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Bio 1A
Lab Exam #1
Summer 2002

Biology 1A - Lab Exam #1 – July 25, 2002

NAME _____ SECTION # 106 GSI NAME Amy Wedemeyer
(PRI

1. Sit every other seat. Sit in your assigned area. All books and papers should be placed on the floor. NO CALCULATORS ARE PERMITTED!
2. On the scantron sheet, write in your student ID #, and the last two digits of your section number below that. Bubble in the appropriate numbers. On this cover sheet clearly print: Your name, section # and GSI name. There are 20 multiple choice questions.

Your SID goes into the first 8 boxes, from top to bottom. (e.g. 12345678).

The last 2 digits of your section number goes into the bottom 2 boxes. (eg. 07).

3. Leave your exam face UP. When told to begin, check your for nine pages.
4. Read all questions very carefully. If you have a question, raise your hand. A GSI will help you. The GSI will not give you the answer or explain scientific terms. Trivial answers will not receive credit, i.e. "it said so in the lab manual", "it increases because the slope increases", etc.
5. Do not talk during the exam. The exam is closed book. No calculator is necessary, nor permitted.
6. When told to STOP--STOP!
7. MOST questions can be answered briefly in one or two sentences. You earn points for correct answers BUT if you have additional answers that are incorrect you will lose some points. For example, 3 answers of which only one is right is not given full credit. You will lose some points for the 2 incorrect answers.

WHEN TOLD TO BEGIN, CHECK FOR 9 NUMBERED PAGES.

DO NOT READ OR WRITE BELOW THIS LINE TODAY. FOR REGRADE USE LATER!

Regrade Instructions

To the Student:

Please review your regrade requests with your GSI first to make sure that the requests are valid. If the request is valid, please write your request on the back of this sheet. Your GSI must then initial it. (GSI's need to initial requests--otherwise, request will not be read.)

You may request up to 3 questions only to be regraded. Additional instructions are on the back of this sheet.

All regrade requests are due Thursday August 8th by 5 PM in the mailbox outside of 2088 VLSB. (If late, no regrading!)

(Summer 2002, 7/25/2002)

1. Which of the following items or chemical solutions require(s) special disposal procedures?
   A) acetone solutions
   B) DNS containing solutions
   C) DCPIP containing solutions
   D) broken glass
   (E) all of the above

2. What is the total magnification of a microscope with a 10X ocular and a 4X objective?
   A) 10X
   B) 14X
   (C) 40X
   D) 140X
   E) can not be determined

For questions 3-5, select the correct answer (from choices A-C) to complete the sentence. Choices may be used more than once or not at all.
   A) Increases
   B) Remains the same
   C) Decreases

3. When you decrease the total magnification, depth of focus ___↑ A___.

4. When you decrease the total magnification, the field of view ___↑ A___.

5. When you increase the total magnification, the distance represented by each micronmeter mark ___↓ C___.

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6. (2 pts) The map distance between a and e is 20 map units, the map distance between e and f is 10 map units. What fraction of the gametes produced by the following individual would have the ef+ alleles? (Ignore the a locus) The individual has the genotype $\frac{a\ e\ f}{a^+ e^+ f^+}$

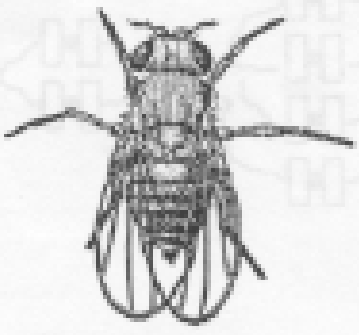
   (A) 5%
   B) 10%
   C) 15%
   D) 30%
   E) 40%

   $\frac{10}{2} = 5\%$

7. Which of the following terms is used when describing a rod-shaped bacteria?
   (A) bacillus
   B) cocci
   C) spirilli

8. In a Gram stain, Gram positive bacteria stain ___purple___. They have ___thick___ cell walls.
   A) purple; thin
   (B) purple; thick
   C) red; thin
   D) red; thick
   E) white; thick

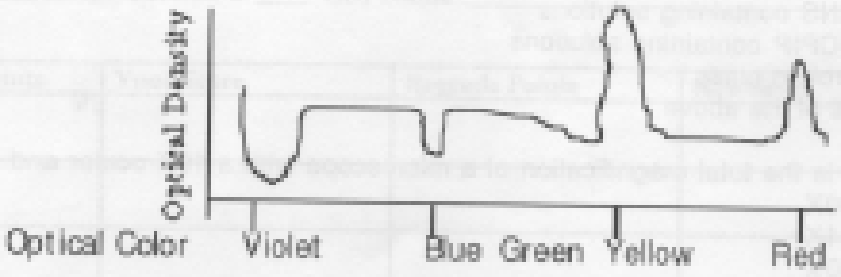
9. Identify the sex of the fly. Mark (A) if Female, Mark B if Male



Name _____ GSI Name Mary

10. Which of the following light colors is absorbed the most by pigment A? The absorption spectrum of pigment A is provided.

