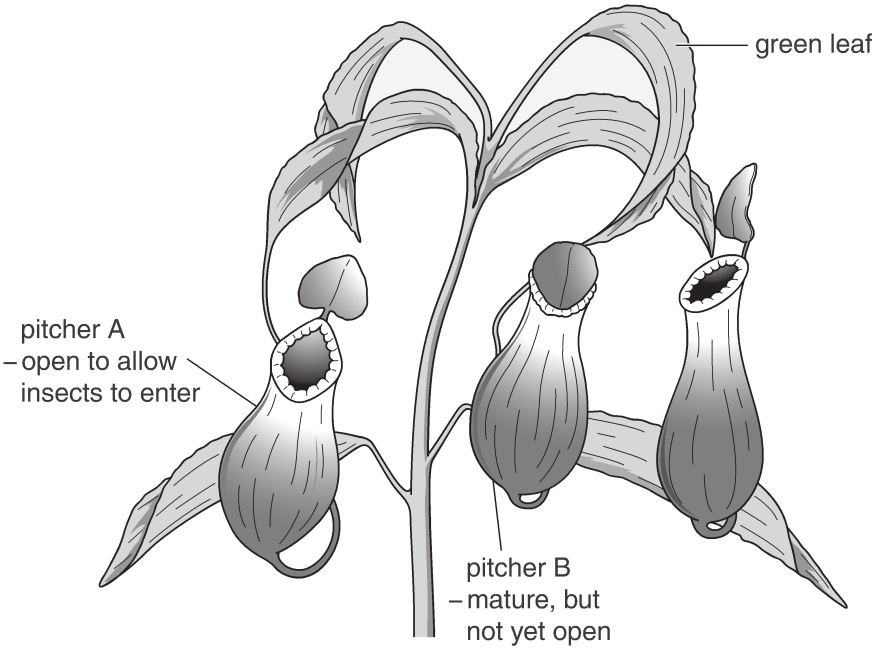

Fig. 3.1

Some pitcher plants attract small mammals such as bats to spend their resting hours comfortably in the opening to their pitchers. Others attract small tree shrews by releasing a sweet, nectar-like substance from glands on the pitcher lids, as shown in Fig. 3.2.

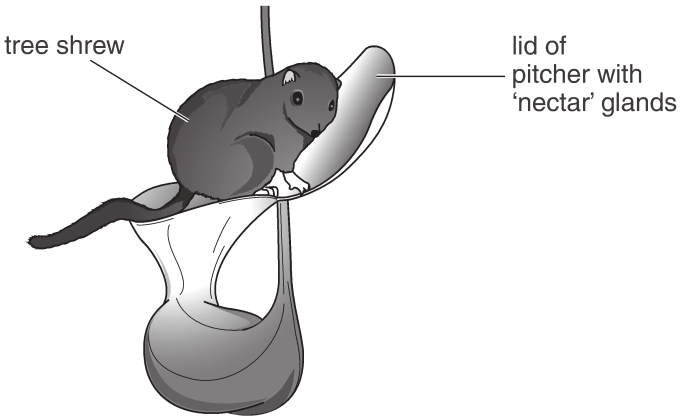

Fig. 3.2

(a) (i) Name the process used by the pitcher plant to manufacture the nectar-like substance before it is released.

..... [1]

(ii) Describe how that substance is translocated to the glands on the pitcher lids.

.....

.....

.....

..... [2]

(b) The pitcher plant that attracts the tree shrew is called the lavatory plant. These pitcher plants that attract small mammals rarely catch and digest many insects.

Suggest and describe how these plants may benefit from the presence of tree shrews and bats.

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..... [5]

4. ***[Nov 2015/P22/Q4]***

Fig. 4.1 shows a section through the leaf of a plant.

