

DIRECTIONS: Read each question carefully. Ask for help if any question is unclear. The number in parentheses by each question is the points for that question. Enough space is given for each question for a complete answer. **Please fill in your name and student ID now!! All questions have a single answer unless otherwise stated.**

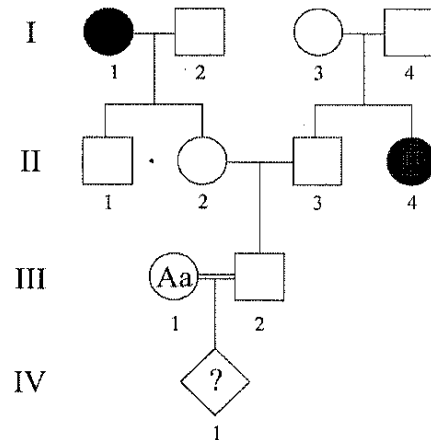
You may need the following section of the Chi-square table for $p=0.05$.

d.f.	1	2	3	4	5	6	7	8	9	10	11
Chi-Square	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51	16.92	18.31	19.68

You may also need this table:

Proportion Selected (p)	0.5	0.25	0.1	0.05	0.01
Selection Intensity (I)	0.8	1.27	1.76	2.06	2.67
Standardized Selection Point (Z)	0	0.67	1.28	1.65	2.33

1. (4) The following is a pedigree for a **Simple Recessive Trait**. Assume individuals entering the pedigree do not carry the allele for this trait unless there is evidence to the contrary.



3/40 Give the probability the indicated individual in Generation IV will show the characteristic.

2. (4) The following are some terms we discussed the last week in class. Fill in the number of the answer that is **BEST** described by the statement given. Each number may be used at most one time (and only one answer for each statement).

1. DNA fingerprinting
2. FISH
3. Microarray
4. SKY

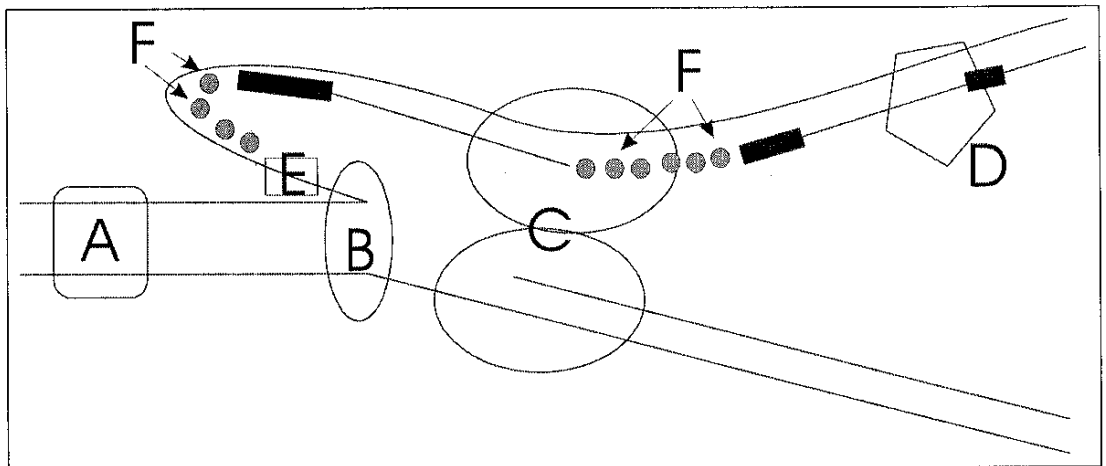
3 Used to **screen** for a disease caused by a single base substitution.

2 Used to observe specific DNA in a **cell**.

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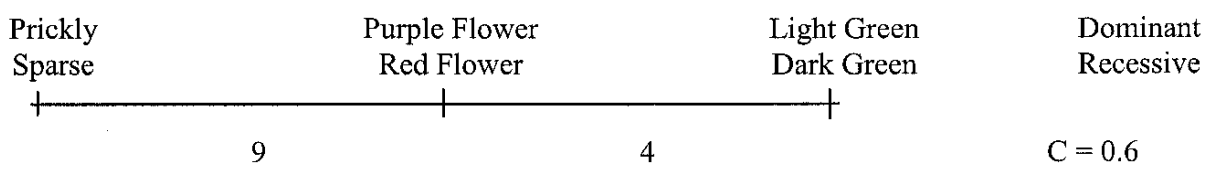
3. (3) X-inactivation is an example of
 a) Maternal Inheritance
 b) Constitutive Heterochromatin
 c) Facultative Heterochromatin
 d) A Maternally Expressed Trait.

