MULTIPLE CHOICE.—For the following multiple choice questions circle the letter in front of the response that best answers the question or completes the sentence. (20%, 2% each)

1. Which of the following Geologic Eras is closes to the present time?
   a. Cenozoic.
   b. Jurassic
   c. Mesozoic.
   d. Paleozoic.
   e. Precambrian.

2. In a population at Hardy-Weinberg equilibrium, if the frequency of bb is 0.16, then what is the frequency of BB?
   a. 0.16
   b. 0.24
   c. 0.36
   d. 0.44
   e. None of the above

3. Which of the following best explains the increase in height of Europeans and North Americans in the late 20th century?
   a. genetic drift
   b. heterozygote advantage
   c. natural selection
   d. phenotypic plasticity
   e. sexual selection

4. Which of the following is NOT an assumption of the Hardy-Weinberg theorem?
   a. no genetic drift
   b. no gene flow
   c. no mutation
   d. no natural selection
   e. no random mating

5. Which of the following modes of speciation involves a geographic separation of populations?
   a. allopatriic speciation
   b. chloropatriic speciation
   c. parapatric speciation
   d. sympatric speciation
   e. None of the above

6. Which of the following BEST explains why photosynthesis in the open ocean is limited?
   a. Currents move photosynthesizers.
   b. Human fishing activities.
   c. Nutrients sink into deep water.
   d. The ocean is cool or cold.
   e. There are few places for photosynthesizers to “root.”

7. The asymmetrically mouthed scale-eating fish species discussed in the textbook is a good example of…
   a. amplification of variation.
   b. frequency-dependent polymorphism.
   c. geographically variable selection.
   d. neutral alleles.
   e. phenotypic plasticity.

8. If a population of 20,000 is undergoing exponential growth with a yearly intrinsic rate of increase of 0.10, then what is the size of the population after 2 years?
   a. 2,200
   b. 22,000
   c. 24,000
   d. 44,000
   e. None of the above

9. Which of the following is a correct species name?
   a. drosophila melanogaster
   b. Drosophila
   c. Drosophila Melanogaster
   d. melanogaster
   e. None of the above

10. Which of the following describes the fact that Cithalamus barnacles CAN live across a wide range of the intertidal zone?
    a. co-evolution
    b. fundamental niche
    c. keystone species
    d. phenotypic plasticity
    e. realized niche
**MATCHING.**—For the following exercise match the effect on variation in the right column with the corresponding process in the left column. Each letter may be used more than once or not at all. (10%, 2% each)

1. genetic drift       
2. inbreeding         
3. mutation           
4. outbreeding        
5. sexual selection   

A. decreases genetic variation  
B. increases genetic variation  
C. maintains genetic variation

**FILL-IN-THE-BLANK.**—For the following exercises write the appropriate word or words in the available space, sketch, or label as appropriate. (24%)

1. Fill in the missing ranks in the Linnean Classification. (4%)

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Identify *three* things that are “wrong” or misleading about this illustration. (6%)

a.  

b.  

c.  

3. Examine the phylogenetic tree below to answer the following questions. (5%)

a. Circle two (2) monophyletic groups on the phylogenetic tree above.

b. To which species is species **D** most closely related.  

4. Fill in the lines on the biogeographic graphs below. (4%)

a.  

b.  

c.  

5. Charles Darwin discussed two evolutionary ideas in his book, *The Origin of Species*. One of these ideas was… (1%)

_
**DEFINITIONS.**—For the following BIOLOGICAL words or phrases define them as accurately and concisely as possible. (20%, 4% each)

1. Biological evolution:

2. Evolutionary species concept:

3. Homology:

4. Logistic population growth:

5. Natural Selection:

**LONG ANSWERS.**—For the following, address each in as concise and lucid a manner as possible. Do NOT exceed the space provided.

1. Both the Amazon Basin of South America and the Congo basin of Africa are hot wet tropical forest areas near the equator. (a) Why are both of these areas climatically hot and wet? (6%) There are many more species in the Amazon Basin than in the Congo basin. The climatic conditions in Amazonia during the last ice ages caused repeated periods where the rainforest was broken into smaller areas separated by grassland, later becoming contiguous again. This happened less extensively in the Congo basin. (b) How could this past pattern result in greater species diversity in Amazonia than in the Congo? (4%)
2. (a) Use the data matrix below to construct a phylogenetic tree of the fish species in the left column. Show the **derived traits** on your phylogenetic tree. (8%)

<table>
<thead>
<tr>
<th></th>
<th>fin supports</th>
<th>upper jaw</th>
<th>tail fin</th>
<th>scales</th>
<th>pelvic fins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trout</td>
<td>soft</td>
<td>2 bones</td>
<td>symmetrical</td>
<td>circular</td>
<td>posterior</td>
</tr>
<tr>
<td>Cod</td>
<td>soft</td>
<td>1 bone</td>
<td>symmetrical</td>
<td>circular</td>
<td>anterior</td>
</tr>
<tr>
<td>Bass</td>
<td>spiny</td>
<td>1 bone</td>
<td>symmetrical</td>
<td>circular</td>
<td>anterior</td>
</tr>
<tr>
<td>Perch</td>
<td>spiny</td>
<td>1 bone</td>
<td>symmetrical</td>
<td>circular</td>
<td>anterior</td>
</tr>
<tr>
<td>Gar (outgroup)</td>
<td>soft</td>
<td>2 bones</td>
<td>asymmetrical</td>
<td>rectangular</td>
<td>posterior</td>
</tr>
</tbody>
</table>

(b) Indicate two monophyletic groups on the phylogenetic tree you constructed. (2%)

3. You study a gene in a population of plains killifish in a large stream in Colorado. The genotype and allele frequencies for the population are $A = 0.67$, $a = 0.33$, $AA = 0.45$, $Aa = 0.44$, $aa = 0.11$. (a) Is this gene at Hardy-Weinberg Equilibrium? (show your calculations)
(b) What can you infer about the population size and mating habits of the fish in this population? (c) Which of the following would best characterize the “A” gene in these fish (circle 1)

neutral alleles  heterozygote advantage  selection favored polymorphism