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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CONTENTS

TOPIC 3

Movement Into and Out of Cells

Diffusion and Osmosis, Active Transport

1. *[June 2014/P21/Q4]*

Fig. 4.1 shows a type of plant cell.

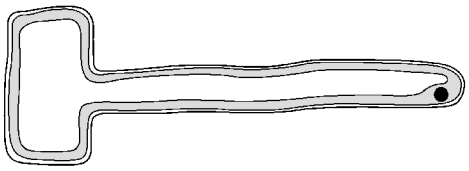

Fig. 4.1

(a) (i) Name the type of cell shown in Fig. 4.1.

..... [1]

(ii) Describe how water is taken up from the soil into the cytoplasm of the cell shown in Fig.4.1.

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..... [3]

(b) The cell shown in Fig. 4.1 also takes up ions from the soil. Fig. 4.2 shows the relationship between the rate of ion uptake and the concentration of oxygen in the soil surrounding the cell.

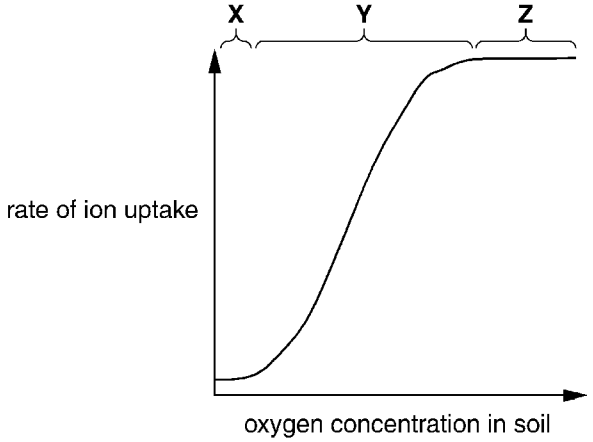

Fig. 4.2

(i) Using Fig. 4.2, describe the effect of increasing oxygen concentration in the soil on the rate of ion uptake.

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..... [2]

(ii) Suggest how most ions are taken up during section **X** and section **Y** on Fig. 4.2. Give an explanation for your answers.

process during section **X** .....

process during section **Y** .....

explanation

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[5]

(iii) Suggest a reason for the shape of the graph during section **Z** on Fig. 4.2.

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..... [1]

2. ***[June 2015/P22/Q7]***

(a) Describe each of the following processes:

(i) active transport

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..... [4]

(ii) osmosis.

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..... [3]

(b) Explain what happens to a red blood cell when it is placed in pure water.

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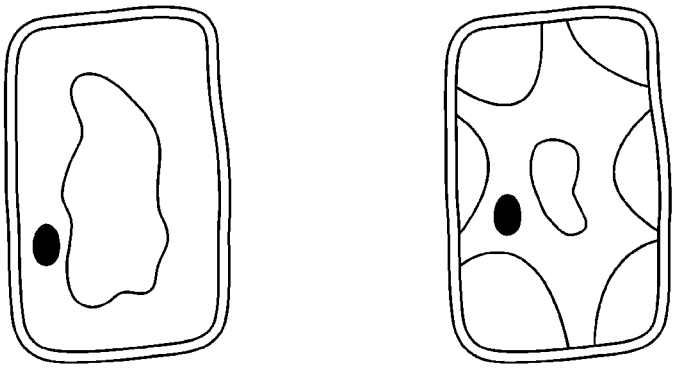
..... [3]

3. ***[Nov 2015/P21/Q1]***

Fig. 1.1 shows a plant cell before and after being placed in a concentrated salt solution.



before after

Fig. 1.1

(a) With reference to **named** parts of the cell, describe changes in the appearance of the cell after being placed in the concentrated salt solution.

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..... [3]

(b) Explain how the changes you have described in **(a)** have occurred.

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..... [3]

4. ***[June 2017/P21/Q9 c]***

Compare diffusion and active transport

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..... [4]

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5. ***[Nov 2018/P21/Q5]***

Fig. 1 shows cells from a plant tissue which have been mounted on a slide with distilled water and viewed using a microscope.

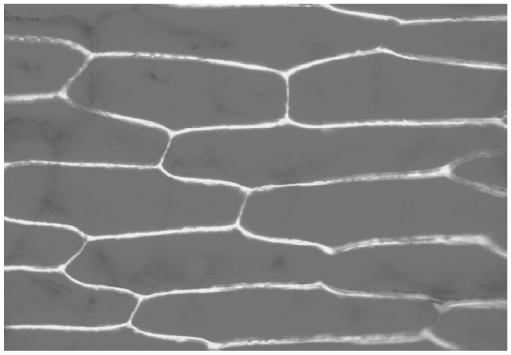

Fig. 1

Fig. 2 shows cells taken from the same plant tissue when mounted on a slide with concentrated salt solution.