4. (6) The following is a diagram showing DNA replication in progress. For each description, give the letter of the structure that fits that description.



- D DNA Polymerase I
E Primase
B Helicase

5. (4) The following is a portion of the linkage map for White Rock Cactus:



The following experiment was run. A pure breeding strain with **Prickly, Red Flowers, and Dark Green Color** is crossed with a pure breeding strain with **Sparse, Purple Flowers, and Light Green Color**. The resulting F₁ is then test crossed. For the following questions, give the expected frequency of each offspring type among the offspring of the test cross.

- a) 0.045 Sparse with Red Flowers.
 b) 0.06284 Prickly with a Light Green Color.

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6. (6) Match the population genetics/evolutionary term or phrase with the description or example. Each number is used at most once.

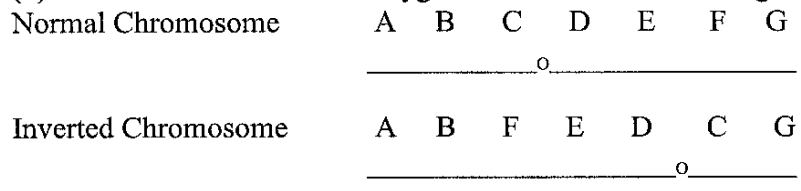
- | | |
|--------------------------|--------------------------|
| 1) Assortative Mating | 5) Migration |
| 2) Random Drift | 6) Directional Selection |
| 3) Stabilizing Selection | 7) Inbreeding |
| 4) Mutation | |

- 2 Changes the allele frequencies due to small population size.
- 1 When individuals with similar phenotype mate.
- 4 The only **one** of the above that is *required* for evolution to occur (as mentioned in class).

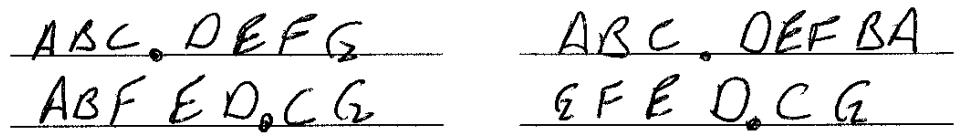
7. (6) We are interested in increasing the yield for a plot of sunflowers. We know that the yield for our plot is normally distributed with a mean of 3.87 bushels and a standard deviation of 0.43 bushels. From similar experiments, we have found heritability in the broad sense to be 0.90 and in the narrow sense to be 0.56. We hope to increase yield by using a mass selection scheme, selecting the top 5% of the population. **Give Units.**

- a) 0.8858 bu What is the Selection Differential?
- b) 0.996098 bu What is the Selection Response?

8. (6) An individual is heterozygous for an inversion as diagrammed below:



- a) This inversion is Pericentric Paracentric
- b) Give the **four** chromatids that result when there is crossing over between D and E.

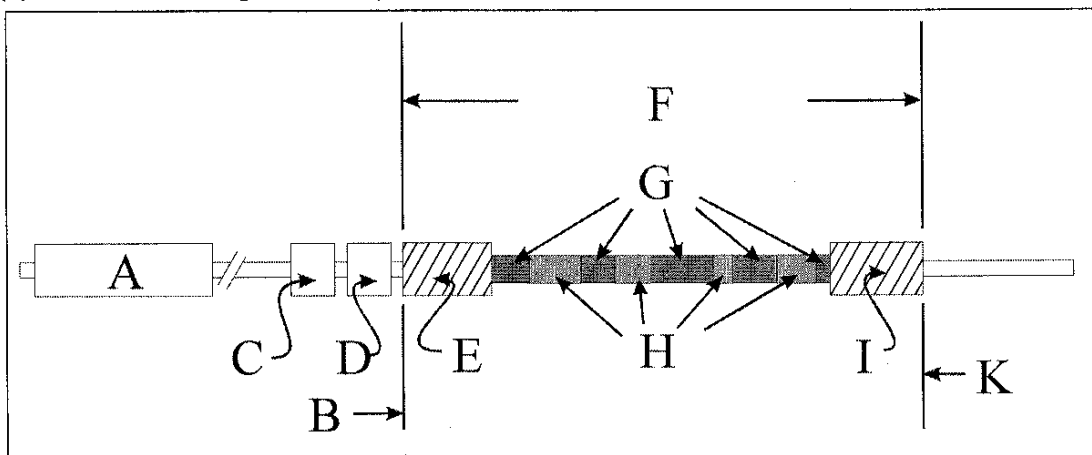


9. (6) We are studying various physical characteristics of pinto beans. We have discovered a variety with **purple flowers** (vs. the normal **blue**) and **Long Stems** (vs. the normal **short**). We feel they are Simple Mendelian Traits. To test this, we do a dihybrid cross. The following are the results.

