

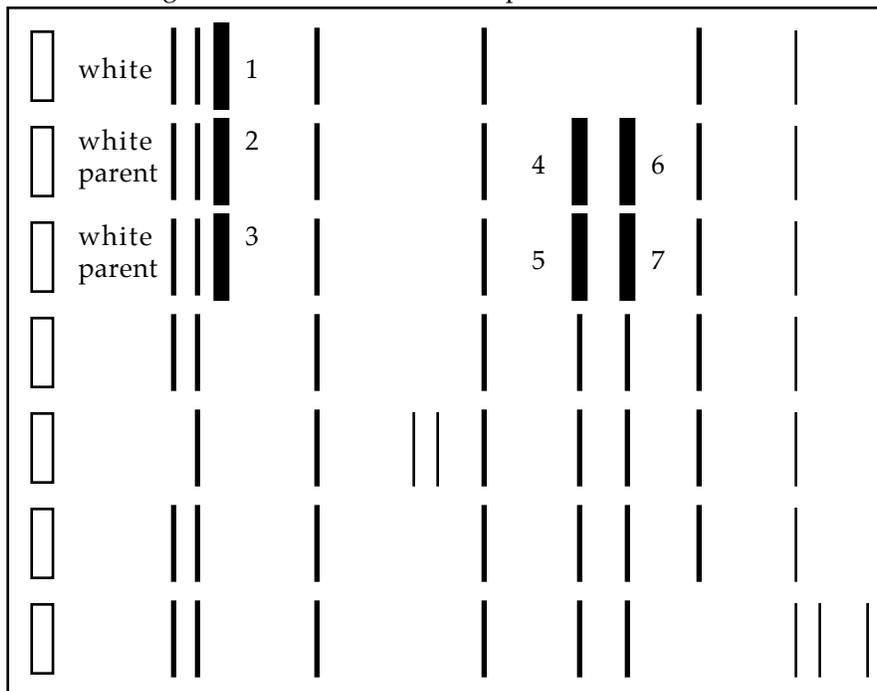
Clemson Biology Merit Exam Answers
April 1, 2011

1. a) Correct, of course. Flies and earthworms are plausible mascots, but what kind of university would use a gamecock as a mascot?
2. d) Correct. By 2 million years ago, there were several australopithecines, *Homo habilis*, *Homo ergaster*, and maybe *Homo erectus*. Modern man would not originate until about 150,000 years ago.
3. c) Correct. The Bengal tiger species would be *Panthera tigris*.
4. b) Correct. All the animals except the lion are members of the same species. By the way, all the tiger subspecies mentioned can interbreed, but lions and tigers can only interbreed with difficulty, and their offspring are fragile and plagued with birth defects.
5. a) Correct. The lion and the tiger diverged longer ago than any of the sibling tiger species did. From the names, we cannot tell the order in which the tiger subspecies diverged.
6. d) Correct. $235 \text{ kg} = 235 \times 2.2 = 517$ pounds. $310 \text{ cm} = 310/2.54 = 122$ inches, or 10 ft, 2 in.
7. c) Correct. The tigers is attempting to keep his body temperature within an acceptable range.
8. b) Correct. The dehydrated tiger's blood is more concentrated than the water he has drunk. This more concentrated solution will suck in water from the gut.
9. a) No. The incisors are the small teeth in the front of the tiger's mouth.
b) Correct. These are homologous to the two slightly pointed teeth in a human mouth.
10. a) Correct. The tapetum is a reflective layer behind the retina. It is the reason that many mammals have "eye shine" when they are illuminated by a flashlight beam or a headlight beam at night.
11. c) No. This is anaerobic respiration, and does not use mitochondria. Also, the final electron acceptor is pyruvate. The pyruvate becomes reduced to lactate.
d) Correct. The sudden burst of speed is financed by anaerobic respiration. The muscles rapidly fatigue because they produce lactic acid and use their muscle glycogen very inefficiently.
12. a) and b). No, these are inside the chest.
c) Correct. The trachea is the windpipe.
d) No, this is on the back of the shoulder.
13. b) Correct. As CO_2 builds up, so does carbonic acid, and the pH drops.
d) No. There is no direct effect of oxygen on pH. If anything, the lack of oxygen would cause production of lactic acid that would cause the pH to go down.
14. a) Correct. The purpose of the stomach is to be an expandable sack that stores large meals.
c) No, the small intestine cannot store large amounts of food.
15. a) Correct. These elements are the biology "big four."
16. c) Correct. Muscle is mostly protein, specifically actin and myosin.