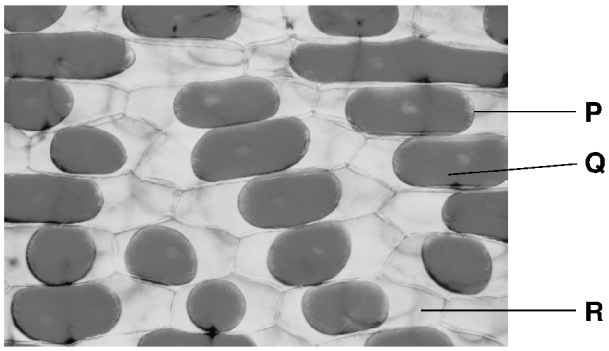

Fig. 2

(a) Explain the appearance of the cells in Fig. 2.

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..... [4]

(b) (i) Identify structures **P** and **Q** in Fig. 2.

P .....

Q .....

[2]

(ii) State the contents of location **R** in Fig. 2.

..... [1]

(iii) The concentrations of substances in structure **Q** are different from those in location **R**.

Explain how the properties of structure **P** result in differences in concentrations of substances in **Q** and **R**.

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..... [3]

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6. ***[Nov 2018/P22/Q9]***

(a) Explain what is meant by each of the following terms and describe **one** example of each in either a plant **or** an animal:

diffusion, ...

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active transport. .....

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[7]

(b) Starch is a carbohydrate stored inside plant cells.

Explain why starch is a more suitable storage substance than glucose.

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..... [3]

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7. ***[June 2019/P21/Q6]***

(a) Define osmosis and explain why osmosis is a special form of diffusion.

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..... [7]

(b) Explain the importance of active transport in the human alimentary canal.

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..... [3]

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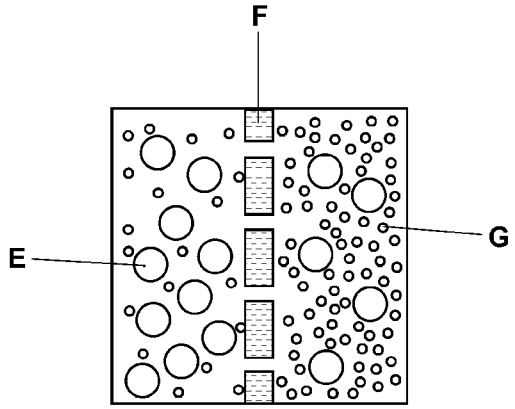
8. ***[Nov 2020/P21/Q5]***

(a) Name the substance absorbed by plants using the process of osmosis.

..... [1]

(b) The diagram represents osmosis taking place between two sucrose solutions of different concentrations.



Identify **E**, **F** and **G**.

molecule **E** .....

structure **F** .....

molecule **G** .....

[3]

ANSWERS

Topic - 3

1. **(a)** **(i)** Root hair cell.

(ii) Water is taken up by osmosis i.e., from relatively high water potential to relatively low water potential across the cell membrane or down the water potential gradient from soil to cytoplasm of root hair cell through partially permeable cell membrane.

(b) **(i)** At **Y** increase in O_2 concentration leads to increase in uptake of ions whereas at **Z** further increase in O_2 concentration leads to no increase in uptake of ions.

(ii) *Process during section **X***: Diffusion.

*Process during section **Y***: Active transport.

Explanation: Diffusion is a passive process hence energy is not required whereas active transport requires energy which comes from aerobic respiration hence oxygen is required.

(iii) Rate of uptake of ions may be affected by some other factors / limiting factor e.g., temperature.

2. **(a)** **(i)** It is the movement of substances like ions, molecules or any particles from lower to higher concentration, i.e. against concentration gradient. Active transport occurs through a living membrane i.e. cell membrane. Process requires energy or ATP which is produced by respiration. Some examples of active transport include absorption of glucose by small intestine or ileum and uptake of mineral ions by root hair cells.

(ii) Osmos means, "water", so osmosis means movement of water molecules down water potential gradient or from higher water potential to lower water potential across a partially permeable membrane. It is a special case of diffusion down water concentration gradient. It is a passive process and does not require extra energy.

(b) A red blood cell placed in water takes up water rapidly as water potential is higher outside the cell, so water moves from higher to lower water potential inside the cell (endosmosis). Volume of cell increases and cell swells. Cell membrane is unable to withstand the pressure so it bursts. It is also called haemolysis.

3. **(a)** Cell membrane has moved away from cell wall and vacuole has become smaller.

