

UNIVERSITY OF BRITISH COLUMBIA

Biology 121

Section 225

Midterm 2 Marking Guide March 2010

Instructor: Dr. Carol Pollock

Name: _____ **Student number:** _____

Instructions:

1. Answer all questions in the space provided.
2. All writing must be in **INK**.
3. Answers may be in sentences or point form. Illustrations are acceptable but must be annotated.
4. Students suspected of any of dishonest practices will be immediately dismissed from the examination and will be subject to disciplinary action.
5. Other than one side of one page for summary notes, no other memory devices are permitted.
6. Students may not speak or in any other way communicate with other students while in the examination room.
7. Students may not expose their written paper to other students. The excuse of accidental exposure, forgetfulness, or ignorance will not be accepted.
8. Make sure you have **FIVE** pages including this cover page.

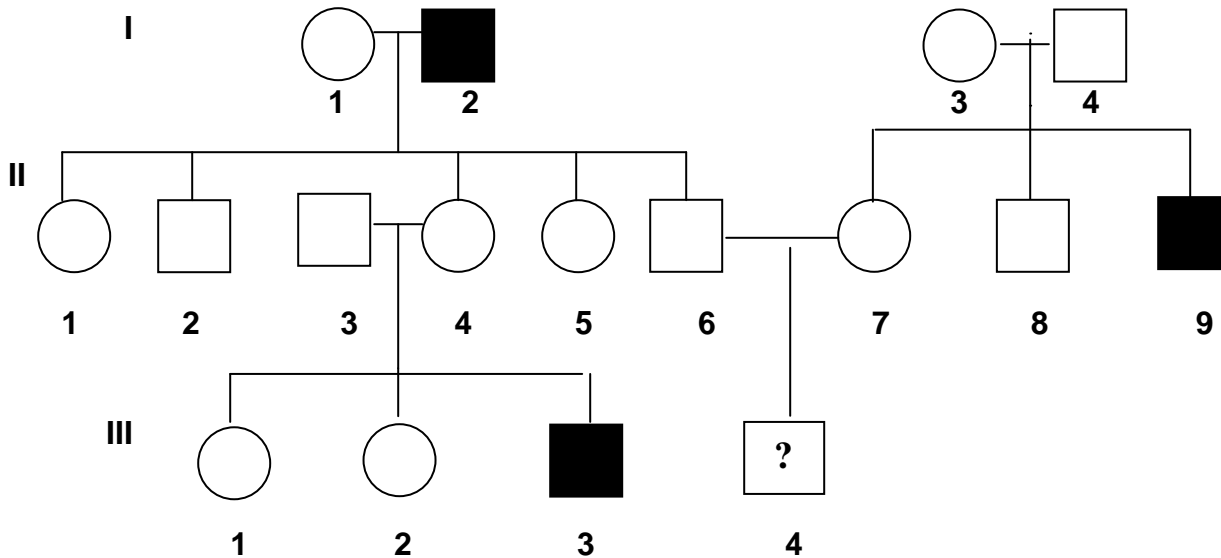
I have read and fully understand these instructions.

Student signature _____

Mark allocation:

Question	Marks possible	Your mark
1.	10	
2.	8	
3.	6	
4.	8	
5.	6	
6.	6	
Total	44	

1. The following pedigree illustrates the inheritance of a disorder in a family.



a. How is the disorder in the above pedigree inherited? Explain your answer with reference to specific individuals within the pedigree. (4 marks)

sex linked or X-linked or on X chromosome 1 mark

recessive 1 mark

Any two of the following for 1 mark each:

something to the effect that all daughters of I-2 are carriers

III-3 got the affected X from his carrier mother

since II-9 is affected, he got an affected X from his carrier mother

If say recessive or autosomal recessive max. 3/4 (lose 1 for not saying X-linked)

1 mark for recessive

any 2 of the following for 2 marks

all children of I-2 are carriers

II-3 also a carrier

I-3 and I-4 are both carriers

b. Write the possible genotypes for each of the following individuals: (4 marks)

2 marks for defining alleles – if wrong but answer to b correct based on answer to a, can get max. 2 marks.

If alleles are defined elsewhere in the answer, that's OK give marks here.

1/2 for using "X", 1/2 for upper case for non-affected, 1/2 for lower case for affected, 1/2 for Y = male

e.g., X^A = normal allele (1/2) + (1/2) for X

X^a = affected allele (1/2)

Y = male (1/2)

I-1 could be $X^A X^A$ (1/2) or $X^A X^a$ (1/2) if say probably $X^A X^A$ since no sons are affected give (1) but if say $X^A X^A$ without any reason give (1/2)

II-4 $X^A X^a$ (1/2)

III-3 $X^a Y$ (1/2)

c. What is the probability that III-4 will have the disorder? Explain. (2 marks)

probability mother is a carrier 1/2 (1/2) because her brother has the disorder (1/2). Probability that she would pass on the affected "X" to her son (1/2). Total probability 1/2 x 1/2 = 1/4 (1/2)

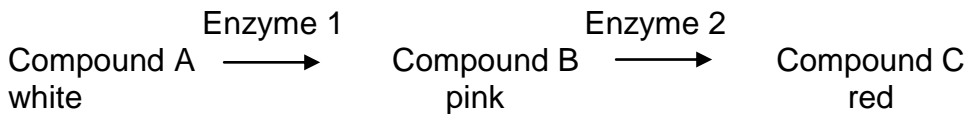
2. A true-breeding *Drosophila* with red eyes and normal bristles was crossed with a true breeding *Drosophila* with brown eyes and forked bristles. The F1 all had red eyes and normal bristles. The F1 were crossed with *Drosophila* with brown eyes and forked bristles. Their progeny were as follows:

red eyes and normal bristles 1191
 red eyes and forked bristles 67
 brown eyes and normal bristles 75
 brown eyes and forked bristles 1203

