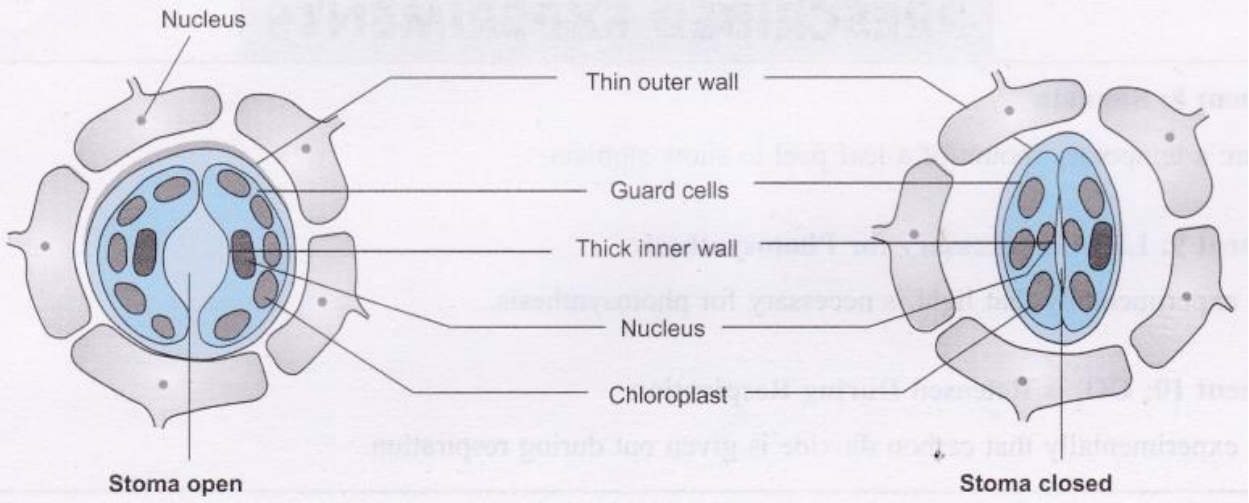
Stomata

Introduction

- All over the plant body epidermis is present. The epidermis is made up of single layer of cells. Epidermis on the aerial parts of the plants often secrete a waxy, water-resistant layer on their outer surface. This prevents water loss, mechanical injury and invasion by parasitic bacteria or fungi. The epidermal cells form a central layer without intercellular spaces. Most of these cells are flat with thicker outer and side walls and thin inner wall. In this epidermic layer of leaves we can see small pores called stomata.
- Stomata are small holes or openings present on the leaf surface in epidermis. The lower side of the leaf has more stomata (singular stoma).

Guard cells

- Stomata has a small pore which is guarded by the guard cells. The guard cells control the opening and the closing of the stomata.
- The guard cells are bean-shaped in dicots and dumb-bell shaped in monocots.



- The inner wall of the guard cell is thick whereas the outer wall is thin.
- Plants need gases like oxygen for respiration and carbon dioxide for photosynthesis. It is through this small opening called stomata the gases diffuse inside the leaf and are taken in.

Opening and Closing of stomata

- During photosynthesis the stomatal pore opens whenever there is demand of carbon dioxide and the opening of these stomata also causes the loss of water by the leaves through the process called transpiration.

- The pressure built in the guard cells due to the water in it is called turgor pressure. .
- The guard cells opening and closing mechanism depends on the turgidity they get due to water.
- The guard cells absorb water and become turgid which results in opening of stomata during the day.
- At night the guard cells are flaccid and so the stomata get closed. But in some desert plants the opening of stomata happens only at night to prevent the loss of water.

