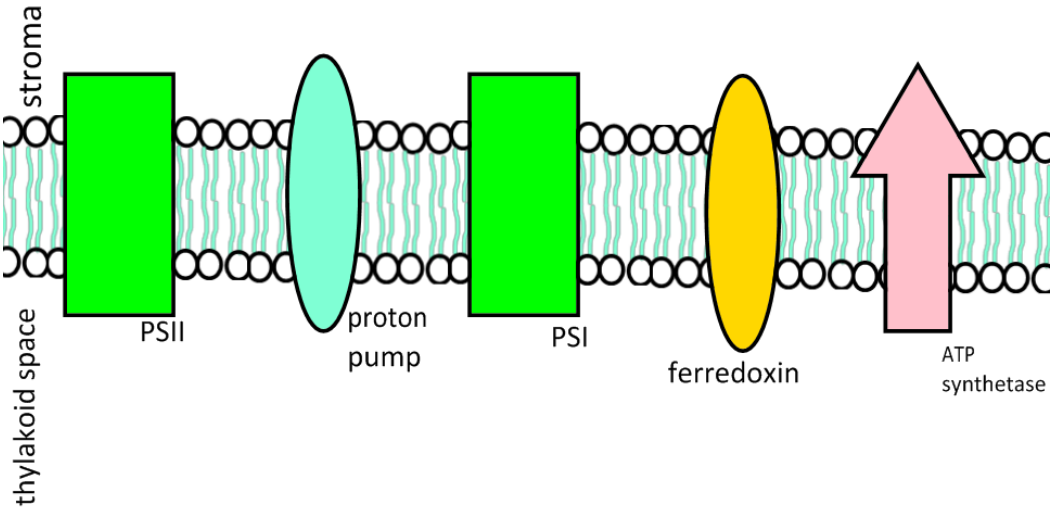
Name _____ Period _____ Date _____

Topic 8.3 Photosynthesis

8.3.U1 Light-dependent reactions take place in the intermembrane space of the thylakoids. & 8.3.U4 Absorption of light by photosystems generates excited electrons. & 8.3.U5 Photolysis of water generates electrons for use in the light-dependent reactions. & 8.3.U6 Transfer of excited electrons occurs between carriers in thylakoid membranes. & 8.3.U3 Reduced NADP and ATP are produced in the light-dependent reactions. & 8.3.U7 Excited electrons from Photosystem II are used to contribute to generate a proton gradient. & 8.3.U8 ATP synthase in thylakoids generates ATP using the proton gradient. & 8.3.U9 Excited electrons from Photosystem I are used to reduce NADP.

1. Annotate the diagram below to explain the light-dependent reactions of photosynthesis. Include: *photolysis, photophosphorylation (and chemiosmosis), movement of electrons, generation of a H+ gradient using a proton pump, reduction of NADP+ by ferredoxin.*



2. Explain what happens to an electron when it is excited by photons of light.
3. Define photolysis
4. Identify the two products of the light-dependent reactions which are carried through to the light- independent reactions.

8.3.U2 Light-independent reactions take place in the stroma. & 8.3.U10 In the light-independent reactions a carboxylase catalyses the carboxylation of ribulose bisphosphate. & 8.3.U11 Glycerate 3-phosphate is reduced to triose phosphate using reduced NADP and ATP. & 8.3.U12 Triose phosphate is used to regenerate RuBP and produce carbohydrates. & 8.3.U13 Ribulose bisphosphate is reformed using ATP.

5. State the name of the 5-carbon compound present in the Calvin cycle.
6. Define carboxylation.
7. State the name of the highly abundant enzyme responsible for fixing CO_2.
8. In the space below, draw a diagram to explain the cycle of reactions that occur in the light-independent stages of photosynthesis. Include: *carboxylation of RuBP to glycerate-3-phosphate by rubisco, reduction to triose phosphate, formation of glucose phosphate and reformation of RuBP*.

8.3.U14 The structure of the chloroplast is adapted to its function in photosynthesis. & 8.3.S1 Annotation of a diagram to indicate the adaptations of a chloroplast to its function.

