PART 1.

MULTIPLE CHOICE

1. The diploid number of chromosomes in humans is 46. The haploid number is:
   A. 138 B. 92 C. 46 D. 23

2. Gregor Mendel's work was different from that of other researchers working on inheritance in his day because he alone:
   A. was a religious man B. worked with pea plants
   C. knew how to grow plants D. actually counted the offspring

3. Tall is dominant to dwarf in peas. If two dwarf pea plants were crossed, their offspring will be:
   A. all tall plants B. all dwarf plants
   C. half tall, half dwarf plants D. plants of an intermediate height

4. The degree of earlobe attachment in humans is inherited as a simple dominant of free earlobes, or as a recessive allele of attached earlobes. What is the probability that a woman with attached earlobes will have children with attached earlobes if their father has free earlobes, but his father had attached earlobes?
   A. 1 in 2 B. 3 in 4 C. 1 in 10 D. none

5. What is the probability of getting a pea plant with recessive green seed color when two heterozygous pea plants, both having the dominant yellow-seeded phenotype, are crossed with each other?
   A. 1 in 6 B. 1 in 4 C. about half D. none

6. Red-green colorblindness is a sex-linked trait. A woman with normal color vision, whose father was colorblind, mates with a colorblind man. What chance do each of their sons have of being colorblind?
   A. 50% chance B. 100% chance C. 0% chance D. 10% chance

7. Human height shows a continuous variation from the very short to the very tall. Height is most likely controlled by:
   A. epistatic genes B. sex-linked genes C. mutations D. multiple genes

8. A couple who are both carriers for the gene for cystic fibrosis have two children who have cystic fibrosis. What is the probability that their next child will have cystic fibrosis?
   A. 0% B. 25% C. 50% D. 75% E. 100%

9. In snapdragons, heterozygotes have pink flowers, whereas the two homozygotes have red flowers or white flowers. When plants with red flowers are crossed with plants with white flowers, what proportion of the offspring will have pink flowers?
   A. zero B. 25% C. 50% D. 75% E. 100%

10. How many unique gametes could be produced through independent assortment by an individual with the genotype Aa Bb Cc Dd EE?
    A. 4 B. 8 C. 16 D. 32 E. 64

11. The fossil record indicates that whales evolved from:
    A. hoofed mammals B. fish C. sharks D. dinosaurs

12. Biochemical changes that occur in organisms through time can help us:
    A. infer relatedness B. construct molecular family trees
    C. understand how groups of organisms changed through time D. all of these

13. Over time, the same bones in different vertebrates were put to different uses. This falls under the category of:
    A. heterologous structures B. vestigial organs
    C. analogous structures D. homologous structures

14. When only a very few individuals give rise to a new population is a new area of favorable habitat, they might differ in appearance from the other, larger population from which they separated. This effect is called the:
    A. mutation effect B. founder effect C. inbreeding effect D. outbreeding effect

15. In human infants, there has long been evolution toward having the highest survival rate at a 6-7 pound birth weight. This is an example of:
    A. directional selection B. disruptive selection
    C. stabilizing or balancing selection D. random chance

16. A certain type of grass has a diploid chromosome number of 8. A similar species of grass has a diploid chromosome number of 10. Interspecific hybridization between the two species results in sterile hybrids that can, nonetheless, reproduce vegetatively. The chromosome number of those hybrids would be
    A. 9 B. 16 C. 18 D. 20 E. 36.

FILL IN THE BLANK

1. The outward expression of an organism's genotype is referred to as its _____.
2. An individual is said to be _____ if it has two copies of the same factor for a given trait.
3. When a gene is carried on one of the sex chromosomes, it is said to be _____.
4. A _____ is a separate group of organisms incapable of interbreeding with other such groups.
5. Pairs of chromosomes that have the same size, shape, and function are _____.
6. An unexpected change in a cell's genetic makeup is called a _____.

SHORT ANSWER

1. What were the inferences that Darwin drew from the following set of observations:
    1. Organisms can reproduce very quickly, yet populations are relatively stable.
    2. Resources are limited.
    3. There is variation within a population and some of the variations are inherited.
2. Please list, with a one sentence explanation, 3 lines of evidence in support of evolution. (e.g. Comparative Embryology shows great similarity among all the vertebrate embryos, suggesting a common ancestor)
3. Define Darwinian or evolutionary fitness.
4. List 2 advantages to storing genetic information in DNA rather than RNA.
5. Create a life cycle diagram showing the relationships among the following 4 terms: haploid, diploid, meiosis, and fertilization.
6. Define:
    a) homologous chromosomes
    b) gene

7. List the processes that must occur in the formation of gametes. Start with a resting cell in the gamete producing tissue containing 14 pieces of DNA, also known as chromosomes. Point out the 2 steps which increase the number of different gametes that can be formed.