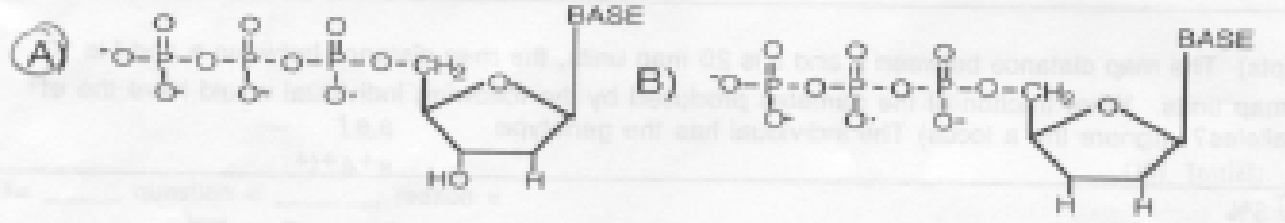
A) violet
B) blue
C) green
(D) yellow
E) red



11. Most glucose units are linked together in cellulose by β 1,4 glyco bonds.
A) alpha 1,4 peptide linkages
B) beta 1,4 peptide linkages
C) alpha 1,4 glycosidic linkages
(D) beta 1,4 glycosidic linkages
E) both A and B are correct

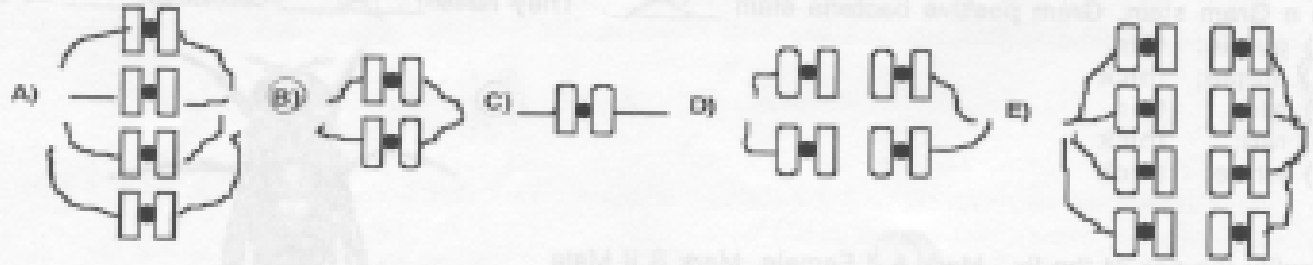
12. (2 pts) The protonation state of an acid or a base can vary with pH. Which form of a weak base, protonated or unprotonated, would predominate at pH 10? If it helps, the pKa of the base is 9.
A) NH_3^+ would predominate over NH_2
(B) NH_2 would predominate over NH_3^+
C) NH_2 and NH_3^+ would each be equal, that is each would be at 50%

13. Circle the correct structure for dGTP (deoxy GTP).



14. What was the purpose of the saline (salt) solution when making wet mounts containing termite gut protists?
(A) slow down the protists
B) maintain isotonicity
C) stain the nucleus of the protists
D) kill the protists
E) increase visual contrast

15. (2) Which figure corresponds to metaphase of a mitotic cell with 1N = 2?



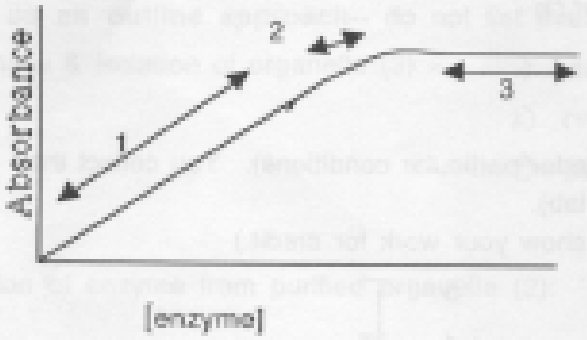
Name _____ GSI Name Gary

16 & 17) A biologist studied amylase and found the data as graphed below (similar to your amylase experiments). Note that three regions are indicated (1, 2 & 3). Answer questions 16 & 17 using this graph and the following choices.