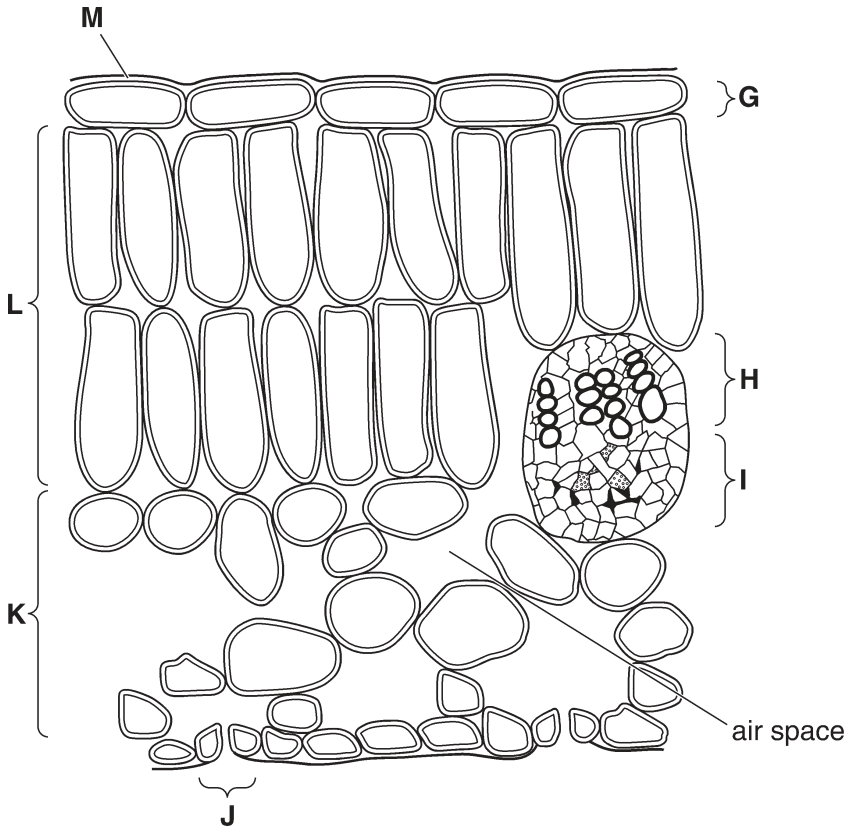

Fig. 4.1

(a) State the letters that identify each of the following:

(i) the region containing cells with the greatest number of chloroplasts

..... [1]

(ii) two regions that contain cells with **no** chloroplasts.

..... and ..... [1]

(b) Explain why Fig. 4.1 shows the leaf during daylight hours.

.....

..... [1]

(c) **(i)** Identify the tissues labelled **H** and **I**.

H .....

I .....

[2]

(ii) Describe the functions of these two tissues.

.....

.....

.....

.....

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.....

.....

..... [4]

(d) Name a gas that gradually increases in concentration in the air space during the hours of darkness. Give an explanation for your answer.

gas .....

explanation .....

.....

.....

.....

[3]

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5. ***[June 2016/P22/Q4 a,c]***

Fig. 4.1 shows the leaves of the same plant during daylight and during the hours of darkness.

in daylight

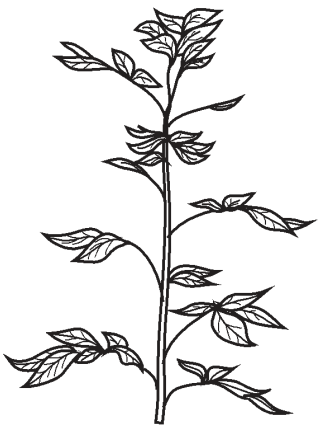


Fig. 4.1(a)

in darkness

Fig. 4.1(b)

ANSWERS

Topic - 6

1. **(a)** Humans cannot produce their food themselves therefore they are totally dependent on plants for their food directly (such as seed and fruits) and indirectly (such as on herbivores for meat) as plants can do photosynthesis, a process with which they not only produce food for themselves but also for other living organisms. They also use CO_2 making environment more suitable for humans (living organisms) and produce O_2 required for respiration to get energy. Humans also get economic benefits from plants by farming / cultivating crops. They also get benefits from their products such as drugs etc.

(b) *Magnesium:* Yellow leaves and stunted growth as it is very important component of chlorophyll, a photosynthetic pigment required for photosynthesis.

Nitrate: Stunted growth and yellow leaves as it is required for protein synthesis and chlorophyll production.

2. **(a)** Molecule of carbon dioxide (CO_2) enters into air space of leaf through stomata and dissolves in thin film of water present on the cell wall of mesophyll cell. It then reaches to the chloroplast through cell wall / cell membrane of mesophyll cell by diffusion. Here it reacts / links with water molecule to make glucose in the process of photosynthesis. Excess glucose is then converted to starch for storage.

