

CONTESTANT NAME \_\_\_\_\_

**2006 UNDERGRADUATE RANGE MANAGEMENT EXAM  
(a mini-URME)**

**Society for Range Management, Wyoming Section Meeting**

**Sheridan, Wyoming  
November 29 and 30, 2006**

**Instructions**

This examination consists of 62 multiple choice or fill in the blank questions, and 3 calculation problems. Show all work on the calculation problems.

**Length of Testing Period**

**60 Minutes**

**Grading**

Multiple-choice questions are worth 2 or 4 points each for a total of 130 points. Problems are worth 5 or 10 points each for a total of 20 points. The entire examination is worth 150 points.

**I. RANGE ECOLOGY (30 points)**

1. \_\_\_\_\_ intensity rain showers will provide \_\_\_\_\_ rates of infiltration than \_\_\_\_\_ intensity thunderstorms.
  - a. **Low, greater, high**
  - b. High, greater, low
  - c. High, similar, low
  - d. Low, lower, high
  
2. Temperature isotherms in North America:
  - a. **follow latitudinal lines closely, except for the mountain regions**
  - b. follow longitudinal lines closely, except for the mountain regions
  - c. are determined by precipitation zones
  - d. are not affected by large bodies of water
  
3. If you had two grassland herbivores, one that fed exclusively on above-ground plant parts and one that fed exclusively on below-ground plant parts, and they both consumed 10% of the plant material available to them, which herbivore consumed the most plant material?
  - a. the above-ground feeder
  - b. **the below-ground feeder**
  
4. As energy moves through trophic levels, it is \_\_\_\_\_ at each step in the food chain through respiration, and its transfer is \_\_\_\_\_ considerably at each stage.
  - a. **dissipated, decreased**
  - b. increased, increased
  - c. concentrated, decreased
  - d. concentrated, attenuated
  - e. none of the above
  
5. Which of the following generalizations is correct regarding plant competition?
  - a. Plant competition generally decreases with increasing productivity of the community
  - b. In semi-arid environments with discontinuous plant cover, plants generally compete for light
  - c. **A shift is expected from competition for soil resources at low productivity to competition for light at high productivity**
  - d. None of the above
  
6. Mycorrhizae supply the vast majority of \_\_\_\_\_ to plants.
  - a. nitrogen
  - b. **phosphorous**
  - c. water
  - d. none of the above

7. A group of individuals in a population that are born during the same time interval is called a:
- deme
  - census
  - cohort**
  - none of the above
8. The process by which deep-rooted plants take in water from lower soil layers and exude that water into upper, drier soil layers is called:
- hydraulic lift**
  - xylem gravitational leakage
  - cohesion-tension
  - preferential root transpiration
9. Rangelands occupy \_\_\_\_\_ % of the earth's land area.
- 10
  - 25
  - 50**
  - 75
10. Which of the following would be a representative  $\delta^{13}\text{C}$  value for a  $\text{C}_3$  plant species?
- 13‰
  - 0‰
  - 27‰**
  - none of the above
11. Which of the following stable isotopes can be used to determine patterns of water acquisition by plants?
- $^{15}\text{N}$
  - $^{18}\text{O}$**
  - $^{13}\text{C}$
  - None of the above
12. Clements described \_\_\_\_\_ as a stage earlier than climax and \_\_\_\_\_ as retrogression succession.
- preclimax, disclimax**
  - preclimax, postclimax
  - secondary succession, primary succession
  - none of the above
13. Size-symmetric competition in plants can be defined as:
- plants acquire similar quantities of nutrients regardless of their biomass
  - plants acquire nutrients in proportion to their biomass**
  - smaller plants acquire disproportionately more nutrients than larger plants
  - all of the above
  - none of the above

14. Turgor pressure is best defined as the:

- a. **pressure in excess of atmospheric within cells**
- b. pressure less than atmospheric within the xylem
- c. presence of solutes that lowers water potential
- d. none of the above

15. According to \_\_\_\_, “vegetation of an area is merely the resultant of two factors, the fluctuating and fortuitous immigration of plants and an equally fluctuating and variable environment”.

