Part A: Multiple choice. Each of the questions or incomplete statements below is followed by suggested answers or completions. Select the answer that is best in each case and enter the appropriate letter in the corresponding space on the answer sheet. When you have completed part A, you should continue on to part B.

1. The reason that linked genes are inherited together is that
   (A) they are located on the same chromosome.
   (B) the number of genes in a cell is greater than the number of chromosomes.
   (C) chromosomes are unbreakable.
   (D) alleles are paired.
   (E) genes align that way during metaphase I.

2. What do all human males inherit from their mother?
   (A) mitochondrial DNA
   (B) an X chromosome
   (C) the SRY gene
   (D) A and B only
   (E) A, B, and C

3. A cell that has $2n + 1$ chromosomes is
   (A) trisomic.
   (B) monosomic.
   (C) aneuploid.
   (D) polyploid.
   (E) both A and C

4. If a chromosome lacks certain genes, what has most likely occurred?
   (A) disjunction
   (B) an inversion
   (C) a deletion
   (D) a translocation
   (E) a nonduplication

5. When Thomas Hunt Morgan crossed his red-eyed F$_1$ generation flies to each other, the F$_2$ generation included both red- and white-eyed flies. Remarkably, all the white-eyed flies were male. What was the explanation for this result?
   (A) The involved gene was on the X chromosome.
   (B) The involved gene was on the Y chromosome.
   (C) The involved gene was on an autosome.
   (D) Other male-specific factors influence eye color in flies.
   (E) Other female-specific factors influence eye color in flies.
6. One possible result of chromosomal breakage is for a fragment to join a nonhomologous chromosome. This is called a (an)
   (A) deletion.
   (B) disjunction.
   (C) inversion.
   (D) translocation.
   (E) duplication.

7. The karyotype shown here is associated with which of the following genetic disorders?
   (A) Turner syndrome
   (B) Down syndrome
   (C) Klinefelter syndrome
   (D) hemophilia
   (E) male-pattern baldness

8. Which of the following statements about mitochondria is false?
   (A) Because of the role of the mitochondria in producing cellular energy, mitochondrial diseases often affect the muscles and nervous system.
   (B) Because mitochondria are present in the cytoplasm, mitochondrial diseases are transmitted maternally.
   (C) Like nuclear genes, mitochondrial genes usually follow Mendelian patterns of inheritance.
   (D) Mitochondria contain circular DNA molecules that code for proteins and RNAs.
   (E) Many mitochondrial genes encode proteins that play roles in the electron transport chain and ATP synthesis.

9. The pedigree in the figure below shows the transmission of a trait in a particular family. Based on this pattern of transmission, the trait is most likely
   (A) mitochondrial.
   (B) autosomal recessive.
   (C) sex-linked dominant.
   (D) sex-linked recessive.
   (E) autosomal dominant.

10. Chromosomes and genes share all of the following characteristics except that
    (A) they are both present in pairs in all diploid cells.
    (B) they both undergo segregation during meiosis.
    (C) their copy numbers in the cell decrease after meiosis, and increase during fertilization.
    (D) they are both copied during the S phase of the cell cycle.
    (E) they both pair up with their homologues during prophase of mitosis.
11. New combinations of linked genes are due to which of the following?
   (A) nondisjunction
   (B) crossing over
   (C) independent assortment
   (D) mixing of sperm and egg
   (E) both A and C

12. The following is a map of four genes on a chromosome: A W E G

   Between which two genes would you expect the highest frequency of recombination?
   (A) A and W
   (B) W and E
   (C) E and G
   (D) A and E
   (E) A and G

13. Males are more often affected by sex-linked traits than females because
   (A) males are hemizygous for the X chromosome.
   (B) male hormones such as testosterone often exacerbate the effects of mutations on the X chromosome.
   (C) female hormones such as estrogen often compensate for the effects of mutations on the X.
   (D) X chromosomes in males generally have more mutations than X chromosomes in females.
   (E) mutations on the Y chromosome often exacerbate the effects of X-linked mutations.