(b) Lack of magnesium in soil means little / no Mg^{2+} is absorbed which leads to deficiency in chlorophyll as it is an important component of chlorophyll, a photosynthetic pigment so relatively less light energy is trapped. Rate of photosynthesis decreases which leads to relatively less production of glucose and starch.

3. **(a)** **(i)** Photosynthesis

(ii) Nectar like substance is in the form of sucrose or sugar in solution and it is transported to the glands on the pitcher lids via the phloem.

(b) Tree shrew while spending its resting hours on the opening of pitcher releases urine or nitrogenous wastes like NH_3 and others into the pitcher. Its egested wastes or faeces also fall into it. These wastes and faeces are decomposed by bacteria which release enzymes. As a result of biochemical reactions, nitrates and other ions or salts are produced. These are absorbed by pitcher plant. Nitrates and other substances are used to make amino acids, which, in turn, are used to synthesise proteins. Proteins are used for growth and repair process. Carbon dioxide produced for respiration is used for photosynthesis to make glucose from which other carbohydrates like starch are made.

4. **(a)** **(i)** **L**

(ii) **G** and **H**

(b) Guard cells open the stomata (**J**).

(c) **(i)** **H**: Xylem.

I: Phloem.

(ii) Xylem (**H**) carries water as well as minerals, ions or salts to plant parts after absorbing this mineral solution from soil through roots. Xylem also provides support to plant.

Phloem (**I**) carries sucrose or sugars along with amino acids which are part of cell sap. This cell sap is carried from leaf to rest of the plant, throughout plant body.

(d) *Gas*: Carbon dioxide (CO_2),

Explanation: At night photosynthesis does not occur. Due to respiration CO_2 is produced which is released in the air space from leaf cells.

5. **(a)** *Process*: Photosynthesis,

Explanation: Leaves are flat, with large surface area and exposed to sun, so can trap light energy. Stomata are present through which carbon dioxide is absorbed. Chlorophyll is present which is activated by light to start photosynthesis. Cuticle and epidermis is transparent so light can pass.

(b) **(i)** Light levels are reduced, so photosynthesis slows down. As a result less oxygen is produced, so less oxygen is lost. Stomata also close preventing loss of oxygen.

(ii) There is pitch darkness or very low light intensity, so photosynthesis almost stops. Hence oxygen found inside the leaves is used or absorbed for respiration process.

6. **(i)** Cholorophyll.

(ii) Carbon dioxide ($6CO_2$) + Water ($6H_2O$) $\rightarrow$ Glucose ($C_6H_{12}O_6$) + Oxygen ($6O_2$)

7. Uptil certain light intensity, rate of photosythesis increases. But after that certain other limiting factors are needed, e.g., water may be insufficient or temperature may be too low or too high. Insufficient CO_2 also affects rate of photosynthesis. Plant cannot store sugars or translocate sucrose more quickly.

8. **(a)** *Light intensity*: With the increase in light intensity, the rate of photosynthesis also increases upto a certain light intensity. Above this intensity, light is no more limiting, some other factor, such as temperature / CO_2 concentration may be the limiting factor therefore rate of photosynthesis will become constant. (when light is the limiting factor, the rate of photosynthesis is directly proportional to light intensity.)

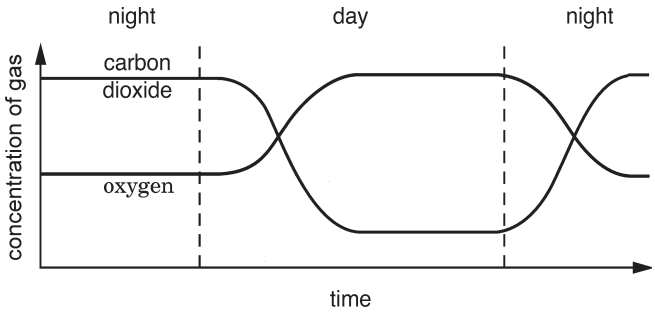
Temperature: Provided that other factors are not limiting, the rate of photosynthesis increases in direct proportion to the temperature.

With the increase in temperature K.E of molecules increases therefore rate of photosynthesis also increases upto optimum temperature. Above the optimum temperature, the rate levels off and then declines largely as a result of enzyme denaturation.

(b) Animals are not able to make their own food unlike plants by photosynthesis therefore they eat plants to get energy when food is metabolized by respiration. They also get oxygen produced in from photosynthesis by plants for respiration.