Phenotype	Observations	Expected	Chi-Square
Purple Long	31	23.0	X
Purple Short	55	69.0	X
Blue Long	62	69.0	X
Blue Short	220	207.0	X
Total	368	368	7.1498

- a) Give the expected number of individuals for each of the phenotypes.
- b) What are the **degrees of freedom** for this experiment? 3
- c) The statistical conclusion is (circle one) **Reject the Hypothesis** Fail to Reject the Hypothesis
- d) The conclusion of this test **in terms of the genetics involved for this experiment** is
 - i) The traits are not Simple Mendelian
 - ii) The traits are Simple Mendelian
 - iii) The data are consistent with these traits being inherited as Simple Mendelian
 - iv) There is sufficient evidence to conclude the traits are Simple Mendelian
 - v) There is sufficient evidence to conclude the traits are not Simple Mendelian

10. (6) This is a diagram from your Course Packet concerning a typical **Eukaryotic mRNA** gene.

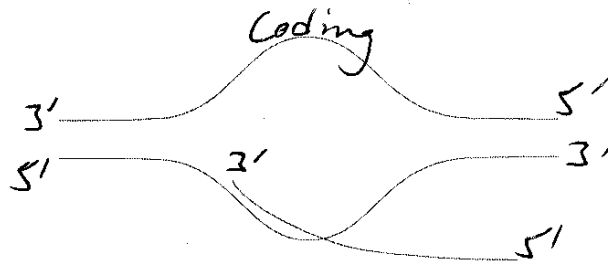


In the space provided, give the letter that **best** represents that region.

- C CAAT
- I Downstream Noncoding Region
- G Exon

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11. (4) This diagram shows a transcription bubble.



- Label all the 5' and 3' ends (6 total).
- Identify and label the **Coding Strand**.

12. (4) The following is a small piece of DNA (only the coding part is given for this gene; the gene goes from left to right, starting with the leftmost base).

5' A T G | G C A | T T T | C G A | C C A | T G A 3'
 3' T A C | C G T | A A A | G C T | G G T | A C T 5'

Consider mutations with this DNA sequence. Each of the following represents a **single mutation** (shown with a line around it). For each mutation, circle the molecular basis (choose from a) and the effect on the protein (choose from b). If it is a frameshift mutation, do not choose from the second row.

Frameshift Base Substitution (Specify, Base Substitution Only: Transition Transversion)
 Nonsense Missense Silent Readthrough (Only if Base Substitution)

5' A T G G C A T T T A G A C C A T G A 3'
 3' T A C C G T A A A T C T G G T A C T 5'

Frameshift Base Substitution (Specify, Base Substitution Only: Transition Transversion)
Nonsense Missense Silent Readthrough (Only if Base Substitution)

5' A T G G C A T T T T G A C C A T G A 3'
 3' T A C C G T A A A A C T G G T A C T 5'

13. (3) The following are the six principles to keep in mind when discussing ethical questions in Genetics.

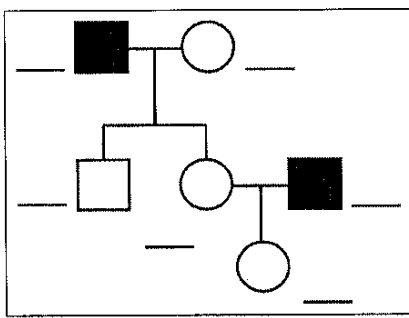
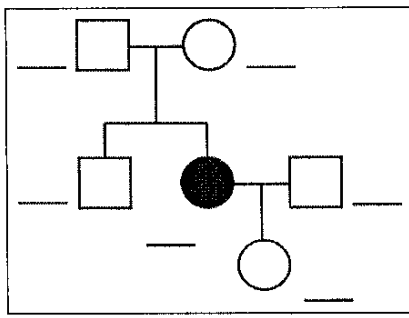
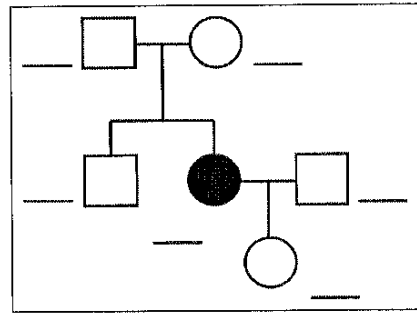
- Autonomy
- Doing no harm
- Justice
- Not allowing harm to come through inaction
- Telling the truth
- Keeping promises/contracts.