14. Red-green color blindness is a sex-linked recessive trait in humans. Two people with normal color vision have a color-blind son. What are the genotypes of the parents?
   (A) XX and X^c Y
   (B) X^c X^c and XY
   (C) XX and XY^c
   (D) XX^c and XY

15. In the following list, which term is *least* related to the others?
   (A) Duchenne muscular dystrophy
   (B) autosome
   (C) sex-linked genes
   (D) color blindness
   (E) hemophilia
16. Sickle-cell anemia results from a point mutation in the *HBB* gene. The mutation results in the replacement of an amino acid that has a hydrophilic R-group with an amino acid that has a hydrophobic R-group on the exterior of the hemoglobin protein. Such a mutation would most likely result in altered

(A) properties of the molecule as a result of abnormal interactions between adjacent hemoglobin molecules
(B) DNA structure as a result of abnormal hydrogen bonding between nitrogenous bases
(C) fatty acid structure as a result of changes in ionic interactions between adjacent fatty acid chains
(D) protein secondary structure as a result of abnormal hydrophobic interactions between R-groups in the backbone of the protein

17. The tiny blue-eyed Mary flower is often one of the first flowers seen in the spring in some regions of the United States. The flower is normally blue, but sometimes a white or pink flower variation is found. The following data were obtained after several crosses.

<table>
<thead>
<tr>
<th>Parents</th>
<th>F1</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue × white</td>
<td>Blue</td>
<td>196 blue, 63 white</td>
</tr>
<tr>
<td>Blue × pink</td>
<td>Blue</td>
<td>149 blue, 52 pink</td>
</tr>
<tr>
<td>Pink × white</td>
<td>Blue</td>
<td>226 blue, 98 white, 77 pink</td>
</tr>
</tbody>
</table>

Which of the following statements best explains the data?

(A) The appearance of blue in the F1 generation of the pink and white cross demonstrates that flower color is not an inherited trait but is determined by the environment.
(B) Flower color depends on stages of flower development, and young flowers are white, advancing to pink and then blue.
(C) Since the F1 and F2 phenotypes of the pink and white cross do not fit the expected genotypic and phenotypic ratios, blue-eyed Mary must reproduce by vegetative propagation.
(D) Flower color is an inherited trait, and the F1 and F2 phenotypes of the flowers arising from the pink and white cross can best be explained by another gene product that influences the phenotypic expression.
In a hypothetical population of beetles, there is a wide variety of color, matching the range of coloration of the tree trunks on which the beetles hide from predators. The graphs below illustrate four possible changes to the beetle population as a result of a change in the environment due to pollution that darkened the tree trunks.

Which of the following includes the most likely change in the coloration of the beetle population after pollution and a correct rationale for the change?

(A) The coloration range shifted toward more light-colored beetles, as in diagram I. The pollution helped the predators find the darkened tree trunks.

(B) The coloration in the population split into two extremes, as in diagram II. Both the lighter-colored and the darker-colored beetles were able to hide on the darker tree trunks.

(C) The coloration range became narrower, as in diagram III. The predators selected beetles at the color extremes.

(D) The coloration in the population shifted toward more darker-colored beetles, as in diagram IV. The lighter-colored beetles were found more easily by the predators than were the darker-colored beetles.
19. Testosterone oxido-reductase is a liver enzyme that regulates testosterone levels in alligators. One study compared testosterone oxido-reductase activity between male and female alligators from Lake Woodruff, a relatively pristine environment, and from Lake Apopka, an area that has suffered severe contamination. The graph above depicts the findings of that study. The data in the graph best support which of the following claims?

(A) Environmental contamination elevates total testosterone oxido-reductase activity in females.
(B) Environmental contamination reduces total testosterone oxido-reductase activity in females.
(C) Environmental contamination elevates total testosterone oxido-reductase activity in males.
(D) Environmental contamination reduces total testosterone oxido-reductase activity in males.

