

Clemson University Biology Merit Exam
20 April 2007

Please choose the **best** answer for each of the following questions. Questions marked with an "*" are worth 4 points each; questions marked with a "#" are worth 2 points each; the unmarked questions are worth 1 point each.

CAUTION: Incomplete erasures and smudges can be read as marks. To avoid having a choice read incorrectly, make your marks lightly at first. After you have made all your changes, blacken in your marks just before you turn in your answer sheet.

The theme of this exam is rice, the world's largest crop, and the major source of food for over half the earth's people.

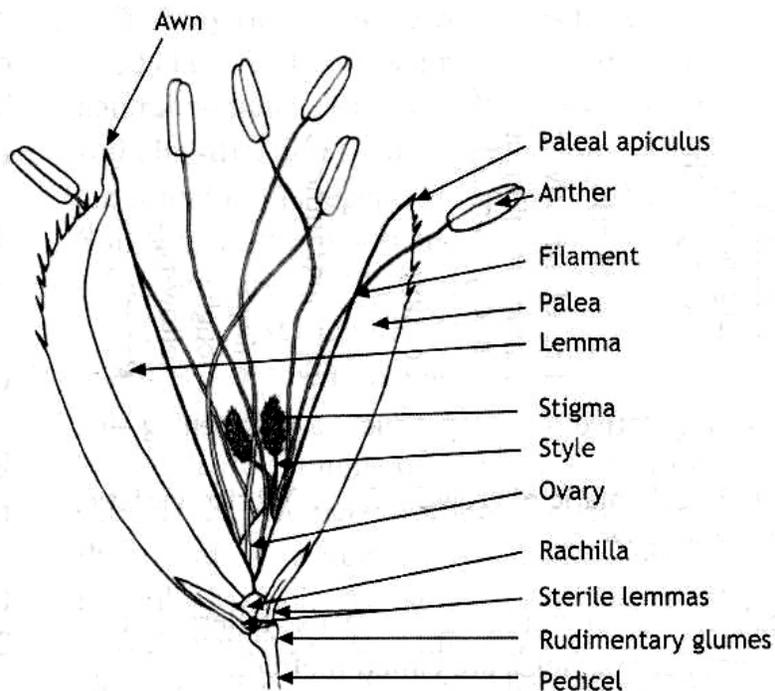


- Of course, rice is a green plant. Which of the following cellular organelles would not be found in a plant cell?
 - a central vacuole
 - mitochondria
 - chloroplasts
 - All of these might be found in a plant cell.
- Rice uses photosynthesis to grow, so we would say that it is
 - autotrophic.
 - heterotrophic.
- The process of photosynthesis uses ... to directly synthesize
 - H_2O , NH_3 and O_2 ... proteins.
 - CO_2 and H_2O ... sugar.
 - CO_2 and O_2 ... pyruvic acid.
 - CO_2 and O_2 ... ATP, NADPH, and sugar.

4. Rice is a type of grass. Cultivated rice belongs to the species *Oryza sativa* (in Asia) or *Oryza glaberrima* (in West Africa). We know that *O. sativa* and *O. glaberrima* belong to the same
- a) genus. b) family. c) order. d) All of these.
- 5.# Rice should not be confused with "wild rice" (*Zizania*). From the names *Oryza* and *Zizania* alone, we know that the two *Oryza* species and *Zizania* belong to
- a) the same order but different families. b) the same families but different orders.
c) different genera. d) None of these conclusions are certain.

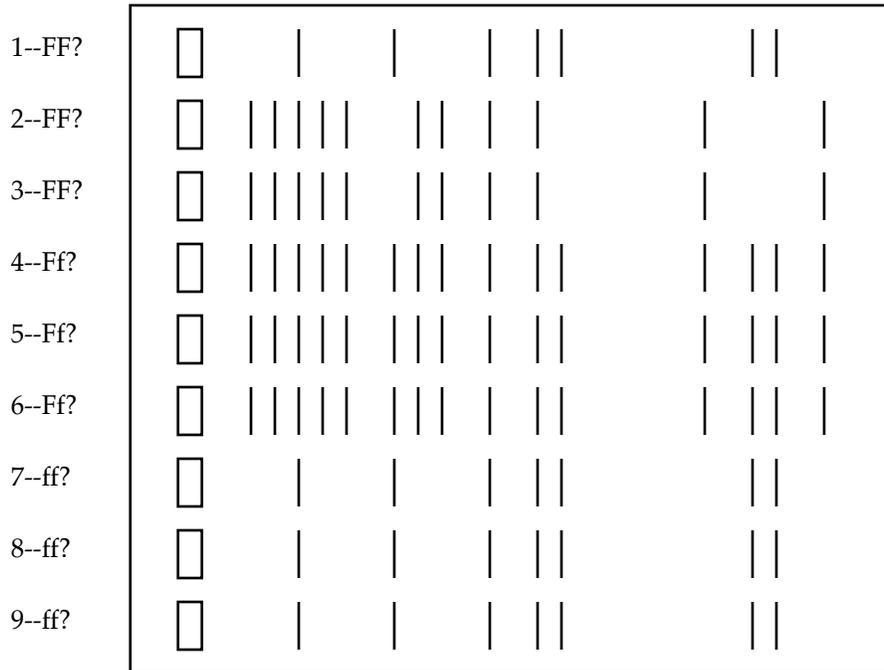
Some sources say that there are over 120,000 varieties of cultivated rice!

