Respiration/Photosynthesis study guide

Do not study details of structures or names of anything but the key players. Think about the big picture and be able to analyze data. You would be far more likely to see a diagram depicting CAM-plant photosynthesis and be asked to make some prediction if some condition were changed then you would be to be asked "what's a CAM plant?"

Some key players (know what these do):

1. The ATP synthase
2. Nucleotide cofactors (NAD^+/NADH; FAD/$FADH_2$; $NADP^+$/NADPH)
3. Photosystems I and II
4. Role of Hemes in Electron transport
5. Phosphofructokinase (know about the feedback)
6. Pyruvate
7. G3P (glyceraldehyde 3 phosphate)
8. RuBisCO (the enzyme
9. RuBP (the substrate for the enzyme)

General guidelines and suggestions

1. For each phase, know what the input molecules are, what the waste products (if any) are; what the important products are and where they go next. For example
   1.1. Glycolysis needs glucose; NAD^+; some ATP. Outputs are: NADH which can go to the mitochondria for oxidative phosphorylation; more ATP than put in; pyruvate, which can go to the mitochondria and to the citric acid cycle
2. Apply the knowledge from above, as in the online quiz question in which you had to know that the light reactions produce the ATP and NADPH needed for the Calvin cycle to answer the question about which intermediates of the Calvin cycle would increase or decrease.
3. Be able to "follow the electrons." A favorite question is to ask you to compare and contrast electron flow in photosynthesis and respiration. Where does the high-energy electron come from (From oxidation of food to reduce NADH and FADH2 for respiration, excited by photon—ultimately stolen from oxygen in water for photosynthesis)? Where does it go to? (Oxygen to make water in respiration; to NADPH ultimately to make food in photosynthesis). I really like that symmetry
4. Another great symmetry comes when comparing the two cycles (Calvin and Citric Acid).
   4.1. Calvin cycle captures CO_2 and reduces the organic acid to a simple sugar (G3P), getting the electrons from NADPH. In the citric acid cycle, carbon from carbohydrates is oxidized, producing CO_2 passing the electrons to NAD^+ to make NADH.
5. Look for commonalities: the ATP synthase driven by proton gradient established by electron transport…details are different but the theme is the same.
6. Know what's oxidized and what's reduced in the major phases (another version of "follow the electrons).
7. You will likely see experiments of the sort where a radioactive tracer is used, or some required step is blocked. Be able to make a reasonable prediction about what would happen.

Things people forget:

1. Plants have mitochondria and therefore carry out respiration
2. "Pyruvate oxidation" is not technically part of the Citric Acid Cycle, but is the step that generates the Acetyl-CoA. It also releases a CO_2 and reduces NAD^+ to NADH.

3. If one thing is oxidized, something else is reduced. When you see NADH or NADPH as a product, something else must have been oxidized. When you see NAD^+ or $NADP^+$ as a product, something else was reduced.
4. The color of light you see coming off a plant is what it is NOT using. It's absorbance spectrum shows you what it is using.
5. Substrate-level phosphorylation…It's just a normal enzymatic reaction running kind of backwards. It takes a phosphate off a substrate and transfers it to ADP to make ATP (Or GDP to make GTP in the citric acid cycle).
6. You don't need stomata or to regulate water loss if you live in water.
7. Free O_2 probably did not exist appreciably before there is photosynthesis.