

**Rangeland Plant Ecophysiology**  
**EXAM 1, REWM 3500, Fall 2008**

Name \_\_\_\_\_

1) Define the following [2 points each]:

*ecology*

*adaptation*

*acclimation*

*Beer's law*

*Fick's law*

*photosynthetic photon flux density (PPFD)*

*photosynthetic irradiance*

*homeostasis*

*stress*

*stress tolerance*

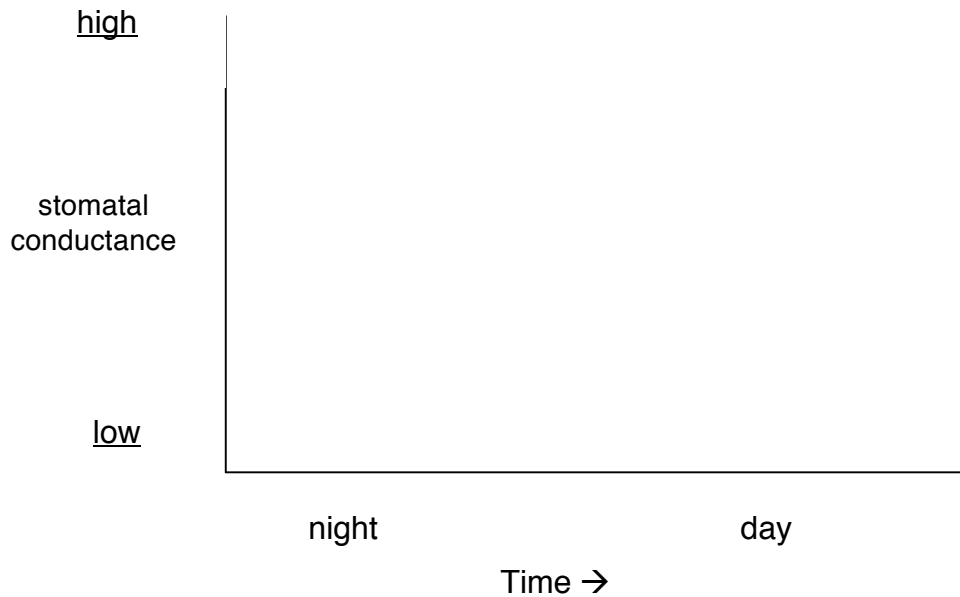
*aerenchyma*

*pneumatophore*

*isotope*

*photoautotroph*

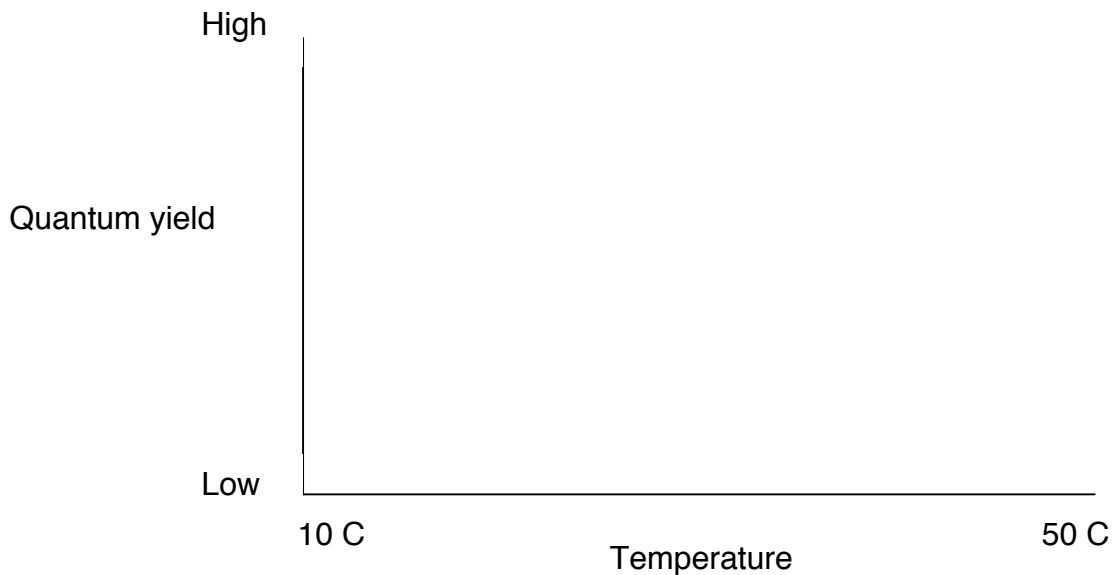
2) CAM idling and CAM cycling are two variations on normal CAM photosynthesis. Draw three curves on the graph below illustrating the daily change (from the nighttime period through the day) in stomatal conductance for these three variations of CAM photosynthesis. Label the curves “**normal CAM**”, “**CAM idling**” and “**CAM cycling**”. In the space below, describe the advantage of CAM idling over C3 photosynthesis. What might be the metabolic cost associated with CAM cycling compared to normal C3 photosynthesis? [10 points]



