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Define the following terms (5 points each):

blastn (be sure to distinguish blastn from other options, such as blastp)

refseq

semidominant alleles

1. (5 points) At a given locus, two alleles, 1 and 2, are present in a population in Hardy-Weinberg equilibrium and no other alleles are present at appreciable frequencies. Homozygotes for allele 1 represent 36% of the population. What fraction is heterozygous?

2. (5 points) Allele 2 confers an increased risk of early-onset Alzheimer's disease in a recessive manner. What fraction of the population shows this increased risk?

You are studying a mutation in the yeast *Saccharomyces cerevisiae* that is temperature sensitive (no growth above 32 degrees). This mutation (which you name *mft2* for my favorite temperature sensitive 2) may be a new gene and you want to investigate.

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First, you cross your haploid *mft2* strain to a haploid strain of the opposite mating type carrying *trp1* and *yfg4*, both recessive markers on chromosome IV. The phenotype of *trp1* is a requirement for tryptophan for growth and this gene is very tightly linked to the centromere. The phenotype of *yfg4* is temperature-sensitivity. However, in this case, there is no growth above 28 degrees. At 30 degrees, *yfg4* cells will not grow but *mft2* cells grow normally.

YFG4 lies 11 map units to the right of *TRP1*, so the expected recombination frequency is 10%.

The resulting *mft2/MFT2; trp1 yfg4 / TRP1 YFG4* diploids are wild-type (they grow at 33 degrees without tryptophan) and sporulate normally.

You induce sporulation and examine the haploid spores.

3. Among the resulting haploid spores 50% are *trp1*. (5 points) What fraction of the *trp1* haploids are also *yfg4* (which you can test by growth at 30 degrees)?

You identify 20 colonies that are *trp1YFG4*.

4. (5 points) If *MFT2* is unlinked (not on chromosome IV), what fraction of these 20 colonies do you expect to grow at 33 degrees?

5. (6 points) In this case (*MFT2* is unlinked) could you determine whether it is near the centromere of the chromosome that it is on? Is so, how would you do that?

6. (5 points) If *MFT2* is 2 cM. to the right of *YFG4*, what fraction of these 20 colonies do you expect to grow at 33 degrees?

7. (5 points) If *MFT2* lies precisely between *TRP1* and *YFG4*, what fraction of these 20 colonies do you expect to grow at 33 degrees?

8. (5 points) If *MFT2* lies 2 cM. to the left of *TRP1*, what fraction of these 20 colonies do you expect to grow at 33 degrees?

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9. (5 points) Here is the sequence of the template strand of a DNA fragment:

GTCGCCGTGCAATGATGTAGGCGACTATGGTTGA

Applying the standard **convention** for polarity (which end is 5' and which is 3'), which of the following would be the complementary, nontemplate, strand?

- a) GTCGCCGTGCAATGATGTAGGCGACTATGGTTGA
- b) CAGCGGCACGTTACTACATCCGCTGATACCAACT
- c) TCAACCATAGTCGCCTACATCATTGCACGGCGAC
- d) AGTTGGTATCAGCGGATCTAGTAACGTGCCGCTG

(4 points each). In the following questions, one of the statements is true.

Circle either **a** or **b** (or **c**), next to the correct statement. Ambiguous marks (circling both, placing a mark between the two statements, etc.) will be considered wrong.

- 10. **a** In tetrad analysis, when two genes are **linked** the number of parental ditypes will be approximately equal to the number of nonparental ditypes.
b In tetrad analysis, when two genes are **unlinked** the number of parental ditypes will be approximately equal to the number of nonparental ditypes.
- 11. **a** In tetrad analysis, when two genes are unlinked the relative number of tetratypes and nonparental ditypes **will depend on** their distance(s) from the centromere.
b In tetrad analysis, when two genes are unlinked the relative number of tetratypes and nonparental ditypes **will be independent of** their distance(s) from the centromere.
- 12. **a** The same mutant allele can be **dominant with respect to some traits and recessive with respect to others**.
b A particular mutant allele is either **dominant or recessive for all traits** that it affects.
- 13. **a** The kinetochore is a specialized structure in the **centrosome** that is specialized for conveyance.
b The kinetochore is a specialized structure in the **centromere** region of each chromatid that is specialized for conveyance.

14. (9 points) Label **each** of the following three statements as

1) true of DNA polymerase, **2)** true of RNA polymerase, **3)** true of both or **4)** true of neither.

_____ **a.** Requires a primer whose 3' end is base-paired to the template.

_____ **b.** Requires a template.

_____ **c.** Adds nucleotides to the 5' end of a polynucleotide chain in accordance with basepairing to a template strand.

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15. (8 points) Label **each** of the following statements as **true** or **false**

- _____ a. The probability of two or more **independent** events occurring together is the **sum** of the probabilities that each will occur by itself.
- _____ b. The probability of two or more **independent** events occurring together is the **product** of the probabilities that each will occur by itself.
- _____ c. The probability of two or more **mutually exclusive** events occurring together is the **sum** of the probabilities that each will occur by itself.
- _____ d. The probability of two or more **mutually exclusive** events occurring together is the **product** of the probabilities that each will occur by itself.

16. (6 points). What is the sequence of this stretch of amino acids in single letter code?