- a. **Gleason**
- b. Clements
- c. Tansley
- d. None of the above

## II. GRAZING MANAGEMENT (26 points)

16. In comparing ruminant and cecum digestive systems, the ruminant digestive system allows for \_\_\_\_\_ efficient use of fibrous forage and microbial protein, while the cecum digestive system allows for relatively \_\_\_\_\_ intake rates of fibrous forage.

- a. **more, higher**
- b. more, lower
- c. less, higher
- d. less, lower

17. Herbivores select diets based on which mechanism?

- a. the innate ability to sense through taste and smell
- b. immediately pleasing to olfactory, gustatory and tactile senses
- c. learning through positive post-ingestive consequences
- d. learning through negative post-ingestive consequences
- e. **all of the above**

18. Bacteria associated with the digestive tracts of grazing animals can synthesize:

- a. fat soluble vitamins and vitamin K
- b. **water soluble vitamins and vitamin K**
- c. carbon
- d. all of the above
- e. none of the above

19. Which of the following is the macromineral that is most limiting to grazing animal productivity throughout the world?

- a. **P**
- b. Se
- c. Mg
- d. Ca
- e. N

20. Which of the following is an advantage of the rumen digestive system?
- provides a source of protein through passing of microbes from abomasum to rumen
  - allows subsistence on lower quality diets compared to cecum digestive system
  - allows greater forage consumption than cecum digestive system through less particle size breakdown
  - all of the above
  - none of the above**
21. What is the relationship between cell wall concentration of forages and forage intake?
- as cell wall concentration declines, intake increases
  - reductions in intake are associated with high cell wall concentrations
  - cell wall concentration has a high negative association with intake
  - all of the above**
  - none of the above
22. A cow gives birth on April 1, 2006. When would be the approximate latest date she would have to breed back in order to give birth to another calf on the same date in 2007?
- May 1, 2006
  - June 20, 2006**
  - August 1, 2006
  - September 1, 2006
  - October 20, 2006
23. Which of the following are direct economic losses from poisonous plants related to grazing livestock?
- Abortions
  - Reduced fertility
  - Birth defects
  - All of the above**
  - None of the above
24. Nitrogen constitutes about \_\_\_\_ % of the total plant mass in most plants grazed by herbivores.
- 1-2**
  - 6-7
  - 40-42
  - None of the above
25. Methane production by ruminants:
- is greatest when eating activity is highest
  - decreases when animals switch from eating to ruminating
  - exhibits a diurnal pattern
  - all of the above**
  - none of the above

For questions 26 to 28, please use the following table from Moisey et al. 2006 (REM)

Cumulative number of *Festuca campestris* plants selected by cattle during spring at increasing cumulative stocking rates from 30 May to 4 June in relation to litter-removal treatments

|           | Stocking rate (AUM/ha) |          |          |          |
|-----------|------------------------|----------|----------|----------|
|           | 0.48                   | 0.73     | 1.22     | 1.46     |
| Treatment | (31 May)               | (1 June) | (3 June) | (4 June) |
| Control   | 10a                    | 15a      | 17a      | 17a      |
| 14        | 19b                    | 20a      | 20a      | 20a      |
| 7         | 20b                    | 20b      | 20a      | 20a      |
| 2.5       | 17b                    | 18ab     | 19a      | 19a      |

Control indicates no litter removed from plants, 14 indicates litter removed above 14 cm stubble height, 7 indicates litter removed above 7 cm, and 2.5 indicates litter removed above 2.5 cm

Within a column, means followed by different letter differ significantly ( $P < 0.05$ )

26. At the final sampling date, which treatment had the most plants selected?

- a. control
- b. 14
- c. 7
- d. 2.5
- e. **None of the above**

27. According to the information provided, the number of plants selected significantly increased from 31 May to 4 June in which treatment?

