CONTESTANT NAME_____

2019 Wyoming/Colorado Section Joint Meeting
Mini-UNDERGRADUATE RANGE MANAGEMENT EXAM

Society for Range Management

Instructions

This examination consists of 63 multiple choice questions. Choose the one best answer for each question and fill in the appropriate circle on the scantron answer sheet provided.

Put your assigned contestant number on this examination booklet. Put your name and contestant number on the scantron answer sheet.

Length of Testing Period

60 Minutes

Grading

The entire examination is worth 150 points.

I. RANGE ECOLOGY (30 points)

1. In drier climates, which of the following soils would have the highest probability of supporting plant species characteristic of wetter climates?
   a. Sandy soils
   b. Silty clay soils
   c. Clay soils
   d. Clay loam soils

2. Which of the following is FALSE?
   a. C_4 plants are considered to be of tropical origin
   b. C_3 plants are light saturated at lower levels of light than are C_4 plants
   c. C_3 plants use water more efficiently than do C_4 plants
   d. C_4 plants use nitrogen more efficiently than do C_3 plants

3. Increasing niche overlap leads to increasing:
   a. Commensalism
   b. Competition
   c. Predation
   d. Mutualism

4. The higher water use efficiency of C_4 plants is most closely correlated with which of the following physiological factors:
   a. Optimum temperatures
   b. CO_2 compensation point
   c. Photorespiration
   d. Respiration rate

5. The ecological law which states that all organisms survive between an ecological maximum and minimum in relation to environmental factors is referred to as the:
   a. Law of the Minimum
   b. Law of Limiting Factors
   c. Law of Tolerance
   d. Law of the Maximum

6. A non-heritable shift in the physiological state of an organism in response to exposure to an environmental condition is:
   a. Natural selection
   b. Acclimation
   c. Mutation
   d. Genetic drift

7. In contrasting C_3 and C_4 plants, which of the following statements is most correct?
   a. C_3 plants reduce carbon via the Calvin-Benson cycle, but C_4 plants do not.
   b. Photorespiration is generally only detectable in C_3 plants
   c. C_3 plants tend to have higher temperature optima for photosynthesis than C_4 plants.
   d. C_3 plants tend to have higher water use efficiencies compared to C_4 plants.

8. Phototropism is:
   a. A response to gravity
   b. A response to moisture
   c. A response to temperature
   d. A response to light

9. Plant competition is characterized by:
   a. Equal quantities of resources required by plants
   b. Scarcity of necessary resources
   c. Equal growth of competing species
   d. Uniform distribution of all species in the community

10. The timing of life cycle or annual cycle events in relation to environmental cues is:
    a. Physiology
    b. Autecology
    c. Phenology
    d. Physiognomy

11. Symbiosis is a process:
    a. That is neutral for both organisms in the relationship
    b. In which both organisms benefit from the relationship
    c. In which both organisms are negatively impacted by the relationship
    d. In which one organism is benefited and the other negatively impacted by the relationship

12. The main distinction between nutrient and energy dynamics in rangeland ecosystems is:
    a. Nutrients flow through ecosystem components while energy is cycled
    b. Nutrients cycle through ecosystem components while energy flows
    c. Nutrients are confined to living portions of the ecosystem while energy is not
    d. The main source of all nutrients is the soil while the sun supplies energy

13. The Principle of Limiting Factors states:
    a. That all soil nutrients are equally important
    b. That nitrogen is always the first limiting nutrient
    c. That the limiting nutrient affects only the dominant plant species
    d. That plant processes are controlled by the resources present in the least amount in relation to that required by the plants

14. Hardin's "Tragedy of the Commons" theory held that:
    a. All uses are completely competitive on wildlands
    b. All individuals using a resource in common will tend to maximize their own benefits even if the resource is degraded
    c. Common use is not possible under a democracy
    d. Community held lands will always be higher in productivity than private lands

15. Water moves through the soil-plant-atmosphere continuum in response to:
    a. Temperature
    b. Relative amounts of soil water
    c. Carbohydrate reserves
    d. Gradients of free energy