9. **(a)** **(i)** Concentration of CO_2 falls during the day and rises at night. During the day as well as night respiration occurs which releases CO_2. Photosynthesis occurs during the day but not at night. Photosynthesis absorbs carbon dioxide. Rate of photosynthesis is faster than rate of respiration during day.

(ii)



(b) time of day **sunset**

Explanation: At this time, there is lesser CO_2 dissolved, so pH increases above 7 and water becomes alkaline. It causes increase in percentage of ammonia.

10. **(i)** Light travels through bacterium. Receptors of bacterium help to detect the light absorbed or received by bacterium. Fibres attaching to a surface then contract which enables bacterium to move towards light.

(ii) As more light enters bacteria, chlorophyll content is activated and bacteria perform photosynthesis. So it produces carbohydrates like glucose and starch.

11. Plants absorb CO_2 and carry out photosynthesis. CO_2 reacts with water (H_2O) in the presence of light which is energy source to produce glucose or starch. This process occurs due to chlorophyll in chloroplasts. In the process oxygen is released.

TOPIC 11

Transport in Humans

Circulatory system, Heart, Blood vessels, Blood

1. ***[June 2015/P21/Q2]***

Table 2.1 shows the volume of blood supplied to parts of the body at rest and during strenuous exercise.

Table 2.1

part of body	volume of blood supplied in cm^3 / min	
	at rest	during strenuous exercise
brain	750	750
heart	250	750
skeletal muscle	1200	12500
skin	500	1900
kidneys	1100	.....
digestive organs	1400	600
other	600	400
Total	5800	17500

(a) (i) Calculate the volume of blood that is supplied to the brain **at rest** as a percentage of the total supplied to the whole body.

Show your working in the space below.

..... % [2]

(ii) Name the blood vessels that supply each kidney with blood.

..... [1]

(iii) Using the information in Table 2.1, calculate the volume of blood supplied to the kidneys during strenuous exercise.

Write your answer in the space provided in Table 2.1. [1]

(b) Use the information in Table 2.1 to name **two** parts of the body that have an increased supply of blood during strenuous exercise.

Explain the advantage to the body of increasing the supply of blood to each of the parts you name.

name of part .....

advantage .....

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.....

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name of part .....

advantage .....

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..... [4]

(c) Using the information in Table 2.1, suggest why eating immediately before exercise is not recommended.

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..... [2]

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2. ***[June 2015/P22/Q3 a]***

Fig. 3.1 shows the blood supply to cells in the liver.

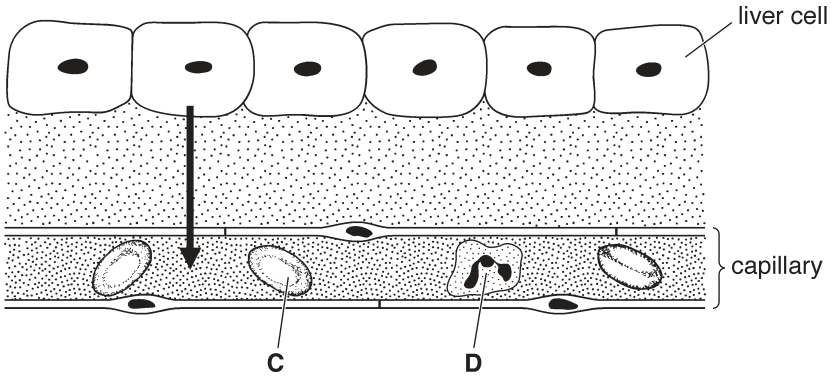

Fig. 3.1

(i) Name the cells labelled **C** and **D** in Fig. 3.1.

C .....

D ..... [2]

(ii) The arrow in Fig. 3.1 shows the movement of substances from the liver cells into the capillary.

Name **three** substances that move in the direction shown.

1 .....

2 .....

3 ..... [3]

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3. ***[Nov 2015/P21/Q2]***

Fig. 2.1 shows a vertical section through a human heart viewed from the front.
Two chambers, **X** and **Y**, are labelled.