9. Draw and label a diagram of a chloroplast, as seen under a TEM. Include: *thylakoid membranes and thylakoid (inner membrane) space, stroma, granum/thylakoid disc, and chloroplast envelope*. Annotate the diagram with the function of each component and the way it is adapted to increase the efficiency of photosynthesis.
10. Certain features of a chloroplast indicate it's probable origin as a prokaryote cell.
    a. State the approximate size of a chloroplast
    b. Identify the other key structures that indicate the probable origin of a chloroplast.
    c. Explain how the size and structures identified above provide evidence of the chloroplast's prokaryote origin.

8.3.A1 Calvin's experiment to elucidate the carboxylation of RuBP.

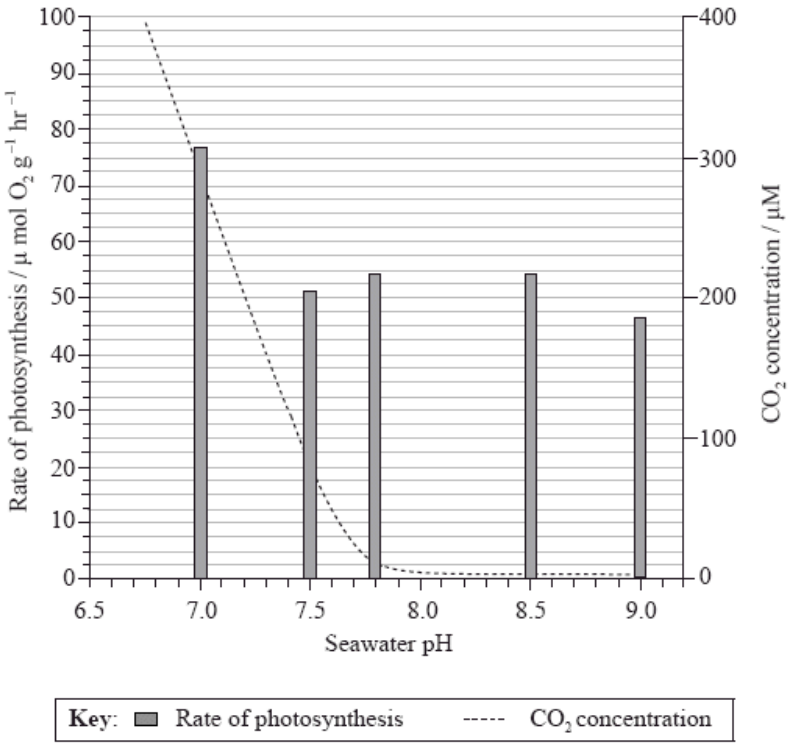
11. Outline the method used by Calvin to discover the carboxylation of RuBP.
12. Explain, briefly, how the separation of the carbon compounds allowed Calvin to discover the carboxylation of RuBP.

Nature of Science: developments in scientific research follow improvements in apparatus - sources of 14C and autoradiography enabled Calvin to elucidate the pathways of carbon fixation. (1.8)

13. State the discovery and the development of what technique allowed Calvin to make his discoveries.

Data Analysis

1. The rate of photosynthesis in the marine seagrass, Zostera marina, was investigated under a range of pH conditions. After a period of darkness, the plants were illuminated at a constant light intensity at 15°C and the rate of photosynthesis was measured. Zostera marina can use both dissolved carbon dioxide (CO_2) and hydrogen carbonate ions for photosynthesis.



a. State the carbon dioxide concentration at pH 7.2. (1)

b. Calculate the percentage decrease in the rate of photosynthesis from pH 7 to pH 7.5. (1)

c. Outline the relationship between pH and the rate of photosynthesis. (2)

d. Suggest how *Zostera marina* can perform photosynthesis even at very low carbon dioxide concentrations. (1)

e. Based on the information and data provided, discuss the role of **one** limiting factor, other than carbon dioxide, and suggest how this would affect the rate of photosynthesis. (2)