For the following statements, give the **single best** answer to each question. Only one answer is the best, but any principle can be used more than one time.

- 5 Lying to resolve a conflict involves a dilemma with this principle
- 6 Telling someone you plan to do something, then not being able to do what you have promised involves a dilemma with this principle.
- 4 Not telling someone about a possibly harmful disease involves a dilemma with this principle.

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14. (6) If the pedigree is consistent with the mode of inheritance given, indicate the genotype for each individual (AA, Aa, aa, AY, or aY, use a dash "-" when appropriate). If the pedigree is **not** consistent with the mode of inheritance, then **circle Can Be Excluded**.

		
X Linked Recessive Can Be Excluded Cannot Be Excluded	X Linked Recessive Can Be Excluded Cannot Be Excluded	Autosomal Recessive Can Be Excluded Cannot Be Excluded

15. (3) The following is the entire mRNA transcript for a Eukaryotic gene. Give the protein as translated from this mRNA.

5' AGGACGG|AUG|CCC|GUG|AGG|UAA|GGUGAAAAAAA 3'

N Met Pro Val Arg C _____

Label the N-Terminus and C-Terminus

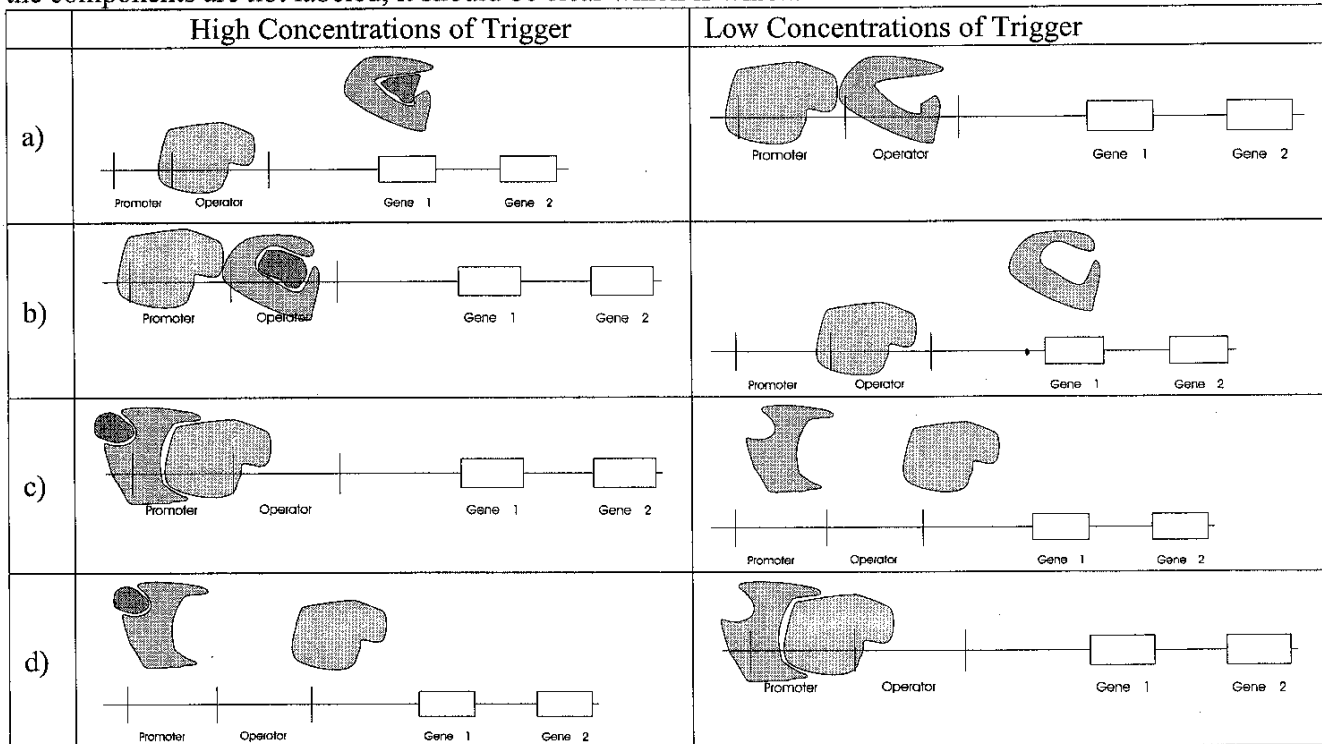
16. (6) All of the following questions have to do with *Initiation* of one step of the Central Dogma.