3) Contrast **holism** and **reductionism** in ecology. Which of the two perspectives is adopted by plant physiological ecologists? [10 points]

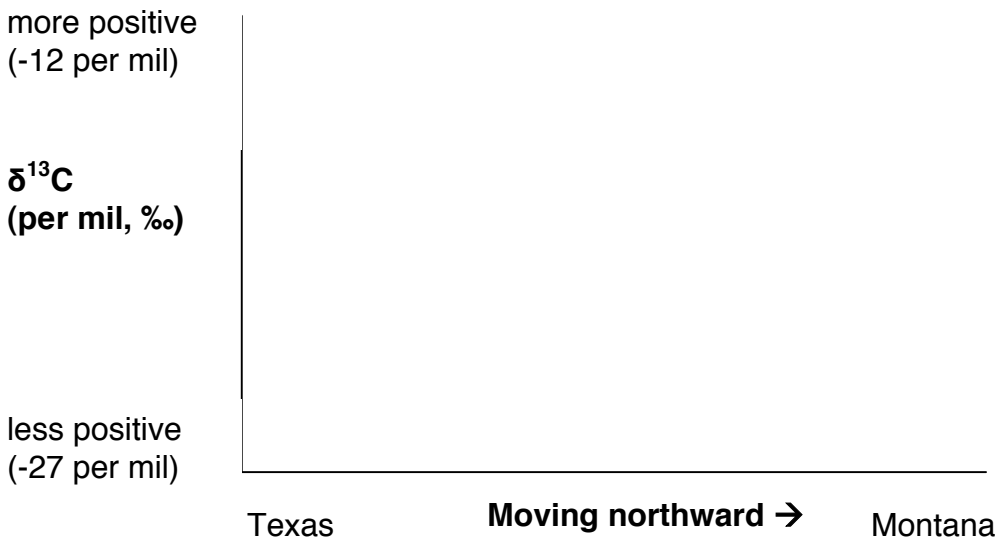
4) Using the conceptual analogy of “filters” that was discussed in class, explain why only a small proportion of the world’s 270,000 vascular plant species occur within a particular region. [10 points]

5) Draw three lines on the graph below representing the **quantum yield** responses of hypothetical **C3** and **C4** plants in relation to **temperature**. One line should represent the response curve for a C3 plant in today’s atmosphere (384 ppm CO<sub>2</sub>; 21% O<sub>2</sub>). Label this line “C3 today.” Another line should represent the response curve for a C4 plant in today’s atmosphere (384 ppm CO<sub>2</sub>; 21% O<sub>2</sub>). Label this line “C4 today.” Finally, draw a line representing the likely response of a C3 plant in air from before the start of the industrial revolution (about 1850) with a CO<sub>2</sub> concentration lower than today (280 ppm CO<sub>2</sub>; 21% O<sub>2</sub>). Label this line “C3 past.” In the space beneath your graph, provide a biochemical explanation for any differences in the three curves drawn. [10 points]

