

Instructions:

Complete Question #1 (required for everyone), and 9 others from the remaining 12.
All questions are worth the same: 10 points per question.
Show all computational work and units where applicable.
You have 48 minutes to complete the test.

Question 1 (Required)

For your favorite forage species, state:

- a) Common name (0) _____
- b) Latin/Scientific Name (1): _____
- c) A variety of your species (1): _____

Write one key point on each of the following:

- d) Most distinguishing morphological feature to identify the species (2)

- e) Main advantage or benefit of this species (2):

- f) Biggest disadvantage or limitation of this species (2):

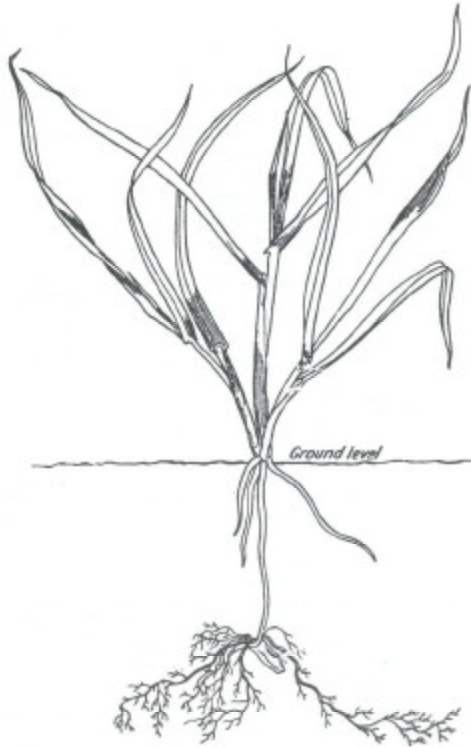
Question 2

For the species that you identified in Question 1, write 5 bullet-style points describing additional aspects of the species not mentioned in Question 1. One might think of sensitivity/tolerance to the environment, drought/freeze tolerance, grazing suitability, insect/disease tolerance, feed quality, fertilizer requirements, or other details.

Question 3

In either of the following diagrams of two forages, label a:

- a) tiller b) stolon c) meristem d) lamina e) petiole f) rooted node
g) sheath (or pseudostem) h) ligule i) flower j) rhizome



Question 4

Complete the sentence with the most appropriate keyword from the list provided

- a) The photoreduction process that converts radiant energy to chemical energy within the chloroplast of plants is
- b) Most (>50%) of the protein in leaves is
- c) Cool-season species have a temperature optimum for growth around 20°C, but grasses have a temperature optimum around 30-35°C
- d) The cation-exchange capacity of soil results from the dissociation of ... from soil particles, leaving areas of localized negative charge which can attract soil cations.
- e) Excessive application of CaCO₃ lime can result in displacement of from the soil by calcium. This can be prevented by using dolomitic lime.

(Photosynthesis, Anions, Magnesium ions, Hydrogen ions, Rubisco, Warm-season, Endophyte)

Question 5

- a) List 2 sources of nitrogen input to the soil (2)
- b) List 2 losses of nitrogen from in the soil (2)
- c) Define soil fertility (2)
- d) Write 2-3 sentences on why is soil fertility important (include mention of the main components of soil fertility) (4)

Question 6

What effect does lime have on the soil? (5)

Why is liming important for forages? (5)

Question 7

(Use the back of this sheet if you need more room for computations)

An alfalfa hay field produces 5 tons/acre/year.

a) If the harvested hay contains 2.5% K, how many pounds of K is removed from an acre in one year? (2)

b) On that same acre, how many pounds of 19-19-19 fertilizer would be required to replace the K lost by crop removal? (4)

c) Three fertilizers have the following characteristics. For each fertilizer, calculate the cost per unit K_2O (\$/pound K_2O) (3)

<u>Fertilizer Formulation</u>	<u>% K_2O</u>	<u>\$/ton</u>	<u>\$/lb K_2O</u>
19-19-19	19%	\$211.28	a) _____
6-15-40	40%	\$169.38	b) _____
12-31-20	20%	\$197.65	c) _____

d) Which fertilizer is the cheapest source of potash? (1)

Question 8 – Multiple Choice Circle the correct answer. Each question = 1 point.

