

Name_____

SSN_____

PCB 3063-02

EXAM 1

Spring 1999

SECTION

I (VOCAB)	12	_____
II (DEFINITIONS)	12	_____
III (MULTIPLE CHOICE)	26	_____
IV (SHORT ANSWER)	16	_____
V (LONG PROBLEMS)	34	_____
(bonus)	5	_____
TOTAL (100 PTS)	100	_____

Class Average _____

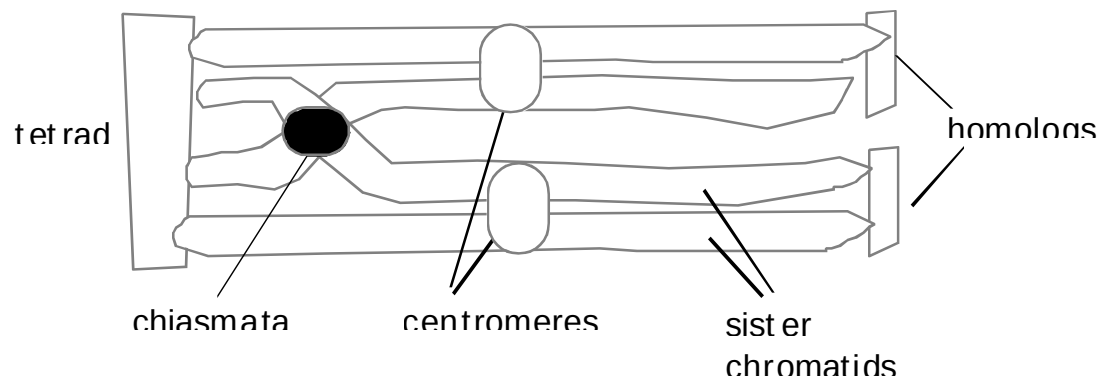
Class Range _____

HONOR CODE

"I did not give or receive help on this exam"

(SIGN) _____

Bonus A:



Bonus B:

(carrier Ps) (cf each) (boy each) = probability
 $1/25 \times 1/25 \times 1/4 \times 1/4 \times 1/2 \times 1/2 = 1/40,000$

I. (12 points, 1 pt each) VOCABULARY:

- 1) The study of biologically inherited traits is called GENETICS
- 2) The process of making an RNA strand from a DNA template is called TRANSCRIPTION
- 3) An individual having the same allele of a given gene on homologous chromosomes is said to be HOMOZYGOUS
- 4) The PHENOTYPE of an organism refers to observable characteristics of an organism.
- 5-8) Mitosis is conventionally divided into four stages known as PROPHASE, METAPHASE, ANAPHASE, and TELOPHASE
- 9) X and Y chromosomes are called sex chromosomes to distinguish them from the other pairs of chromosomes, which are called AUTOSOMES
- 10) POLYPLOIDY is a condition where the cell has more than two complete sets of chromosomes.
- 11) Mature reproductive cells such as eggs or sperm are called GAMETES
- 12) The GENOTYPE of an organism refers to the genetic (allelic) composition of its genome.

II. (12 points, 3 points each) DEFINITIONS:

Give brief definitions, twenty words or less each (complete and correct = full credit; partial and correct = partial credit; any part incorrect = no credit; > 20 word answer = no credit)

1) allele

One of a pair or series of alternative forms of a gene at a given locus in a chromosome.

2) epistasis

Interaction between products of genes. The phenotype of a genotype at one locus depends on the genotype at one or more other loci.

3) 9:3:3:1 ratio

The ratio of phenotypes in the F₂ expected from a dihybrid cross with two independently assorting genes.

4) homolog

Diploid organisms have two of each chromosome: independently they are referred to as homologs.

III. (26 Points) MULTIPLE CHOICE (Cicle ONE letter for each):**1-8 -> C D B C and B A A D****1) (2 PT.) A CELL'S CHROMOSOMES CAN BE FOUND IN THE**

