Rangeland Plant Ecophysiology **Name**_____
EXAM 2, REWM 3500, Fall 2008

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 dry to support plant life
b) generally nutrient poor
c) characterized by soils with low pH
d) characterized by soils with high pH
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) 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

5) The law describing the flow rate of liquid water through a vessel 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

6) The law describing the rate of 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

7) The law describing the rate of convective heat loss from a leaf in relation to the leaf temperature, air temperature and boundary layer thickness is:

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

8) 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

9) The soil water potential at which a plant can no longer absorb water and suffers damage is often termed the:

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

10) 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

11) 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

12) 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

13) The two components of soil 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

14) The portion of solar radiation from about 0.7 to 3.0 micrometers wavelength is called:

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

15) Plants with adaptations allowing them to survive in salt affected soils are known as:

a) halophytes
b) poikilophytes
c) epiphytes
d) xeriphytes
e) phreatophytes

16) List five important reasons why plants require water. **[5 points]**

17) **<u>Describe</u>** *three* (3) 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. **[9 points]**

18) 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? **[10 points]**

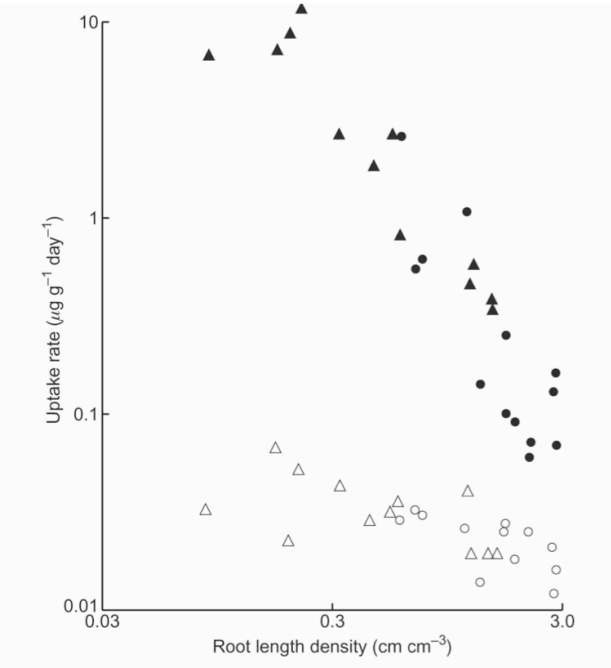
19) Explain the mechanism causing cavitation in tracheids and vessels of plant xylem during a freeze-thaw event. Is there a trade-off between vulnerability to freeze-thaw cavitation and hydraulic conductance through a plant? If so, why? **[10 points]**

20) Describe four (4) mechanisms or characteristics that allow plants to survive in the alpine environment at high elevation. **[8 points]**

21) List three (3) morphological adaptations in plants that have evolved to alter the amount of absorbed shortwave radiation. **[9 points]**

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

23) The figure below is taken from the lecture slides. It shows the relationship between phosphorus (open symbols) and potassium (filled symbols) uptake rates per unit root mass (y axis) across a range of root length densities (x axis). First, why do the uptake rates per unit root mass DECLINE with increases in root length density? Second, why is the decline more pronounced for potassium than for phosphorus? **[12 points]**



3 Point BONUS!!! Coarse textured soils hold less plant available water at field capacity than do clay textured soils. Why then do we often observe greater vegetation productivity on coarse textured than on fine textured soils in semi-arid and arid regions?