HMB265H1S Midterm Exam 2010-11
FORM A
Name_____ Student #_____

Part 1--MULTIPLE CHOICE. Choose the one answer that best answers the question. 16 questions worth 2 marks each, total 32 marks.

1) What does NOT describe an individual who is XO, with just a single X chromosome and no Y chromosome?
   A) *Drosophila* with 1:2 ratio of X:autosomes
   B) *Drosophila* male
   C) human male
   D) cause is a nondisjunction event during meiosis

2) Two individuals with the same genetic disease have a child who does not have the disease. What could NOT explain this disease?
   A) incomplete dominance
   B) dominant, with parents having mutations in the same gene
   C) recessive, with parents having mutations in different genes
   D) incomplete penetrance

3) The following shows a genetic pathway involving three genes acting as catalysts (A, B and C). Dominant wild type alleles at each gene are functional, and catalyze the next step in the pathway, while recessive mutations are nonfunctional, inactive versions of the gene. A cross is made between AaBbCc and aaBBCc. Assuming that the genes are unlinked, what proportion of the progeny is expected to be yellow?

$$\text{Red} \xrightarrow{A} \text{Green} \xrightarrow{B} \text{Yellow} \xrightarrow{C} \text{Blue}$$

   A) 1/4
   B) 1/8
   C) 1/16
   D) 3/16

4) The Wright lab is studying a mutation that makes hermaphroditic Capsella plants self-compatible, in contrast to the wild type self-incompatible phenotype. In a cross between inbred lines, the F1 is found to be self-compatible, and the F2 shows a 3:1 segregation pattern of self-compatible: self-incompatible. A graduate student in the lab looks at the protein level, and observes that the F1 does not express any of the normal wild-type protein, but only expresses aberrant proteins characteristic of the self-compatible type. How are these results best explained?
   A) codominance
   B) complementation
   C) dominant negative
   D) haplosufficiency

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5) What does NOT characterize the results of a three-point testcross with linked genes?
A) Interference increases the observed number of double recombinants.
B) Map distances are most accurate when using the closest gene pairs.
C) Rarest classes are the double recombinants.
D) Most common classes are the parental types.

6) Based on the Depp family pedigree (**Figure 2** at the end of this exam) and the likely mode of inheritance of the disease, what is the probability that a child of individuals III-3 and III-5 will have the disease?
A) 1/2
B) 1/3
C) 1/4
D) 2/3

7) The frequency of a dominant autosomal disease allele is 0.1 in a population. What proportion of the population is expected to have the disease, assuming the population is at Hardy-Weinberg equilibrium?
A) 19%
B) 10%
C) 18%
D) 1%

8) When is Mendel's Law of Independent Assortment violated?
A) only in rare cases such as meiotic drive
B) never
C) when genes are found on different chromosomes
D) when genes are found nearby on the same chromosome

9) In the Jones family, an individual affected with the rare X-linked recessive disease haemophilia appears (see pedigree Figure 1 at the end of the exam; shaded individual, II-1). What is the probability that the first child of individuals II-3 and II-4 is affected by haemophilia?
A) 1/8
B) 1/2
C) 1/4
D) 3/16

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10) A cross was performed between individuals homozygous for three linked genes, where one parent had the genotype AABBcc and the other parent had the genotype aabbCC. An F1 individual was then testcrossed. Of 1000 total progeny, 1 was found to have the genotype Aabbcc, and another was found to have the genotype aaBbCc. The genetic map for these genes is:
A-----20cM-----B------10cM------C.
Given these results, what is the coefficient of interference?
A) 1
B) 0
C) 0.1
D) 0.9

11) As an expert in human genetics, you are asked to consult about a patient, Sarah, who has an X-linked recessive disorder, red-green colour blindness. What can you immediately say about one of her relatives?
A) Her mother's mother must be either a carrier or red-green colour blind.
B) Her father's father must be red-green colour blind.
C) Her mother's father must be red-green colour blind.
D) Her father's mother must either be a carrier or red-green colour blind.