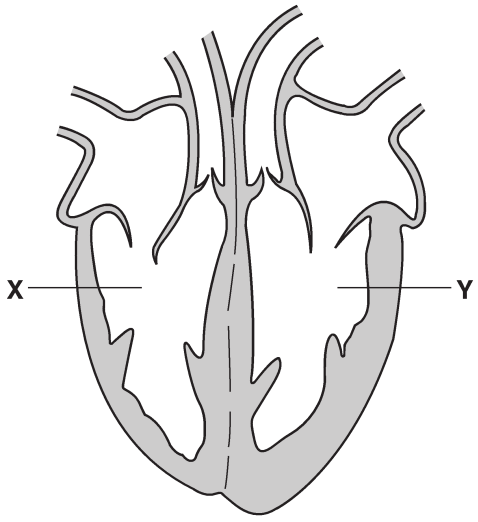

Fig. 2.1

(a) Use Fig. 2.1, and your knowledge of the circulatory system, to complete Table 2.1.

Table 2.1

chamber	name of chamber	name of blood vessel carrying blood from chamber
X		
Y		

[4]

(b) Fig. 2.2(a) shows how the mean blood pressure changes as blood flows through different types of blood vessel after leaving the heart.

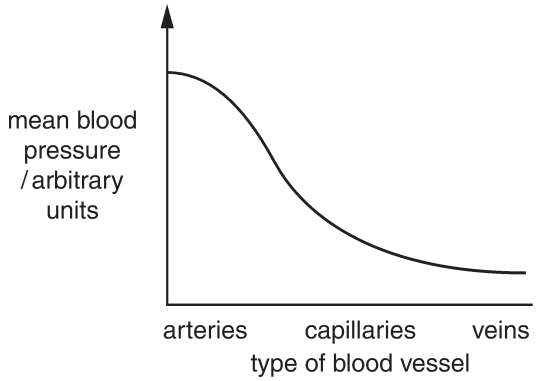

Fig. 2.2(a)

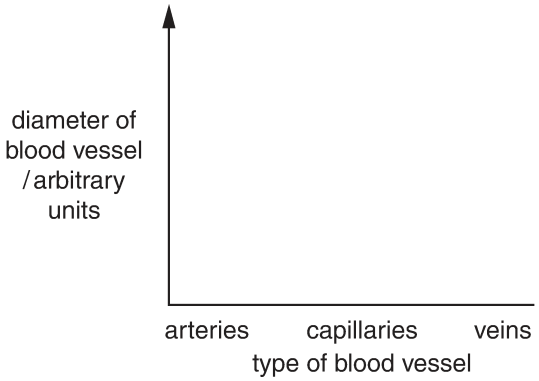

Fig. 2.2(b)

(i) Draw a line on Fig. 2.2(b) to show how the diameters of the vessels that blood flows through vary. [2]

(ii) Use the line you have drawn on Fig. 2.2(b), and your biological knowledge, to explain why the mean blood pressure is higher in an artery than in a vein.

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..... [4]

(c) Fig. 2.3 shows blood returning to the heart at low pressure through a vein in a leg.

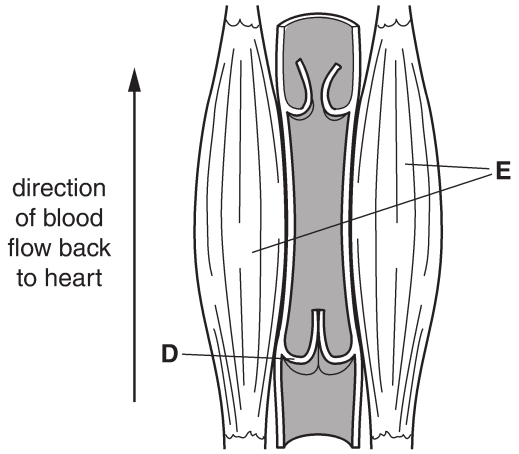

Fig. 2.3

Name part **D** in Fig. 2.3.

Explain how this part enables blood to return to the heart.

(i) name of part **D** .....

function .....

.....

.....

[2]

(ii) Suggest how the parts labelled **E** in Fig. 2.3 help blood to return to the heart.

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..... [2]

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4. ***[Nov 2015/P21/Q8]***

Name the components of human blood and explain how each component carries out its function.

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..... [10]

5. ***[Nov 2015/P22/Q3]***

Fig. 3.1 shows blood pressure changes as blood flows through part of the circulatory system, beginning at the right atrium, travelling to the lungs, and ending in the pulmonary vein.