A) Region 1
B) Region 2
C) Region 3
D) Regions 1 & 2
E) Regions 2 & 3

16. (2) Which portion(s) of the curve illustrate that Substrate is in excess supply? 3 C

17. (2) Which portion(s) of the curve illustrate that Substrate is limiting? 1, 2 D



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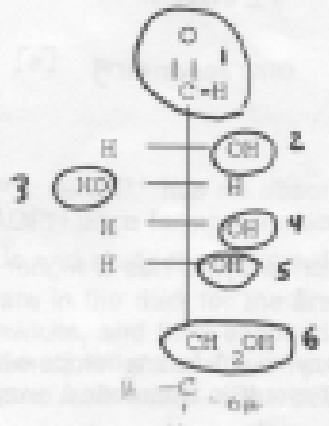
18. (2) The linear form of glucose is shown at the far right. Six groups are indicated and numbered (1 at the top, 6 at the bottom). Use the following choices to select which group(s) react(s) with DNS when heated at temperatures greater than 95 °C.

A) Group 1
B) Groups 2, 3, 4 & 5
C) Groups 2, 3, 4, 5 & 6
D) Group 6
E) All groups (1, 2, 3, 4, 5 & 6)



19. Which functional group is more hydrophobic?

A) $-\overset{O}{\overset{\|}{C}}-OH$ B) $-\overset{O}{\overset{\|}{C}}-H$ C) CH_2OH D) CH_3 E) all have equal hdyrophobicity

20. E coli genomic DNA is _____ and it has _____ than plasmid DNA.

A) single stranded; fewer base pairs
B) single stranded; more base pairs
C) double stranded; fewer base pairs
D) double stranded; more base pairs
E) linear and double stranded; fewer base pairs

Name _____ GSI Name Corey

Short answers begin here.

(2) 1. (2) For 2 points, put your name and your GSI's name on each and every remaining page.

2. (2) In the amylase lab, DNS denatured the amylase. And it was used to follow the breakdown of starch. Is it necessary to heat the DNS/amylase solution to drive the denaturation reaction? Explain your answer.

(1 1/2) No, DNS denatures amylase upon contact; ~~it~~ without heat b/c of its pH heat is used to drive the reaction of DNS + reducing units, and follow the breakdown of starch.

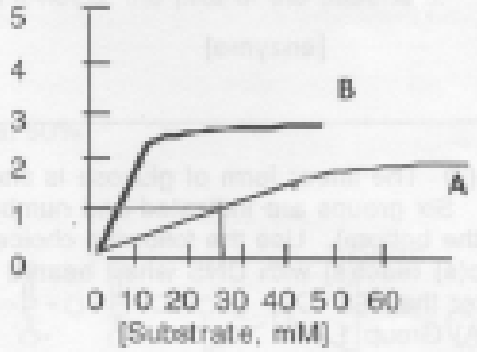
3. You are trying to determine the K_m of an enzyme (under particular conditions). You collect the following data (using protocols similar to those used in lab).

i) (2) Calculate the K_m for enzyme A. (You must show your work for credit.)

(3/4) V_{max} A = 2

$1/2\ V_{max}$ A = 1

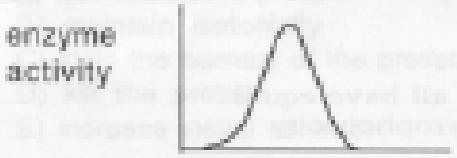
corresponding [S] = 25 mM = 15 mM



(1) ii) (1) Which enzyme has a higher affinity, enzyme A or enzyme B? Circle your answer: A (B)

4. (2) Enzyme 20 has a temperature optimum at 20 °C as shown. Explain why temperatures greater than 20 °C result in decreased enzyme activity.

(2)



The heat at higher temperatures denatures the enzymes

(0) **5.** (2) Safeway sells potatoes. Do they contain amylase? Explain.

No, because amylase is used to break down starch, and potatoes don't need to break down starch.

 pts this page 7 1/4 total pts 7.25

Name _____ GSI Name Gary

6. (3) During the Hill reaction you measured the reduction of DCPIP.

a) Where are photosystems located in a chloroplast? Be specific. thylakoid membrane

b) Sodium phosphate buffer buffers against pH .

c) Which photosystem is most closely associated with the oxidation of water? PS II

3

7. (5) You decide to study DNA polymerase in onion root tip cells. To do this you must first purify the appropriate organelle. Outline a general procedure for a crude purification of DNA polymerase. You have some of the similar tools/solutions present in the enzyme and photosynthesis labs (blender, various buffers, centrifuge, hexane- an organic solvent, paper chromatography, pipettes, spectrophotometer, tubes, etc.). (Note: Tools are listed in alphabetical order and may not all be used.) **Give us an outline approach-- do not list every little detail of your experiment.**

Organelle & isolation of organelle (3) =

1) add a ② buffer and place in blender

2) centrifuge and filter the contents

3) ~~keep the supernatant~~ nuc. in pellet -1

2

Isolation of enzyme from purified organelle (2):

1) centrifuge (what?)

