Question Bank

Transpiration

1. Name the following:

(i) The process that occurs in the plant when the root pressure is high and transpiration is low.

(ii) The plant in which stomata are absent.

(iii) The structures through which most of the transpiration takes place.

(iv) The microscopic pores which are surrounded by two kidney-shaped guard cells and concerned with gaseous exchange.

(v) The loss of water from the aerial parts of the plant in the form of vapour.

(vi) The waxy protective layer on the leaf epidermis meant to reduce transpiration rate.

(vii) A substance which causes partial closure of stomata.

(viii) The apparatus used to measure transpiration.

Ans. (i) Guttation    (ii) Hydrilla

(iii) Stomata    (iv) Stoma

(v) Transpiration    (vi) Cuticle

(vii) Anti-transpirant    (viii) Potometer.
2. Complete the following statements by choosing the correct alternative out of those given within brackets.

(i) Transpiration rate is the highest during (summer / winter / rainy season).

(ii) Potometer is an instrument for measuring the rate of (flow of blood in an artery / photosynthesis / transpiration).

(iii) Most transpiration in a herbaceous plant occurs through (xylem / lenticle / stomata).

(iv) Leaves modified into needles, as in pine, is (to increase photosynthesis / to increase transpiration / to control excessive transpiration).

(v) A dry cobalt chloride paper is (blue / pink / purple) in colour.

(vi) Lenticels are openings on the (stem / leaf tips / leaf margins).

Ans. (i) Summer

(ii) Transpiration

(iii) Stomata

(iv) To control excessive transpiration

(v) Blue

(iv) Stem.

3. Mention if the following statements are true or false. If false, rewrite the wrong ones by changing only the words printed in bold face.

(i) The wall of guard cells towards stoma is thin.

(ii) A controlled experiment is one in which two different experiments are set-up.

(iii) The upper surface of a dorsiventral leaf transpires more.
(iv) Transpiration results in weight **loss**.

(v) **Transpiration** in garden nasturtium takes place through hydathodes.

**Ans.**

(i) False (Thick)  
(ii) False (Identical)  
(iii) False (Under surface)  
(iv) True  
(v) True.

4. Given below is an example of a certain structure and its special functional activity : Chloroplast and photosynthesis.

In a similar way, write the functional activity against each of the following :

(a) Hydathodes and ...............................  
(b) Leaf spines and ...............................  
(c) Lenticels and ...............................  
(d) Thick cuticle and ...............................  

**Ans.**

(a) Guttation.  
(b) Reduced surface area for transpiration.  
(c) Lenticular transpiration.  
(d) Cuticular transpiration (lesser transpiration)

5. Give suitable explanations for the following:

(a) A higher rate of transpiration is recorded on a windy day rather than on a calm day. 

(b) Excessive transpiration results in the wilting of the leaves.  

(c) Water transpired is the water absorbed.  

(d) More transpiration occurs from a lower surface of a dorsiventral leaf.
Ans. (a) Rate of transpiration is more on a windy day than calm day because wind velocity increases the rate of transpiration as it increases the pressure gradient.

(b) In some plants, e.g. balsam, the leaves of the plants wilt during the mid-day. In such cases, the rate of transpiration during mid-day exceeds the rate of absorption of water by the roots. The cells, therefore, lose turgidity and wilts.

(c) Roots continuously absorb a very large quantity of water. Transpiration is an effective method of removing excess water from the plant body. Thus water transpired is the water absorbed, obviously the excess water.

(d) Stomata are minute openings occurring in large numbers on the lower surface of a dorsiventral leaf. The more the number of stomata, the more the rate of transpiration. That’s why, transpiration is more in the lower surface of the dorsi-ventral leaf.

6. What are anti-transpirants? Name one anti-transpirant.

Ans. Anti-transpirants are chemical substances which reduce the rate of transpiration. They are generally used to improve the efficiency of water utilisation by plants, without affecting the carbon dioxide uptake. Example - Phenylmercuric acetate.
7. Suppose the walls of the guard cells of a dicot plant are uniformly thick. How would it affect the rate of transpiration from such a leaf? Explain.

**Ans.** In a normal guard cell, the outer walls are thin while the inner ones are thick. On absorbing water, guard cells become turgid and the outer walls become convex, resulting in the opening of stomata which allows transpiration. If the walls of guard cells are uniformly thick, they will not expand and stomata will not open, hence no transpiration will occur.

8. Mention the significance of transpiration.

**Ans.** **Significance of transpiration**

(i) It helps in the absorption of water from the soil.

(ii) Produces cooling effect.

(iii) Maintains cell turgidity.

(iv) Controls opening and closing of stomata.

(v) Helps in absorption of minerals from the soil.
9. What is wilting? Distinguish between temporary and permanent wilting.

