

Instructions:

Complete Question 1 (required) and 9 other questions from the 12 options.

All questions carry equal credit (10 points per question)

Show working and units in all calculations

Time allowed: 48 minutes

Question 1 (Required)

For one forage species you are familiar with, state:

Common name (0)

a) Latin name (1)

b) Name of one variety (1)

Write one key point on each of the following:

c) The most distinguishing feature to identify the species (2)

.....
.....

d) The main agronomic requirement of the species (2)

.....
.....

e) The main advantage/benefit of this species (2)

.....
.....

f) The biggest disadvantage/limitation with this species (2)

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.....

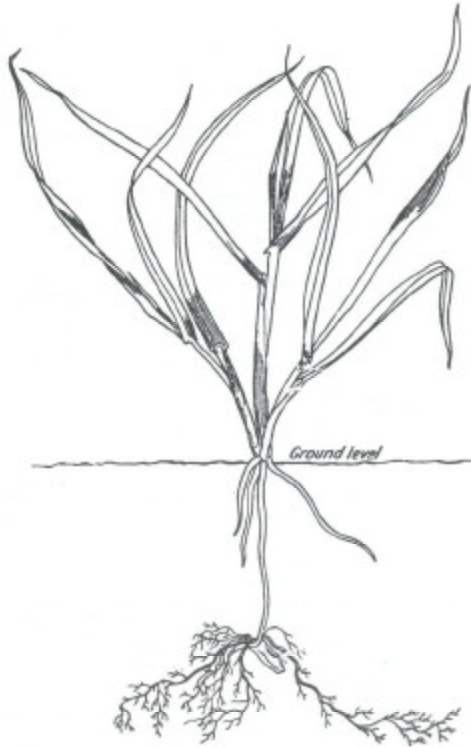
Question 2

For the species identified in Question 1, write 5 bullet-points describing additional aspects about this species not already mentioned in Question 1. (e.g. tolerance/sensitivity to the environment, drought and freezing tolerance, suitability for grazing, insect/disease tolerance, quality for animals, fertilizer requirement 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

An alfalfa hayfield produces 6 ton/acre/year

- a) If the hay was 2.5% K, how much K is removed from the field in one year? (2)
- b) How much 19-19-19 fertilizer would be required to replace the lost K? (4)
(K₂O = 83% K)
- c) Three fertilizers have the following characteristics. For each fertilizer calculate the cost per unit K₂O (\$/lb K₂O) (3)

Fertilizer form	% K ₂ O	\$/ton	\$/lb K ₂ O
19-19-19	19%	\$209.05	
6-15-40	40%	\$170.38	
12-31-20	20%	\$199.62	

Question 8 – multi-choice. Circle the only correct answer

12.1 A stolon is:

- a) An under-ground (burrowing) stem
- b) An above-ground (creeping) stem
- c) Part of all grass plants
- d) Part of all legumes

12.2 The Latin name for perennial ryegrass is:

- a) *Lolium multiflorum*
- b) *Lolium hybridum*
- c) *Lolium perenne*
- d) none of the above

12.3 Compared to C3 species, warm season grasses are

- a) more tolerant of dry conditions and low CO₂ concentrations
- b) less tolerant of dry conditions and low CO₂ 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)

12.4 The most important reserve for initial growth of forages in early-spring is:

- a) stored protein
- b) stored carbohydrates
- c) lignin
- d) photosynthesis

12.5 The most water soluble (and volatile) nutrient is:

- a) NO₃⁻
- b) SO₄⁼
- c) PO₄³⁻
- d) Ca⁺⁺

12.6 One important loss of PO₄³⁻ from soil is:

- a) Volatilization into the atmosphere
- b) Leaching in drainage water
- c) Adhering to soil particles that are lost into waterways
- d) All of the above

12.7 A fertilizer which has the specifications 6-15-40 has

- a) 6% K
- b) 40% K₂O
- c) 40% K⁺
- d) 15% K₂O

12.8 Endophyte fungi are found in the following forages

- a) all grasses
- b) orchardgrass, ryegrass and alfalfa
- c) ryegrass and tall fescue
- d) tall fescue and Kentucky bluegrass

12.9 Freezing tolerance and winter survival in alfalfa is improved by:

- a) application of N fertilizer to promote fall growth
- b) application of K fertilizer to enhance osmoprotection
- c) close cutting before winter sets in
- d) none of the above

12.10 K31 is a common variety of:

- a) white clover
- b) tall fescue
- c) alfalfa
- d) ryegrass

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)

- e)
- f)
- g)
- h)
- i)
- j)

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)