(b) Above changes have occurred because water has moved out of the cell down the water potential gradient across the partially permeable cell membrane by osmosis.

4. Movement of molecules are involved in both types of method of transport across the cell membrane although in diffusion molecules move down the concentration gradient without the use of energy whereas in active transport molecules move against the concentration gradient with the use of energy which comes from cellular respiration.

5. **(a)** In Fig. 2 plasmolysed cells are visible as water has moved out of cells by exosmosis down the water potential gradient through partially permeable membrane because plant tissue has been mounted / placed in a concentrated solution which has relatively low water potential.

(b) **(i)** **P**: Membrane.

Q: Cytoplasm.

(ii) Salt + water solution.

(iii) Structure **P** is partially permeable therefore only water can pass through where as other substances such as salts cannot pass through.

TOPIC 19

Relationships of Organisms with One Another and with the Environment

Energy flow, Nutrient cycles, Ecosystems and biodiversity, Effects of humans on ecosystems, Conservation

1. ***[Nov 2015/P22/Q2 b,c]***

Fig. 2.1 shows a sloth. The sloth is a mammal that lives in the trees of the South American rainforests.

Sloths have the following features:

- They are extremely slow moving.
- Some tear leaves from trees using their lips and the teeth at the back of their mouths.
- They have no front teeth.
- They climb down the tree to deposit their faeces in a hole they dig near the foot of the tree.
- They lose over a quarter of their body weight when they defaecate, which may be once every 6–8 days.
- Their fur is often green since it contains single-celled, plant-like organisms (algae).
- Their fur also contains blood-sucking mosquitoes and many small animals such as adult moths that feed on the algae and on the hair of the sloth.
- Moths lay their eggs in the faeces of the sloth on which the moth larvae feed.
- The major predators of the sloth are jungle cats and the harpy eagle.

(a) Complete the food web in Fig. 2.2 to show the feeding relationships of the organisms.

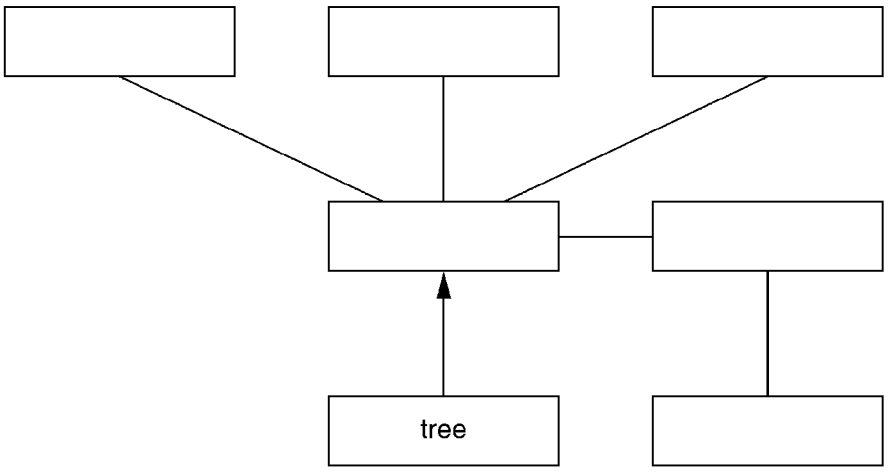


Fig. 2.2

[4]

(b) Suggest and explain an advantage to the sloths of each of the following:

(i) the algae that live in their fur

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..... [2]

(ii) burying their faeces at the foot of the trees in which they live.

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..... [3]

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2. ***[Nov 2015/P22/Q5]***

Fig. 5.1 shows some human activities that have an effect on the environment.

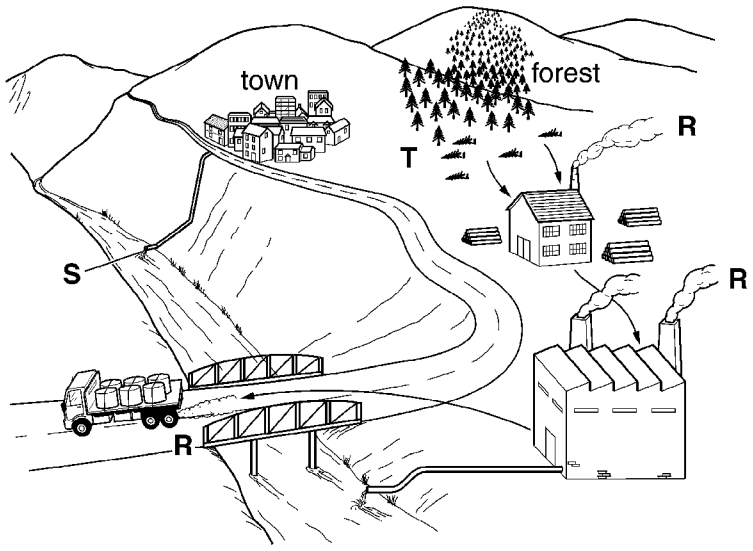

Fig. 5.1

(a) Name **two** gases, other than carbon dioxide, released at **R** that are harmful to the environment. For each gas, state the harm that it causes.

gas 1 .....

harm caused .....