12) A female fly with genotype Aa; BB ; Cc ; dd is crossed with a male fly that has genotype aa; Bb; cc; DD. Assuming independent assortment, what proportion of the progeny will be heterozygous at all genes?
A) 1/4
B) 1/16
C) 1/8
D) 1/2

13) A population off the coast of South America has an X-linked recessive disease that results in low muscle tone. The disease allele has a frequency of 5%. What percent of males is NOT expected to have the disease, assuming the population is at Hardy-Weinberg equilibrium?
A) 95%
B) 10%
C) 5%
D) 90.25%

14) What best describes a situation where a mutation is identified that causes both liver degeneration and high cholesterol?
A) incomplete penetrance
B) pleiotropy
C) multigene inheritance
D) varying expressivity

15) A researcher was trying to determine whether two RFLP markers, A and B, were linked to each other on the same chromosome. A cross was performed between two inbred lines, and the F1 was crossed to an individual homozygous for both uncut alleles (Figure 3 at the end of this exam). If the genes are linked and 20 cM away from each other, what percent of the progeny from this cross are expected to show the exact same banding pattern as the F1 individuals?
A) 40%
B) 10%
C) 20%
D) 5%

16) Tasha has type AB blood and her husband Max has type B blood. If Max's mother has type A blood, what is the probability that Tasha and Max's first child will be a girl and have type A blood?
A) 0
B) 1/2
C) 1/8
D) 1/4

Part 2-- SHORT ANSWER. Write your answer in the space provided. (1 question, 4 marks total)

17) Kevin is an undergraduate student working in a mouse genetics lab. In his mutagenesis screen, he identifies three inbred strains of mice with mutant white coat colours. When he crosses strains A and B, all the progeny have the wild type brown coat colour. In contrast, when he crosses strains A and C, all the progeny have a white coat colour.

17. a) **(1 mark)** What is the name of the genetics experiment Kevin performed?

Answer:

Complementation (or complementation test) -1 mark

17. b) **(2 marks)** What can be concluded from Kevin's results?

Answer:

The mutations come from two different genes (or A and C are in the same gene and B is in a different gene) --2 marks

17. c) **(1 mark)** What will most likely happen if he crosses strains B and C?

Answer:

Crossing B and C should give a wild-type brown coat mouse -1 mark

Figures:

Figure 1- Pedigree for the Jones Family

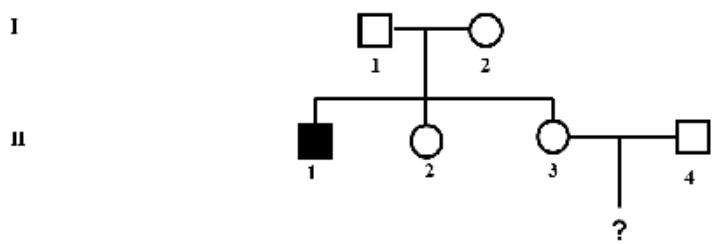
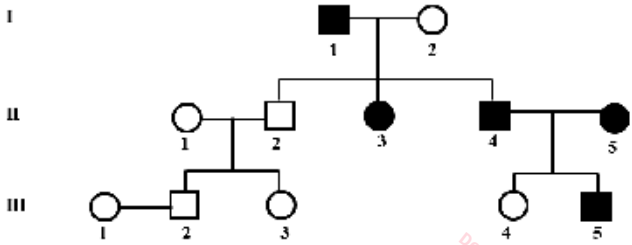


Figure 2 – Pedigree for the Depp family



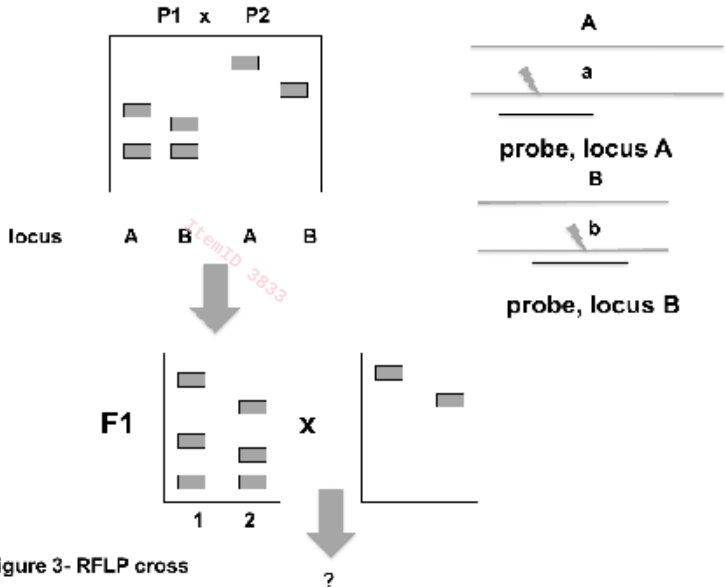


Figure 3- RFLP cross