- a. control
- b. 14
- c. 7
- d. 2.5
- e. **None of the above**

28. At which sampling date did the number of plants selected differ between the control treatment and all the other treatments?

- a. **31 May**
- b. 1 June
- c. 3 June
- d. 4 June
- e. None of the above

**IIa. GRAZING MANAGEMENT PROBLEM (5 points)**

**SEE END OF TEST**

### III. RANGE IMPROVEMENT (24 points)

29. (4 points) How many kg of pure live seed (PLS) are in a 100-kg sack with a label that has the following information: germination=60%, heterogenesis=70%, purity=80% and inert materials=20%

- a. **48**
- b. 56
- c. 60
- d. 80
- e. none of the above

30. Which of the following statements is correct regarding methods of top removal of sprouting and non-sprouting species?

- a. cabling and chaining are effective methods for controlling sprouting species
- b. **top removal at any time by any method will effectively control non-sprouting species**
- c. fire and disking are effective methods for controlling sprouting species
- d. all of the above
- e. none of the above

31. In rangeland fires, which of the following contributes the most preheating of fuels preceding consumption by a head fire?

- a. conduction
- b. **convection**
- c. radiation

32. The single most important factor influencing potential for soil erosion on rangeland is:

- a. range type
- b. slope length
- c. slope steepness
- d. **vegetation cover**

33. (4 points) A forest company has 320,000 ha of productive forest land with an average growth rate of 2 m<sup>3</sup>/ha/year, and the rotation length is 80 years. Assuming no fire or insect losses, what level of cutting can be sustained indefinitely?

- a. **640,000 m<sup>3</sup>/year**
- b. 160 m<sup>3</sup>/year
- c. 160,000 m<sup>3</sup>/year
- d. 8,000 ha/year

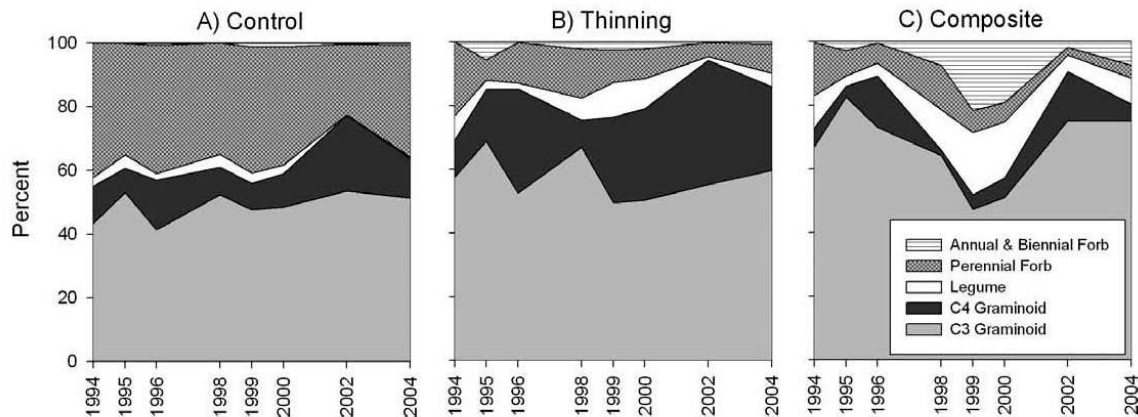
34. Water repellency (i.e. hydrophobic soils) following burning is most common in:

- a. fine textured soils that are dry
- b. coarse textured soils that are wet
- c. fine textured soils that are wet
- d. **coarse textured soils that are dry**

35. Transitory range is:

- forested land that is made suitable for grazing for a limited time by burning or cutting**
- range that is occupied by wild ungulates on a seasonal basis
- range that is occupied by domestic ungulates on a seasonal basis
- B and C
- none of the above

For questions 36-38, please use the following figure from Moore et al. 2006 (REM)



**Figure 5.** Distribution of total standing crop among functional groups in: A) control, B) thinning, and C) composite restoration treatments between 1994 and 2004.