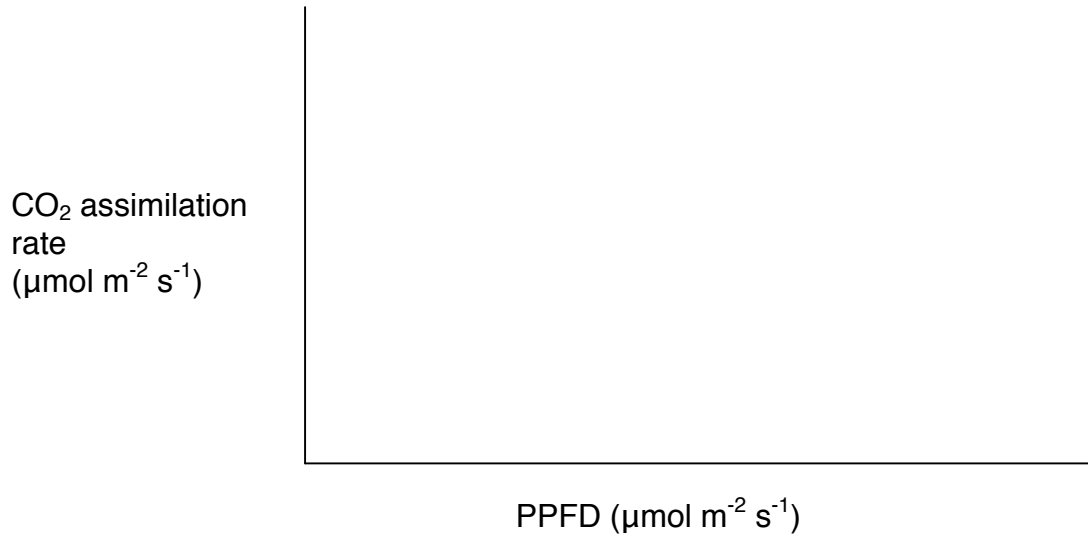


6) Consider the quantum yield responses for C3 and C4 plants above. Suppose growing season temperature rises by several degrees Celsius in the North American prairies over the next 100 years as is predicted by climate change models. How would you expect the distribution of C3 and C4 grasses to shift across a latitudinal gradient (north-south gradient) in these prairies under this scenario? Assume all other aspects of the environment remain unchanged. **[5 points]**

7) On the graph below, draw a line representing the expected value of the carbon isotope ratio ( $\delta^{13}\text{C}$ ) of bone protein in bison feeding on native prairie grasses across North America from south Texas to Montana. In the space below the graph, explain why you might expect this pattern. **[10 points]**



8) Draw two lines on the graph below representing light response curves of photosynthesis. The first line should represent that for a **shade-acclimated leaf**. Use a **solid (—) line** for this shade curve. The second line should represent the light response curve of photosynthesis for a **sun-acclimated leaf** on this tree. Use a **dashed (- - -) line** for the sun curve. On the curve for the sun-acclimated leaf, identify the dark respiration rate ( $R_d$ ), the light compensation point (**LCP**), and the maximum rate of photosynthesis ( $A_{max}$ ). [6 points]



9) For each leaf biochemical, physiological or anatomical property listed below, state whether the quantity of that property would be “higher” or “lower” in the shade-acclimated leaf compared to the sun-acclimated leaf from question #8. [5 points]

“higher” or “lower”

leaf nitrogen content [N]

leaf protein content

leaf thickness

specific leaf area ( $m^2/g$ )

chlorophyll content / [N]

**10)** Plant physiological ecology as a scientific discipline made tremendous advancement during the 1950's through the 1970's. List at least three important factors that stimulated this period of advancement? **[6 points]**

**BONUS:** Why does the carbon-13 to carbon-12 isotope ratio of cheap Mexican, American and Canadian beers differ from the more expensive German beers? **[2 points]**