- A CYTOPLASM
- B ENDOPLASMIC RETICULUM
- C NUCLEUS**
- D VESICLES

2) (3 PT.) STARTING WITH A CROSS BETWEEN AA AND AA, THE PROPORTION OF HETEROZYGOTES IN THE F2 PROGENY WILL BE

- A 1 / 8
- B 1 / 4
- C 1 / 3
- D 1 / 2**
- E ALL HETEROZYGOTES

3) (3 PT) PROBABILITIES ARE CALCULATED USING THE MULTIPLICATION RULE WHEN THEY

- A ARE EQUALLY LIKELY
- B ARE INDEPENDENT**
- C ARE MUTUALLY EXCLUSIVE
- D OCCUR DISPROPORTIONATELY

4) (3 PT) A MUTATION IN WHICH THE GENE PRODUCT IS PRODUCED IN GREATER ABUNDANCE THAN IN WILDTYPE IS CALLED

- A HYPOMORPH
- B EPIMORPH
- C HYPERMORPH**
- D NEOMORPH
- E ZENOMORPH

5) (4 PT) MATING OF TWO ORGANISMS PRODUCES A 1:1 RATIO OF PHENOTYPES IN THE PROGENY. THE PARENTAL GENOTYPES ARE

- A AA X AA
- B AA X AA**
- C AA X AA
- D AA X AA

6) (3 PT) THE CHROMATIDS IN A PAIR OF CHROMOSOMES ARE HELD TOGETHER AT A SPECIFIC REGION OF THE CHROMOSOME CALLED

- A CENTROMERE**
- B MITOTIC SPINDLE
- C CENTROSOME
- D CHROMOSOME BINDING SITE

7) (4 PT) A GENETICALLY IMPORTANT EVENT CALLED CROSSING-OVER OCCURS DURING WHICH MEIOTIC STAGE

- A PROPHASE I**
- B ANAPHASE I
- C TELOPHASE I
- D METAPHASE II
- E TELOPHASE II

8) (4 PT) TURNER SYNDROME IS THE RESULT OF

- A TRISOMY OF THE X CHROMOSOME
- B THE PRESENCE OF AN EXTRA Y CHROMOSOME
- C THE ABSENCE OF AN Y CHROMOSOME
- D MONOSOMY OF THE X CHROMOSOME**
- E AN EXTRA CHROMOSOME NUMBER 13

IV (Short Answers, 16 points)

1) (4 points) Instead of the expected 9:3:3:1 ratios in an F₂ generation from true-breeding parents, one sees a 9:7 ratio. **A)** (2 pt) Explain, and **B)** (2 pt) What does this suggest about the metabolic requirements for phenotype expression in this case?

9:7 is a modified 9:3:3:1 where the 3:3:1 (=7) all produce the same phenotype. This suggests that both genes are required for making the product such that
A_B_ = normal
A_bb = mutant
aaB_ = mutant
aabb = mutant

2) (4 points) Trisomy 13 is known as Patau syndrome. If in a child with Patau syndrome two of the three copies of chromosome 13 both carry the father's father's centromere, then when during the meiotic process did the nondisjunction event occur?

2nd division non-disjunction.
Replicated (identical) centromeres ended up in a single gamete.

3) (4 points) What is the genetic basis for Down syndrome? the mechanistic basis (error) for it's occurrence? and the genetic nomenclature for the syndrome ? [in the form, for example, the Patau Syndrome = 47,13+]

Anueploidy involving chromosome 21, trisomy 21, 2n + 1, and extra chr. 21

The error comes from a non-disjunction

47, 21 +

5) (4 points) Describe Mendel's Second Law of Inheritance.

Mendel's 2nd Law is the law of independent assortment. According the Mendel's 2nd law, during gamete formation, the alleles at one gene segregate (or assort) in a way that is completely independent of the segregation of alleles at a different gene. Also known as Mendel's 4th postulate, now known to result from disjunction of homologs at meiosis I.

V (Long Problems, 34 points,)

1) (8 points). A tomato breeder is examining crosses for five Mendelian traits:

- a) fruit shape (Normal *O*-, oblong *o o*)
- b) fruit color (red *R*-, yellow *r r*)
- c) flower color (yellow *W*-, white *w w*)
- d) plant height (Tall *D*-, dwarf *d d*)
- e) leaf shape (Normal *B*-, broad *b b*)

She makes the following cross:

O o R r W w D d B b X *o o R r w w D d b b*

(Show your work on the following--use the back of the page if necessary)

What proportion of the progeny will phenotypically resemble

(a) the first parent (the one on the left) ?

$$= 1/2 \times 3/4 \times 1/2 \times 3/4 \times 1/2 = 9/128 = 7.0 \% = 1 \text{ in } 14$$

(b) the second parent?

$$= 1/2 \times 3/4 \times 1/2 \times 3/4 \times 1/2 = 9/128 = 7.0 \% = 1 \text{ in } 14$$

(c) either parent?

$$= a + b$$

$$= 9/128 + 9/128 = 18/128 = 9/64 = 14.1 \% = 1 \text{ in } 7$$

(d) neither parent?

$$= 1 - c$$

$$= 128/128 - 18/128 = 110/128 = 55/64 = 86 \% = 1 \text{ in } 1.2$$

What proportion of the progeny will genotypically resemble

(e) the first parent?

$$= 1/2 \times 1/2 \times 1/2 \times 1/2 \times 1/2 = 1/32 = 3.1 \% = 1 \text{ in } 32$$

(f) the second parent?

$$= 1/2 \times 1/2 \times 1/2 \times 1/2 \times 1/2 = 1/32 = 3.1 \% = 1 \text{ in } 32$$

