

BIOL 121 Section 123 2022T1

Genetics Group Midterm

Group Number from Canvas _____ Max Group Members = 6

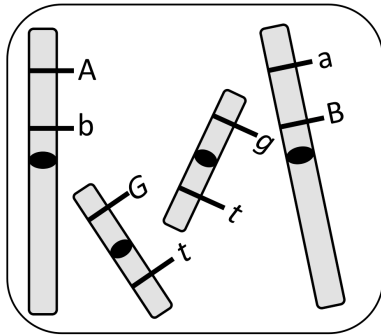
Name	Student Number
1)	
2)	
3)	
4)	
5)	
6)	

- 1) Don't take the test booklet apart.
- 2) Answer all questions in the space provided.
- 3) Writing can be in pencil or ink, but pencil, erasable ink or answers with white-out **cannot** be remarked.
- 4) Answers may be in sentences or point form. Illustrations are acceptable but must be annotated.
- 5) Students suspected of any of dishonest practices will be immediately dismissed from the examination and will be subject to disciplinary action.
- 6) Other than a **one-page** (double-sided) study sheet, no other memory devices are permitted. Study sheets that exceed the size limit may be confiscated and may be considered as cheating.
- 7) Students may speak with group members but not other groups.
- 8) Make sure you have 6 pages (3 pieces of paper) including this cover page.

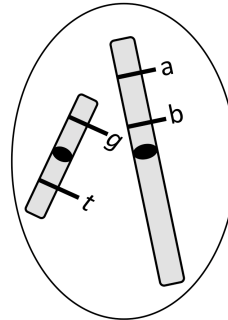
Question	Value	Score
#1	16	
#2	6	
#3	3	
Total	25	

Question 1

The picture below shows the chromosomes in a cell from an F1 plant at G1 and one of the products of meiosis. For this activity, if crossing over occurs, assume that only one crossing over event occurs per chromosome per meiosis (i.e. only one pair of chromatids will be recombinant).



Cell from an F1 individual at G1.



One of the four gametes produced

1a) What is the ploidy of the F1 individual? (0.5 marks) Diploid

1b) What is the haploid number of the F1 individual? (0.5 marks) 2

1c) Considering only the genes and alleles diagrammed in the figure above, how many different haploid genotypes can be produced by the F1 individual? (1 marks)

number of possible haploid genotypes = $2^3=8$

1d) If the parents of the F1 individual were pure breeding, what are all the possible genotypes of the parents that generated this F1 individual? (2 marks)

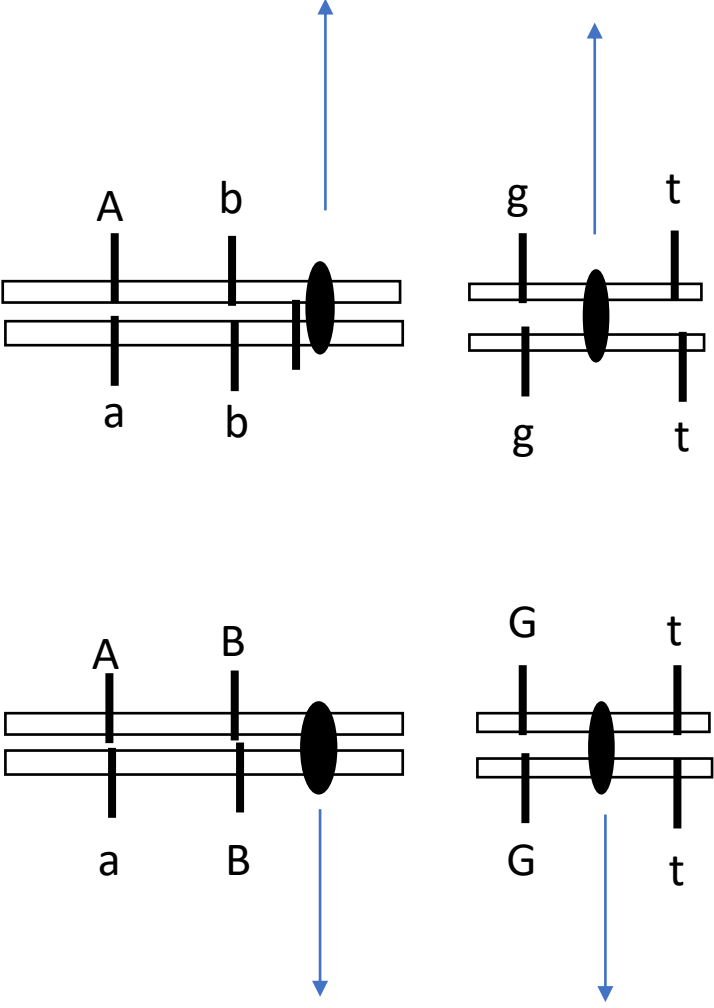
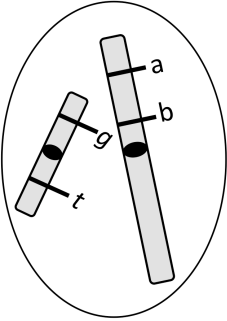
AAbbGGtt **aaBBGGtt**

AAbbggtt **aaBBggtt**

1e) In the table below, draw cells at each of the stages given in column 1. Your drawings must reflect the specific arrangement(s) of chromosomes that will give rise to the gamete shown above. You will need to draw the other haploid products resulting from this meiosis.

- Show the spindle or use arrows to indicate the direction of chromosome movement (if relevant), and clearly label the genes and alleles on all of the chromosomes or chromatids.