.....

gas 2 .....

harm caused .....

.....

[4]

(b) Explain how recycling could prevent the damage caused to the environment at **S** and **T**.

at **S** .....

.....

.....

at **T** .....

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..... [3]

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3. ***[June 2016/P21/Q7]***

(a) Describe how the nitrogen cycle makes nitrogen in the air available for **both** plant and animal protein.

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..... [5]

(b) Nitrogen can also be made available in the form of nitrogen-containing fertilisers. Describe the possible effects of using nitrogen-containing fertilisers on each of the following:

the production of crops by farmers,

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the environment.

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[5]

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4. ***[Nov 2016/P21/Q9]***

(a) Discuss reasons for the conservation of species with reference to the management of fisheries.

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(b) Describe the consequences of deforestation.

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..... [6]

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5. ***[Nov 2016/P22/Q5]***

Sweet clover is a member of the pea and bean family (leguminous plants) that grows amongst grass in fields used for cattle feed.

(a) Explain how sweet clover can improve the soil in which it grows.

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..... [2]

(b) As sweet clover dries, fungi that grow on it produce a chemical (dicoumarol) that prevents blood from clotting.

Suggest a protein that cattle which eat sweet clover affected by such fungi might be unable to produce.

..... [1]

(c) Dicoumarol has been used for many years as a constituent in a form of rat poison.
Fig. 5.1 shows the change in the LD_{50} for dicoumarol in rats from 2000 to 2015.
The LD_{50} is a measure of the amount of poison that will kill 50% of the rats that consume it.

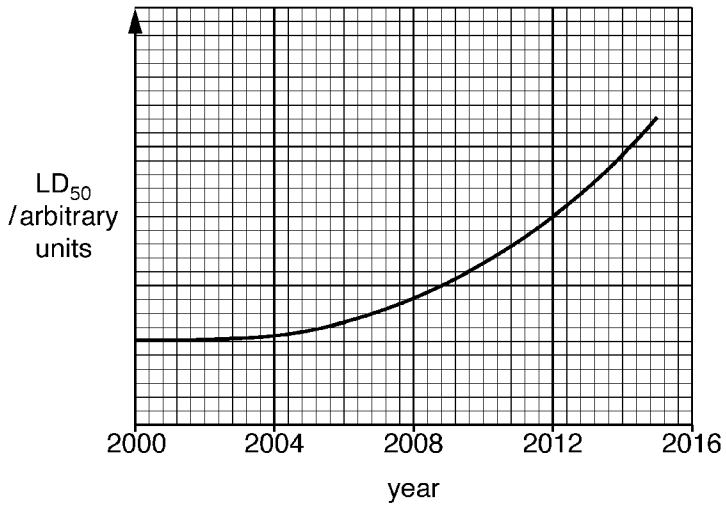

Fig. 5.1

(i) Describe the change in the LD_{50} for dicoumarol in rats from 2000 to 2015.

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..... [2]

(ii) Suggest an explanation for the change you have described.

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..... [4]

6. ***[June 2017/P22/Q8]***

This is a simple food chain:

tree → insect → bird → fox

(a) Draw and label a pyramid of biomass for this food chain.

[2]

(b) Explain why only a small proportion of the energy in the insects passes to the birds.

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..... [4]

(c) The foxes are infested with fleas (small, blood-sucking insects).

Draw and label a pyramid of numbers for the complete food chain **including** the fleas.

[4]

7. ***[Nov 2017/P21/Q3]***

Fig. 3.1 shows the flow of energy within a biological system.