**Ans.** When the rate of transpiration is more than the rate of absorption of water by roots, the leaves droop down due to lowering of turgor pressure. This flaccid condition is known as wilting.

In temporary wilting, observed during summer, the leaves droop down during day time due to excessive transpiration but regain their turgidity by evening as by then the rate of transpiration decreases while the rate of absorption from soil increases. In permanent wilting the plant does not recover due to deficiency of water in soil.

10. Differentiate between transpiration and guttation.

**Ans. Differences between transpiration and guttation:**

<table>
<thead>
<tr>
<th>Transpiration</th>
<th>Guttation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Water is lost in vapour form.</td>
<td>Water is lost in liquid form.</td>
</tr>
<tr>
<td>(ii) It takes place through stomata, lenticels or cuticles.</td>
<td>It takes place through hydathodes.</td>
</tr>
<tr>
<td>(iii) Water lost is pure.</td>
<td>Water lost contains minerals and other organic substances.</td>
</tr>
<tr>
<td>(iv) It occurs during the day. It increases with rise in temperature.</td>
<td>It occurs in early morning and evening when temperature is low.</td>
</tr>
<tr>
<td>(v) It has a cooling effect.</td>
<td>No such effect.</td>
</tr>
</tbody>
</table>
11. Differentiate between transpiration and evaporation.

**Ans. Differences between transpiration and evaporation:**

<table>
<thead>
<tr>
<th>Transpiration</th>
<th>Evaporation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) It is a physiological process.</td>
<td>It is a physical process.</td>
</tr>
<tr>
<td>(ii) It takes place from the exposed plant surfaces.</td>
<td>It takes place from the free surface of water.</td>
</tr>
<tr>
<td>(iii) It is regulated by the activity of guard cells.</td>
<td>Guard cells play no role in evaporation</td>
</tr>
<tr>
<td>(iv) It takes place during day time.</td>
<td>It takes place at all the times.</td>
</tr>
<tr>
<td>(v) It is affected by environmental factors as well as internal factors like</td>
<td>It is affected by environmental factors like temperature</td>
</tr>
<tr>
<td>leaf anatomy and the rate of absorption of water by roots.</td>
<td>relative humidity.</td>
</tr>
</tbody>
</table>

12. Mention various adaptations by which the plants tend to reduce transpiration.

**Ans.** Excessive transpiration can prove to be harmful for the survival of plants. Hence, the plants adopt both morphological and anatomical means to reduce excessive transpiration.

(i) **Morphological Adaptations:** Since 80-90% of transpiration takes place through leaves, the leaf area is reduced. (a) They become modified into spines, as in cactus, or needles, as in pine. (b) The leaves may fold-up or roll. (c) Leaves may be shed during winter as in deciduous trees.
(ii) **Anatomical Adaptations:**

(a) The number of stomata are reduced and may be sunken.
(b) The leaves may develop multiple epidermis.
(c) Leaf surface may be covered by a dense coating of cutinised hair or scales.
(d) Trees develop a water-proof covering of cork or bark.
(e) Evergreen trees develop a thick waxy cuticle on the epidermis of leaf.

13. List three ways by which a plant transpires.

**Ans.** Transpiration takes place by the following ways:-

(i) **Stomatal Transpiration:** Stomata are pores present in the epidermis of the leaves. These normally remain open during the day time to take in carbon dioxide for photosynthesis. Simultaneously water vapour diffuses out of the stomata. Approximately, 80-90% of transpiration takes place through stomata.
(ii) **Cuticular Transpiration:** Cuticle is a thin waxy layer on the surface of the leaf. Some amount of water vapour escapes through it.

(iii) **Lenticular Transpiration:** In woody plants, the stem has openings on their surface called lenticels which is composed of loose mass of cells. Water vapour easily escapes through them.

14. (i) Give biological reasons for the following.
   (a) A tiger owes its existence to chlorophyll.
   (b) Some plants show wilting of their leaves during mid day even when the soil is well watered.
   (c) On sprinkling common salt on grass growing in a lawn, the grass is killed.

(ii) (a) Draw a neat diagram of the stomatal apparatus found in the epidermis of leaves and label the Stomata, Guard cells, Chloroplast, Epidermal cells, Cell wall and Nucleus.

(b) Complete the following processes to show how the oxygen in the air reaches a mesophyll cell of the leaf.

   Oxygen in air → □ → □ → Mesophyll cell.
Ans. (i) (a) Green plants synthesize food by photosynthesis using chlorophyll.

Tigers feed on animals which feed on green plant, thus they obtain their food indirectly from green plants.

(b) During mid-day, rate of transpiration is higher than the rate of absorption of water by the roots. That’s why leaves show wilting.