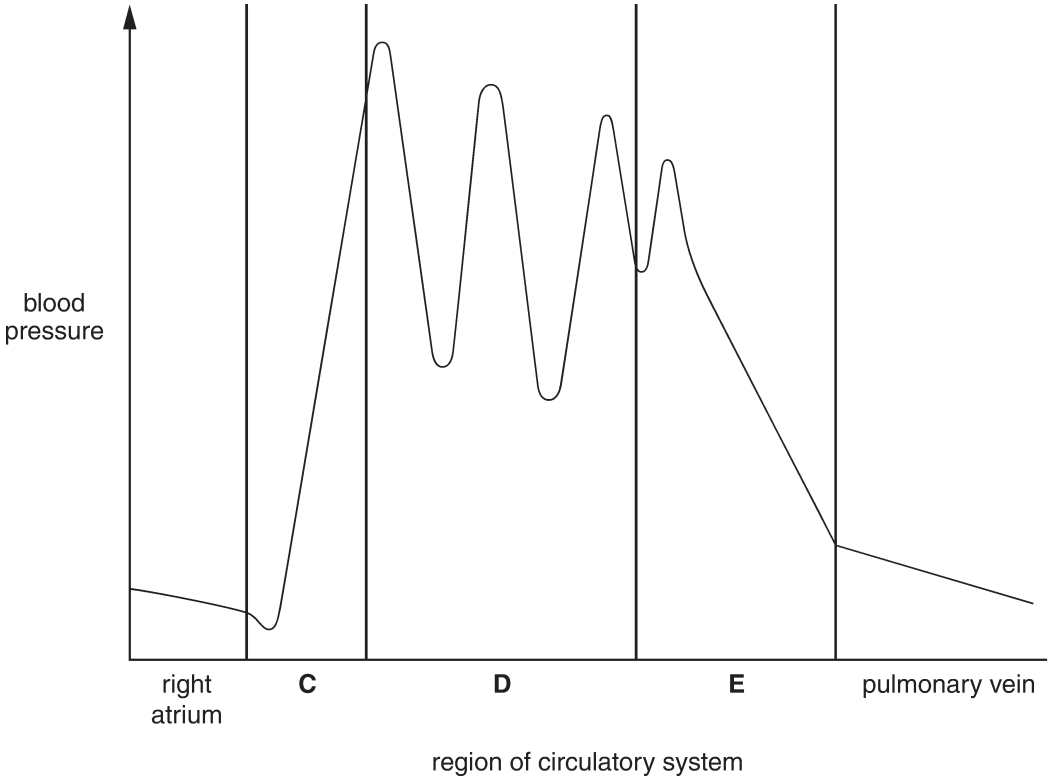

Fig. 3.1

(a) State which chamber of the heart is represented by **C**. Explain your answer.

chamber **C** .....

explanation .....

.....

[2]

(b) Explain the reasons for the regular changes in blood pressure in region **D**.

.....

.....

.....

..... [2]

(c) Important chemical changes occur in the blood as it passes through region **E**.

(i) Identify region **E**.

..... [1]

(ii) Describe and explain the chemical changes that occur.

.....

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..... [3]

(d) Describe and explain how the shape of a graph drawn to show blood pressure changes as blood flows from the heart to the rest of the body and back again would differ from Fig. 3.1.

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ANSWERS

Topic - 11

1. **(a)** **(i)** $\text{Volume of blood} = \frac{750}{5800} \times 100$

$= 12.9 \approx 13\%$

(ii) Renal artery.

(iii) $17500 - (750 + 750 + 12500 + 1900 + 600 + 400)$

$= 17500 - 16900 = 600$

(b) *Name of part:* Heart

Advantage: To supply more oxygen and glucose for higher aerobic respiration and to prevent anaerobic respiration. It also prevents the accumulation of CO_2 and lactic acid.

Name of part: Skeletal muscle.

Advantage: To prevent muscle fatigue and overheating.

(c) Less blood supply to digestive organs reduces the rate of digestion and absorption of products of digestion.

2. **(i)** **C**: RBC or erythrocyte,

D: WBC or phagocyte.