17. d) Correct. Rotenone is a toxin that is used to poison fish.
18. a) No. This is a sulfur-containing acid.
b) No, this is deoxyribose.
c) No, this may look faintly like an amino acid, but it is not.
d) Correct. This is the amino acid serine. All amino acids have an alpha carbon (center) that has a carboxyl group, an amino group, a hydrogen, and an R group.
19. a) No, this shows transmittance declining, which would happen if the protein were increasing. Answers c and d have the same problem. Absorbance should decrease, not increase.
b) Correct. Transmittance is increasing as the colored protein is digested into amino acids.
20. a) Correct. If we increase the amount of polymer, the enzyme will become saturated because it can't work any faster. Only the initial reaction rates should be recorded because after that there might be depletion of the polymer.
b) No, this wouldn't work. The less polymer we put in, the faster it would be depleted. This is not going to demonstrate enzyme saturation.
21. b) No, this does happen in glycolysis, but much later than the addition of the phosphate. Also, the reaction that cleaves the glucose is not hydrolysis.
c) Correct. The first step of glycolysis is the formation of glucose-6-phosphate.
22. d) Correct. Fiber must come from vegetable matter. All the other answers are very abundant in meat.
23. b) Correct. Thylakoids are the membranous sacs inside chloroplasts. Leaves have the other cellular structures mentioned.
24. a) Correct. Leaves do respire, but their purpose is photosynthesis.
25. c) Correct. Phloem transports organic material throughout the plant. The purpose of xylem is water and mineral transport, not organic matter transport.
26. a) Correct. Prokaryotes have ribosomes, but none of the other organelles.
27. a) and b). There is no Kingdom Monera (although there used to be). The Plantae and Protista are both eukaryotic.
d) Correct. Bacteria and Archaea are the prokaryotic kingdoms.
28. a) and d). No. These look like bacterial chromosomes.
b) No. Closer, but muscle cells would have monad chromosomes.
c) Correct. Cells that have not gone through S phase have monad chromosomes.
29. c) Correct. It has two enzyme alleles (one from its mother and one from its father). If it is heterozygous at that locus, the alleles could be different.
30. b) Correct. The number of possible arrangements is 2^n where n is the haploid number. Since the haploid numbers of tigers and humans are 19 and 23, so the human has 2^4 times as many possible arrangements as the tiger.
31. a) Correct. This is hard, but you don't need a calculator. Two random, normal-looking tigers,

each with one chance in 10,000 of having the white allele, give one chance in 100,000,000 of a mating where both tigers have the white allele. If they both are heterozygous for the white allele, they have a 1/4 chance of producing a white offspring. The overall probability is 1/400,000,000.

32. d) Correct. If they've already had a white offspring, they must both be heterozygous for the white allele. They have one chance in four of producing a homozygous recessive offspring.
33. a) Correct. They are restriction fragments, or pieces of DNA produced by the cutting action of a restriction enzyme. Each cut is at a restriction site, and this is why tiny changes in DNA can be spotted as they create or delete restriction sites.
34. Take a look at the diagram with certain bands emphasized:



Bands 1, 2, and 3 are all associated with the white allele. The homozygous recessive offspring has only that band, and the parents have one copy of that band. Bands 4-7 are the normal allele, which the offspring doesn't have, but each of the parents have one copy of it because they are heterozygous. All the remaining tigers have these bands too because they are homozygous for the normal allele.

- a) No. The white allele is not cut as the normal allele is.
- d) Correct. The white allele remains uncut and heavy because it lacks the restriction site. The normal allele is cut (smaller, lighter bands 4, 5, 6, and 7 are the result)
35. d) Correct. Only the white tiger and its parents have bands 1-3. None of the other tigers have this restriction fragment in either the homozygous or heterozygous state. Some of the other tigers vary from each other in other ways, but the bands that matter are 1-3 only.
36. c) Correct. And you shouldn't need a calculator. If they drop by 60% per decade, then 40% remain per decade, and after two decades we should have $(0.4)(0.4) = 0.16$ of the 2008 number. $(1400)(0.16) = 224$.
37. a) No. They probably will be well adapted to local conditions because the population is small

- and isolated.
- b) Correct. Genetic drift is much worse in a small population. Extreme mating outcomes are not balanced by opposite extreme mating outcomes in another part of the population. Alleles fluctuate violently in frequency and may be lost.
 - c) No. They might suffer from inbreeding. Outcrossing is genetically healthy, but hard in a small population.
 - d) No. The mutation rate will not be increased by the fact that the population is small.
38. a) Correct. Wandering males will tend to inject genes from distant subpopulations into the local population. However, the fact that all breeding must be with this male will reduce the genetic diversity.
39. d) Correct. A pheromone is a chemical that is released into the environment and is intended to influence the behavior of other organisms of the same species.
40. a) An active lifestyle does not cause a big territory. Mice and small birds have a very high metabolic rate, and are very abundant.
- b) No. Meat is not hard to digest and is energy-rich.
 - c) Correct. Because about 70% of all the energy that enters a trophic level is lost to respiration, after several trophic levels, there is very little energy left for the top carnivores.
 - d) No, tigers are endotherms (warm-blooded).