8. Variation in a population is very important since the environment is always changing. If the individuals are all identical and the environment becomes inhospitable, the species disappears.
   a. What is the ultimate source of all variability?
   b. List 4 ways in which variability is maintained in populations.

PART 2.

LONGER ANSWER QUESTIONS

1. In dogs, black (*B*) is dominant to chestnut *(b)*, and solid color (*S*) is dominant to spotted (*s*). What are the genotypes of the parents that would produce a cross with 3/8 black solid, 3/8 black spotted, 1/8 chestnut solid, and 1/8 chestnut spotted puppies? (Hint: first determine what genotypes the offspring must have before you deal with the fractions.)

2. Two breeds of dogs, one with straight, black fur and one with curly brown fur were mated. The hybrids were mated with each other and produced the following F2:

brown, straight	35	black, wavy	179
brown, curly	29	black, straight	95
brown, wavy	62	black, curly	89

   A) Propose a hypothesis to explain these results.
   B) What is phenotype of the F1 individuals predicted by your hypothesis?

3. The skin pattern of the common leopard frog is genetically determined. When striped frogs are mated with spotted frogs, all of the offspring are striped. The F1x F1 cross produced an F2 generation of 104 striped and 33 spotted. Which pattern is due to a dominant allele?
   A) How many of the F2 are expected to be heterozygous?
   B) How many of the F2 with the recessive phenotype are expected to be homozygous?

4. In crosses between two crested ducks approximately ¾ of the eggs hatch. The embryos of the remaining quarter develop nearly to hatching and then die. Of the ducks that do hatch about 2/3 are crested and 1/3 are crestless.
   A) Explain these results genetically.
   B) What would you expect from a cross of a crested with a crestless duck?
   C) Is it possible to establish a true-breeding strain of crested duck? Explain.

5. Given two pure breeding strains for the traits A, B and a,b. Mate the strain pure for A and B with the strain pure for a and b. What are the genotypes and phenotypes of the offspring?
   If we mate these offspring with the strain pure for traits a and b, predict the offspring proportions:
   A) if the two traits are independent
   B) if the two traits are pleiotrophic
   C) if the two traits are the result of genes on the same chromosome.

6. Given a flower where pure red crossed with pure white gives all pink. If 36% of the population have red flowers:
   A) what is the frequency of the white allele
   B) what is the frequency of heterozygotes in the population

7. Given a recessive trait that appears once every 100 births:
   A) what is the frequency of the recessive allele
   B) what fraction of the population are carriers for the trait?

ESSAYS

1. Given a population split in two by a canyon. The canyon persists for a very long time. In this allopatric situation, describe how the two populations could diverge enough over time to become two species, so that if the canyon filled and the two populations were reunited, they would not be able to interbreed.
2. A new organism is discovered in the deserts of New Mexico. Scientists determine that the polypeptide sequence of Hemoglobin from the new organism has 68 amino acid differences from humans, 62 differences from a monkey, 24 differences from a rat and 6 differences from a frog. What might you hypothesize from these observations and how might you test this?
3. Many species can reproduce either asexually or sexually. It is often when the environment changes in some way that is unfavorable to an existing population that the organisms begin to reproduce sexually. Speculate about the evolutionary significance of this switch from asexual to sexual reproduction.
4. Some species have been rescued from near extinction by conservationists. In terms of evolutionary theory, what problems do such species face as their populations rebound from a small size.
5. An orange grower discovered that most of his trees were infested with destructive mites. He sprayed the trees with insecticide, which killed 99% of the mites. Five weeks later, most of the trees were infested again, so he sprayed again, using the same quantity of the same insecticide. This time, only about half the mites were killed. Explain why the spray did not work as well the second time.
6. Mature nerve cells no longer divide, so they do not replicate their DNA. A cell biologist found that there was X amount of DNA in a human nerve cell. The biologist then measured the amount of DNA in 4 other types of human cells; the results are shown below. Match the amounts of DNA with the correct choice from the following list: a) sperm cell; b) bone marrow cell just finishing mitosis; c) skin cell partway into mitosis; d) intestinal cell just before the chromatids split.

Cell A	2X DNA
Cell B	1.6X DNA
Cell C	0.5X DNA
Cell D	X DNA