You may use either “bars” or straight lines to represent chromatids. Chromosomes should be diagrammed as condensed at all stages for clarity. (6.5 marks)

Stage of Cell Cycle	Diagram of chromosomes at the given stage
Cell at anaphase of meiosis I	 <p>The diagram illustrates the anaphase stage of meiosis I. It shows two pairs of homologous chromosomes moving apart from the center of the cell. The left pair consists of two chromosomes, each with two arms. The top chromosome has arms labeled 'A' and 'b', and the bottom chromosome has arms labeled 'a' and 'b'. The right pair consists of two chromosomes, each with two arms. The top chromosome has arms labeled 'g' and 't', and the bottom chromosome has arms labeled 'g' and 't'. Blue arrows indicate the direction of movement: upwards for the top chromosomes and downwards for the bottom chromosomes. A black oval represents the centromere where the two arms of each chromosome meet.</p>
The four resulting gametes (one of	 <p>The diagram shows four resulting gametes. One gamete is shown with arms labeled 'a', 'b', 'g', and 't'. The other three gametes are shown with arms labeled 'A', 'B', 'G', and 't'. The gametes are represented by small rectangles with lines indicating the arms. A black oval represents the centromere.</p>

<p>them is given)</p>	
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1f) For the plant cell from the F1 individual, indicate when each of the events occurs (**1.5 marks**):

Crossing over Late prophase I

Segregation Anaphase I (sometimes Anaphase II)

Independent assortment Metaphase I

1g) In the life cycle of this plant, indicate when the ploidy changes (**2 marks**).

At the end of meiosis I; fertilization

1h) When Mendel crossed F1 pea plants with round yellow seeds that had the genotype RrYy, what processes were responsible for generating the observed 9:3:3:1 phenotypic ratio in the offspring?
(2 marks)

Independent assortment

Random fusion of gametes

Segregation

Question 2

Having taken some genetics classes, you are approached by a friend who is a butterfly breeder. Your friend has butterflies with wings that either have long or short tail-like extensions and bodies that are grey or black. Your friend has performed some crosses and want help interpreting the data. Different individuals were used for each cross and the number of offspring are indicated in brackets. The results of the crosses are shown in the table below. From your research, you know that in this species females are XX and males are XY.

	Parents		Offspring	
	Male	Female	Males	Females
1	Grey body, long tail	Black body, short tail	Black body, short tail (100) Grey body, short tail (100)	Black body, short tail (100) Grey body, short tail (100)
2	Black body, short tail	Grey body, Long tail	Black body, long tail (100) Grey body, long tail (100)	Black body, short tail (100) Grey body, short tail (100)
3	Grey body, long tail	Grey body, Long tail	White body, long tail (100) Grey body, long tail (200) Black body, long tail (100)	White body, long tail (100) Grey body, long tail (200) Black body, long tail (100)

a) Choose a trait to investigate and circle your choice (no marks).

Body Color / Tail length

b) Define gene and allele symbols for your trait of choice (1.5 mark).

- c) Indicate the genotypes and phenotypes for your trait of choice (**1.5 mark**)
- d) How is the trait you chose inherited in this species? Justify your answer with reference to results from specific crosses, crosses can be diagrammed as Punnet squares. Include a brief, written explanation of how the data support your conclusions. (**3 marks**)

Body color (B gene)

Alleles B^B = Black allele

B^W = white allele

(B^G could be used in place of the white allele as long as the genotype-phenotype connections are correct)

Marks may be deducted if there is not a clear distinction between genotypes and phenotypes or if 3 alleles are described e.g. if B^B = Black; B^W = white B^G = grey – it may be unclear if these are alleles or genotypes

Body color alleles incompletely or co-dominant

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Cross #3

Grey $B^B B^W$ x grey $B^B B^W$

	B^B	B^W
B^B	$B^B B^B$	$B^B B^W$
B^W	$B^B B^W$	$B^W B^W$

$B^B B^B$ = black

$B^B B^W$ = grey

$B^W B^W$ = white

Expect a 1:2:1 ratio of black to grey to white – observe a 1:2:1 ratio of black to grey to white

Tail length

Alleles T^L = long allele

T^S = short allele

Marks may be deducted if there is not a clear distinction between genotypes and phenotypes

Tail length is X-linked; short is dominant to long

Cross 2

	Male Parent	
Female	T^S	Y
T^L	$T^S T^L$	$T^L Y$

Expect all males with long tails; all females with short tails – consistent with observations from cross

Question 3

Consider three traits in pea plants. Seed shape, seed color and flower color. Each trait is controlled by a single gene with two alleles. Round “R” is dominant to wrinkled “r”; yellow “Y” is dominant to green “y”. For flower color the purple “P” and white “p” alleles are codominant/incompletely dominant, the heterozygotes have pink flowers.

You cross a pure breeding plant with round, green seeds and purple flowers with another pure breeding plant that has wrinkled yellow seeds and white flowers.

- a) What are the phenotype(s) and frequencies of the F1 plants produced by this cross? (**1 mark**)

Parent 1 RR yy PP x Parent 2 rrYYpp

F1 genotype = Rr Yy Pp

Phenotype all F1 = Round yellow seeds, pink flowers

- b) You self-pollinate the F1 plants to produce a large number of F2 offspring. What is the expected frequency of offspring that have round green seeds and pink flowers. Show your work (**2 marks**)

Probability of Round seeds $R_ = \frac{3}{4}$

Probability of green seeds $yy = \frac{1}{4}$

Probability of pink flowers = $Pp = \frac{2}{4}$

Probability of round seeds, and green seeds, and pink flowers = $\frac{3}{4} \times \frac{1}{4} \times \frac{2}{4} = \frac{6}{64} = \frac{3}{32}$