HMB265H1F Midterm Exam 2012-13
**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) An autosomal dominant disease is present at a frequency of 19% in a South Pacific population. What proportion of the population is expected to be homozygous for the disease allele, assuming the population is at Hardy-Weinberg equilibrium?
   A) 90%
   B) 10%
   C) 9%
   D) 1%

recessive: 100-19 = 81 = 0.81
q = sqrt(0.81) = 0.9
p = 1-q = 0.1
p^2 = 0.01 = 1%

2) What is **CORRECT** about Mendel's Law of Independent Assortment?
   A) only violated in the case of meiotic drive
   B) violated in the case of epistasis
   C) determined using a monohybrid cross
   D) violated every generation in humans

Guessing because of meiosis (where nondisjunction is frequent) and humans haxe complex traits (e. g. skin colour)

3) Sheila's father has type A blood, and her mother has type B. If all four of her grandparents were type AB and her husband has type O, what proportion of Sheila's children is expected to be type A?
   A) 1
   B) 1/2
   C) 0
   D) 1/8

Sheila is AB since all of her grandparents were AB (no one has the i allele), which means her father was AA and mother was BB

AB x ii -> 1 Ai : 1 Bi
Therefore probability of children to be type A = 1/2

4) The following genetic pathway catalyzes the formation of brown mice, where dominant wild-type alleles at each step are required to proceed along the pathway. If a brown individual of *A*/*a*; *B*/*b*; *C*/*c* genotype is crossed with a yellow individual of *A*/*a*; *B*/*b*; *c*/*c* genotype, what proportion of the progeny will have a yellow phenotype?

$$\text{White} \xrightarrow{A} \text{White} \xrightarrow{B} \text{Yellow} \xrightarrow{C} \text{Brown}$$

   A) 13/64
   B) 9/32
   C) 1/32
   D) 3/32

AaBbCc x AaBbcc
↓
Aa x Aa -> 3/4 will be A-
Bb x Bb -> 3/4 will be B- (yellow)
Cc x cc -> 1/2 will be cc (since dominant C will give you brown)
Proportion of progeny that will be yellow: (3/4)*(3/4)*(1/2) = 9/32

5) A cross was performed in sunflowers, tracking the segregation of three linked genes, where the genetic map was A------25cM-------B------20cM------C.

The cross was performed between a parent with genotype *AAbbCC* and a parent with genotype *aaBBcc*. The $F_1$ progeny were then testcrossed. Assuming no interference, what proportion of the progeny is expected to be *AaBbCc*?

AbC/aBc x AbC/aBc

You want: ABC/abc (which are recombinants)

A) 2.5%
B) 45%
C) 5%
D) 25%

0.25*0.2 (use both distances since the B is the only differing aspect when compared to the parent types)
0.25*0.2 = 0.05/2 = 0.025 (divide by two since you can have abc AND ABC)
0.025 = 2.5%

6) Three different genes are known to each have two different alleles: One allele with a restriction site and a second allele with no restriction site, resulting in restriction fragment length polymorphisms (RFLPs). A cross was performed between two individuals with distinct RFLP profiles (shown in **Figure 2** at the end of the exam). What proportion of the progeny is expected to show the pattern in offspring A?

A) 1/4
B) 1/2
C) 1/8
D) 1/16

Didn't bother with this

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

7) Based on this pedigree, what is the likely mode of inheritance of this disease?

A) X-linked dominant
B) autosomal dominant
C) X-linked recessive
D) autosomal recessive

- Dominant since you see it in every generation
- Not X-linked, since III-2 isn't affected even though both of her parents are

8) If individual III-1 had a child with individual III-3, what is the probability that the child will **NOT** have the disease?

A) 1/3
B) 2/3
C) 3/16
D) 1/4

III-3: homozygous recessive since she doesn't have the disease
III-1: 2/3 chance he's heterozygous (out of 3 since he's definitely not homozygous recessive)
1/2 chance child will inherit recessive allele from III-1
Therefore probability child will NOT have disease: (2/3)*(1/2) = 2/6 = 1/3

9) A cross is performed between two white-flowered lines and the $F_1$ progeny are all blue. When the $F_1$ generation is self-crossed, it is observed that 9/16 of the $F_2$ progeny are blue, while the rest are white. What genetic phenomenon best describes this example?