36. Standing crop of C4 graminoids is most often largest in which treatment?

- control
- thinning**
- composite

37. Annual and biennial forbs:

- rarely contribute to standing crop in all three treatments
- contribute more to standing crop in the thinning treatment than control and composite
- contribute less to standing crop in the composite treatment than the control
- all of the above
- none of the above**

38. Which functional group makes the greatest relative contribution to standing crop in all three treatments?

- Annual and biennial forb
- Perennial forb
- legume
- C4 graminoid
- C3 graminoid**

**IIIa. RANGE IMPROVEMENT PROBLEM (5 points)**

**SEE END OF TEST**

#### IV. RANGE REGIONS (16 points)

39. A typical leaf area index (LAI) for the Tallgrass Prairie is:

- a. <1
- b. 4**
- c. 8
- d. 12
- e. none of the above

40. The distribution of C<sub>4</sub> grasses:

- a. decreases from Canada to Mexico
- b. is highest in the boreal regions
- c. increases toward the poles
- d. increases toward the equator**

41. \_\_\_\_\_ of the rangeland in North America is considered to be part of a riparian zone.

- a. <2%**
- b. 5%
- c. 10%
- d. 15%
- e. none of the above

42. In the western United States, what community would you expect to occur at a higher elevation than Sagebrush-Grass?

- a. Palouse Prairie
- b. Pinyon-Juniper**
- c. Salt-desert Shrub
- d. none of the above

43. Which of the following range types has had the native vegetation altered the most by livestock grazing?

- a. Northern Mixed Prairie
- b. California Annual Grasslands**
- c. Fescue Grasslands
- d. Tallgrass Prairie

44. Forest soils are generally \_\_\_\_\_ leached and \_\_\_\_\_ fertile than grassland soils.

- a. more, less**
- b. less, more
- c. less, less
- d. more, more

45. You would expect a hot desert of the southwestern United States to be dominated by:

- a. *Artemisia tridentata* and *Atriplex confertifolia*
- b. *Grayia spinosa* and *Atriplex gardneri***
- c. *Prosopis glandulosa* and *Pinus edulis*
- d. *Arctostaphylos pungens* and *Chrysothamnus nauseosus*

46. What percentage of the total precipitation in the tallgrass prairie occurs during the summer growing season?

- a. <10%
- b. 25%
- c. 50%
- d. **75%**

**V. RANGE INVENTORY AND ANALYSIS (20 points)**

47. If you were to estimate basal, foliar, and canopy cover of the same species on the same plot you would expect the magnitude of the estimates to follow what order (smallest to largest)?

- a. foliar, basal, canopy
- b. basal, canopy, foliar
- c. canopy, foliar, basal
- d. **basal, foliar, canopy**

48. **(4 points)** The scale of an air photo would be \_\_\_\_\_ if the photographic distance between two road intersections is 60 mm and the map distance between the same two intersections is 1584 m.

- a. 1:264,000
- b. 1:2,640
- c. **1:26,400**
- d. none of the above

49. Which type of diversity measurement takes into account changes in species between one site and another?

- a. alpha diversity
- b. **beta diversity**
- c. gamma diversity
- d. none of the above

50. Which of the following correctly describes the relationship between annual precipitation amounts and proper utilization percentages?

- a. proper utilization percentages increase with decreasing annual precipitation amounts
- b. proper utilization percentages decrease with increasing annual precipitation amounts
- c. **areas receiving low annual precipitation amounts will have lower proper utilization percentages compared to areas receiving higher annual precipitation amounts**
- d. there is no relationship between annual precipitation amounts and proper utilization percentages as proper use is defined as 50% for all rangelands
- e. none of the above

For questions 51-55, please use the following table from Nichols et al. 2006 (REM)

Summary of regression relationships between sediment yield (SY) and runoff (Q) determined for stock pond watersheds within the Walnut Gulch Experimental Watershed.