- a. Explain why you suspect these genes are on the same chromosome. (4 marks)
If they were on different chromosomes they would assort independently (1) and the F2 ratio would be 1:1:1:1 (or equal numbers of each phenotype) (1). But there are more of the parental phenotype (1) and fewer of the recombinants (1).
- b. How far apart are they on the chromosome? Show all your work. 4 marks

$$\text{freq. of recom.} = \frac{\text{no. of recombinants}}{\text{total offspring}} = \frac{142}{2536} (1) = 5.6\% (1)$$
therefore distance = 5.6 map units or cM (centimorgans) (1)
3. Recombinant DNA procedures have provided us with many products. Describe one example of a genetically modified organism that was discussed in class. Explain its effect or potential contribution to human quality of life. (4 marks)
*2 marks for one example – must be specific and explain what has been genetically modified and 2 marks for one effect or potential contribution to human quality of life (must be specific) – can be positive **or** negative.*
examples: drug therapy e.g., can replace alleles for missing enzymes e.g., SCIDS and allele for immune system (don't have to give the name of the enzyme). Allows people with this disorder to live a normal life, negative – cancer, if these people reproduce the alleles may increase in the population
growth hormone gene into E. coli or yeast – produces enough growth hormone so people with pituitary dwarfism can grow to near-normal size.
transgenic organisms producing drugs for therapy e.g. yeast and insulin vaccines, Arabidopsis and land mine detection - change in colour in presence of NO₂
Genetically modified foods e.g., golden rice– introduce gene for converting β-carotene vitamin A into rice endosperm via Agrobacterium - more nutritious since regular rice endosperm lacks vit A.
Other GM foods – tomatoes, gene for firmness - shelf life extended negative – allergies, insecticides; roundup ready canola gene for herbicide resistance, easier to treat with herbicides, negative changes the way farmers collect seeds, may affect unintended organisms Growth factor gene may treat diseases but may also lead to cheating in sports.
Marks deducted for errors

4. Roses are flowers that come in a variety of colours. The pigment pathway responsible for synthesizing the red pigment is as follows:



a. If you cross a true-breeding plant with pink flowers with a true-breeding plant with white flowers, the F1 are all red. Explain how these three phenotypes are inherited. Show all your work. (4 marks)

Must be more than one gene because more than one enzyme

Define alleles ¼ mark for each allele = 1 A = Enzyme 1 functional a = enzyme 1 non functional

B = Enzyme 2 functional b = enzyme 2 non functional

pink flowers AAbb (enzyme 1 functional, enzyme 2 non functional)

white flowers aaBB (enzyme 1 non functional, enzyme 2 functional)

Parental cross AAbb (1) x aaBB (1)

F1 all AaBb (1) red

If define alleles and give phenotype and genotype that is consistent with allele definitions 2 marks

b. If you self-crossed the F1 from part a, what phenotypic ratio do you expect in the F2? Show all your work. (4 marks)

AaBb x AaBb

Can do Punnett square or probability

F2 from F1 self using probability:

½ mark for each correct fraction or ratio and ½ for each correct phenotype plus 2 for showing how got answer = 4

p(A_B_) = ¾ x ¾ = 9/16 red

p(aaB_) = ¼ x ¾ = 3/16 white

p(A_bb) = ¾ x ¼ = 3/16 pink

p(aabb) = ¼ x ¼ = white

i.e. 9:4:3 red:white:pink

½ mark for each correct fraction or ratio and ½ for each correct phenotype plus 2 for Punnett square

Male \ female	AB	Ab	aB	ab
AB	AABB red	AABb red	AaBb red	AaBb red
Ab	AABb red	AAbb pink	AaBb red	Aabb pink
aB	AaBB red	AaBb red	aaBB white	aaBb white
ab	AaBb red	Aabb pink	aaBb white	aabb white

9 A_B_ (red):3 aaB_ (white):3 A_bb (pink):1aabb (white)

If incorrect but consistent with part (a) 2 marks

5. Buckskin horses have a golden yellow coat, bay horses have a red coat, and perlino horses have a coat that is almost white. A series of crosses between the three different types of horses produce the following progeny:

Cross	Offspring
buckskin x buckskin	13 buckskin, 6 bay, 5 perlino
bay x bay	16 bay
perlino x perlino	15 perlino
buckskin x bay	8 buckskin, 7 bay
buckskin x perlino	12 buckskin, 10 perlino
bay x perlino	19 buckskin

Explain the inheritance of buckskin, bay and perlino phenotypes in horses. 6 marks

Incomplete dominance (1) – 1 gene- as seen by the ratios from the different crosses.

bay and perlino are homozygous because they give only one type of offspring (2)

buckskin is heterozygous (1) since

- there are three phenotypes when crossed with other buckskins which correspond to the genotypic ratio (1)

- there are two phenotypes when crossed with either homozygote and the progeny are in a 1:1 ratio (1)

If two genes are proposed – max. 3 marks because ratios are not consistent with this solution.

6. Describe two observations Darwin made on his journey on the Beagle and explain how these observations helped form his theory of evolution by natural selection. (6 marks)

any two, 1 mark each plus 2 marks for each explanation

e.g. mockingbirds or finches– one species that changed as a result of adaptation on a particular island

animal spp. in temperate S. America more similar to animal spp. in tropical S. America than to temperate spp. in N. America and vice versa

fossil record of species that no longer live in S. America ancestral forms that changed over time.

If not what Darwin observed but could have seen and consistent with his ideas, OK

If ideas of others and not what Darwin observed or could have observed max. 4