II. GRAZING MANAGEMENT (26 points)

16. **(4 pts)** A particular state in an ecological site has a recommended stocking rate of 0.50 AUM/ha. How many hectares would be needed to graze 70 steers (0.6 AUE) from May 15 to September 1?
    a. 147 ha
    b. 189 ha
    c. 294 ha
    d. 378 ha

17. Which of the following lists contain only plant characteristics that promote grazing tolerance in grasses?
    a. Short shoots, high reproductive to vegetative shoot ratio, many basal buds
    b. Short shoots, low reproductive to vegetative shoot ratio, many basal buds
    c. Long shoots, low reproductive to vegetative shoot ratio, many basal buds
    d. Long shoots, high reproductive to vegetative shoot ratio, few basal buds

18. Plant adaptations to grazing:
    a. Involve both tolerance and avoidance mechanisms
    b. Are similar for shrubs and grasses
    c. Are similar for different species of grasses
    d. Involve only morphological mechanisms

19. A cow gives birth on April Fool's Day 2020. When would be the approximate latest date she would have to breed back in order to calve on the same date in 2021 as 2020?
    a. May 1, 2020
    b. June 20, 2020
    c. August 1, 2020
    d. September 1, 2020

20. The grazing optimization hypothesis implies that:
    a. Grass plants are stimulated by all levels of defoliation or grazing
    b. Grass plants are detrimentally impacted by any defoliation or grazing
    c. Some grass plants are stimulated by defoliation up to a point and then detrimentally impacted as levels of defoliation increase
    d. Defoliation or grazing does not influence plant vigor

21. The defining feature of rest rotation grazing is:
    a. Rest for the same period for each pasture
    b. Periodic rest for one year for each pasture
    c. Rest of each pasture until the period of maximum seed set for dominant species
    d. Rotation of rest for the same length of time for each pasture each year

22. Preference is:
    a. Similar for most plant species
    b. Often expressed as the ratio between the quantity of plant species in the diet compared to that available
    c. The frequency of occurrence of a plant species in the diet compared to the frequency on the rangeland
    d. Higher for shrubs than grass for cattle

23. Of the following, which is the smallest spatial scale of diet selection by herbivores?
    a. Landscape
    b. Plant community
    c. Patch
    d. Feeding station

For questions 24 and 25, please use the following figure
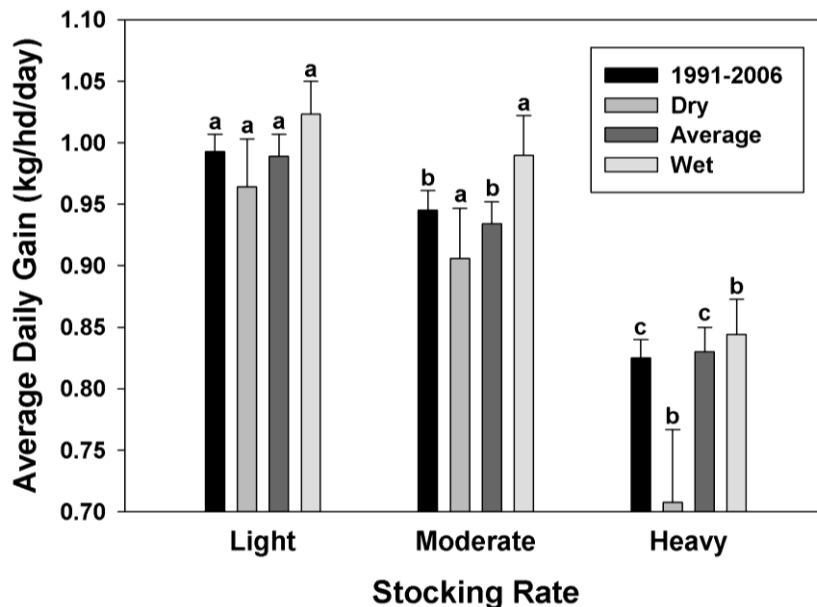
24. **(4 pts)** Which of the following statements is most correct?
    a. Average daily gain differs between light and moderate stocking rates for all year comparisons
    b. Average daily gain differs between moderate and heavy stocking rates for all year comparisons
    c. Average daily gain is higher for heavy than light stocking rates for all year comparisons
    d. All of the above
    e. None of the above