Stomata distribution

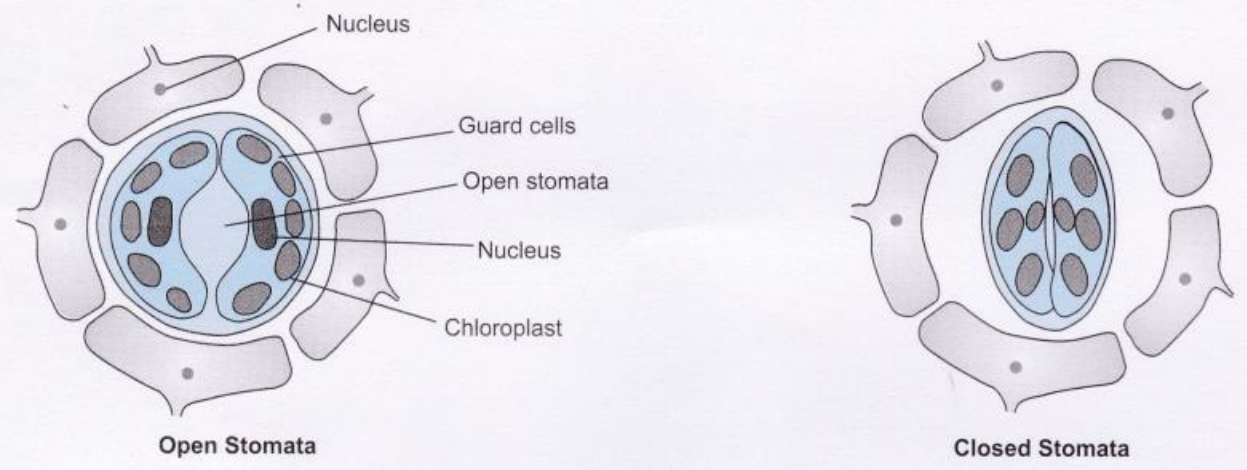
- Stomata are spread out over leaves so that the waste gases produced by the leaf can diffuse away quickly, this stops the build-up of excreted products, which would slow gas exchange.
- More stomatal pores are present on the dorsal side of leaf than the ventral side.
- In desert plants, stomata are more sunken type compared to tropical plants.
- Distribution of stomata in the plants differ from species to species present in the same region.
- In cactus plants, leaves are reduced to spines so stomata are present on the stem.
- In aquatic plants, stomata are either absent or non-functional stomata are absent in roots.
- Fewer stomata on the upper surface prevent excessive loss of water due to transpiration as this surface is directly exposed to sunlight.

Science Lab Manual Experiment – 1

Aim
To prepare a temporary mount of a leafpeel to show stomata.
Theory

- Plants need oxygen for respiration and carbon dioxide for photosynthesis. The exchange of gases in plants occurs through the surface of stems, roots and leaves.
- On leaves there are plenty of small tiny pores called stomata.
- On the dorsal side of leaf more stomatal pores are present than the ventral surface of leaf.
- Through these pores, plants can also lose water by the process called transpiration.
- To avoid excess loss of water, the stomata pores closes and when gases are required, these pores open.
- This opening and closing of pores is monitored by guard cells.
- The guard cells swell when water flows into them, causing the stomata pore to open. When the guard cells shrink the stomata pores close.

- The guard cells contain chloroplast and nucleus in it. They are bean-shaped in dicots and dumb-bell shaped in monocots.