- 6.# Because rice is a grass, we also know that it is a ... and a(n)
- a) monocot ... angiosperm. b) dicot ... angiosperm.
c) monocot ... gymnosperm. d) dicot ... gymnosperm.
- 7.* A diagram of a rice flower is shown below. While much of the terminology is highly technical and specific to grass flowers, does this diagram show both male and female reproductive organs?



- a) Yes, it shows both. b) It shows female organs but not male ones.
c) It shows male organs but not female ones. d) No, it shows no reproductive organs.
- 8.# Rice flowers, like all grass flowers, are small and inconspicuous. This gives evidence that they
- a) use swimming sperm. b) disperse spores rather than seeds.
c) have naked ovules. d) are wind-pollinated.

- 18.* The rice plant sprouts extra stems called tillers. Tiller production is controlled at the T locus. TT plants have the most tillers, Tt plants have an intermediate amount, and tt plants have the fewest tillers. These tillers are only useful to the farmer if they have flowers on them. If they don't, they drain away resources without producing rice. Flowers are controlled at the F locus (on a different chromosome from the T locus), and tillers on Ff plants produce the most flowers. Either FF or ff tillers produce the same small number of flowers per tiller. If a TtFf plant fertilizes itself, the fraction of the offspring that will have the high-production TTff genotype is
 a) 1/2. b) 1/4 c) 1/8 d) 1/16
- 19.# The most common offspring genotype from the cross above will be
 a) TtFf b) TTFf c) TTff d) TTFf
- 20.* While the T and F loci are on different chromosomes, say a rice variety is discovered in which T and F are on the same chromosome. Assume a TtFf parental plant has T and F on its maternal chromosome and t and f on its paternal chromosome. Assume that crossing over does not occur. If this plant fertilizes itself, it will be able to produce ... different offspring genotypes, and ... of these will be the high-production TTFf genotype.
 a) 1 ... none b) 2 ... 1/4 c) 3 ... 1/8 d) 3 ... none
- 21.* The DNA of nine rice plants are treated with a restriction enzyme and electrophoresed. We suspect that these are three FF plants, three Ff plants, and three ff plants, but we can't be sure because the low-flower genotypes (FF and ff) look alike. We use a Southern blot to look at only the F locus. The results are shown below.



Our conclusions from this are that, probably

- a) the F and f alleles are about the same size, and no plants are misclassified into the wrong genotype.
 b) the f allele is smaller than the F allele, and plant 1 is really an ff plant.
 c) the F allele is smaller than the f allele, and plants 2 and 3 are really Ff plants.
 d) The F and f alleles are about the same size, and we were really wrong on our genotype classification. Plant 1 is the only ff plant. Plants 2, 3, 4, 5, and 6 are FF, and plants 7, 8, and 9 are Ff.

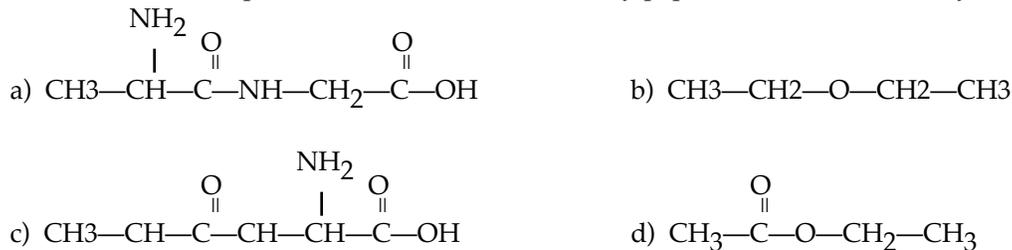
26.# These hormone subunits are made of amino acids. An amino acid has an "alpha carbon" atom that always has four groups on it. Which of the following is not one of those groups bound directly to the alpha carbon?

