Rangeland Plant Ecophysiology **Name**_____
EXAM 2, REWM 3500, Fall 2007

Multiple choice. Circle the letter corresponding to the single most correct answer for each of the following. [2 points each]

1) An oligotrophic habitat is one that is:

a) too cold to support plant life
b) characterized by soils with high pH
c) characterized by soils with low pH
d) generally nutrient poor
e) affected by high concentrations of salts

2) Water potential is properly defined as:

a) the internal pressure of water relative to that of air
b) the free energy of water relative to that of pure water at standard conditions
c) the tensile strength of water relative to that of copper
d) the flow of water through a plant due to gravity
e) the energy necessary to vaporize liquid water

3) A plant with an internal water status that closely tracks the moisture content of the atmosphere and its surroundings is termed a _____ plant.

a) calcifuge
b) heliotropic
c) poikilohydric
d) calcicole
e) homeohydric

4) Forced convection refers to:

a) heat dissipation from turbulent movement of air over a surface induced by wind
b) strong adhesive forces between water and cell surfaces driving water movement
c) electrochemical gradients driving ion uptake in roots
d) heat dissipation from vaporization of water at leaf surfaces
e) active transport of water through a plant

5) The law describing the flow rate of liquid water through a plant in relation to the pressure gradient in the xylem and the xylem conductivity is:

a) Poiseuille's law
b) Fick's law
c) Newton's law of cooling
d) Darcy's law
e) Steffan-Boltzman law

6) The law describing the flow rate of liquid water through a vessel cell in the xylem in relation to a pressure gradient and vessel diameter is:

a) Poiseuille's law
b) Fick's law
c) Newton's law of cooling
d) Darcy's law
e) Steffan-Boltzman law

7) A plant that establishes a deep root system to tap into a stable groundwater supply is a _____ .

a) halophyte
b) calcicole plant
c) poikilohydric plant
d) calcifuge plant
e) phreatophyte

8) The stunted and shrubby form that trees take on at upper tree line at high altitude is referred to as the _____ growth form

a) tussock
b) giant rosette
c) Krumholz
d) cushion
e) erect

9) The thickness of the air boundary layer over a leaf is related to these two parameters:

a) leaf volume and solar radiation
b) solar radiation and leaf color
c) leaf color and wind speed
d) wind speed and leaf width
e) leaf width and leaf volume

10) The two components of cell water potential most useful for understanding drought effects on plants, as discussed in class, are:

a) gravitational potential and matric potential
b) osmotic potential and pressure potential
c) pressure potential and matric potential
d) matric potential and osmotic potential
e) osmotic potential and gravitational potential

11) The soil water potential at which a plant can no longer absorb water from the soil is the:

a) soil water holding capacity
b) soil osmotic potential
c) permanent wilting point
d) available soil water
e) soil matric potential

12) The law describing the longwave radiation emitted by a leaf in relation to leaf temperature is:

a) Poiseuille's law
b) Fick's law
c) Newton's law of cooling
d) Darcy's law
e) Steffan-Boltzman law

13) The breakage of the water column inside a vessel or tracheid in the xylem due to entry of air is called:

a) diffusion
b) cavitation
c) embolism
d) convection
e) conduction

14) The portion of solar radiation from about 300 to 400 nanometers wavelength is called:

a) near infrared
b) thermal infrared
c) visible
d) ultraviolet
e) infraviolet

15) The water inside plants often can remain as a liquid even when temperatures drop well below the freezing point. This phenomenon is called:

a) freezing point depression
b) freeze-thaw cavitation
c) chilling
d) supercooling
e) ice translocation

16) Of the processes accounting for the delivery of inorganic nutrients to the soil environment, this one is the most important in terms of quantity delivered at any instant in time:

a) decomposition of organic detritus
b) atmospheric deposition
c) chemical weathering of rock
d) capillary rise from groundwater

17) List five important reasons why plants need water. **[5 points]**

18) **<u>Describe</u>** *five* adaptations in sagebrush (*Artemisia tridentata*) that allow this beautiful shrub to survive the hot, dry summers on western rangelands. **DO NOT** just **LIST** these adaptations. Rather **<u>describe</u>** each one in enough detail to show that you know why these adaptations are important for sagebrush. **[15 points]**

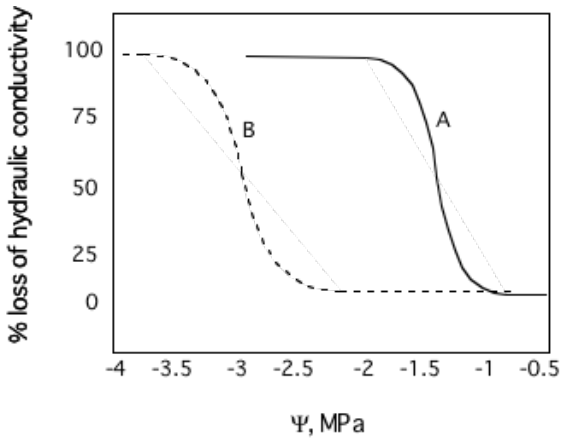
19) The tree growth form is not found in high elevation environments where mid-summer temperatures average less than about 10°C. Why? What is the ecophysiological explanation for this observation. **[6 points]**

20) The broader capacity to tolerate toxic concentrations of heavy metal or nutrient ions in the soil involves one or both of these adaptive mechanisms: Exclusion and Amelioration. Describe these two adaptive mechanisms and provide a specific example of each. **[8 points]**

21) From the figure below showing vulnerability to cavitation in two tree species (A and B), answer the following **[5 points]**:

- The xylem conduits (vessels, tracheids) in tree B become completely embolized at what value of plant water potential?

- Which of the two tree species would you expect to find only in wet, riparian habitats and why?



22) List three (3) morphological adaptations in plants that have evolved to alter the amount of absorbed shortwave radiation. **[6 points]**

23) List two morphological adaptations providing enhanced nutrient uptake in plants. **[4 points]**

24) Describe how the giant rosette growth form of *Espletia* in alpine areas of South America confers freezing resistance. **[8 points]**

25) Plants of semi-arid and arid regions conveniently are classified into three groups or adaptive strategies based on their rooting distribution and dynamics of internal water status. List and describe these three adaptive strategies**. [6 points].**

26) Suppose the amount of summer precipitation in the American west increased substantially over the next several decades. Which of the adaptive strategies described above in question #25 would you expect to be favored most by this pattern of climate change and why?
[5 points]

3 Point BONUS!!! Some epiphytic orchids have a very specialized root anatomy consisting of an epidermis with multiple cell layers. What is the term for this multiple epidermis and what is its function in epiphytic orchids?