25. **(4 pts)** Which of the following statements is most correct?
    a. Average daily gain is similar among stocking rates in dry years
    b. Average daily gain is similar among stocking rates in wet years
    c. Average daily gain is similar among stocking rates in average years
    d. All of the above
    e. None of the above

IIa. GRAZING MANAGEMENT PROBLEM (5 points)

SEE END OF TEST

III. RANGE IMPROVEMENT (24 points)

26. **(4 pts)** An application rate of 4.5 kg a.i per hectare of 2,4-D is recommended for control of a target species. The herbicide purchased contains 0.9 kg a.i. per liter. How many liters of 2,4-D are needed to spray 5 hectares?
    a. 15
    b. 25
    c. 50
    d. 100

27. Consider the following two fuel types, both of which have equal weight and have been subjected to a lengthy drying period. Type A is made up of a loose pile of twigs and small tree boles, while Type B is made up of a tightly packed pile of large tree boles. Which of the following statements is most correct?
    a. Type A will burn at a higher intensity, but will burn longer than Type B
    b. Type A will burn at a lower intensity, but will burn longer than Type B.
    c. Type A will burn at a lower intensity, but will burn faster than Type B.
    d. Type A will burn at a higher intensity, but will burn faster than Type B.

28. **(4 pts)** Seed source A costs $1.17 per kg PLS and is 80% PLS. Seed source B costs $1.45 per kg PLS and is 87% PLS. Herbicide 1 has 550 grams per liter of active ingredient and costs $18.40 per liter. Herbicide 2 has 400 grams per liter active ingredient and costs $15.75 per liter. Based solely on cost, which seed source and herbicide would you recommend for a land owner?
    a. Seed source A and Herbicide 1
    b. Seed source A and Herbicide 2
    c. Seed source B and Herbicide 1
    d. Seed source B and Herbicide 2

29. Marginal revenue is:
    a. The cost for each product unit
    b. The total cost of all product
    c. Profit
    d. Additional revenue produced by the last unit of output

30. Discount rates reflect the influence of:
    a. Time
    b. Location
    c. Commodity
    d. Price per unit product

31. Internal rate of return is defined as:
    a. The interest rate that allows a positive return for investment in a range improvement
    b. The interest rate that allows future returns that equal the investment cost of the range improvement
    c. The interest rate that results in negative net returns
    d. The value of the land on which the range improvement is planned

32. Opportunity costs are:
    a. The financial returns given up by not putting a factor of production to another use
    b. Those costs incurred by an outside investor
    c. Those costs incurred by the owner
    d. Those costs incurred by the sale of land rather than livestock

33. Discounting is a procedure used to determine:
    a. The cost of an improvement practice
    b. The returns from an improvement practice
    c. The present value of a future sum
    d. Current ranch value

34. **(4pts)** If the purity of a seed lot is 50% and the germination is 40%, the PLS is:
    a. 10%
    b. 20%
    c. 45%
    d. 90%

IIIa. RANGE IMPROVEMENT PROBLEM (5 points)

SEE END OF TEST

IV. RANGE REGIONS (16 points)

35. The distribution of C4 grasses:
    a. decreases from Canada to Mexico
    b. is greatest in the far northern latitudes
    c. increases towards the equator
    d. decreases from Siberia to India

36. Riparian zones in the western rangelands of North America constitute approximately _____ % of the land area.
    a. <2
    b. 10
    c. 50
    d. >98

37. Which of the following is the most prevalent warm-season (C4) grass species in the shortgrass prairie?
    a. *Hesperostipa comata*
    b. *Schizachyrium scoparium*
    c. *Bouteloua gracilis*
    d. *Pascopyrum smithii*

38. Which of the following is NOT a correct elevation sequence?
    a. Salt desert shrub, sagebrush grass, ponderosa pine, Douglas fir
    b. Sagebrush grass, salt desert shrub, ponderosa pine, Douglas fir
    c. Salt desert shrub, pinyon-juniper, ponderosa pine, Douglas fir
    d. Sagebrush grass, pinyon-juniper, ponderosa pine, Douglas fir