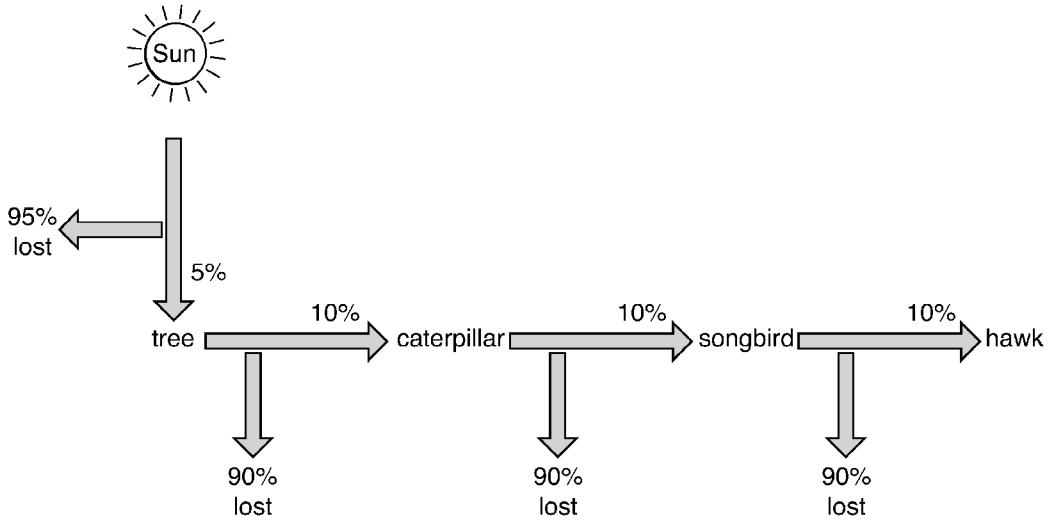

Fig. 3.1

(a) (i) Name the type of chart shown in Fig. 3.1.

..... [1]

(ii) Name **one** example, shown in Fig. 3.1, of each of the following types of organism.

producer .....

carnivore .....

[2]

(b) (i) Suggest why only 5% of the energy from the Sun passes to the tree.

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..... [2]

(ii) Describe how energy is lost between the songbird and the hawk.

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..... [3]

(c) Fig. 3.2 shows two possible uses of the same area of land to produce food.

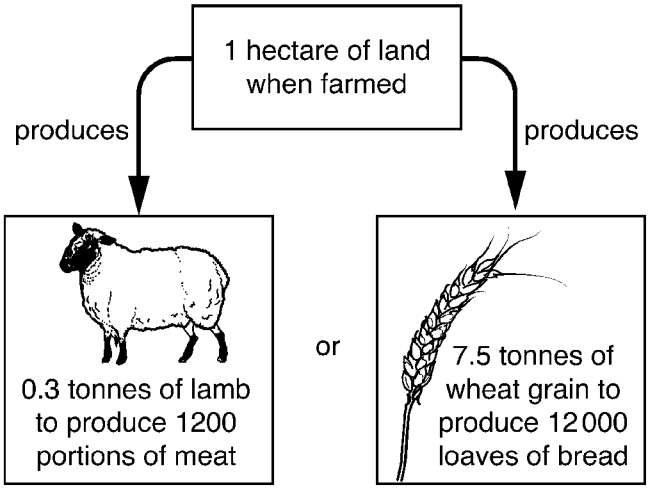

Fig. 3.2

Use the information in Fig. 3.1 and Fig. 3.2, and your own knowledge, to explain why it is possible to feed a greater number of people if the area of land is used to farm crops rather than to farm animals.

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..... [5]

8. ***[Nov 2017/P22/Q4]***

Fig. 4.1 shows the relationships between a number of organisms living together in a South American rainforest.