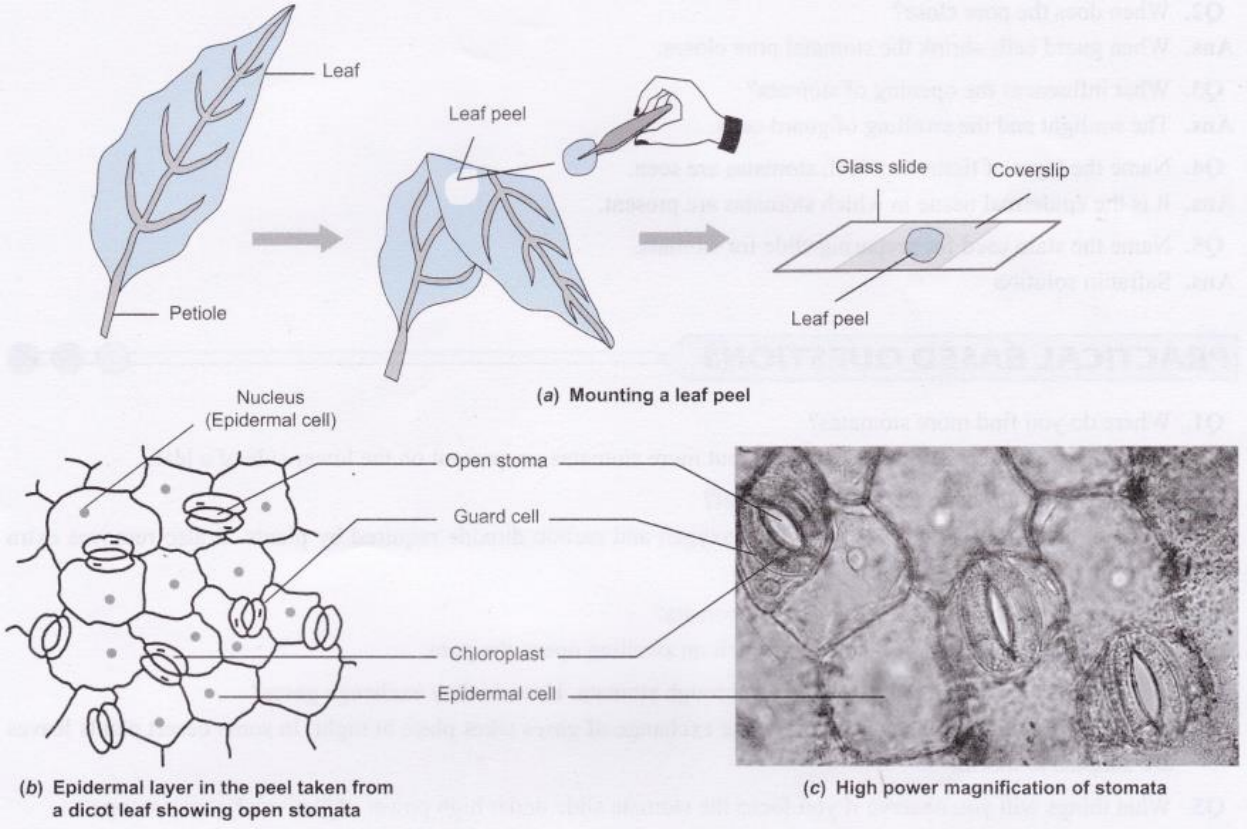


Materials Required

Freshly plucked leaf of Rheo or Tradescantia, petri dish, slide, coverslip, needle, forceps, brash, dropper, watch glass, filter paper, glycerine, safranin solution and microscope.

Procedure

1. Take a freshly plucked leaf (Rheo or Tradescantia).
2. Stretch the leaf with its dorsal (lower) part facing upwards.
3. Break the leaf by applying suitable pressure so that the epidermis projects from the leaf.
4. Cut the epidermis and put it in a petri dish.
5. Take a watch glass, add few drops of water and a drop of stain in it.
6. Transfer the small piece of epidermis from petri dish into the watch glass with the help of brash.
7. Allow the peel to remain in the stain for 2-3 minutes, so that it can take up the stain.
8. With the help of brush transfer the stained peel into a petri dish with water to remove the extra stain.
9. Now take a clean slide and place it on a filter paper. In the centre of the slide put a drop of glycerine and transfer the stained peel from petri dish on the slide.
10. Gently hold the coverslip with the needle and place it on the peel. Avoid air bubbles formation.
11. Use the filter paper to clean the excess stain, water or glycerine that comes out from the coverslip sides.
12. Ensure that the slide is clean and place it under the microscope. First view it under low power (10X) and then under high power(45X).
13. Record your observations.



Observations

1. In an epidermal peel we see single layer of cells.
2. In between the epidermal layer small spots are seen.
3. When focused under powerful microscope the stomata pores are clearly seen.
4. Each stomata pore has two kidney-shaped cells called guard cells.
5. Each guard cell has one nucleus and many chloroplasts.