39. Which environmental factor listed below is common to both Arctic and alpine tundra?
    a. Intensity of solar radiation
    b. Extent of permafrost
    c. Temperature
    d. Amount of wind

40. The "Big Four" grasses of the True Tallgrass Prairie all share this characteristic.
    a. The C4 photosynthetic pathway (warm-season grasses)
    b. The C3 photosynthetic pathway (cool-season grasses)
    c. The rhizomatous growth form
    d. The bunchgrass or caespitose growth form

41. California annual grasslands have climates characterized by:
    a. Summer-dominated rainfall
    b. Evenly distributed rainfall among all twelve months
    c. Fall-dominated precipitation with winter and spring drought
    d. Winter- and spring-dominated precipitation and summer drought

42. The climatic region with a winter precipitation pattern occurring in the rain shadow of the Sierra Nevada mountains is the:
    a. Great Plains
    b. Gulf Plains
    c. Great Basin
    d. Pacific Mediterranean

V. RANGE INVENTORY AND ANALYSIS (20 points)

43. Which of the following plots would have the largest perimeter to area ratio?
    a. Circular plot with area of $1m^2$
    b. Square plot with area of $1m^2$
    c. Rectangular plot with area of $1m^2$
    d. Square plot with area of $2m^2$

44. Plant water status can be measured with a(n):
    a. Infrared gas analyzer
    b. pH meter
    c. Penetrometer
    d. Pressure chamber
    e. Thermometer

45. Line intercept sampling was designed to determine:
    a. Biomass
    b. Cover
    c. Density
    d. Diversity

46. Net primary productivity is:
    a. Total increase in plant biomass minus that used in respiration for a specified period of time
    b. Plant biomass at any one period of time
    c. Total plant biomass accumulated over the growing season
    d. The amount of carbohydrates translocated to roots during growing season

47. Proportional allocation of sampling units means:
    a. Sample units are allocated in proportion to the area of subunits
    b. Sample units are located at random
    c. Sample units are located systematically
    d. The number of subunits is equal in all subunits

48. Water use efficiency is determined by:
    a. Dividing the amount of dry matter produced by the amount of water in the soil
    b. Dividing the amount of root growth by the number of days in the growing season
    c. Dividing the amount of dry matter produced by the amount of water used by plants
    d. Dividing the amount of water used by plants by the amount of dry mater produced

49. The standard error is:
    a. A measure of the total variation of all individuals in the population
    b. The difference between the largest and smallest item in a sample
    c. A measure of the variation of all possible sample means drawn from a population
    d. A measure of the central tendency of a population
    e. The standard deviation divided by the mean

50. In random sampling:
    a. Each sample unit represents an equal portion of the population
    b. Data cannot be analyzed by statistical methods appropriate for normal populations
    c. Each item in the population has an equal chance of being selected
    d. Only extreme values should be selected

51. Evapotranspiration is calculated as the amount of water:
    a. Lost from the soil surface due to evaporation
    b. Absorbed by plant roots from soil
    c. Lost by evaporation from soil and water bodies, and transpiration from vegetation over a given period of time
    d. Present in the soil profile at a given point in time

52. Inventory involves:
    a. Repeated measurements over time
    b. Sampling before and after a treatment has been initiated
    c. Complete census of all plants and animals for five years
    d. Determining ecosystem properties at one point in time

Va. RANGE INVENTORY AND ANALYSIS PROBLEM (10 points)

SEE END OF TEST

VI. MULTIPLE USE RELATIONSHIPS (14 points)
53. Hydric soils are formed under _____ conditions.
    a. Aerobic
    b. Dry
    c. Anerobic
    d. Unsaturated

54. What type of ecosystem will typically support the greatest diversity of wildlife?
    a. Grassland
    b. Shrubland
    c. Savanna
    d. Conifer forest

55. When plentiful quantities of nitrogen and phosphorous are introduced into aquatic systems they:
    a. Are quite beneficial because of greatly increased aquatic growth
    b. Increase oxygen levels and improve fish habitats
    c. Result in excessive aquatic growth and low oxygen levels

