

1). ABO blood groups. [25 Points]

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a) What are the expected offspring, and their frequencies, if mom is Type AB and dad is Type O? [10 points]

b) Suppose that dad is type Rh+, while mom is type Rh-. If their son is Rh+, and their two daughters Rh-, what are the genotypes of both parents at the Rh locus? [5 points]

c) An A+ woman has an O- son, and claims one of two persons is the father. Joe has type AB-, while Sam has type B+. Can either (or both) be excluded as the potential father? Why? [10 points]

2) Basic probability. [25 points]

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Consider a population where the ABO alleles have frequencies
 $\text{freq}(A) = 0.5$, $\text{freq}(B) = 0.4$, $\text{freq}(i) = 0.1$

a) What is the expected frequency of an individual of blood type AB? [5 points]

b) What is the expected frequency of a type A individual? [5 points]

c) What is the probability of getting any genotype besides Type O? [5 points]

d) How many individuals do we have to sample to have at least a 90 percent probability of drawing a type O? [10 points]

3) DNA structure. [25 points]

Consider the following DNA sequence

5' A G T T C G A G G G G G G G C C A A 3'

a) Draw the complementary strand on the figure below [5 points]

5' A G T T C G A G G G G G G G C C A A 3'

b) Suppose you add a 5' G G C C 3' primer. Show on the sequence below (i) where this binds and (ii) the new DNA generated from this primer. [10 points]

5' A G T T C G A G G G G G G G C C A A 3'

c) You wish to use a PCR reaction to amplify the G G G G G G G region in the middle. What are the two four-base primers you need to do this? Hint: (i) Don't forget polarity, and (ii) your answer from (a) will be very useful! [10 points]

5' A G T T C G A G G G G G G G C C A A 3'

**4) Short answers (one-two sentences)
[5 points each]**

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- a) What is the difference between genotype and phenotype?
- b) List two advantages for forensics from using PCR.
- c) What was Mendel's key idea about genetics?
- d) Give one reason while use now use STR markers in place of RFLP markers for forensics.
- e) What are the AND and OR rules of probability?