| Stock Pond No. | Regression equation | R <sup>2</sup> | P value |
|----------------|---------------------|----------------|---------|
| 201            | SY = 0.003Q + 39.0  | 0.26           | 0.09    |
| 207            | SY = 0.008Q + 2.8   | 0.63           | 0.01    |
| 208            | SY = 0.005Q + 10.7  | 0.86           | 0.0003  |
| 213            | SY = 0.008Q + 64.7  | 0.99           | 0.00    |
| 214            | SY = 0.006Q + 352.0 | 0.15           | 0.16    |
| 215            | SY = 0.006Q + 172.0 | 0.61           | 0.02    |
| 216            | SY = 0.01Q + 104.0  | 0.63           | 0.02    |
| 223            | SY = 0.02Q + 112.0  | 0.35           | 0.06    |

51. How many of the regression equations are statistically significant if the alpha level was set at 0.05?

Answer: \_\_\_\_\_ (5)

52. Which stock pond regression equation explains the most variability?

Answer: \_\_\_\_\_ (213)

53. Which stock pond regression equation has the greatest slope?

Answer: \_\_\_\_\_ (216)

54. Which stock pond regression equation has the lowest y-intercept?

Answer: \_\_\_\_\_ (207)

55. Which stock pond regression equation has the most significant P value?

Answer: \_\_\_\_\_ (213)

#### Va. RANGE INVENTORY AND ANALYSIS PROBLEM (10 points)

**SEE END OF TEST**

#### VI. MULTIPLE USE RELATIONSHIPS (14 points)

56. The kinetic energy of a given amount of rain depends on the sizes and terminal velocities of the raindrops. These factors are associated with rainfall:

- probability
- return interval
- intensity**
- none of the above

For questions 57 and 58, please use the following figure from Owensby et al. 2006 (REM)