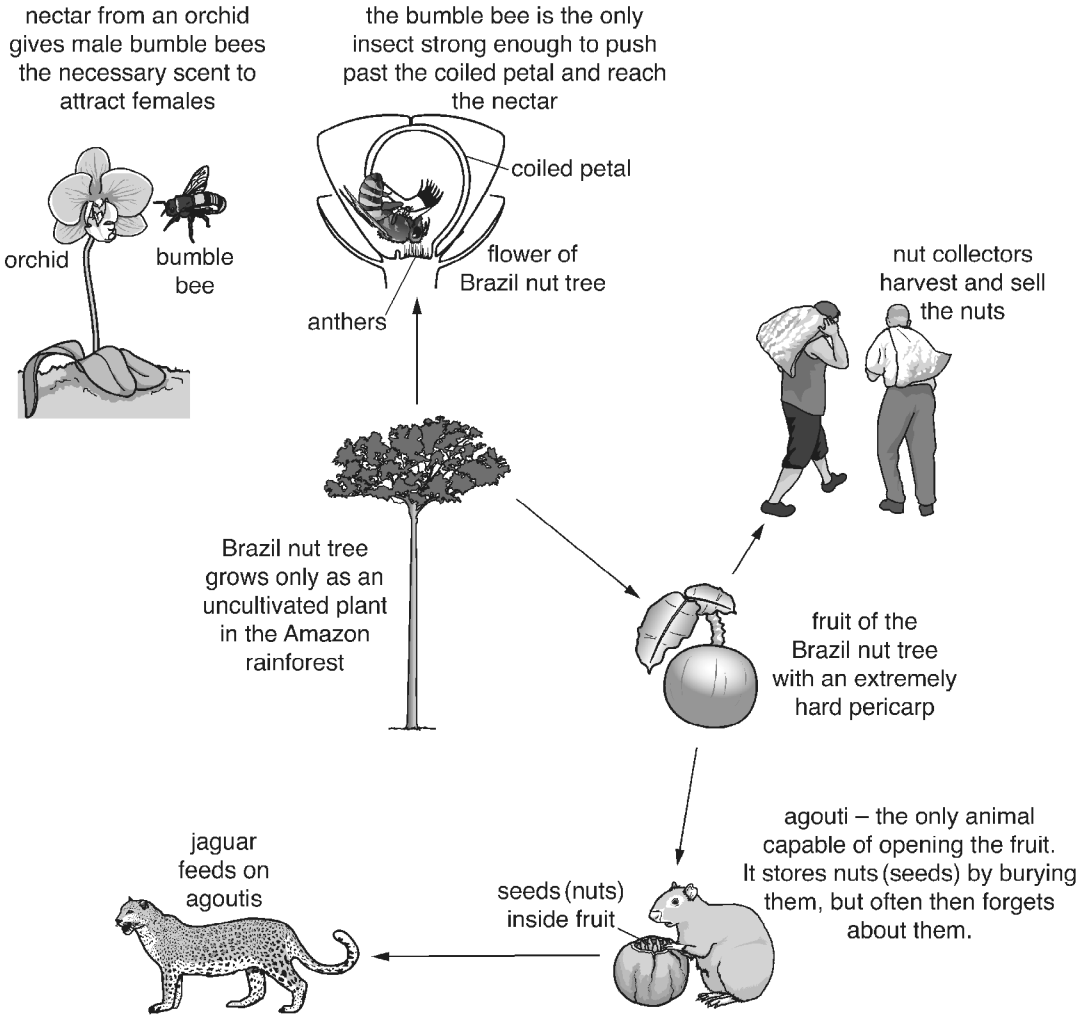
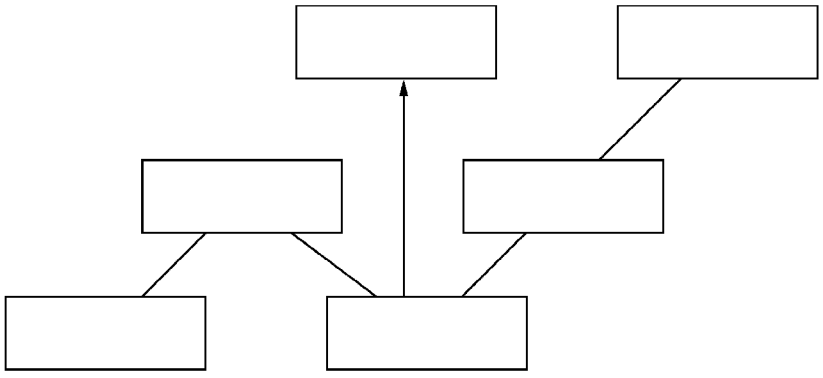


Fig. 4.1

(a) Fig. 4.2 is an incomplete food web for these organisms. Complete Fig. 4.2 by:

- writing the name of an organism in each box,
- completing the arrows to show the flow of energy.



[4]

Fig. 4.2

(b) Name the type of seed dispersal found in the Brazil nut tree. Give a reason for your answer.

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..... [2]

(c) Suggest the possible effects on the community in the rainforest if the orchids were killed by disease.

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..... [6]

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9. ***[Nov 2017/P22/Q6 a]***

Explain why most living organisms depend on photosynthesis.

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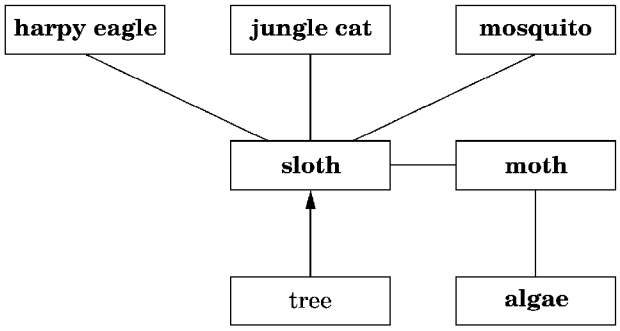
..... [6]

ANSWERS

Topic - 19

1. (a)



(b) (i) Due to green algae, sloth undergoes camouflage and is less easily seen by predators. So it is not visible and escape predators, i.e., harpy eagle or cat. Sloth is itself slow moving and can't escape quickly. However, algae help in escape from predators safely.