A) incomplete dominance
B) codominance
C) complementation
D) variable expressivity

I don't know how to explain this really, so I'll say it in a "method of elimination" style:
A) Can't be incomplete dominance, since that means the flowers will be LIGHT blue
B) Can't be codominant, that means you'll see blue AND white
D) Can't be variable expressivity since you don't have a range of outcomes

10) **Figure 3** at the end of the exam shows a pedigree for an X-linked recessive disease in the Gibbs family. If individuals II-3 and III-3 have a daughter, what is the probability that she will **NOT** have the disease?

A) 1/4
B) 1/2
C) 1/8
D) 3/4

1/2 chance III-3 is heterozygous (Xx)
II-3: xY
Probability of having a daughter: 1/2
Probability of inheriting recessive x from mother: 1/2
(1/2)*(1/2) = 1/4
Probability of daughter NOT having disease: 1-(1/4) = 3/4

11) A mutation is discovered that causes diabetes in individuals that are either heterozygous or homozygous for the mutation. When the gene was characterized, it was found that heterozygotes have only 1% of the active enzyme observed in wild-type homozygotes. What is this best described as?

A) pleiotropy
B) haplosufficiency
C) dominant negative
D) haploinsufficiency

If it was haploINsufficient, then 50% of the active enzyme would be observed, not 1%.

12) Two genes (*A* and *B*) were found to control the heart-shaped fruit morphology of the Shepherd's Purse plant. The genes show redundant function, such that the presence of at least one wild-type dominant allele at one of the two genes is enough to produce heart-shaped fruits, while homozygous mutants at both genes produce elongated fruits. A cross was made between a plant that is *A*/*a; B*/*b* and a plant that is *a*/*a; B*/*b*. Assuming independent assortment, what proportion of the progeny will have heart-shaped fruits?

A) 1/16
B) 15/16
C) 9/16
D) 7/8

AaBb x aaBb
Aa x aa = 1/2 probability A-
Bb x Bb = 1/4 chance bb
Probability of not being heart shaped: (1/2)*(1/4) = 1/8
Probability of being heart shaped: 1-(1/8) = 7/8

13) Two linked genes in mice are known to cause lethality when both genes are homozygous recessive, while any other genotype is viable. A cross is performed between two inbred lines, *AAbb* and *aaBB*, and the $F_1$ generation are interbred to form an $F_2$ generation. If the genes are 40 cM away from each other, what proportion of the $F_2$ progeny is expected to die?

A) 80%
B) 8%
C) 4%
D) 2%

Ab/aB x Ab/aB -> ab/ab
0.4*0.4=0.16
0.16/4=0.04=4%
Divide by 4 because you can have AB, Ab, aB, ab

14) Four individuals were found to be homozygous for a recessive condition causing heart disease. However, only three of the four individuals have heart disease. What is this an example of?

A) variable expressivity
B) pleiotropy
C) epistasis
D) incomplete penetrance

Since one individual doesn't show it (all individuals don't show it, only 3 do)

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15) Sarah's mother's mother (maternal grandmother) has Duchenne's muscular dystrophy, a rare X-linked recessive disease, but no one else in the family does. What is the probability that Sarah's first child will have the disease?

A) 1/8
B) 3/4
C) 1/4
D) 1/2

Probability of Sarah being a carrier: 1/2 (her mother is a definite carrier since it's recessive and x-linked and Sarah's grandmother is homozygous recessive for it)
Only Sarah's son will have disease since it's x-linked (no one besides her grandmother has the disease in her family, including her husband)
Probability of passing the recessive allele: 1/2
Probability of having a son: 1/2
Therefore probability of having an affected child: (1/2)*(1/2)*(1/2) = 1/8

16) What describes an individual who is XYY?

A) *Drosophila* female
B) inviable human genotype
C) human male
D) inviable *Drosophila* genotype

Only inviable human genotype is YO, and having at min 1 Y will result in a human male

17) Which of the following is NOT a likely explanation for the persistence of genetic diseases in human populations?

A) mutation-selection balance
B) genetic drift
C) dominance
D) past selective advantage

This one is pretty obvious/self-explanatory