HMB265H1F Midterm Exam 2011-12
FORM A
Name_____ Student #_____

Part 1--MULTIPLE CHOICE. Choose the one answer that best answers the question. 17 questions worth 2 marks each, total 34 marks.

1) Which of the following is an example of variable expressivity?
   A) The homozygous recessive genotype is sometimes, but not always, shorter than the wild type genotype.
   B) A *Drosophila* size gene shows incomplete dominance, where the heterozygote is intermediate in size compared with the two alternative homozygotes.
   C) The dominant wild type allele at a gene makes flies much bigger than the homozygous recessive genotype.
   D) In *Drosophila*, the homozygous recessive genotype makes flies either slightly smaller or much smaller than wild type.

2) Two different true-breeding lines of mice, both with recessive mutations for a bone disorder, are crossed and they give rise to F1 mice without the disorder. If an F1 individual is backcrossed to one of the parents, what proportion of the mice is expected to have the disorder?
   A) 9/16
   B) 1/4
   C) 1/8
   D) 1/2

3) A cross is performed between two individuals with the RFLP banding patterns shown in **Figure 3** at the end of this exam. The F1 individual is then crossed with individual P3 shown in the figure. If genes A and B are on different chromosomes, what percent of the progeny in the F1 x P3 cross is expected to show the exact same banding pattern as the F1 individuals?
   A) 10%
   B) 25%
   C) 40%
   D) 50%

4) Mary is interested in the inheritance of flower colour in monkey-flowers. She crosses a true-breeding yellow-flowered plant with a true-breeding purple- flowered plant and the offspring are all yellow-flowered. When she crosses the F1 individuals together, she obtains the following results for the F2 generation: 12/16 are yellow-flowered, 3/16 are blue-flowered, and 1/16 are purple-flowered. What is the best explanation for flower colour inheritance based on these results?
   A) Two genes with complementation.
   B) Two genes with dominant epistasis.
   C) A single gene with variable penetrance.
   D) A single gene with incomplete dominance.

5) Chromosome 4 in *Drosophila* experiences no recombination. Which of the following statements is correct?
   A) A gene on this chromosome will not show independent assortment with a gene on another chromosome.
   B) The chromosome must have extremely little DNA.
   C) Only two gamete types would be expected in an individual that is heterozygous for two genes on this chromosome.
   D) All genes in a genetic mapping experiment on chromosome 4 would have a genetic distance of less than 50 cM but greater than 0 cM.

6) The following shows a genetic pathway involving three genes acting as catalysts (A, B, and C). Dominant wild type alleles at genes B and C are functional and catalyze the next step of the pathway, while a homozygous recessive aa genotype is required in the first step of the pathway (dominant A alleles block further steps in the pathway). A cross is made between AaBbCc and aabbCc. Assuming that the genes are not linked, what proportion of the progeny is expected to be white?

aa B C
White ⇒ White ⇒ White ⇒ Red

   A) 9/16
   B) 13/16
   C) 1/16
   D) 3/16

7) The following two questions refer to the Tyler family pedigree (**Figure 1** at the end of this exam), which shows two individuals with a very rare disease.

   7) Based on this pedigree, what is the likely mode of inheritance of the disease?
      A) X-linked recessive
      B) X-linked recessive and autosomal recessive are equally likely
      C) autosomal recessive
      D) X-linked dominant

8) If individual III-2 had three children with individual III-4, what is the probability that they are all male and none have the disease?
   A) 1/16
   B) 9/16
   C) 1/64
   D) 63/64

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9) Which of the following statements about an individual who is XXY is NOT correct?
   A) In *Drosophila,* the individual would be female.
   B) In humans, the individual would be female.
   C) In humans, the individual would be male.
   D) They were likely formed via nondisjunction of the sex chromosomes during meiosis.

10) Pablo and both of his parents have type A blood, while his sister has type O blood. If Pablo's wife has type O blood, what is the probability their first child will have type O blood?
   A) 1/3
   B) 1/8
   C) 1/2
   D) 2/3

11) Daniel has a recessive X-linked disorder, haemophilia, and so does his father but not his mother. If Daniel has two sisters, what is the probability that neither of them will have haemophilia?
   A) 1/2
   B) 1/4
   C) 1/8
   D) 3/4

12) The Morgan family, whose pedigree is shown in **Figure 2** at the end of this exam, is affected by a very rare autosomal dominant disorder. If this disorder shows 25% penetrance in both heterozygous and homozygous form, what is the probability that both children of individuals III-4 and III-5 have the disorder?
   A) 1/64
   B) 1/8
   C) 1/16
   D) 1/4

13) In *Drosophila,* wild type alleles are often found to be dominant over mutant alleles. What is this referred to as?
   A) dominant negative
   B) haploinsufficiency
   C) epistasis
   D) haplosufficiency

14) The Wright lab identified a mutation in the plant Capsella that reduces both pollen number and petal size. How is this best explained?
   A) recessive epistasis
   B) pleiotropy
   C) incomplete penetrance
   D) variable expressivity

15) When is Mendel's Law of Segregation violated?
   A) never
   B) when genes are found on different chromosomes
   C) when genes are far apart on the same chromosome
   D) with mitochondrial inheritance

16) A population on an Oceanic island has red-green colour blindness, an X-linked recessive condition. If the allele for red-green colour blindness is at 20% frequency on this island, what percentage of females are expected to be red-green colour-blind? Assume that the population is at Hardy-Weinberg equilibrium.
   A) 60%
   B) 80%
   C) 20%
   D) 4%

17) A true-breeding mouse with a brown back and yellow belly is crossed with a true-breeding mouse with a black back and white belly, and all of the progeny have a black back and yellow belly. If two F1 individuals are crossed with each other and the genes are known to be completely linked, what proportion of the progeny will have a black back and yellow belly?
   A) 9/16
   B) 1/4
   C) 3/4
   D) 1/2