(ii) 1. Carbon dioxide,

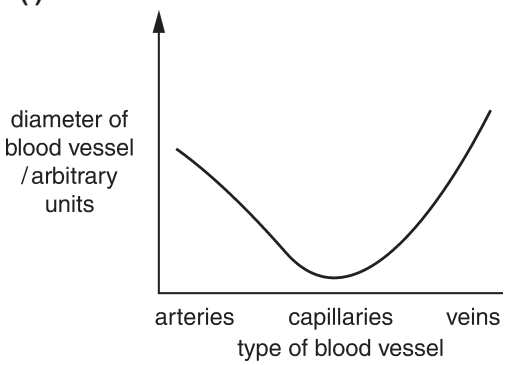
2. Urea,

3. Glucose.

3. **(a)**

chamber	name of chamber	name of blood vessel carrying blood from chamber
X	Right ventricle	Pulmonary artery
Y	Left ventricle	Aorta

(b) **(i)**



(ii) Arteries receive blood from heart which pumps it forcefully where as veins receive blood from capillaries without the source of pressure.

Blood pressure decreases in arteries as the distance from heart increases although it remains relatively high with the help of thick muscular and elastic walls along with narrow lumen.

(c) **(i)** *Name of part **D***: Valve / semi-lunar valve.

Function: Prevents backflow of blood / allows flow in one direction only.

(ii) Muscles contract and put pressure on the wall of vein and blood inside the vein to push it towards heart.

4. Blood consists of following two components:

1. *Liquid component*: Blood plasma

It consists of water and dissolved substances such as minerals along with blood proteins such as fibrinogen (soluble), converted to fibrin (insoluble fibres) during blood clotting.

2. *Solid component*: Blood cells.

(a) *Red blood cells (RBC)*:

Have haemoglobin for transport of oxygen and an enzyme carbonic anhydrase for conversion of CO_2 into HCO_3^- ions and its transport.

(b) *White blood cells*:

- Phagocytes for phagocytosis / removal of microorganisms (bacteria).
- Lymphocytes for production of antibodies and tissue rejection.

(c) *Platelets*:

Fil / plug holes present within fibrin fibres to make scab / blood clot.

5. (a) *Chamber **C***: Right ventricle,

Explanation: Blood flows from right atrium to right ventricle, where pressure increases.

(b) Blood pressure increases when ventricles of heart contract and pump the blood into arteries. It decreases when ventricles relax and do not pump the blood.

(c) (i) Lungs or capillaries.

(ii) When blood reaches lungs, it passes through capillaries around alveoli of air sacs, where diffusion of gases occurs. Due to gas exchange, CO_2 is lost and O_2 is gained. As blood is oxygenated, haemoglobin binds to O_2 and oxyhaemoglobin increases. Also there are changes in pH, as blood becomes less acidic because CO_2 moves out by concentration gradient.

(d) As blood passes to different parts of body, there is wide variation in pressure. Blood is pushed into body by left ventricle. Wall of left ventricle is thick and more muscular, so it pushes the blood with higher pressure into aorta. Blood has further to travel and it takes longer to reach other parts of body, so gradually pressure decreases and shows many fluctuations in certain parts. Hence curve shows undulations.

6. (a) Blood passing through heart twice to complete one cycle is known as double circulation. The pulmonary and the systemic circulations make up the double circulation in human. Pulmonary artery carries deoxygenated blood to the lungs from right ventricle where blood loses carbon dioxide and picks up oxygen. Oxygenated blood is returned to the heart by pulmonary vein. This circulation linking the lungs to the heart is known as pulmonary circulation.

Oxygenated blood leaves the left ventricle of the heart with relatively high pressure and is distributed by arteries to all parts of the body except lungs to supply nutrients and oxygen. Veins carry blood from all parts of body back to the right side of heart. This is the main circulation, called systemic circulation.