(c) Sprinkling common salt in a lawn makes surrounding water a hypertonic solution. Water from the root hair cells comes out by the process of exosmosis and cells get plasmolysed and die.

(ii) (a) See the diagram given below.

(b) Oxygen in air → stoma → sub-stomal space → stomal space → Mesophyll cell.

15. Transpiration is a necessary evil. Comment.

Ans. A major portion of water absorbed by plants is lost into the atmosphere through the process of transpiration. Yet it is advantageous for the plant. Some of the advantages are as follows:

(i) It helps in ascent of sap.

(ii) It has cooling effect.

(iii) It helps in absorption and conduction of minerals.
(iv) It favours extensive growth of the root system.
(v) It helps to maintain cell turgidity.

However, transpiration is also a threat to life of the plant as well. Wilting takes place if the rate of transpiration exceeds the rate of water uptake from the soil. Reduction in turgor of plant parts may finally lead to the death of plant.

Water is lost through stomata, the structures which allow gaseous exchange for photosynthesis and respiration. The principal function of stomata is to allow exchange of carbon dioxide and oxygen, loss of water is inevitable and unavoidable. Transpiration is thus referred to as a necessary evil.

16. How do the following factors influence the rate of transpiration: light, temperature, humidity, wind, soil, water?

Ans. (i) Light
—It influences transpiration through its effect on the opening of stomata.
—Only a small portion of light is used in photosynthesis, rest is converted into heat energy which increases the temperature of the leaf and leads to more water loss.

(ii) Temperature
—Within limits, rise in temperature leads to an increase in transpiration.
—However, stomata close at very high temperature.

(iii) Humidity
—The rate of transpiration decreases with increase in humidity.
(iv) Wind
— Moderate wind velocity increases the rate of transpiration as it increases the vapour pressure gradient.
— High wind velocity often induces stomatal closure, causing a decrease in transpiration.

(v) Soil water
— The rate of transpiration is lowered if the amount of water in the soil is less.
— Wilting occurs when loss of water by transpiration exceeds the rate of uptake by roots.

17. Describe an experiment to demonstrate that suction force develops due to transpiration.

**Ans. Experiment to demonstrate that suction force is developed due to transpiration.**

**Procedure:** A narrow glass tube is fixed to the lower end of the manometer through the rubber cork as shown in the figure. The glass tube and the manometer are completely filled with water and placed in a beaker containing mercury.

A leaf shoot cut under water is fixed to one of the tubes of the manometer through the rubber cork. The other arm is also closed with a rubber cork and all connections are made air-tight with vaseline. Allow transpiration to take place for a few hours.
**Observation:** Mercury rises in the glass tube to a significant height.

**Inference:** Evaporation of water from the internal tissues of the leaf through the leaf surface increases the concentration of cell sap of mesophyll which draws water from xylem tracheids in the veins. The tracheids, in order to maintain the continuity of the water column, absorb water from the neighbouring cells and the water moves from the root hair into cortex and on to the xylem vessels of the root, resulting in the rise of mercury. Thus, a transpiration pull is exerted on the long tube which ‘pulls’ the water upwards through the tube into the branches of the shoot.
18. Describe an experiment to demonstrate weight loss due to transpiration.

**Ans. Experiment to demonstrate weight loss due to transpiration**

**Procedure:** A well-watered potted plant is taken. A polythene sheet is wrapped around the pot and tied firmly round the stem of the plant. This is done to prevent direct evaporation of water from the soil in the pot.

The plant is weighed and then allowed to transpire for a few hours. The plant is weighed again after a given period of time.

**Observation:** A decrease in weight is noted.

**Inference:** The decrease in weight shows the amount of water lost during transpiration.
19. The figure alongside represents the vertical section of a leaf.

(i) Name the given structure.

(ii) Name the parts labelled 1 to 5.

(iii) Give an example of two plants where this structure is present.

(iv) Which physiological process takes place through this structure?

(v) Give three conditions which favour this physiological process.

Ans. (i) Hydathode

(ii) 1 - Cavity of the water pore
    2 - Guard cell
    3 - Epithem
    4 - Tracheids
    5 - Chlorenchyma.

(iii) Garden nasturtium, grasses

(iv) Guttation

(v) (a) Large amounts of water in the plant
    (b) Low temperature
    (c) All conditions that inhibit transpiration favour guttation.
20. The figure below represents an experiment performed to demonstrate certain phenomenon in plants. The set-up was kept in sunlight for about two hours.

(i) What is the aim of this experiment?

(ii) Define the process mentioned in (i).

(iii) What do you observe in the experiment as an evidence of the process stated in (i) and (ii)?

(iv) What precautions would you take for proper results in the experiment?

(v) Suggest a suitable control experiment for comparison.

Ans. (i) Aim of this experimental set-up is to demonstrate transpiration in plants.

