PLANT ANATOMY AND PHYSIOLOGY ANSWERS

1. (a) Process by which most cells utilise oxygen, produce carbon dioxide water and energy in the form of ATP (b) Process of synthesising carbohydrates from carbon dioxide and water, by utilising the radiant energy of light captured by chlorophyll (c) Evaporation of water from the leaves of plants, and aids in drawing water up the stem (d) Process of drawing water up the thin xylem and phloem vessels in stems of tracheophytes (e) Movement of molecules from an area of higher concentration to an area of lower concentration across a differentially permeable membrane (f) Diffusion of water molecules (g) Transport of molecules requiring expenditure of energy (h) Transport of molecules without using energy
2. More cells are produced by cell division of mitosis in the meristematic cells at the ends of stems, roots and so on.
3. Carbon dioxide + Water $\xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$ Glucose + Oxygen
4. Increase in light intensity, temperature and /or carbon dioxide
5. The reaction of photosynthesis is regulated by enzymes which are chemicals that speed up the reaction. Therefore the rate of photosynthesis will be limited by the amount of both enzymes and reactants present.
6. Red-orange and violet colours of light are those most greatly absorbed by green plants.
7. Glucose is made in the reaction of photosynthesis. It may be stored temporarily in the leaves of plants as sucrose and usually transported throughout the plant as sucrose. However it may be converted to starch for storage in many plants in the leaves, stems or roots.
8. Yes. Plants respire to obtain energy as animals do.
9. Glucose + Oxygen $\longrightarrow$ Carbon dioxide + Water + Energy
10. Some plants during the night and through the winter consume more carbohydrates than they make. Hence carbohydrates are stored as sucrose (e.g. sugarcane) or starch (e.g. potatoes).
11. Though the reactants and products appear as the opposites of each other, the enzymes involved in each process are different.
12. (a) Because the cuticle is made of waxy water-proof cutin, the cuticle reduces water loss through transpiration.
12. (b) The epidermis is a colourless layer of cells that protect the upper and lower sides of the leaf. The lower epidermis is interspersed with stomata.
12. (c) The mesophyll layer which lies between the two epidermal layers of a leaf contains chlorophyll for photosynthesis. There are two types of photosynthetic cells - the palisade cells which are closely-packed cylindrical cells at right angles to the leaf surface, and the spongy cells which are more loosely packed with air spaces between them.
12. (d) Stomata (stomates) are pores in the lower side of a leaf which open through the daylight hours to take in carbon dioxide for photosynthesis, and release some water and oxygen.

12. (e) Guard cells are found on each side of the stoma and control the exchange of gases and the release of water by opening and closing the stomata.
12. (f) “Veins” are the vascular bundles of xylem and phloem carrying water and nutrients throughout the plant.
13. The bean-shaped guard cells have thicker walls on the side toward the stoma than on the other sides. Increased turgor pressure causes their outer walls to bulge and the inner walls become curved so that they move apart, creating the stomatal opening between them.
14. Transpiration is reduced by stomates being positioned on only the underside of the leaf.
15. Enclose two plants of the same size, type, size and shape. Place one in light and the other in darkness for a few hours. Place a lighted taper into each container. The taper in the container with the plant in the light should continue to burn for some time. The taper, when placed in the container with the plant that was in darkness will probably extinguish.
16. The water required for photosynthesis must diffuse into the plant root from the soil water, and then travel up to the leaves by both capillary action and the drawing effect of transpiration. This occurs slowly so watering of the plant early in the day maximises water intake for photosynthesis. It also reduces water loss through evaporation that can occur if watered later in the day.
17. Most Australian plants have sunken stomata, small leaf size and leaf hairs which reduce water loss. Also many have leaves which hang at right angles to the direction of sunlight.
18. Refer to the textbook.
19. Nitrogen and magnesium.
20. Active transport.
21. Energy is used to transport phosphates from the soil to the root hairs, so this is a form of active transport.
22. The yellowing of leaves combined with stunted growth could indicate a lack of nitrogen or calcium. To remedy this, nitrates and ammonia containing nitrogen, or lime containing calcium could be added to the soil.
23. The roots of about 80% of all plants form mutualistic relationships with fungi in the soil. The fungus increases the plant’s uptake of nutrients, particularly phosphates, because the fungal hyphae act as an extension of the plant roots in the soil, thus increasing the surface area for nutrient uptake.
24. Both serve to increase surface area for uptake of nutrients and water.
25. The xylem vessels transport water and dissolved salts, whereas phloem vessels transport sap containing nutrients, such as sucrose, and hormones.
The processes involved are mainly diffusion, root pressure, capillary action and transpiration.
26. (a) *Spirogyra* has higher concentrations of nutrients in the cytoplasm and less water inside the cell than in the surrounding distilled water, so water will enter the cell by osmosis causing swelling or turgor, and some nutrients will diffuse out of the cell until the concentrations of nutrients inside and outside the cell are the same.
26. (b) The concentration of salt inside the cell is lower than that outside the cell, so salt will diffuse into the cell until the salt concentrations inside and outside the cell are the