- 8.1: A rhizome is:
- a) An underground/burrowing stem
 - b) An above-ground/creeping stem
 - c) A part of all grass plants
 - d) A part of all broadleaf plants
- 8.2: The Latin name for perennial ryegrass is:
- a) *Lolium multiflorum*
 - b) *Lolium hybridum*
 - c) *Lolium perenne*
 - d) None of these
- 8.3: Compared to C3 species, warm-season grasses are:
- a) more tolerant of dry conditions and low carbon dioxide concentrations
 - b) less tolerant of dry conditions and low carbon dioxide concentrations
 - c) more drought tolerant, but less tolerant of high temperatures (30 C)
 - d) less drought tolerant, but more tolerant of high temperatures (30 C)
- 8.4: The most important reserve for initial growth of forages in early spring is:
- a) stored protein
 - b) stored carbohydrates
 - c) lignin deposits
 - d) soil carbon dioxide
- 8.5: The most volatile and water soluble nutrient is:
- a) NO_3^-
 - b) SO_4^{2-}
 - c) C
 - d) Ca^{+2}
- 8.6: One important loss of PO_4^{3-} is:
- a) Volatilization
 - b) Leaching into groundwater
 - c) Adhering to floating soil particles into a waterway
 - d) All of the above are plausible answers
- 8.7: A fertilizer labeled with the numbers 6-15-40 contains:
- a) 6% N
 - b) 6% NO_3^-
 - c) 15% NH_4^+
 - d) 6% P_2O_5
- 8.8: Endophyte fungi are found in the following forage species:
- a) All grasses have them
 - b) Kentucky bluegrass and tall fescue
 - c) Ryegrass and tall fescue
 - d) Orchardgrass, alfalfa, and ryegrass
- 8.9: Freezing tolerance and winter survival in alfalfa is improved by:
- a) application of high N fertilizers to promote fall growth
 - b) use of endophytes to help strengthen alfalfa stands in general
 - c) application of K fertilizers to enhance osmoprotection
 - d) close cutting right before winter sets in
- 8.10: Kentucky 31 (K31) is a common variety of:
- a) white clover
 - b) crimson clover
 - c) Kentucky bluegrass
 - d) tall fescue

Question 9

A productive legume can fix 200 lbN/acre/yr.

- a) name 3 legume species that can fix this amount of N (3)

- b) nitrogen is fixed by a symbiotic association with which bacteria? (1)

- c) how much urea would need to be applied to equal this rate of N fixation? (2)
(urea = 46-0-0)

- d) What would this cost if it had to be applied as fertilizer? (2)
(urea = \$186/ton)

- e) Urea application suppresses nitrogen fixation by 1 lb N-fixed/2 lb of fert-N. If a farmer applied 100 lbN/acre/year, what would the resultant rate of nitrogen fixation? (2)

Question 10

- a) The red:far-red ratio determines many aspects of forage growth and development. What is one effect of red light on forages? (2)

- b) What is one effect of far-red light on forages? (2)

- c) Why are forages (and all plants) green? (2)

- d) What is vernalization? (2)

- e) What is meant when plants are categorized as “long-day plants”? (2)

Question 11

- a) What is endophyte? (2)
- b) Name one forage species that can be infected with endophyte (1)
- c) Name one forage species that does not have endophyte (1)
- d) What are two animal symptoms of endophyte toxicity? (2)
- e) Currently there is an emphasis to have endophyte-free forage. What are two sources of contamination in “clean” forage. (2)
- f) What are novel endophytes? (2)

Question 12

Sustainability means different things to different people, and is virtually impossible to define. However, there are some important themes that are implied in sustainability. Name 4 of these.

- (4)
- a)
 - b)
 - c)
 - d)

Give 6 ways that forage-based farming systems might be more sustainable than traditional cropping systems (6)

- a)
- b)
- c)
- d)
- e)
- f)

Question 13

Nitrogen, sulphur and phosphorous are all anions with contrasting chemistry that influences their importance in agriculture.

- a) Which is the most important in determining the short-term (1-2 month) growth of forages? (2)
- b) Which is the most important in determining the long-term (1-2 year) growth of forages? (2)
- c) Which is the least limiting to forage growth in USA? (2)
- d) Which is the most soluble and volatile? (2)
- e) Which has the greatest potential to accumulate in soil? (2)