Questions 20–23

A student placed 20 tobacco seeds of the same species on moist paper towels in each of two petri dishes. Dish A was wrapped completely in an opaque cover to exclude all light. Dish B was not wrapped. The dishes were placed equidistant from a light source set to a cycle of 14 hours of light and 10 hours of dark. All other conditions were the same for both dishes. The dishes were examined after 7 days, and the opaque cover was permanently removed from dish A. Both dishes were returned to the light and examined again at 14 days. The following data were obtained.

<table>
<thead>
<tr>
<th></th>
<th>Dish A</th>
<th></th>
<th>Dish B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 7 Covered</td>
<td>Day 14 Uncovered</td>
<td>Day 7 Uncovered</td>
<td>Day 14 Uncovered</td>
</tr>
<tr>
<td>Germinated Seeds</td>
<td>12</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Green-leaved seedlings</td>
<td>0</td>
<td>14</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Yellow-leaved seedlings</td>
<td>12</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mean stem length below</td>
<td>8 mm</td>
<td>9 mm</td>
<td>3 mm</td>
<td>3 mm</td>
</tr>
<tr>
<td>First set of leaves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

20. According to the results of this experiment, germination of tobacco seeds during the first week is

(A) increased by exposure to light
(B) unaffected by light intensity
(C) prevented by paper towels
(D) accelerated in green-leaved seedlings
21. The most probable cause for the difference in mean stem length between plants in dish A and plants in dish B is which of the following?

   (A) Shortening of cells in the stem in response to the lack of light
   (B) Elongation of seedlings in response to the lack of light
   (C) Enhancement of stem elongation by light
   (D) Genetic differences between the seeds

22. Which of the following best supports the hypothesis that the difference in leaf color is genetically controlled?

   (A) The number of yellow-leaved seedlings in dish A on day 7
   (B) The number of germinated seeds in dish A on days 7 and 14
   (C) The death of all the yellow-leaved seedlings
   (D) The existence of yellow-leaved seedlings as well as green-leaved ones on day 14 in dish B

23. Additional observations were made on day 21, and no yellow-leaved seedlings were found alive in either dish. This is most likely because

   (A) yellow-leaved seedlings were unable to absorb water from the paper towels
   (B) taller green-leaved seedlings blocked the light and prevented photosynthesis
   (C) yellow-leaved seedlings were unable to convert light energy to chemical energy
   (D) a higher rate of respiration in yellow-leaved seedlings depleted their stored nutrients

24. The processes illustrated in the models depicted above all result in which of the following?

   (A) Transcription
   (B) An increase in genetic variation
   (C) An increase in the chromosome number
   (D) Horizontal gene transfer

25. Scientists have found that the existing populations of a certain species of amphibian are small in number, lacking in genetic diversity, and separated from each other by wide areas of dry land. Which of the following human actions is most likely to improve the long-term survival of the amphibians?

   (A) Cloning the largest individuals to counteract the effects of aggressive predation
   (B) Reducing the population size by one-fifth to decrease competition for limited resources
   (C) Constructing a dam and irrigation system to control flooding
   (D) Building ponds in the areas of dry land to promote interbreeding between the separated populations
Questions 26-28

*Rhagoletis pomonella* is a parasitic fly native to North America that infests fruit trees. The female fly lays her eggs in the fruit. The larvae hatch and burrow through the developing fruit. The next year, the adult flies emerge.

Prior to the European colonization of North America, the major host of *Rhagoletis* was a native species of hawthorn, *Crataegus marshallii*. The domestic apple tree, *Malus domestica*, is not native to North America, but was imported by European settlers in the late 1700s and early 1800s.

When apple trees were first imported into North America, there was no evidence that *Rhagoletis* could use them as hosts. Apples set fruit earlier in the season and develop faster, while hawthorns set later and develop more slowly.

