Question1:

1. Because the name suggests that the Calvin cycle only occurs in the dark, while it is true that the Calvin cycle is not directly dependent on light energy, it still requires products from the light-dependent reaction: ATP and NADPH. And those products only last for a few seconds, meaning that the Calvin cycle consistently relies on the light-dependent reaction, thus indirectly relying on the light.
2. Twelve turns are required for two 6-carbon sugar because six turns are required to produce one 6-carbon sugar. We need that many turns because G3P will also be used by the Calvin cycle to regenerate Ru5P. Only after three turns of the cycle will one G3P be available to use 6-carbon sugars, and each such sugar needs 2 G3P molecules. We need two 6-carbon sugars, thus 4 G3P molecules, thus twelve turns of the cycle.
3. The extra ATP is generated through cyclic electron flow happening in PSI where electrons released are recycled via FD to PQ and follows the electron transport chain to produce one ATP.

Question2:

1. Photorespiration is a process where RubisCO functions as an oxygenase and adds Oxygen from O2 to RuBp to produce 2-PG. This process does not produce ATP as photosynthesis does. Photorespiration occurs because RubisCO’s affinity for carbon dioxide is not strong, and RubisCO can bind to O2 instead of CO2. When RubisCO binds to O2 produced during photosynthesis, carbon fixation in the Calvin cycle is blocked.
2. A sunny summer afternoon. Because under such conditions, the temperature is high, and the plant will lose water, so stomata are likely to close. Therefore gas exchange is stopped, and oxygen produced by photosynthesis is trapped inside the plant, while carbon dioxide consumed by photosynthesis is not replenished. Thus, RubisCO will favour oxygenase activity to increase the rate of photorespiration.
3. Because PEP carboxylase has a high affinity for the hydrated form of CO2 and is not affected by the presence of a concentration of O2, therefore, it can be used more efficiently to fix carbon dioxide, decreasing photorespiration.
4. In an African savanna, because higher temperature range is optimal for C4, and it also has less water loss.

Question3:

1. Pruning will suppress apical dominance, and the lateral buds start growing because pruning will remove the shoot tip where auxin is produced to suppress axillary buds from becoming secondary branches. We can get a similar result by applying cytokinin to the lateral buds.
2. Auxin because high auxin : low cytokinin rate promotes root formation. Auxin accumulates at the cut site because auxin is mainly transported by polar transport, which is unidirectional, with a shoot-root orientation towards the root.

Question 4:

1. Fruit drop. Auxin can decrease the sensitivity of abscission zone cells to ethylene so that unmatured fruit will not be affected by ethylene to drop.
2. Ethylene can promote fruit ripening by promoting enzymatic digestion of middle lamella to soften fruit and synthesis of sugars from energy reserves like starch or organic acids to sweeten the fruit.
3. Fruit change colour because of the degradation of chlorophyll promoted by ethylene. Unripened banana contains chlorophylls, so it is green. And it will turn yellow once ripened because chlorophylls are degraded, and other accessory pigments like carotenoids become more visible to give a yellow colour.
4. A ripe banana because it releases a high level of ethylene gas which can promote fruit ripening, while lime is non-climacteric.

Question 5:

1. PSII and photolysis require water to finish. However, if the plant is under drought conditions, those reactions cannot be processed, but the chlorophylls will still absorb light energy and release electrons, and the plant cannot consume those energies; thus, photodamage is increased. Moreover, plants will likely close the stomata due to drought conditions and high light, and will increase photorespiration rates. This is not damaged directly by light but is still harmful and reduces efficiency.
2. Kalanchoes blossfeldiana is a succulent plant. CAM photosynthesis is one way to reduce photodamage. They open the stomata during the night and close the stomata during the day, so they can reduce water loss and exposure to high light. Also, it can also make chloroplast form a ball around the nucleus in response to high blue light, ABA, and drought treatment. This ball can limit light exposure, thus reducing photodamage.

Question 6:

1. It indicates biotic stress by pathogens like fungi, bacteria, or viruses. At the site of the lesion, hypersensitive response (HR) is occurring, causing programmed local cell death and producing antimicrobial compounds. Throughout the plant, systemic acquired resistance (SAR) is the occurring systemic response that leads to the production of compounds that attenuate pathogen growth and increase the levels of resistance of the whole organism.
2. It’s probably the indirect defence by plant volatiles to attract natural predators of attacking herbivores, also called tri-trophic interactions. The two hormones are ethylene and jasmonic acid. Ethylene initiates a volatile jasmonic acid signalling pathway and green leaf volatile emission, which also promotes salicylic acid to prevent infection at the sight of injury. Jasmonic acid can stimulate defence response in plants and neighbouring plants to enforce interplant communication in response to herbivores attacking.