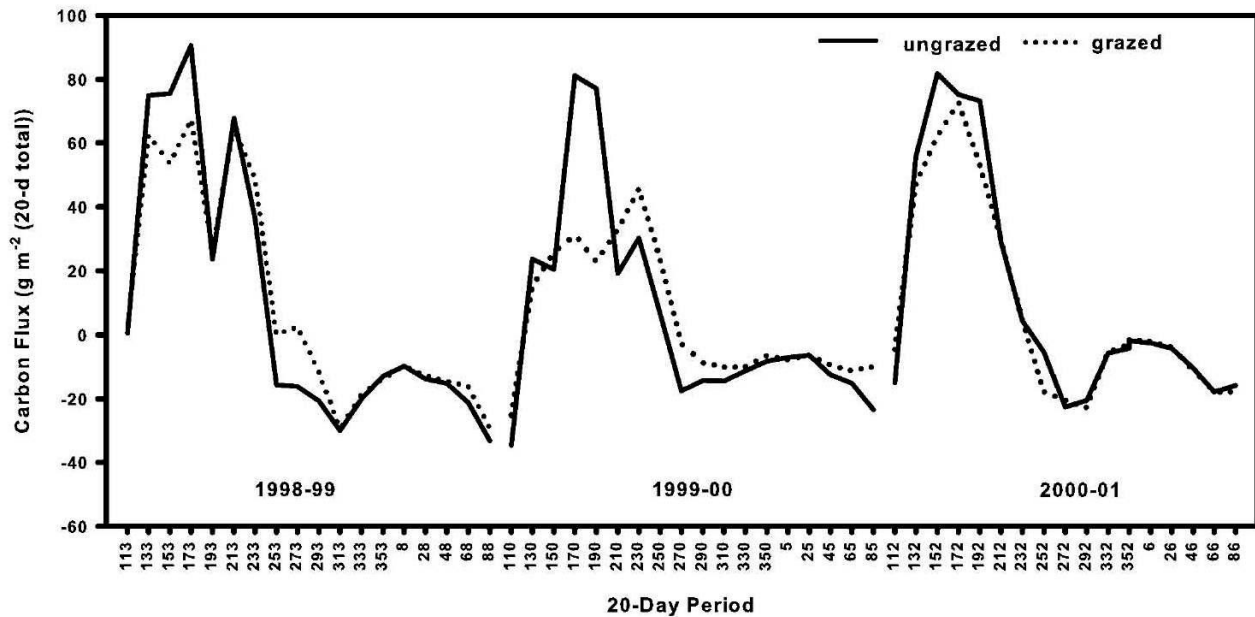


Figure 6. Net carbon exchange for grazed and ungrazed tallgrass prairie for the 1998–2001 carbon years. Values are 20-day accumulations.

57. Peaks in carbon flux are found:

- during winter
- when drought occurs
- during the growing season**
- when plants are dormant

58. A negative carbon flux value indicates that:

- an instrument error occurred
- carbon uptake by plants is greater than respiration
- more carbon is entering the atmosphere than being taken up by plants**
- all of the above
- none of the above

59. Which of the following animals would typically require the highest quality but lowest quantity of forage?

- cow
- deer**
- elk
- bison

60. The quality of spawning habitat for fish in streams generally \_\_\_\_\_ with \_\_\_\_\_ embeddedness.

- increases, increasing
- decreases, decreasing
- decreases, increasing**

61. Foresters are most concerned with damaging effects of livestock grazing in regards to:

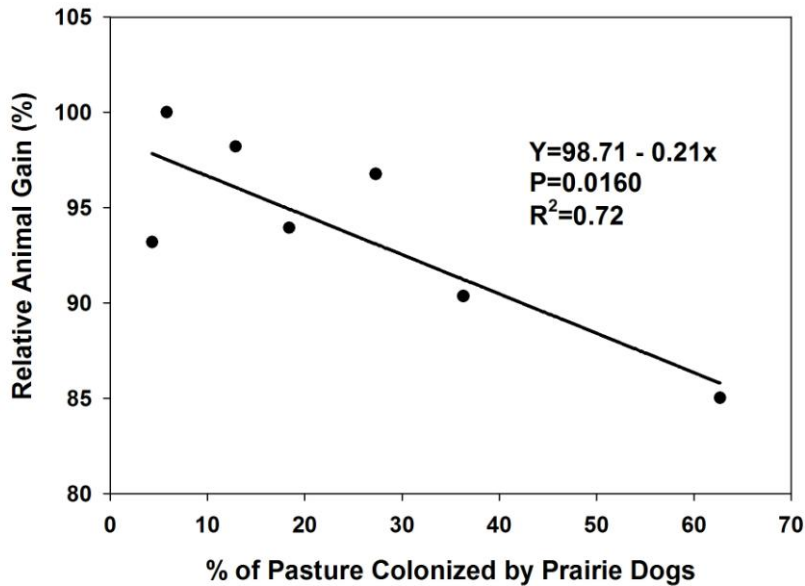
- a. **tree seedlings**
- b. water quality
- c. adolescent trees
- d. mature trees
- e. none of the above

62. Prairie dogs tend to promote a higher composition of \_\_\_\_\_ and tend to reduce \_\_\_\_\_ through their foraging activities.

- a. **Forbs, grasses**
- b. Grasses, shrubs
- c. Shrubs, grasses
- d. Grasses, forbs
- e. Shrubs, forbs

### GRAZING MANAGEMENT PROBLEM (5 points)

Using the figure below (Derner et al. 2006, *Frontiers in Ecology and the Environment*), calculate the expected difference in relative animal gain in pastures with 20 and 60 % colonization by prairie dogs.