Recent analysis of *Rhagoletis* populations has shown that two distinct populations of flies have evolved from the original ancestral population of flies that were parasitic on hawthorns. One population infests only apple trees, and the other infests only hawthorns. The life cycles of both fly populations are coordinated with those of their host trees. The flies of each population apparently can distinguish and select mates with similar host preferences and reject mates from the population specific to the other host tree. There is very little hybridization (only about 5 percent) between the two groups.

26. The divergence between the two populations of *Rhagoletis* must have occurred very rapidly because

   (A) the apple tree was imported into North America with European settlement approximately 200 years ago
   (B) flies were imported into North America with European settlement approximately 200 years ago
   (C) long-distance rail transport of fruit increased only after the American Civil War (1861–1865)
   (D) heavy use of gunpowder during the American Civil War (1861–1865) led to increased mutation rates in many natural populations of plants and animals

27. Initially, which of the following isolating mechanisms is likely to have been the most important in preventing gene flow between the two populations of *Rhagoletis*?

   (A) Gamete incompatibility
   (B) Temporal isolation
   (C) Mechanical isolation
   (D) Reduced hybrid viability

28. Matings between individuals from the two populations of *Rhagoletis* produce hybrid flies that appear to be healthy and have normal life spans. The eggs laid by these hybrid flies, however, hatch less often than those of flies from either of the two populations. What isolating mechanism seems to be important in this hybrid population?

   (A) Prezygotic isolation
   (B) Mechanical isolation
   (C) Reduced hybrid fertility
   (D) Habitat isolation
29. A group of mice was released into a large field to which no other mice had access. Immediately after the release, a representative sample of the mice was captured, and the fur color of each individual in the sample was observed and recorded. The mice were then returned to the field. After twenty years, another representative sample of the mice was captured, and the fur color of each individual in the sample was again recorded. Which of the following best explains the change in the frequency distribution of fur color phenotypes in the mouse population, as shown in the figures above?

(A) The allele for gray fur color is unstable, and over twenty years most of those alleles mutated to become alleles for black fur.
(B) The field was composed primarily of light-colored soil and little vegetation, affording gray mice protection from predators.
(C) Sexual selection led to increased mating frequency of black and brown versus gray and brown.
(D) The gray mice were hardest to capture and so were underrepresented in the twenty-year sample.

30. A new mutation that arose in one copy of gene X in a somatic cell resulted in the formation of a tumor. Which of the following pieces of evidence best describes how the new mutation directly caused the tumor?

(A) Protein X normally stimulates cell division, and the mutation created an overactive version of protein X.
(B) Protein X normally activates a growth hormone receptor, and the mutation decreased the stability of protein X.
(C) Protein X normally prevents passage through the cell cycle, and the mutation created an overactive version of protein X.
(D) Protein X normally regulates gene expression, and the mutation created an underactive version of protein X that blocked the cell cycle.
31. If chemical signals in the cytoplasm control the progression of a cell to the M phase of the cell cycle, then fusion of a cell in G₁ with a cell in early M phase would most likely result in the

(A) replication of chromosomes only in the G₁ cell  
(B) exiting of both cells from the cell cycle and into the G₀ phase  
(C) condensation of chromatin in preparation of nuclear division in both cells  
(D) transfer of organelles from the G₁ cell to the cell in the M phase

32. Cystic fibrosis is a recessively inherited disorder that results from a mutation in the gene encoding CFTR chloride ion channels located on the surface of many epithelial cells. As shown in the figure, the mutation prevents the normal movement of chloride ions from the cytosol of the cell to the extracellular fluid. As a consequence of the mutation, the mucus layer that is normally present on the surface of the cells becomes exceptionally dehydrated and viscous.

An answer to which of the following questions would provide the most information about the association between the CFTR mutation and the viscous mucus?