56. You have been asked to design a 1000 ha forest clearcut that would create maximum edge for wildlife. Your 1000 ha clearcut would resemble:
    a. A circle
    b. A square
    c. A rectangle

57. Which of the following is most responsible for water quality problems in riparian areas of western rangelands?
    a. Pesticides
    b. Herbicides
    c. Soil sediments
    d. Radioactive materials

58. Ecological functions of wetlands on rangelands include all of the following EXCEPT:
    a. Filtering out impurities in water prior to that water reaching a waterway
    b. Serving as the basis for aquatic food chains
    c. Stopping soil erosion
    d. Providing habitat for wildlife

59. The habitat most favorable for mule deer in woodland vegetation is:
    a. Large unbroken blocks of woodland
    b. Large open area of herbaceous vegetation and small patches of woodland
    c. Interspersion of small blocks of open herbaceous vegetation and woodland
    d. Late successional stands of unbroken woodland
    e. Open grassland with few shrubs present

GRAZING MANAGEMENT PROBLEM (5 points)

One of your best friends has recently purchased a 14,000-ha ranch in Brazil and invites you to provide consulting for the operation regarding grazing management. The ranch in Brazil is in the cerrado (open woodland/savanna) region. Current ranch managers provide you with a quick overview of the primary forage species (all C4 grasses) and the generalities of the grazing seasons (7 months wet / 5 months dry), along with prior management on the ranch: 4000 Zebu (*Bos indicus*) yearlings (AUE=0.60) were run on the ranch for the entire year. Your friend wants to increase that number by 25% this year and intensify management by increasing stock density to 25 yearlings/ha during the wet season months.

60. **(5 pts)** Using the data provided above, determine how many equal-sized pastures (assume capacity is similar across the entire ranch) are needed to meet the goal of stock density during the wet season grazing, if each pasture is used only once, all the yearlings graze as a single herd, and the entire ranch is grazed only during the wet season?
    a. 70
    b. 88
    c. 120
    d. 146
    e. 560

RANGE IMPROVEMENTS PROBLEM (5 points)

You have been selected to be the lead consultant with Fire-R-Us and are responsible for acquiring information pertaining to prescribed burns that will be conducted in northern mixed-grass prairie to create a mosaic of vegetation communities. The following information is provided to your new I-Phone 11 from a colleague for calculation of fuel loads (see below)

Peak aboveground biomass determinations – 2019

	Plot (100 cm X 50 cm)					
	1	**2**	**3**	**4**	**5**	**6**
Total biomass (g)	78	82	80	84	76	80

The biomass was determined to be 60% green and 40% non-green, and green biomass is assumed to have a water content of 50% and non-green biomass is 0% water,

Using this information, calculate the average dry fuel load on a kg/ha basis.

61. **(5 pts)** The average dry fuel load is:
    a. 480 kg/ha
    b. 640 kg/ha
    c. 960 kg/ha
    d. 1120 kg/ha

RANGE INVENTORY AND ANALYSIS PROBLEM – 10 points total
You are the lead consultant with Rangeland Transitions providing management recommendations to a natural resource manager for a ranch in the shortgrass steppe where the prevailing Ecological Site is Loamy (State-and-Transition (S/T) model provided below).