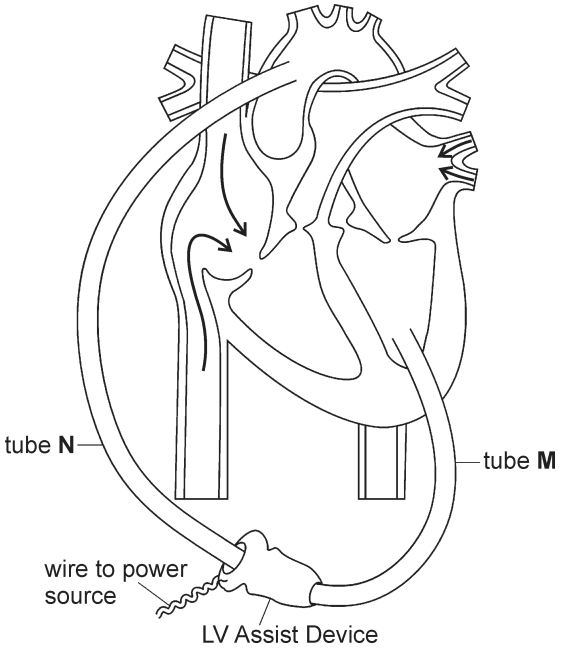
(b) Capillaries are microscopic blood vessels which are made of only a single layer of greatly flattened cells known as endothelium. Wall of capillary also has large number of pores for release of components of blood into intercellular space to make tissue fluid. Dissolved food substances such as glucose, amino acids and oxygen diffuse from the blood of capillaries into the tissue fluid.

7. (a) (i) It is called LV Assist Device because it helps blood flow or maintain pressure in left ventricle.

(ii) Muscle

(iii) Aorta

(b) (i) & (ii)



(c) Aortic or semilunar valve.

(d) For artificial assistance of pulmonary circulation, Assist Device would be fitted in right ventricle and pulmonary artery, because blood flows from right ventricle to pulmonary artery.

8.

	P (vein)	**R** (Artery)
1.	Relatively thin wall.	Relatively thick wall.
2.	Relatively large / wide lumen.	Relatively small / narrow lumen.
3.	Semi-lunar valves present.	Semi-lunar valves absent.
4.	Less elastic and muscular.	More elastic and muscular.

9. **(a)** Carbon dioxide is produced in cells where respiration occurs. It diffuses through cytoplasm across the cell membrane to tissue fluid outside the cell and then through the nearby capillary epithelium into the blood moving in the lumen of capillary. It moves in plasma as well as red blood cells. From capillary, it enters vein and then to vena cava, which carries it to right side of heart. From right atrium it then enters right ventricle and then through pulmonary artery it reaches to capillary around the alveolus. From alveoli it diffuses into the air in air sacs, from which it is then exhaled.

(b) Blood flows in blood vessels due to certain pressure. While in foot its pressure keeps it flowing. Due to contraction of skeletal muscles, it moves into veins. Veins in the leg push it upward. There are valves in veins which prevent back flow of blood, so it keeps on moving from veins to vena cava and then into heart.

10. **(a)** *Name*: Red blood cell / erythrocyte.

Function: It is used for transport of oxygen.

(b) A person with an unusually low number of RBC may become tired quickly because of reduced oxygen supply which leads to reduced respiration and release of energy, required for different activities such as exercise.

(c) It will expand and burst as water moves into the cell down the water potential gradient by osmosis and there is nothing to resist such as cell wall.

11. **(a)**

contain oxygenated blood	**contain deoxygenated blood**
A + B + C	D + E + F

(b) **(i)**

blood to or from the lungs	**blood to or from the body tissues**
F → B → C	A → E → D

(ii) Pressure of blood in the circulation to the body tissues is higher than the pressure of blood in the circulation of the lungs.

(iii) The wall of left ventricle is relatively more thick and muscular to generate relatively large amount of force when contracted, and pushes the blood towards body tissues through aorta.

12. **(a)** **(i)** Coronary artery.

(ii) Coronary heart disease (CHD).

(iii) 1. Diet containing fat, oil or cholesterol.
2. Lack of exercise.
3. Inheritance or genetic effect.

(iv) Narrowing of vessel **F** may cause heart attack or angina or breathlessness because less blood goes to body tissues or organs. So less oxygen and glucose is supplied to tissues or organs. Hence less aerobic respiration occurs. Ability of heart to contract or pump blood decreases. Ability to carry out physical activity also decreases because less energy is available.

(b) *Inflating the balloon*: It opens the metal mesh and pushes or compresses the blockage or deposition of fat. It ultimately widens lumen of blood vessel.

Leaving the hollow metal mesh in the blood vessel: In order to maintain the diameter of vessel or wider lumen, metal mesh is left in the vessel. It increases the blood flow.

13. **(a)** **(i)** *Fig 1*: Artery / arteriole

Fig 2: Vein / venule

(ii) Artery wall is thicker and more muscular compared with wall of vein. Lumen of artery is narrower than that of vein.