- | | |
|--|-------------------|
| 1. Ori | 7. Rho Factor |
| 2. cis-element | 8. Shine-Dalgarno |
| 3. ^{Met} tRNA | 9. Sigma Factor |
| 4. Ligase | 10. Start Codon |
| 5. ^{Met} _{init} tRNA | 11. UGA |
| 6. Primase | |

Fill in the number of the answer that is **BEST** described by the statement given. Each number may be used at most one time (and only one answer for each statement).

- 1 Signal that helps initiate Replication.
- 6 Enzyme that starts each Okazaki Fragment.
- 8 Signal for initiation of translation in Prokaryotes.

17. (6) The following are some diagrams describing possible modes of **Prokaryotic Regulation**. Although the components are not labeled, it should be clear which is which.



Answer the questions. Choose the **best** system that is described by each sentence. As system can be used more than one time, and you need not choose each system.

- b Which of these regulation systems is **negative control** where the genes are produced when the trigger is present in *low* concentrations.
a Which shows the classic **Lac Operon Model**?

18. (4) Identify floral structure in the 4 whorls for a flower (what do they look like) when the B gene is modified to be expressed everywhere.

- Whorl 1 (outside): Petal
 Whorl 2: Petal
 Whorl 3: Stamen
 Whorl 4 (inside): Stamen

19. (6) The following are the four types of bacterial recombination we covered in class. Match the names with the attributes. Match the number for the type of recombination with the statement. **Numbers can be used more than one time, but only one number per answer.**

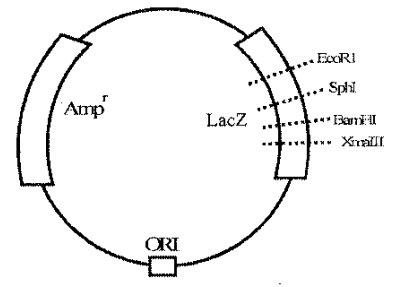
1. Conjugation 2. Generalized Transduction 3. Specialized Transduction 4. Transformation
- 1 Involves an F plasmid.
4 Involves DNA in the environment from dead bacteria.
3 Must involve the lysogenic pathway.

20. (4) The following are some genes used in sex determination in *Drosophila*. Fill in the number of the term best described by each phrase. Each number is used at most once.

1. Doublesex
2. Sex lethal
3. Transformed

2 Covers an RNA signal so it is not detected.
3 Part of a spliceosome.

21. (3) Consider the following plasmid cloning vector. We are interested in cloning a piece of human DNA in this plasmid, using the EcoRI restriction endonuclease. To detect our DNA, we make two replica plates, MM and MM + Ampicillin. Circle the description of the colonies we wish to keep.



- a) Survives with Ampicillin and is Blue.
- b) Survives with Ampicillin and is White.
- c) Sensitive to Ampicillin and is Blue.
- d) Sensitive to Ampicillin and is White.

22. (5 Points Extra Credit)

Course Evaluation

Please take a minimum of 10 minutes to complete the Faculty-Course Evaluation. In addition to answering the multiple choice items, please make written comments on the back of the form. Generally, the written comments are the most useful to us, so please elaborate!! NOTE: Make sure you have no identifying marks (e.g., name) on the course evaluations. Circle the option you have chosen:

- a) I will complete the CALS evaluation as soon as I turn in the exam.
- b) I am leaving now and will not complete the CALS evaluation. I forfeit the extra credit.

Coding Dictionary

	U	C	A	G	
U	UUU Phe	UCU	UAU Tyr	UGU Cys	U
	UUC	UCC Ser	UAC	UGC	C
	UUA Leu	UCA	UAA Stop	UGA Stop	A
	UUG	UCG	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC	CCC	CAC	CGC	C
	CUA	CCA	CAA Gln	CGA	A
	CUG	CCG	CAG	CGG	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC	ACC	AAC	AGC	C
	AUA	ACA	AAA Lys	AGA Arg	A
	AUG Met	ACG	AAG	AGG	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC	GCC	GAC	GGC	C
	GUA	GCA	GAA Glu	GGA	A
	GUG	GCG	GAG	GGG	G

7+5