Conclusion

Epidermal layer of leaf peel has many stomata pores. Each stomatal pore has two kidney shaped guard cells, in dicots plants. Each guard cell has one nucleus and many chloroplasts.

Precautions

1. While removing the epidermal peel, ensure that you pluck the thinner scrap of leaf.
2. Do not overstain the peel.
3. Avoid air-bubbles formation while placing the coverslip.
4. The peel should not be folded.
5. The slide should be clean and dry before placing it under microscope.

Science Lab Manual Viva Voce

Question 1:
What controls the opening and closing of stomata?
Answer:
The guard cells controls the opening and closing of stomata.

Question 2:
When does the pore close?
Answer:
When guard cells shrink the stomatal pore closes.

Question 3:
What influences the opening of stomata?
Answer:
The sunlight and the swelling of guard cells.

Question 4:
Name the layer of tissue in which stomatas are seen.
Answer:
It is the epidermal tissue in which stomatas are present.

Question 5:
Name the stain used for preparing slide for stomata.
Answer:
Safranin solution

Science Lab Manual Practical Based Questions

Question 1:
Where do you find more stomatas?
Answer:
Stomatas are present on leaves and stem, but more stomatas are present on the lower side of a leaf.

Question 2:
What is the importance of stomata for a leaf?
Answer:
Stomata helps in exchange of gases like oxygen and carbon dioxide required by plants. It also removes extra water from leaves by transpiration.

Question 3:
How does guard cells help in opening of stomata?

Answer:
The guard cells are bean-shaped cells which on swelling opens the pore.

Question 4:
Desert plants cannot afford to lose water through stomata. How do they exchange gases?
Answer:
In desert plants the stomata are sunken, the exchange of gases takes place at night. In some desert plants leaves are adapted to thorns.

Question 5:
What things will you observe if you focus the stomata slide under high power objective of a microscope?
Answer:
Under high power objective we can see the stomata surrounded by guard cells. Each guard cell have nucleus and chloroplast.

Science Lab Manual Questions

Question 1:
What is the function of guard cells in stomata?
Answer:
Guard cells control the opening and closing of pore in stomata.

Question 2:
Why is the number of stomata greater on the lower surface of a leaf?
Answer:
To maintain the amount of water in the cells of leaf and control the rate of transpiration the lower surface of the leaf has more stomata than the upper surface of the leaf.

Question 3:
Why are stomata absent in roots?
Answer:
The role of stomata is to exchange gases during photosynthesis and respiration and helps in transpiration. The roots helps in the absorption of water and hence stomata is not required on the roots.

Question 4:
What is the shape of guard cells in stoma of grass leaf?
Answer:
Grass leaf has dumb-bell shaped stomata.

Question 5:
Do guard cells have rigid or elastic walls? Justify your answer.

Answer:
Guard cells have elastic walls. It is the elastic walls of the guard cells which changes its shape to open or close the stomata. When the guard cells are turgid the pore opens due to the concave shape formation of the guard cells.

Science Lab Manual Multiple Choice Questions (MCQs)

Questions based on Procedural and Manipulative Skills

Question 1:
The stomata openings are seen in the single-layered tissues of
(a) epidermal tissue
(b) sclerenchyma tissues
(c) parenchyma tissue
(d) collenchyma tissues.

Question 2:
The stain used to prepare stomatal slide is
(a) methylene blue
(b) safranin
(c) acetocarmine
(d) cotton blue.

Question 3:
While preparing the stomatal slide, glycerine is used to
(a) prevent air bubbles
(b) avoid drying of peel
(c) to stain the peel
(d) make it visible

Question 4:
To prepare a temporary mount of a leaf peel one should take:
(a) a leaf plucked a day in advance
(b) a freshly plucked leaf.
(c) a dried and preserved leaf
(d) a leaf plucked a few hours before the mounting.

Question 5:
The opening and closing of stomata is controlled by
(a) transpiration
(b) turgidity of cells
(c) intensity of light
(d) all of these.