(ii) Faeces at the foot of the tree decay or decompose. Break down products act as fertiliser. Different mineral ions, CO_2, and other nutrients are absorbed by tree and used by tree, thus helping in growth of tree. So a well grown tree provides food to sloth and also habitat for sloth. Faeces at the foot of tree in a hole remain hidden from predators.

2. (a) *Gas 1*: Oxides of sulphur,

Harm caused: In air they can produce sulphuric acid (H_2SO_4), which can become part of acid rain.

Gas 2: Oxides of nitrogen,

Harm caused: It produces nitric acid (HNO_3) in air, thus, causing acid rain. It is also greenhouse gas and causes global warming.

(b) At **S**: Recycling of water may occur. Due to sewage or water treatment, fertilisers are produced. It reduces pollutants entering water. Diseases, eutrophication, death or harm to organisms can be prevented.

At **T**: Recycling of paper or tree-based products occurs. It prevents deforestation as cutting trees can be replaced by growing more trees. It prevents consequences of deforestation like soil erosion, flooding etc.

3. (a) Nitrogen in air can be fixed and available for both plant and animal by different ways e.g. by free living soil bacteria (Azotobacter), symbiotic bacteria (Rhizobium) in root nodules, which in presence of oxygen are able to convert atmospheric nitrogen into ammonium compounds, some of which are also liberated into soil, where they are eventually changed to nitrates by nitrification, and used by plants for their growth. These plants are then eaten by animals which digest proteins and use their product (amino acids) for the making of their own proteins.

(b) *The product of crops by farmers:* Use of nitrogen containing fertilisers improves growth of crop plants with the result yield / profit increases.

The environment:

1. More growth in plants increases the percentage of O_2 as more CO_2 is removed by photosynthesis which not only reduces the risk of global warming but also provides neat and healthier environment to live.
2. Excess use of nitrogen containing fertilisers may lead to eutrophication and death of aquatic life.

4. (a) Fisheries management aims to achieve the optimal and sustainable utilization of the fishery resource for the benefit of humans whilst safeguarding the ecosystem. Modern fisheries management is based on scientific information that is used to develop the rules under which the fisheries operate. It also maintains biodiversity and prevents extinction by over-fishing of particular species in the wild.

(b) Deforestation causes increased carbon dioxide concentrations in the atmosphere as photosynthesis decreases, leading to global warming with relatively reduced oxygen concentration.

It also causes biodiversity loss owing to habitat destruction. It disrupts the hydrologic cycle, and in severe circumstances, it can also lead to desertification.

It causes soil erosion, flooding, fewer crops and a host of problems for indigenous people.

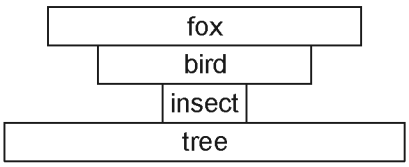
5. **(a)** Sweet clover has Rhizobium bacteria in its root nodules which fix atmospheric nitrogen into nitrites and nitrates. When field is ploughed or digging of soil is done, then decomposition of roots occurs producing nitrates and nitrites of ammonium. So soil is rich in nitrogen fertilizer.

(b) Fibrinogen or fibrin.

(c) **(i)** LD_{50} increases. For first 2–3 years, i.e. from 2000 to 2002 or 2003, there is hardly any change but after 2004, there is exponential increase.

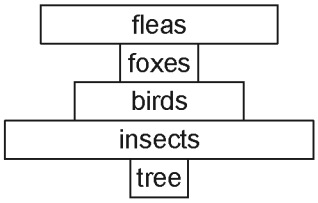
(ii) Change in LD_{50} may have occurred due to a mutation or variation in DNA or gene which developed resistance to poison, or gene became better adapted to environment causing survival of some rats. Surviving animals reproduced and due to breeding, more resistant offsprings were produced by natural selection or evolution. So greater amount of dicoumarol was now required to kill the rats, hence LD_{50} must be increased.

6. **(a)**



(b) Not all insects or all parts of insects are eaten by birds, therefore some energy remains in insects which are not eaten. All parts of insects are not digested and some are lost as faeces or egested by birds. Insects release energy in respiration. Energy from insects is used in muscle contraction or movement. Some energy is lost as heat.

(c)



7. **(a)** **(i)** Food chain.

(ii) *Producer*: Tree.

