

Restrict your responses **only** to the space available. Answer directly and fully - don't beat around the bush. Point values for each question are given in parentheses. Of course, any notes you are allowed in answering the exam. All page 25-29 references refer to Wanda's notebook. Write your name at the bottom of each page.

1 (10) Leaf temperatures of *Encelia farinosa* are lower than those of other neighboring shrub species and also lower than the surrounding air temperature. Please explain why leaf temperatures in *Encelia farinosa* are below those of air temperature, using the data on page 25 as supporting information.

Leaf temperatures fall below air temperature because low absorptance reduces absorbed solar radiation and high leaf conductances increase evaporative cooling. Convection will tend to warm the leaf (approaching air temperature, but appears to be a small factor here.

2 (5) Based on the data presented on page 25, what is the relationship between water stress and leaf absorptance?

A water stress increases, leaf absorptance decreases.

3 (12) On the road trip described on page 26, climate diagrams for four different locations are presented. What biome or vegetation type was observed at each of the locations?

Site #1 grassland Site #2 grassland

Site #3 grassland Site #4 grassland

4a (2) On the road trip described on page 26, would you expect to find C₄ photosynthesis plants at any of these locations?

Yes x No

4b (4) Which location(s)? **Site #2, site #3, and site #4**

4c (4) Justify your answer(s) above.

C₄ grasslands are expected in warm growing season grasslands, Sites #2, #3, and #4 are the warmest of the four sites. Site #1 is a cool site.

5 Data to answer this series of sub-questions come from page 27.

5a (2) What term describes the relationship between net photosynthesis and PFD? **Saturating**

5b (2) What is the leaf photosynthetic rate value at a PFD of 2000 $\mu\text{mol m}^{-2} \text{s}^{-1}$? **42 $\mu\text{mol CO}_2 \text{ m}^{-2} \text{s}^{-1}$**

5c (10) What changes are taking place that result in the c_i/c_a ratio remaining essentially constant at PFD values between 400-2000 $\mu\text{mol m}^{-2} \text{s}^{-1}$?

As the photosynthetic rate decreases with decreasing PFD, the stomates close proportionately to keep the c_i/c_a ratio nearly constant. In economic terms, the supply rate decreases as the demand rate decreases, sustaining the c_i/c_a at a constant operational point.

5d (6) Over what range of PFD values is the photosynthesis rate both increasing and linearly related to PFD?

0 – 800 $\mu\text{mol m}^{-2} \text{s}^{-1}$

5e (6) BONUS Over the PFD range answered in Question 5c, what term is used to describe this response when photosynthetic rate is linearly related to PFD? What is the slope of that relationship (show your math)?

Quantum yield for CO_2 uptake

$$0.045 = (32 - (-4))/(800 - 0)$$

6 Data to this series of sub-questions come from page 28.

6a (4) Which of the four locations (if any) are Mediterranean climate sites?

San Diego and La Serena

6b (6) Based on the information in the climate diagrams, please describe the expected natural vegetation at Hilton Head and Melo.

Deciduous forest

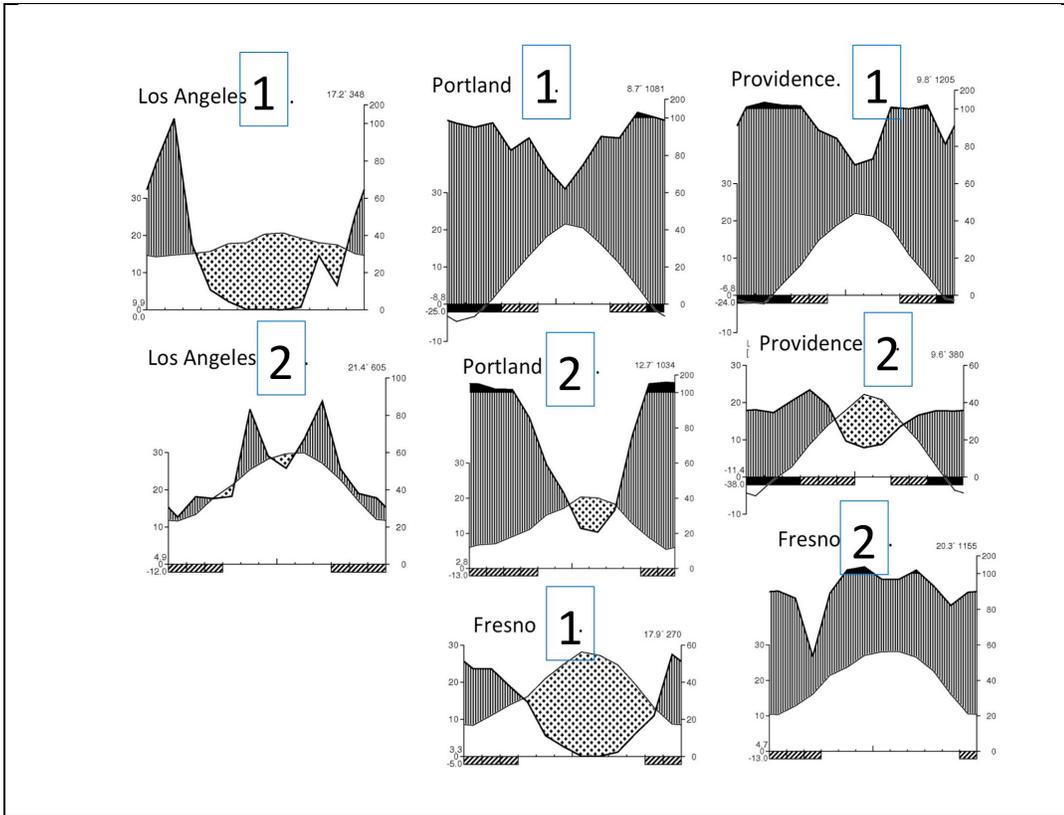
6c (10) Please explain why the precipitation patterns are so different on east versus west locations on the same continents, even though all sites are at the same latitudinal distance from the equator?

The climate and precipitation differences are either side of the continents at equal latitudes arise because of differences in ocean circulation patterns. One the east sides of continents, warm ocean temperatures circulate from equatorial zones result in significant summer precipitation. In contrast, on western sides of the continents, colder ocean temperature circulate from colder subpolar regions.

7 Data to this series of sub-questions come from page 29 (climate diagrams below)

Write your name on every page

Name _____



7a (10) For the two Los Angeles cities presented, what vegetation is expected to naturally occur in

Los Angeles 1 **Mediterranean shrub woodland**

Los Angeles 2 **Grassland**

7b (10) Providence 2 is Providence, Utah and its natural vegetation is quite different from the vegetation expected to naturally occur in the region surrounding Providence 1. What vegetation type is expected to naturally occur in the area surrounding Providence 1 and justify your answer.

Providence 1 should have a deciduous forest. The reason is that deciduous forests are found in regions with abundant year round precipitation, cool to cold winter temperatures, and warm summer temperatures. Each of these criteria are shown in the Providence 2 climate diagram.

7c (5) Both Portland 2 and Fresno 2 receive sufficient precipitation that the perennial vegetation is typically not very water stressed. Yet the two locations have significant temperature differences. Based on your understanding, which location is more likely to have a coniferous forest instead of a deciduous angiosperm forest? Justify your answer.

Portland 2 is more likely to have a coniferous forest. This is because in humid regions with abundant precipitation, conifers tend to dominate in the cooler temperature and therefore lower transpiration sites, whereas angiosperm deciduous forest tend to occur in warmer temperature regimes which may where plants may exhibit higher transpiration rates.