Question 6:
To remove the extra stain, water or glycerine collected on the slide, the correct method is
(a) wash the sides of the slide
(b) clean it with handkerchief
(c) use cotton swabs to collect it
(d) use filter/blotting paper to clean it.

Question 7:
A student was asked to prepare a temporary mount of stomata from a leaf. He should select:
(a) tip of the leaf
(b) midrib of the leaf
(c) epidermis of stem
(d) lower epidermis.

Question 8:
To prepare a temporary mount of a leaf peel for observing stomata the chemicals used for staining and mounting respectively are
(a) safranin and iodine
(b) safranin and glycerine
(c) iodine and safranin
(d) glycerine and iodine.

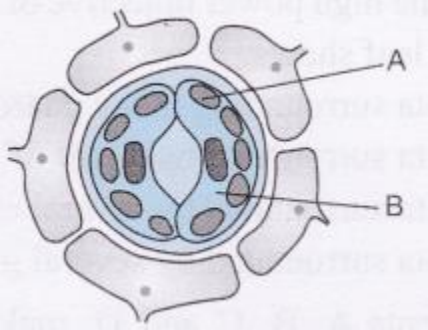
Question 9:
Which one of the following is the correct method of obtaining a leaf peel for observing stomata?
(a) Crack the leaf and pluck the peel.
(b) Take a leaf and with blade make thin sections.
(c) Use needle and forcep to pluck a thin layer of leaf.
(d) Break the leaf and remove the projections of epidermal layer.

Question 10:
The steps involved in making a slide of epidermal peel of leaf are as follows:
I Put out a thin peel from the lower surface of the leaf.
II Place a drop of glycerine on the slide.
III Stain the peel in safranin.
IV Place the stained peel on the glycerine.
V Remove the extra stain by washing with water. VI Place the coverslip over the peel.
Which one is the correct sequence of steps to be followed?
(a) I, II, III, IV, V, VI
(b) I, III, V, II, IV, VI
(c) I, III, IV, II, V, VI
(d) I, II, IV, III, V, VI.

Question 11:
A student focussed the epidermal peel of leaf under the low power of a microscope but could not see the parts. He should
(a) use the coarse adjustment knob again to focus the slide.
(b) use the fine adjustment knob to increase magnification.
(c) focus under high power using coarse adjustment knob.
(d) focus under high power using fine adjustment knob.

Question 12:
Given below are the steps in the preparation of a temporary mount of a stained leaf peel.
(i) Cover the material with the cover slip.
(ii) Transfer the stained peel to the clean glass slide and add a drop of glycerine.
(iii) Remove the peel from the lower surface of the leaf,
(iv) Drop it in the water in a petri dish and add a drop of safranin stain.
The correct sequence of steps is:
(a) (iii), (iv), (ii), (i)
(b) (i), (if), (iii), (iv)
(c) (ii), (iii), (iv), (i)
(d) (iii), (iv), (i), (ii).

Questions based on Observational Skills
Question 13:
In the figure given below of stomata the correct label for A and B are



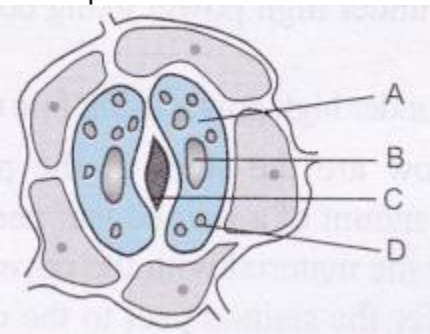
(a) A – nucleus, B – guard cells
(b) A – guard cells, B – nucleus
(c) A – chloroplast, B – nucleus
(d) A- chloroplast, B – guard cell. .

Question 14:
The temporary mount of stomata was seen under the microscope which appeared pink in colour. The stain used was
(a) iodine
(b) acetocarmine
(c) phenolphthalein
(d) safranin.

Question 15:
A well stained leaf peel mount, when observed under the high power of a microscope, shows nuclei in
(a) epidermal cells
(b) guard cells
(c) both guard cells and epidermal cells
(d) none of these.