(ii) Transpiration is a physiological process of loss of water in the form of water vapour from the internal tissues of plants, through the aerial parts of the plants.

(iii) Water vapour condensed on the inner wall of the bell jar is an evidence of transpiration.
(iv) (a) A well-watered potted plant where the pot is wrapped with a polythene sheet and firmly tied around the stem.

(b) The base of the bell jar is sealed with vaseline.

(v) A control experiment is a similar set-up but without a plant.

21. In an experiment, four freshly picked leaves of a china-rose plant were treated as follows:
A - Coated with vaseline on both the surface.
B - Coated with vaseline on lower surface.
C - Coated with vaseline on the upper surface.
D - Left uncoated.

All the four leaves are left at room temperature for about 24 hours.

(i) Which leaf dries first?
(ii) Which leaf dries in the last?
(iii) Which leaf does not show any change?
(iv) What precautions are taken for proper results in the experiment?
(v) What is the aim of the experiment?
(vi) Suggest an alternative experiment to prove the aim.
Ans. (i) Leaf D dries first, since both surfaces are exposed.  
(ii) Leaf B dries in the last.  
(iii) Leaf A does not show any change as it transpires the least. Water is conserved since both surfaces of the leaf are greased.  
(iv) Cut end of each leaf stalk must be covered with vaseline.  
(v) Greater transpiration occurs from the lower surface of a dorsiventral leaf.  
(vi) Strips of dry cobalt chloride paper are fixed securely to both surfaces of the leaf of a potted plant by means of a leaf clasp. After some time it is observed that the cobalt chloride paper on the lower surface of the leaf turns pink in less time than that on the upper surface. This shows greater transpiration from the lower surface which is due to the larger distribution of stomata on the lower surface.

22. The diagram shown below is an apparatus used to study a particular phenomenon in plants:

(i) Name the apparatus.  
(ii) What is its used for?  
(iii) State the use of (a) capillary tube; (b) scale; (c) water reservoir.  
(iv) What happens to the movement of air bubbles if the apparatus is kepts.  
   (a) In sunlight; (b) In the dark; (c) In front of a fan.
Ans. (i) Ganong’s potometer.

(ii) It is used to study the rate of water uptake in a leafy shoot.

(iii) (a) **Capillary tube**: The horizontal part of the apparatus where the air bubble is introduced for recording the water column movement over a fixed distance.

(b) **Scale**: To measure the distance travelled by the air bubble in the horizontal arm.

(c) **Water reservoir**: To restart the experiment or if the air bubble reaches the end of the capillary tube, the bubble can be moved back by momentarily opening the top of the reservoir.

(iv) (a) The movement of air bubble is faster in sunlight.

(b) The movement of air bubble is slow in dark.

(c) The movement of air bubble is faster in front of a fan.
23. Three plants A, B and C are placed in a beaker containing coloured water. The water in each beaker is covered with a layer of oil. Plant A is left intact; while leaves are removed from plant B. Plant C is exposed to strong light.

(i) In which plant A, B or C, would water move up the fastest?
(ii) In which plant would water move slowly?
(iii) Why is water covered with oil?
(iv) What is the purpose of this experiment?

**Ans.** (i) Water moves up fastest in plant C as transpiration is enhanced in the presence of light.
(ii) Water moves slowly in plant B as there are no leaves and little or no transpiration takes place.

(iii) Water is covered with oil as a precaution to prevent evaporation of water from the beaker thus affecting the result.

(iv) Transpiration and various factors controlling transpiration are being investigated by this experiment. Strong light increases the temperature which increases the rate of transpiration. The experiment also shows that transpiration mainly occurs through the leaves and if they are removed, absorption of water is inhibited.

24. What is Ganong’s Potometer used for? Write any two limitations of this apparatus.

Ans. Ganong’s potometer is an apparatus to measure the rate of transpiration. Two limitations of this apparatus are:

1. It cannot measure the amount of water lost due to transpiration.
2. The measurement of rate of transpiration is difficult in humid weather.
25. Fill in the blanks:

(a) Transpiration is the loss of water as water _____ from the ______ parts of the plant.
(b) Closing of _________ and shedding of leaves reduces ____________.
(c) Transpiration helps in creating _________ and in eliminating excess

Ans. (a) Vapour, aerial
    (b) Stomata, transpiration
    (c) Suction force, water

26. There is a general belief that forests tend to bring more frequent rains. Can you explain its scientifically?

Ans. Plants give out large quantities of water during transpiration. Trees, being larges plants, loses more water by the way of transpiration. For eg. an apple tree may loose about 30 litres of water per day. Thus transpiration increases the moisture in the atmosphere and bring rain. That is why it is believed that forests tend to bring more frequent rains.