same. Also, since there is a higher proportion of water in the cytoplasm compared with the outside saline solution, the water will leave the cell by osmosis, causing the cytoplasm to shrink, the cell membrane to break away from the cell wall, and the alga to plasmolyse.
27. (a) Containing xylem and phloem vessels.
27. (b) Vascular plants - fern, cycad, Ginkgo, conifer, flowering plant
Non-vascular plants - alga, bryophyte (moss, liverwort)
28. Xylem vessels transport water and dissolved salts. They are dead and without cytoplasm and their ends when mature. They contain holes (pits) in their walls to allow water to enter from the surrounding cells.
Phloem vessels transport sap containing nutrients such as sucrose, as well as hormones. Phloem cells are alive and contain cytoplasm whem mature, but lose their nuclei. They are closely associated with companion cells which supply substances that would normally be supplied by the nuclei.
29. The vascular bundles containing xylem and phloem cells are arranged in a ring in the dicotyledons, but are scattered throughout the stem in monocotyledons.
30. Between the xylem and phloem cells in each vascular bundle is the cambium, a group of cells which will develop into xylem or phloem cells by cell division as the plant grows.
31. Herbaceous plants have soft thin stems without the extra supporting cork layer possessed by the woody plants. Herbaceous plants usually have a life-cycle of one year (annuals) or two years (biennials), but woody plants usually have a many-year life-cycle (perennials).
32. In the vascular bundles in the stems of trees, the phloem vessels are on the outside of the xylem vessels. When “ring-barking” occurs, only the phloem vessels are damaged. Hence, the tree will continue to live for some time before dying due to lack of nutrients.
33. The problems faced by terrestrial plants are obtaining and keeping sufficient water, and support. Roots have root hairs to increase surface area to take in water, water loss is reduced by small leaf size, stomata on the underside of the leaf and the controlled opening of the stomata by the guard cells, and the support is provided by both turgor pressure and lignified walls of the vascular cells.
34. The Indian ink particles are too large to pass through the root hair cell membranes, but the dye particles are small enough to dissolve and diffuse into the root.
35. As the roots take in water, the water pressure (turgor) inside the plant increases giving it more support.
36. This is done to stop air bubbles entering the xylem vessels, which would reduce capillary action and limit the life of the cut flowers.
37. Many soluble salts such as nitrates diffuse into the plant roots. If the soluble salt concentration of the soil water becomes very low such as in waterlogged soil, then insufficient salts will enter the plant inhibiting growth.
38. (a) Geotropism (also called gravitropism) involves a positive growth response towards the earth (e.g. roots) and a negative growth response away from the earth (e.g. shoots). An example is where seeds may be sown in the soil haphazardly but will still grow their roots downward and their shoots upward.
38. (b) Phototropism is a positive growth response of the coleoptile of a plant towards light. Auxins are produced mainly in the meristem of the coleoptile and travel from cell to cell along the dark side of the coleoptile, elongating the cells. This allows the plant to

bend towards the light. Refer to your textbook for better understanding of the many famous experiments involving phototropism.
38. (c) Thigmotropism is a response to the stimulus of touch or contact. Two examples are where a vine will cling to walls or trellises, and another is the closing movement of the *Mimosa pudica* plant when touched.
39. There are 3 different groups of plant hormones. The first group, the auxins, are responsible for most of the growth phenomena of plants such as growing toward light. The second group, the kinins, promote cell division and growth of plant tissue cultures. The third group, the gibberellins, promote the elongation of young stems in certain plants amongst other functions.
40. (a) The photo-period is the number of hours a day that a plant is exposed to light, so photo-periodism is the response of plants (usually flowering) to varying hours of light at different times of the year. It is the increasing or decreasing lengths of continuous darkness that stimulates the flowering response in many flowering plants.
40. (b) “Long night” (“short day”) plants such as asters, cosmos, chrysanthemums, dahlias, poinsettias and potatoes will only flower when the photo-period is more than 9 hours but less than 14 hours per day.
“Short night” (“long day”) plants such as beets, clover, corn, delphinium and gladiolus will only flower when the photo-period is more than 14 hours per day.
“Indeterminate” plants such as carnations, cotton, dandelions, sunflowers and tomatoes are relatively unaffected by the amount of daylight per day.
40. (c) Phytochrome is a blue pigment found in the leaf which allows plants to measure the amount of daylight.