(A) Is the mucus also secreted from the cells through the CFTR proteins?  
(B) How does the disrupted chloride movement affect the movement of sodium ions and water by the cell?  
(C) How does the mutation alter the structure of the CFTR proteins?  
(D) What is the change in nucleotide sequence that results in the CFTR mutation?
33. A student in a biology class crossed a male *Drosophila melanogaster* having a gray body and long wings with a female *D. melanogaster* having a black body and apterous wings. The following distribution of traits was observed in the offspring.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Number of Offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray body, long wings</td>
<td>42</td>
</tr>
<tr>
<td>Black body, apterous wings</td>
<td>41</td>
</tr>
<tr>
<td>Gray body, apterous wings</td>
<td>9</td>
</tr>
<tr>
<td>Black body, long wings</td>
<td>8</td>
</tr>
</tbody>
</table>

Which of the following is supported by the data?

(A) The alleles for gray body and long wings are dominant.
(B) The alleles for gray body and long wings are recessive.
(C) Genes for the two traits are located on two different chromosomes, and independent assortment occurred.
(D) Genes for the two traits are located close together on the same chromosome, and crossing over occurred between the two gene loci.

**Questions 34-37**

The following figures display data collected while studying a family, some members of which have sickle-cell disease—a rare genetic disorder caused by a mutation in the hemoglobin beta gene (*HBB*). There are at least two alleles of the *HBB* gene: the *HbA* allele encodes wild-type hemoglobin and the *HbS* allele encodes the sickle-cell form of hemoglobin. Genetic testing provided insight into the inheritance pattern for sickle-cell disease.

![Pedigree of a family with affected individuals.](image)

**Figure 1.** Pedigree of a family with affected individuals. Squares represent males, circles represent females, shaded symbols represent individuals with sickle-cell disease.

5′ CTG ACT CCT GAG GAG AAG TCT 3′ Non-template Strand
3′ GAC TGA GGA CTC CTC TTC AGA 5′ Template Strand

**Figure 2.** A portion of the DNA sequence from the wild-type Hemoglobin allele (*HbA*) that codes for normal hemoglobin.
Figure 3. Codon table showing nucleotide sequences for each amino acid.

<table>
<thead>
<tr>
<th>Second Base in Codon</th>
<th>U</th>
<th>C</th>
<th>A</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>CUU [Leu]</td>
<td>CUC [Val]</td>
<td>CUA [His]</td>
<td>CUG</td>
</tr>
<tr>
<td>A</td>
<td>AAU [Ser]</td>
<td>AAC [Thr]</td>
<td>ACA [Thr]</td>
<td>ACG</td>
</tr>
<tr>
<td>G</td>
<td>GUU [Val]</td>
<td>GUC [Val]</td>
<td>GCA [Asp]</td>
<td>GCC</td>
</tr>
</tbody>
</table>

Figure 4. Image of a gel following electrophoretic separation of DNA fragments of the $HBB$ gene from three individuals in the pedigree in Figure 1.

34. Based on the data shown in Figure 1, which of the following best describes the genotypes of individual family members in the pedigree?

(A) All affected individuals possess at least one dominant allele of the hemoglobin beta gene.
(B) Healthy individuals may possess one mutant allele ($HbS$) of the hemoglobin beta gene.
(C) Individuals IV and V must be heterozygous for the $HbS$ (mutant) allele.
(D) Individuals II and VI possess two copies of the $HbA$ (wild-type) allele.
35. The *HbS* allele, which causes sickle-cell disease, results from a mutation in the DNA sequence shown in Figure 2 that produces a valine (val) in the place of a glutamic acid (glu) residue in the hemoglobin protein. Which of the following mRNA sequences is derived from the *HbS* allele?

(A) 5′ GAC TGA GGA CTC CTC TTC AGA 3′
(B) 5′ UCU GAA GAG GAA UCC UCA GUC 3′
(C) 5′ AGA CTT CTC CTC AGG AGT CAG 3′
(D) 5′ CUG ACU CCU GUG GAG AAG UCU 3′

36. The restriction endonuclease *Mst* II recognizes the sequence 5′ CCT(N)AG (where N = any nucleotide) and cuts DNA at that site, producing separate fragments. Which of the following best explains the banding patterns exhibited in Figure 4?