Shortgrass Steppe – MLRA 67B - Loamy
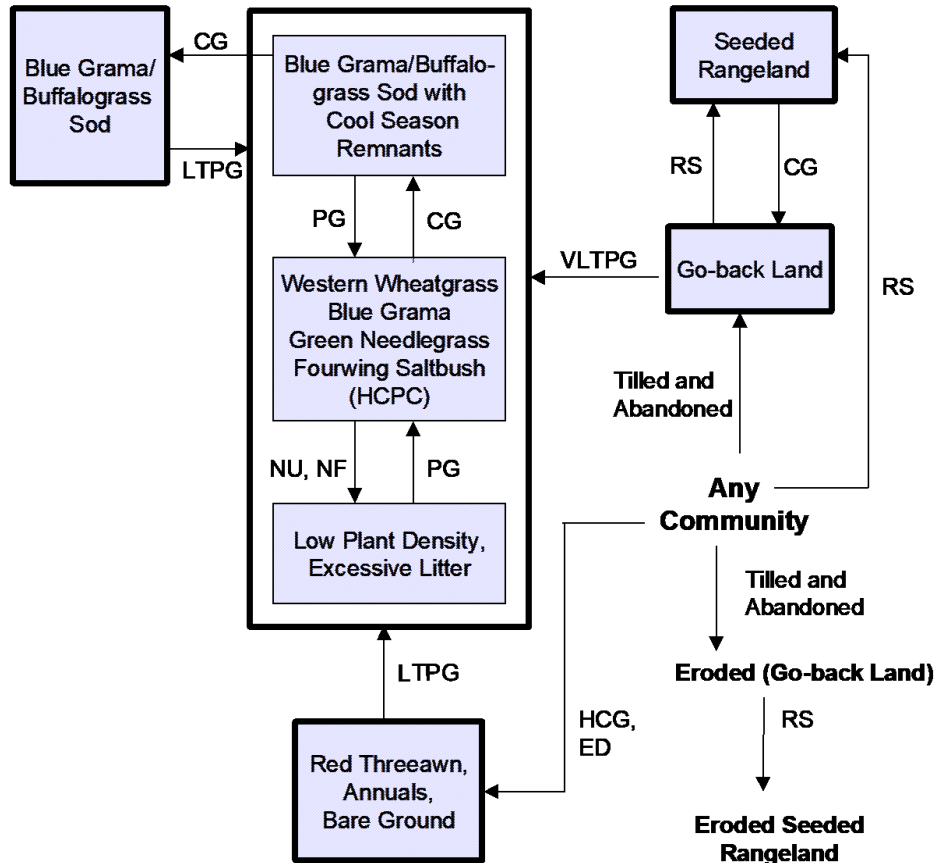
CG - continuous grazing w/o adequate recovery opportunity, ED - excessive defoliation, HCG - heavy continuous grazing, HCPC - Historic Climax Plant Community, LTPG - long term prescribed grazing (>40 yrs), NF - no fire, NU - non use, PG - prescribed grazing with adequate recovery period, RS - range seeding, VLTPG - very long term prescribed grazing (>80 yrs)

62. **(3 pts)** Which of the plant communities in this S/T model is the most desirable?
   a. Blue grama/buffalograss sod
   b. Historical Climax Plant Community (HCPC)
   c. Blue grama/buffalograss sod with cool season remnants
   d. Depends on the objectives of the natural resource manager

Since the natural carbon isotopic difference between C_3 and C_4 plants can be used estimate the relative proportions of C_3 vs. C_4 carbon in aboveground biomass, you obtain a bulk aboveground biomass sample from a plant community on this ecological site and have it analyzed.

The proportion of carbon derived from C_4 sources in aboveground biomass carbon is estimated by the mass balance equation:

$$\delta^{13}C = (\delta^{13}C_{C4})\,(x) + (\delta^{13}C_{C3})\,(1\text{-}x)$$

where $\delta^{13}C$ is the $\delta^{13}C$ value of the whole sample, $\delta^{13}C_{C4}$ is the average $\delta^{13}C$ value of the C_4 species at the site, x is the proportion of carbon from the C_4 species, $\delta^{13}C_{C3}$ is the average $\delta^{13}C$ value of the C_3 species at the site, and $1\text{-}x$ is the proportion of carbon from the C_3 species.

Your bulk aboveground biomass $\delta^{13}C$ value from the plant community comes back from the laboratory with a value of –24.30 ‰. Use the information provided below for some reference species that are dominant in the plant community.

Species	$\delta^{13}C$ (‰)
Pascopyrum smithii	-27.98
Bouteloua gracilis	-13.26
Hesperostipa comata	-25.82

63. **(7 pts)** What is the relative proportion of C_4 plants in the bulk aboveground biomass sample?
    a. 13.3%
    b. 19.6%
    c. 24.3%
    d. 45.4%
    e. 80.4%