Heredity, Genetics and Cloning Review

1. In the lab where you work, you find an incomplete illustration of a sequence of nitrogenous bases, drawn by Rodrigo, a researcher away on vacation.

G G G T C T G A T

Is this the sequence of a DNA molecule or an RNA molecule? Explain your answer.

2. If 32 percent of the nitrogenous bases in an organism's DNA are adenine, . . .

a) what percentage of the bases will be thymine? Explain your answer.

b) what percentage of the bases will be cytosine? Explain your answer.

3. Three students are discussing protein synthesis.

Cassandra says, "During protein synthesis, a messenger RNA must be built based on the DNA."

"No, no, no!" objects Ivan. "During protein synthesis, transfer RNA is needed to transport amino acids to the ribosomes."

Sylvia adds, "You're both right, but you're talking about two different processes in protein synthesis. You should also know that the messenger RNA produced in the nucleus attaches itself to a ribosome during protein synthesis."

Which of the three students is referring to the transcription stage in his or her description of protein synthesis?

4. Using the lead DNA strand below, answer the questions.

CCG TAC GCT ACC ACT GGT TTC TAC CCC CCT ATT

a- Give the complimentary strand.

b- Give the mRNA strand.

c- Give the tRNA strand

d- Give the sequence of amino acids produced.

5. Make a DNA sequence using the following parameters:
   - The DNA strand must have 27 nucleotides
   - The start codon is the 1st triplet
   - The 2nd, 5th and 9th codons must be different, but must produce the same amino acid
   - The 3rd and 6th codon must be different, but must produce the same amino acid
   - The 7th codon is the stop codon

6. In his research, Mendel cross-pollinated a pure-line pea plant with round seeds and a pure-line pea plant with wrinkled seeds. Given that the allele for round seeds is dominant over the allele for wrinkled seeds, what percentage of the first-generation plants obtained had round seeds? Explain your answer, using a Punnett square.

7. Mendel then cross-pollinated two individuals from the first generation described in the previous question. Was the percentage of individuals with round seeds the same among the new generation? If not, what is the percentage? Explain your answer, using a Punnett square.

8. There are four children in the Chapel family. Lewis and Louise have brown eyes, and Olivia and Oliver have blue eyes. The parents, Denis and Denise, have brown eyes. What are their genotypes? Describe how you arrived at your answer, assuming that eye colour is determined by a single gene whose allele for brown eyes is dominant over the allele for blue eyes.

9. In her lab, Lucy is trying to develop a technique to grow a new cornea from cells taken directly from the injured cornea of a person who has sustained an accident to the eye.

a) Why can Lucy's work be considered an example of cloning?

b) Is it natural or artificial cloning? Explain your answer.

10. Do the following examples refer to a genotype or a phenotype?

a) Chromosome 21 is not normal. _____

b) A baby has blond hair. _____

c) The sex chromosomes are the 23rd _____

d) A girl has blue eyes. _____

e) A boy has olive skin. _____

11. You crossbreed purple-flowered pea plants with long stems (PpLl) with purple-flowered plants with short stems (Ppll). What are the possible offspring's phenotypes and genotypes?

12. A- Colour blindness is a sex linked trait. Determine the possible outcomes of the offspring if a colour blind male mates with a carrier female.

B- How do the possibilities change if the mother is colour blind, but not the father?

C- In sex linked traits, why does the sex of the offspring change matter when inheriting a trait?

13. Protein synthesis occurs as a result of certain processes in a cell. Place the following steps in the correct order.

A. An mRNA is formed.
B. tRNA bond with the mRNA. Amino acids are joined together.
C. The synthesized protein detaches itself from the ribosome and folds into its final shape.
D. The two strands of DNA separate.
E. An mRNA attaches itself to a ribosome.

14. Does each of the following statements refer to DNA or RNA?

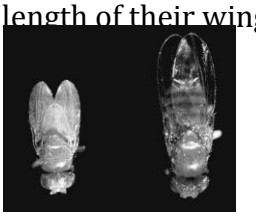
a) I do not contain any thymine. _____

b) Most of the time, I am a molecule made up of two complementary strands. _____

c) One of my nitrogenous bases is uracil. _____

d) I act as a messenger during protein synthesis. _____

15. Among the character traits studied in fruit flies is the length of their wings. Two shapes are possible for this character trait: normal wings and miniature wings. If two pure-line individuals with normal wings are crossbred, what proportion of the offspring will also have normal wings? Explain your answer.



16. When a fruit fly has an allele for normal wings and an allele for miniature wings, its phenotype for this character trait is "normal-winged."

a) Is this individual homozygous or heterozygous for the character trait?

b) Which of the two alleles is dominant?

c) Which of the two alleles is recessive?

d) What would be the possible genotype or genotypes for a fruit fly with normal wings?

e) What would be the possible genotype or genotypes for a fruit fly with miniature wings?

17. In tomatoes, the allele for purple stems (P) is dominant over the allele for green stems (p). Second, the allele for red fruit (R) is dominant over the allele for yellow fruit (r). Two tomato plants that are heterozygous for the two character traits are crossbred. Supposing that 160 new plants are obtained, use a Punnett square to show how many of them, in theory, will have:

a) a purple stem and yellow fruit _____

b) a purple stem and red fruit _____

c) a green stem and yellow fruit _____

d) a green stem and red fruit _____

18. Campers are planning to grow pea plants in the garden. They can only get two varieties of seeds from the supply store. One type is heterozygous for round seeds and yellow seeds. The other type is homozygous for wrinkled seeds and green seeds. To increase the variety of peas in their garden the campers plan to cross these pea plants. Determine the expected ratio of phenotypes from this cross.

19. DNA is the molecule that allows us to code all genetic characteristics. During protein synthesis, new molecules are formed to facilitate this process. A strand of DNA is shown below.

AGC TAC CTG GAA GTT CCT

Which strand of mRNA below, corresponds to the strand of DNA above?

A) UCG AUG GAC CUU CAA GGA
B) UCT AUT TAC CUU CAA TTA
C) TCG ATG GAC CTT CAA GGA
D) TCG UTG GUC err CUU GGU

20. Read the following text and then answer the questions below.

In Canada, one in 10 000 people suffers from Huntington's chorea, which causes neurons in the brain to decay. Patients typically have difficulty controlling their movements; eventually they become completely immobile and die. On our fourth pair of chromosomes, we all have a gene called the *Huntington gene.* It contains instructions for synthesizing a protein called *huntingtin,* whose exact function in our neurons remains unexplained. It is known, however, that a particular amino acid is repeated in its structure. If this amino acid is repeated fewer than 35 times in a row, the carrier does not normally suffer from Huntington's chorea. When there is a sequence with more than 35 repetitions, the person has the disease. Unfortunately, people who carry the allele causing Huntington's chorea in their DNA are inevitably afflicted with the disease. The first symptoms of this hereditary disease usually appear between the ages of 30 and 45 years, so affected adults may already be parents before realizing that they are sick.

a- Which mRNA has the longer nucleotide sequence: the one copied from the mutant allele associated with Huntington's chorea or the one copied from the normal allele? Explain your answer.

b- Which of the two alleles is dominant: the one that causes the disease or the one that does not? Explain your answer.

c- What are the possible genotypes for a person with this disease?

d- If the father of a child is heterozygous for this character trait and the mother does not have Huntington's chorea, what is the probability that the child will have the disease?