(A) The *HbA* DNA contains a recognition site for the *Mst* II restriction enzyme.
(B) The *HbA/HbS* DNA contains three recognition sites for the *Mst* II restriction endonuclease.
(C) Individual I has only one copy of the hemoglobin gene; therefore there is only one band on the gel.
(D) The *HbS/HbA* DNA contains three different alleles for sickle-cell disease.

37. Possessing a single copy of the *HbS* allele has been shown to provide some resistance to infection by *Plasmodium falciparum*, the parasite that causes malaria. Which of the following individuals represented in the pedigree would have the greatest selective advantage in an area where malaria is common?

(A) I
(B) II
(C) III
(D) V

38. The data below demonstrate the frequency of tasters and nontasters of a certain compound in four isolated populations that are in Hardy-Weinberg equilibrium. The allele for nontasters is recessive. In which population is the frequency of the recessive allele highest?

<table>
<thead>
<tr>
<th>Population</th>
<th>Tasters</th>
<th>Nontasters</th>
<th>Size of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>1</td>
<td>110</td>
<td>32</td>
</tr>
<tr>
<td>(B)</td>
<td>2</td>
<td>8,235</td>
<td>4,328</td>
</tr>
<tr>
<td>(C)</td>
<td>3</td>
<td>215</td>
<td>500</td>
</tr>
<tr>
<td>(D)</td>
<td>4</td>
<td>11,489</td>
<td>2,596</td>
</tr>
</tbody>
</table>
39. In a Hardy-Weinberg population with two alleles, $A$ and $a$, that are in equilibrium, the frequency of allele $a$ is 0.2. What is the frequency of individuals with $Aa$ genotype?
   (A) 0.20
   (B) 0.32
   (C) 0.42
   (D) 0.80
   (E) Genotype frequency cannot be determined from the information provided.

40. Most copies of harmful recessive alleles in a sexual species are carried by individuals that are
   (A) haploid.
   (B) polymorphic.
   (C) homozygous for the allele.
   (D) heterozygous for the allele.
   (E) B and C

41. Which of the following is not a requirement for maintenance of Hardy-Weinberg equilibrium?
   (A) an increasing mutation rate
   (B) random mating
   (C) large population size
   (D) no migration
   (E) no natural selection

Refer to the information below to answer questions 42 - 44.

You are studying three populations of birds. Population 1 has ten birds, of which one is brown (a recessive trait) and nine are red. Population 2 has 100 birds. In that population, ten of the birds are brown. Population 3 has 30 birds, and three of them are brown. Use the following options to answer the questions:

A. Population 1
B. Population 2
C. Population 3
D. They are all the same.
E. It is impossible to tell from the information given.

42. In which population is the frequency of the allele for brown feathers highest?
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

43. In which population would it be least likely that an accident would significantly alter the frequency of the brown allele?
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E
44. Which population is most likely to be subject to the bottleneck effect?
(A) A
(B) B
(C) C
(D) D
(E) E

45. Which factor is the most important in producing the variability that occurs in each generation of humans?
(A) mutation
(B) sexual recombination
(C) genetic drift
(D) nonrandom mating
(E) natural selection

46. Which of the following chromosomal mutations can increase the mass of DNA present in an organism's genome, creating superfluous DNA that may undergo further changes producing entirely new genes?
(A) transposition
(B) translocation
(C) inversion
(D) duplication
(E) crossing over

47. In DNA molecules, A-T base pairs are held to each other by two hydrogen bonds, whereas the more stable G-C base pairs are held to each other by three hydrogen bonds. If DNA mutability increases as DNA stability decreases, then which of the five exons of a hypothetical gene should be most highly conserved over evolutionary time (assuming no selection and no transposition occurs)?