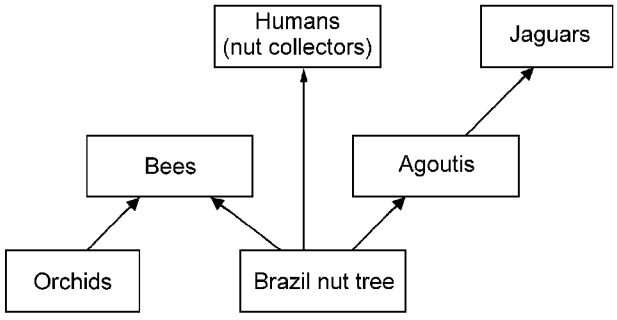
Carnivore: Songbird / hawk.

(b) **(i)** Majority of light is intercepted by other objects in global atmosphere such as clouds, dust particles etc. and only small amount is received by leaves of plant some of which is also reflected back and not used in photosynthesis.

(ii) Hawk doesn't eat / digest all parts of songbird, therefore energy trapped in undigested food is wasted in the form of faeces. Some of energy is used to maintain body temperature, movement / flight, and in excretion.

(c) It is possible to feed a greater number of people if the area of land is used to farm crops rather than to farm animals as relatively more food is produced e.g. 7.5 tonnes of wheat grains produce 12000 loaves of bread as compared to 0.3 tonnes of lamb which produce 1200 portions of meat. At the same time / similarly fewer trophic levels in food chain are involved for the production of wheat grains, therefore relatively less / no energy is lost through other activities such as movement, excretion etc.

8. **(a)**



(b) Animal help in seed dispersal. Some of the animals are agoutis while others are human nut collectors.

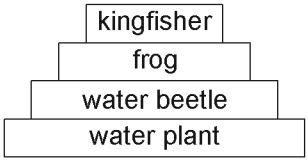
(c) Due to elimination of orchids, male bumble bees cannot get scent or less scent is available, so female bees are not attracted. It causes less reproduction of bees. Less anthers are scattered or transferred by bees for pollination. Due to less pollination, less trees are cultivated. So fruits or nuts are less produced. It will cause negative economic impact and human nut collectors will face loss of jobs. Also food availability for agoutis decreases which causes death and population of agoutis may reduce. Due to death of agoutis, jaguars also get less food and may face death and reduction in population.

9. Plants are producers having leaves. Being autotrophs, they synthesise their own food, by photosynthesis. Plant leaves absorb light energy and convert it into chemical energy. By photosynthesis, plants make carbohydrates like glucose, sugars or starch. Plants are eaten by herbivore animals being primary consumers, which in turn, are eaten by carnivores or secondary consumers. In photosynthesis, plants use carbon dioxide and produce oxygen, which is used for respiration of plants and animals. By using oxygen and glucose carbon dioxide is produced in respiration. Plants also provide habitat for other living organisms.

10. (a) (i)

statement	number
the number of producers	1
the number of consumers	**6**
the number of herbivores	**3**
the number of carnivores	**3**
the number of food chains	**3**

(ii)



(b) Population of frogs decreases. As a result of the increased availability of nutrients (nitrogen), a rapid growth in algal populations will occur (algal blooms). In Eutrophic pond, algae are starved for light and stop producing oxygen and in turn begin consuming oxygen. When algae die, there will be an increase in the number of saprophytic microbes (decomposers), oxygen is consumed resulting in low levels of oxygen, which leads to death of aquatic animals such as water beetles, snails and frogs.

11. (a) (i) Without using fertiliser crop yield is 200 kg per hectare. By increasing fertiliser crop yield also increases, i.e., using 150 kg per hectare fertiliser, crop yield increased to 5600 kg. However above 150 kg or high fertiliser content, crop yield does not increase.

(ii) Minerals like nitrates are absorbed through root hairs by active transport, as mostly concentration gradient is opposite, however some may be taken up down the concentration gradient by diffusion. Nitrogen in the nitrates is used up for production of amino acids needed for synthesis of proteins. Proteins are needed for increased growth of plant.

(iii) High mass of fertiliser runs off due to leaching or washed away with rain water. So eutrophication occurs in nearby streams, canals or rivers. It is harmful to animals. Fertilisers are also expensive. So there is less possible economic return over increased cost.

(b) *Type of mineral ion*: Phosphate.

Importance to plant: Synthesis of DNA, RNA and phospholipids of cell membranes.

12. (a) *The agricultural land*: Use of pesticides will contaminate drinking water / river water where as use of fertilizers leads to eurtophication because of leaching / run-off water. This will cause the death of river / marine life.

The power station: Burning of fossil fuels releases CO_2 and SO_2 gas. Increase of CO_2 increases green house effect which leads to global warming. Similarly increase in SO_2 or oxides of nitrogen leads to risk of acid rain which may damage crops / buildings.

(b)
- Plant more trees.
- Reduce the use of plastic and fossil fuel.
- Recycle glass, metal and paper.
- Use renewable energy source such as wind and solar energy.