Question 16:
A well stained leaf peel preparation, when focused under high power of microscope, would show
(a) epidermal cells, stomata, guard cells each with one nucleus and many chloroplasts.
(b) epidermal cells, stomata, guard cells with many nuclei and one chloroplast.
(c) stomata and guard cells without nuclei or chloroplasts.
(d) stomata but no guard cells or epidermal cells.

Question 17:
In the diagram of the stomatal pore given below the marking corresponding to the chloroplast is:



(a) A
(b) B
(c) C
(d) D

Question 18:
In the sketch of the stomatal apparatus which of the following is missing:
(a) cell membrane of the cells
(b) cell wall of the cells
(c) nuclei of guard cells

(d) chloroplast in guard cells.

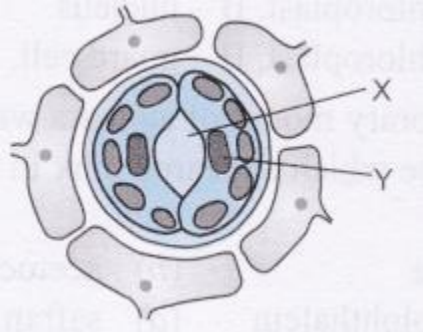
Questions based on Reporting and Interpretation Skills

Question 19:

On using the high power objective of a microscope an epidermal leaf shows:
(a) stomata surrounding many guard cells
(b) stomata surrounded by a pair of guard cells
(c) stomata surrounded by several epidermal cells
(d) stomata surrounded by several guard cells.

Question 20:

Four students A, B, C and D, make the following records given below, for the parts marked X and Y in this diagram.

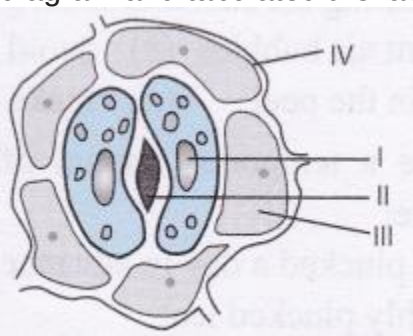


Student	X	Y
A	Stoma	Nucleus
B	Nucleus	Stoma
C	Epidermal cell	Stoma
D	Cell wall	Epidermal cell

The correct record, is that of student
(a) A
(b) B
(c) C
(d) D

Question 21:

The labelling for the slide of leaf peel showing stoma by the four students who made the diagram and tabulated the labels, is as follows:



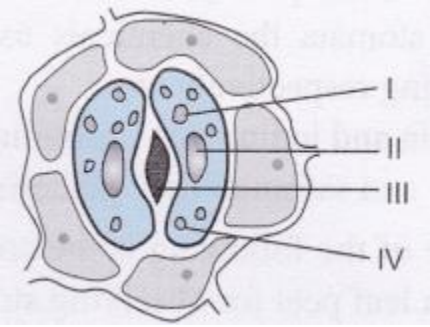
Student	I	II	III	IV
A	Stoma	Nucleus	Epidermal cell	Cell wall
B	Nucleus	Stoma	Epidermal cell	Cell wall
C	Epidermal cell	Stoma	Nucleus	Cell wall
D	Cell Wall	Epidermal cell	Nucleus	Stoma

The student who made the correct labelling is:

(a) Student A
(b) Student B
(c) Student C
(d) Student D.

Question 22:

In the following sketch of the stomatal apparatus, the parts I, II, III and IV were labelled differently by four students

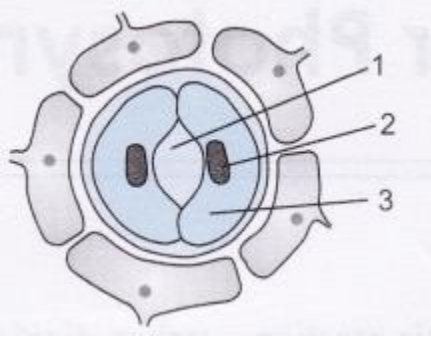


The correct labelling, out of the following is:

(a) (I) guard cell, (II) stoma, (III) starch granules, (IV) nucleus
(b) (I) chloroplast, (II) nucleus, (III) stoma, (IV) guard cell

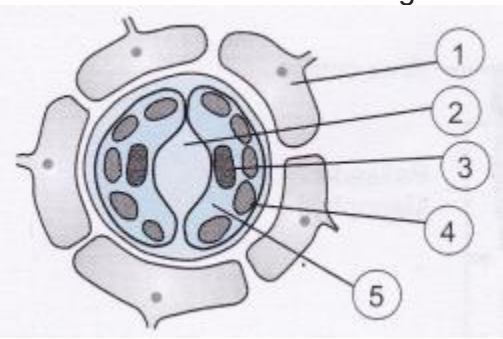
(c) (I) guard cell, (II) starch, (III) nucleus, (IV) stoma
(d) (I) cytoplasm, (II) chloroplast, (III) stoma, (IV) nucleus.

Question 23:
The correct labellings for the given diagram are respectively



(a) stoma, guard cell, nucleus
(b) stoma, chloroplast, epidermal cell
(c) stomatal pore, nucleus, guard cell
(d) stoma, guard cell, epidermal cell.

Question 24:
A student draws the following sketch of the stomatal apparatus:



The chloroplast and nucleus is denoted by
(a) 5 and 3 respectively
(b) 4 and 3 respectively
(c) 3 and 5 respectively
(d) 4 and 5 respectively.

Question 25:
The correct sequence, out of the following options, for focusing a slide of epidermal peel of a leaf under a microscope to show the stomatal pore is:
I. Observe under low power.
II. Adjust mirror to get maximum light.
III. Place the slide on the stage.
IV. Focus under high power.
(a) II, III, I, IV
(b) I, II, III, IV

(c) III, II, IV, I
(d) III, II, I, IV

Answers:

1. (a)	2. (b)	3. (b)	4. (b)	5. (d)
6. (d)	7. (d)	8. (b)	9. (d)	10. (b)
11. (a)	12. (a)	13. (d)	14. (d)	15. (c)
16. (a)	17. (d)	18. (c)	19. (b)	20. (a)
21. (b)	22. (b)	23. (c)	24. (b)	25. (d)

Science Lab Manual Scoring Key With Explanation

1. (a) Stomata is present in epidermal layer.
2. (b) Safranin is used for plants slide mount.
3. (b) Glycerine has the property to retain water.
4. (b) A fresh leaf gives better mount.
5. (d) All the factors are responsible for the opening and closing of stomata.
6. (d) Filter paper helps in absorbing the extra liquid near coverslip on the slide.
7. (d) On lower epidermis of leaf, more stomatas are present.
8. (b) Safranin stains and glycerine prevents drying of the mount.
9. (d) A single layer of epidermis is best obtained by this method.
10. (b) It is the correct procedure for making a temporary slide.
11. (a) The right focus adjustment can make the slide rightly focussed.
12. (a) It is the correct procedure for making a temporary slide.
13. (d) Guard cells are bean shaped and makes the pore and chloroplast is present in the cell.
14. (d) Safranin stain is pink in colour.
15. (c) Both the cells have nucleus in them.
16. (a) Under high power, the cells and its components are seen clearly.
17. (d) Chloroplast is present in the cell and are many in number.
18. (c) Guard cells have prominent nucleus.
19. (b) Under high power, the guard cells are distinctly seen.
20. (a) Pore is stoma and the nucleus is present in the cell.
21. (b) Nucleus is in the cell, the pore is made by guard cells and the layer is epidermis.
22. (b) Nucleus is in the cell, the pore is made by guard cells and the layer is epidermis.
23. (c) Pore is surrounded by guard cells and nucleus is in the cell.

24. (b) Chloroplasts are many in number and nucleus is big and one prominent structure in cell.
25. (d) A slide of epidermal peel of a leaf under a microscope to show the stomatal pore is to place the slide on the stage then adjust mirror to get maximum light first observe the side under low power and then under high power.