<table>
<thead>
<tr>
<th>Exon</th>
<th>% of A-T pairs</th>
<th>% of G-C pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>B</td>
<td>46</td>
<td>54</td>
</tr>
<tr>
<td>C</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>D</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>E</td>
<td>62</td>
<td>38</td>
</tr>
</tbody>
</table>

(A) Exon A
(B) Exon B
(C) Exon C
(D) Exon D
(E) Exon E

48. The following important concepts of population genetics are due to random events or chance except
(A) mutation.
(B) the bottleneck effect.
(C) the founder effect.
(D) natural selection.
(E) sexual recombination.
49. You are maintaining a small population of fruit flies in the laboratory by transferring the flies to a new culture bottle after each generation. After several generations, you notice that the viability of the flies has decreased greatly. Recognizing that small population size is likely to be linked to decreased viability, the best way to reverse this trend is to
   (A) cross your flies with flies from another lab.
   (B) reduce the number of flies that you transfer at each generation.
   (C) transfer only the largest flies.
   (D) change the temperature at which you rear the flies.
   (E) shock the flies with a brief treatment of heat or cold to make them more hardy.

50. If the frequency of a particular allele that is present in a small, isolated population of alpine plants should change due to a landslide that leaves an even smaller remnant of surviving plants, then what has occurred?
   (A) a bottleneck
   (B) genetic drift
   (C) microevolution
   (D) A and B only
   (E) A, B, and C

51. Through time, the movement of people on Earth has steadily increased. This has altered the course of human evolution by increasing
   (A) nonrandom reproduction.
   (B) geographic isolation.
   (C) genetic drift.
   (D) mutations.
   (E) gene flow.

52. Which of the following is one important evolutionary feature of the diploid condition?
   (A) An extra set of genes facilitates the inheritance of characteristics acquired by the previous generation.
   (B) Recombination can only occur in diploid organisms.
   (C) DNA in diploid cells is more resistant to mutation than is the DNA of haploid cells.
   (D) Diploid organisms express less of their genetic variability than haploid organisms.
   (E) Diploid organisms are more likely to clone successfully than are haploid organisms.

53. The Darwinian fitness of an individual is measured by
   (A) the number of its offspring that survive to reproduce.
   (B) the number of supergenes in the genotype.
   (C) the number of mates it attracts.
   (D) its physical strength.
   (E) how long it lives.

54. The higher the proportion of loci that are "fixed" in a population, the lower is that population's
   (A) nucleotide variability.
   (B) genetic polymorphism.
   (C) average heterozygosity.
   (D) A, B, and C
   (E) A and B only
55. If neutral variation is truly "neutral," then it should have no effect on
   A) nucleotide diversity.
   B) average heterozygosity.
   C) our ability to measure the rate of evolution.
   D) relative fitness.
   E) gene diversity.

56. The allele that causes phenylketonuria (PKU) is harmful, except when an infant's diet lacks the amino acid, phenylalanine. What maintains the presence of this harmful allele in a population's gene pool?
   (A) heterozygote advantage
   (B) stabilizing selection
   (C) balanced polymorphism
   (D) diploidy
   (E) balancing selection

Choose among these options to answer questions 57 - 63. Each option may be used once, more than once, or not at all.

A. random selection
B. directional selection
C. stabilizing selection
D. disruptive selection
E. sexual selection

57. Brightly colored peacocks mate more frequently than do drab peacocks.
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

58. Most Swiss starlings produce four to five eggs in each clutch.
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

59. Fossil evidence indicates that horses have gradually increased in size over geologic time.
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

60. The average birth weight for human babies is about 3 kg.
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E
61. A certain species of land snail exists as either a cream color or a solid brown color. Intermediate individuals are relatively rare.
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

62. Pathogenic bacteria found in many hospitals are antibiotic resistant.
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

63. An African butterfly species exists in two strikingly different color patterns.
   (A) A
   (B) B
   (C) C
   (D) D
   (E) E

END OF PART A