**Answer: Relative animal gain is decreased by 12.6% ( $0.21 \times 60$ ) in a pasture with 60% colonization and decreased by 4.2% ( $0.21 \times 20$ ) in a pasture with 20% colonization. Thus, the expected difference in relative animal gain between the two pastures is 8.4%.**

**RANGE IMPROVEMENTS PROBLEM (5 points)**

You have been selected to be the lead consultant with Fire-R-U's that will be responsible for acquiring all relevant information pertaining to prescribed burns that will be conducted in shortgrass steppe with the main objective to create a patchy, mosaic of vegetation at the landscape scale. Your first deliverable is to determine the existing fuel loads for input into computer simulations using newly-developed software to assess the risks of conducting fires during the summer months. From contacts you developed as a result of college classes, organizations and internships, you know that data is available to estimate fuel loads. After calling one of these contacts, she sends the following information to your Blackberry (see below)

2006 peak aboveground biomass determinations – collected August 3, 2006

|                   | Plot (100 cm X 50 cm) |    |    |    |    |    |
|-------------------|-----------------------|----|----|----|----|----|
|                   | 1                     | 2  | 3  | 4  | 5  | 6  |
| Total biomass (g) | 38                    | 42 | 40 | 42 | 38 | 40 |
| % green           | 75                    | 90 | 80 | 90 | 75 | 80 |

Using this information, calculate the average dry fuel load on a kg/ha basis using the assumption that green biomass has a water content of 50%, and non-green biomass is 0% water.

**Answer:**

**Plots 1 and 5: 760 kg/ha total: 190 is non-green and 570 is green (285 of this is dry), thus  $190+285=475$**

**Plots 2 and 4: 840 kg/ha total: 84 is non-green and 756 is green (378 of this is dry), thus  $84+378=462$**

**Plots 3 and 6: 800 kg/ha total: 160 is non-green and 640 is green (320 of this is dry), thus  $160+320=480$**

**$(475+475+462+462+480+480)/6 = 472\text{kg/ha dry fuel load estimate}$**

**RANGE INVENTORY AND ANALYSIS PROBLEM – 10 points total**Background:

The natural carbon isotopic difference between C<sub>3</sub> and C<sub>4</sub> plants can be utilized to assess vegetation change, and to estimate the relative proportions of C<sub>3</sub> vs. C<sub>4</sub> carbon in above- and belowground biomass and soil.

The proportion of carbon derived from C<sub>4</sub> sources in aboveground standing crop, roots, and soil organic carbon is estimated by the mass balance equation:

$$\delta^{13}\text{C} = (\delta^{13}\text{C}_{\text{C}_4}) (x) + (\delta^{13}\text{C}_{\text{C}_3}) (1-x)$$

where  $\delta^{13}\text{C}$  is the  $\delta^{13}\text{C}$  value of the whole sample,  $\delta^{13}\text{C}_{\text{C}_4}$  is the average  $\delta^{13}\text{C}$  value of the C<sub>4</sub> species at the site,  $x$  is the proportion of carbon from the C<sub>4</sub> species,  $\delta^{13}\text{C}_{\text{C}_3}$  is the average  $\delta^{13}\text{C}$  value of the C<sub>3</sub> species at the site, and  $1-x$  is the proportion of carbon from the C<sub>3</sub> species.

Bulk aboveground biomass  $\delta^{13}\text{C}$  value from an unknown site is  $-24.30$  ‰. Using information provided below for some reference species thought to be present at the unknown site, calculate the relative proportion of C<sub>4</sub> plants in the bulk aboveground biomass sample from the unknown site.

| Species                    | $\delta^{13}\text{C}$ (‰) |
|----------------------------|---------------------------|
| <i>Buchloe dactyloides</i> | -14.28                    |
| <i>Pascopyrum smithii</i>  | -27.98                    |
| <i>Bouteloua gracilis</i>  | -13.26                    |
| <i>Hesperostipa comata</i> | -25.82                    |

**ANSWER**

average  $\delta^{13}\text{C}$  value of the C<sub>4</sub> species at the site = -13.77, of C<sub>3</sub> species = -26.90

$$-24.30 = (-13.77) (x) + (-26.90) (1-x)$$

$$2.6 = 13.13x$$

19.8% C<sub>4</sub>