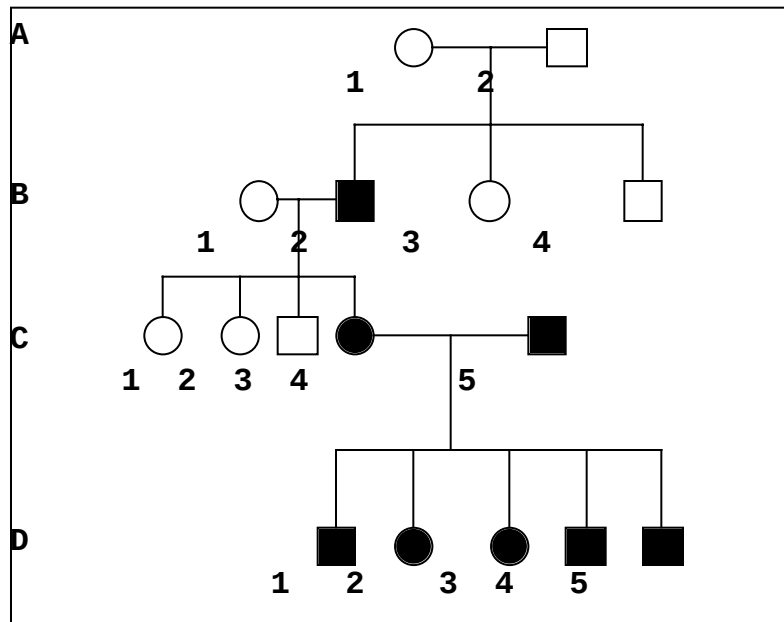
(g) either parent?

$$= a + b = 1/32 + 1/32 = 2/32 = 1/16 = 6.3 \% = 1 \text{ in } 16$$

(h) neither parent?

$$1 - g = 16/16 - 1/16 = 15/16 = 93.8 \% = 1 \text{ in } 1.1$$

2) Pedigree:(8 points)



Albinism is a homozygous recessive condition resulting in a total lack of pigment. Using the pedigree for albinism above, indicate the genotypes using A and a to indicate dominance and recessivity. Solid figures indicate an albino individual.

- | | | |
|----|-------|-----------|
| A. | A - 1 | Aa |
| B. | A - 2 | Aa |
| C. | B - 1 | Aa |
| D. | B - 2 | aa |
| E. | C - 3 | Aa |
| F. | C - 4 | aa |
| G. | C - 5 | aa |
| H. | D - 1 | aa |

3) (sex chromosomes: 8 points.).

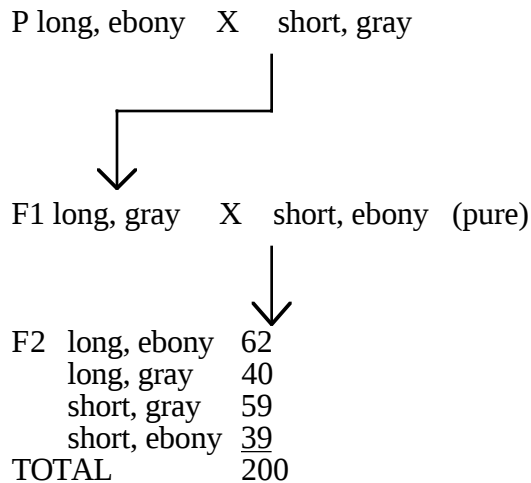
Explain why an man with Klinefelter syndrome can exhibit mosaicism for an X-linked trait (4 points) AND list three main components of the Lyon hypothesis (4 points).

A Klinefelter syndrome man has 47, XXY and inactivation one X in some cells and the other X in other cells (in embryo development) can give rise to mosaicism.

Lyon hypothesis:

- 1) X inactivation occurs in early embryo development**
- 2) X inactivation is random with respect to which X chromosome**
- 3) X inactivation is stable**
(producing sectors/lineages/mosaics)

4. (10 points) In *Drosophila*, the allele dp^+ determines long wings and dp determines short (dumpy) wings. At a separate locus e^+ determines gray body and e determines ebony body. Both loci are autosomal. (dp is recessive to dp^+ and e is recessive to e^+). The following crosses were made, starting with pure-breeding parents.



Use the χ^2 test to see if these loci fit with the idea of independent assortment (which would produce a 1:1:1:1 of the four F2 categories above). (a) calculate χ^2 , **showing your work (suggestion: set up a table with columns for F2 class, # observed, # expected, ...)**, (b) state the which degrees of freedom curve you will use, (c) state the p value, and (d) indicate whether you accept or reject your hypothesis.

hypothesis - independent assortment of 2 unlinked traits:

a)

	obs	exp	(obs-exp) ²	$\frac{(obs-exp)^2}{exp}$
long ebony	62	50	144	144/50 = 2.88
long gray	40	50	100	100/50 = 2.00
short gray	59	50	81	81/50 = 1.62
short ebony	39	50	121	121/50 = 2.42
	200	200	SUM = χ^2 = 8.92	

b) 4 classes - 1 = 3 d.f.

c) p = < 0.05

**d) reject - data does not fit well with independent assortment
(loci may be linked or lethal in some combinations)**