Question1:

1. Collenchyma cells and sclerenchyma fiber cells both provide mechanical supports to plants. They are both usually elongate with thick cell walls. However, collenchyma cells provide flexible support, are lack of secondary walls, and can grow into various shapes. While sclerenchyma fiber cells provide rigid support because they have secondary walls fortified with lignin. Besides, collenchyma cells are usually in a ring shape or discrete bundles, located just beneath epidermis, while sclerenchyma fiber cells are clustered in groups.
2. Collenchyma cells. Annual flowers usually have soft stems and require flexible support to bend which is exactly what collenchyma cells provide.
3. Sclerenchyma fiber cells. Perennial tree usually grows high, thus the trunk needs to have rigid support to withstand many stressors like wind or its own gravity, while flexibility is not a concern. Sclerenchyma can provide such rigid support with lignin reinforced secondary walls.

Question2:

1. The periderm consists of protective layers of tissues produced by cork cambium to prevent the tree from physical damage and predation. The periderm also has suberin, a complex polyester biopolymer to protect the plant from water loss and pathogenic organisms. It functions as a barrier of water and solutes.
2. The epidermis is covered with cuticle and surface waxes which can protect the plants from water loss, light irradiation and pathogen attack. The epidermis may also contain the hair-like trichomes to defend the plant against insects by physical barriers and deterrents to insect movement. Some may secret essential oils to prevent predation, repel insect and antimicrobials.

Question3:

1. SAM and RAM are located at tips of stems and roots, respectively. They are responsible for primary growth and all undifferentiated initial cells are arranged in meristem clusters. They grow in length.

While lateral meristems are located “inside stems”, in the regions of maturation in stems and roots that have completed growing in length. They are cylindrical (in terms of cross section view of trunk). They grow for radial expansion.

1. Lateral buds form between the stem and the leaf petiole. Lateral roots form from pericycle.
2. Dedifferentiation signaled by hormones.

Question 4:

1. Secondary growth allows for an increase in girth, so it can increase mechanical support. New xylem and phloem are produced in secondary growth as well, so it can also increase conduction for water and nutrients. Finally, the new tissues in vascular bundles and cortex can replace old tissues.
2. Gymnosperms have simpler vascular systems which is less efficient than angiosperms. Secondary growth can produce larger number of vascular tissues to conduct water and nutrients more efficiently to compensate that. Besides, gymnosperms often live in harsh environments and need to deal with many stressors, and secondary growth can provide more mechanical support for them.
3. Monocots do not have a vascular cambium, which is a type of lateral meristem responsible for secondary growth in dicots and gymnosperms.

Question5:

1. Two ways:
2. Casparian strips: present in exo- and endodermis. They block apoplastic pathway and only allow symplastic and transmembrane, which can force water and solutes to cross the plasma membrane (where there are semi-permeable barriers) before they can enter the stele. Also, symplastic transport can have size exclusion limit.
3. Lignified secondary walls in exo- and endodermis: They further restrict apoplastic transport, so enforce semi-permeable barriers in plasma membrane or size exclusion limit in symplastic
4. Fungi can facilitate absorption of water and nutrients in various ways, particularly phosphorus for roots, which is beneficial to plants. Plants can also provide protection, foods (carbohydrates and amino acids) and substrate for fungi. For ectomycorrhizae, fungi remain on surface, or epidermis, and forming a mantle around the root. While for endomycorrhizae, fungi can penetrate root cortex and form arbuscules.

Question 6:

1. Because stomata have guard cells to regulate themselves to open and close in response to different environment and conditions. Potassium ions and water potential can control the turgor pressure of guard cells, which controls stomata to open or close. This process has various signals like water status and carbon dioxide levels. While lenticle and cuticles are static. Cuticle is simply a waxy layer on top and lenticels cannot regulate themselves to open or close.
2. Leaves in arid environment can have thicker cuticles on the surface to reduce water loss.
3. In cold and arid climates, embolisms are more likely to happen by frozen water or air bubbles. In vessel members, water is less supported because they are wider, and vessel members are also open on the ends and stack on each other to form long pipes, so it is more likely to form embolisms, and when it occurs, the entire column is damaged. While tracheid is closed and narrow, embolisms only form separately. And it also has pits for lateral flow. So, in tracheid, only partial of the column will be filled with air or ice.