- a) a hydrogen atom. b) a carboxyl group. c) an hydroxyl group. d) an amino group.

27.* Carbon atoms usually have four bonds while oxygen atoms usually have two bonds because carbon ... while oxygen Choose the reason most directly responsible.

- a) has an s and a p subshell in its valence shell ... has a valence shell that only has an s subshell.
 b) is not very electronegative ... is the second most electronegative element.
 c) has an equal number of protons and neutrons ... has more neutrons than protons.
 d) has four valence electrons ... has six valence electrons.

28.* The amino acids in this plant hormone are connected by peptide bonds, as shown by answer



29. Transfer RNAs were used during the synthesis of the F and f polypeptides. These transfer RNAs got the amino acids in their correct spots in the polypeptide by

- a) folding the mRNA until it matched the shape of the tRNA.
 b) pairing their anticodons with codons in mRNA.
 c) using ribozymes to synthesize a section of mRNA complementary to the tRNA.
 d) using reverse transcriptase to make cDNA complementary to the mRNA.

30. The cellular organelle on which this protein synthesis occurred was the

- a) mitochondrion. b) centriole. c) ribosome. d) nucleosome.

31.# The rice grain is mainly a seed that results from double fertilization. The ... results from fertilization by one sperm, and the ... results from fertilization by the other sperm.

- a) pedicel ... ovule b) gametophyte ... sporophyte
 c) stamen ... pistil d) endosperm ... embryo.

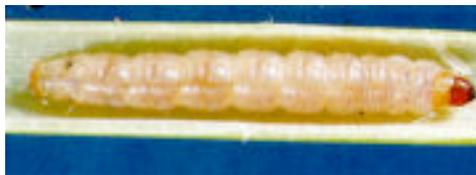
32.# Raw rice grains are about 79% starch. Once the seed is milled to remove its outer coatings, "white rice" is left. White rice at this stage of processing is almost pure starch. A human attempting to live on pure starch would soon need other foods to supply

- a) amino acids. b) calories. c) glucose. d) All of these.

33.# When the digestion of the starch was complete, the monomers would travel to the individual's liver and would be stored there as

- a) starch. b) amylose. c) glycogen. d) amylopectin.

34. # If our rice eater ate too much rice, he might need his ... to secrete some ... in order to keep his
- adrenal glands ... glucocorticoids ... blood sugar from rising.
 - heart ... ANP ... blood pressure from falling.
 - liver ... bile ... blood sugar from falling.
 - pancreas ... insulin ... blood sugar from rising.
35. * Nutrient molecules coming from the rice-eater's liver would enter his heart at the The blood in that chamber would have a relatively ... concentration of oxygen and a relatively ... concentration of CO₂.
- left atrium ... low ... low
 - right atrium ... low ... high
 - left atrium ... high ... high
 - right atrium ... high ... low
36. # The rice farmer will need all these nutrients if he finds that his rice is infected with a disease or is being eaten by pest insects. An important rice disease is bacterial blight, caused by the bacterium *Xanthomonas oryzae*. Which of the following would not be found in or on a bacterial cell?
- a cilium
 - a cell wall
 - a ribosome
 - a plasma membrane
37. * One of the most common rice pests is the stem borer, a moth larva that eats the inside the rice stem.



Stem borer larva in rice stem.

- This insect is a member of the phylum ... and the order
- Arthropoda ... Hymenoptera.
 - Annelida ... Hirudinea.
 - Arthropoda ... Lepidoptera.
 - Arthropoda ... Coleoptera.
38. # A farmer tries to control the stem borers by using an insecticide. No insecticide has ever been used in his field before. This will probably result in ... selection on the stem borers in the field.
- stabilizing
 - directional
 - disruptive
 - no consistent
39. * As the farmer is spraying the insecticide, he worries that the stem borers will become resistant to it. He knows that there is a stem borer allele for resistance to this insecticide. Which of the following situations would make the appearance of resistant stem borers more certain?
- None of the stem borers in this area have the resistance allele.
 - Stem borers that have the resistance allele have different pheromones, and have a hard time attracting mates.
 - The resistance allele makes the stem borer adults slower and easier prey for birds.
 - Neighboring farms have used this insecticide for years, and the stem borer moths can easily fly long distances.
40. Ecologically, rice is a ... and the stem borer is a
- primary producer ... primary consumer.
 - primary consumer ... decomposer.
 - secondary producer ... secondary consumer.
 - primary producer ... decomposer.