2) decant and use pellet

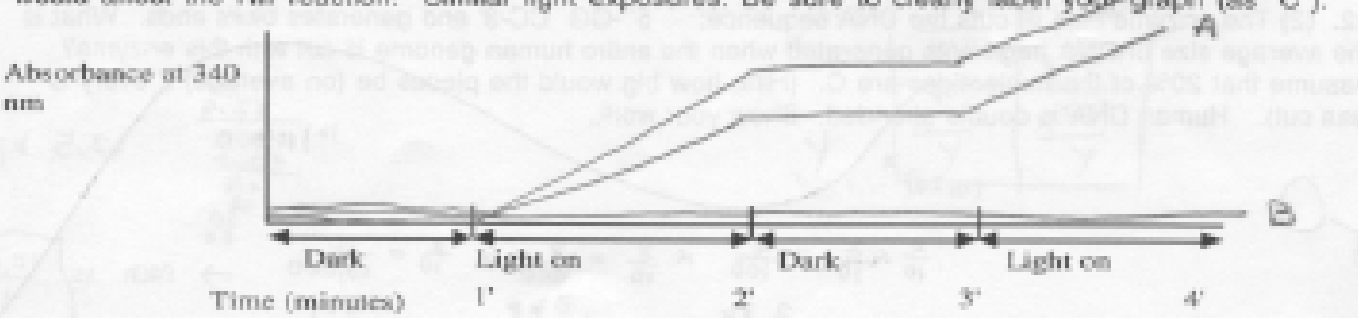
0

8. The physiological acceptor of electrons for the Hill reaction is $NADP^+$. $NADP^+$ has no absorbance at 340 nm but its reduced form, NADPH, absorbs strongly at 340 nm. NADPH once formed is stable and does not get oxidized back to $NADP^+$. You work with isolated thylakoids and study the Hill reaction by adding excess $NADP^+$ (instead of DCPIP). The isolated chloroplasts are in the dark for the first minute, then exposed to light for another minute, then in the dark for another minute, and then exposed to light for another minute (total time = 4 minutes). The X axis illustrates the dark/light status in your experiment. Graph your expected experimental results under 3 conditions, A, B and C. See below.

A. (2) Show on the graph how absorbance would change with time under the different exposures (light off, then on, then off again, then on again). Be sure to clearly label your graph (as "A").

B. (2) Show on the same graph how DBMIB, a compound that behaves like the compound DCMU, would affect absorbance. Similar light exposures. Be sure to clearly label your graph (as "B").

C. (2) Ammonia behaves similarly to the compound methylamine. Show on the graph how ammonia would affect the Hill reaction. Similar light exposures. Be sure to clearly label your graph (as "C").



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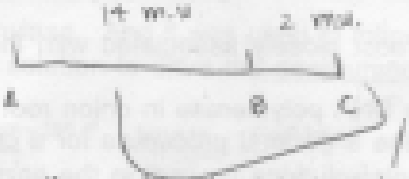
 pts this page 11 total pts 18.25

Name _____ GSI Name Gary

9. (3) Use the following data to determine the gene order and map distances separating A, B & C.

Recombination between A & B is 14%. = 14 mu
Recombination between A & C is 16%. = 16 mu
Recombination between B & C is 2%. = 2 mu

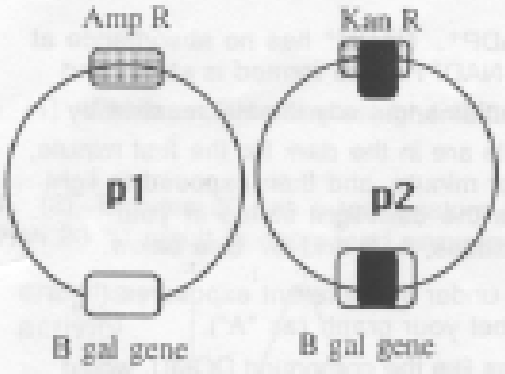


10. (4) A biologist has just finished a ligation reaction and is about to transform some E. coli. Explain what control(s) they should perform, the expected results of each control and why they performed the control(s).

+ positive control: ensure bacteria are competent
(should have a lawn)
* use plasmid for transformation
* plate on LB/amp/x-gal

- negative control: ensure no contamination
* no plasmid DNA
(should have no growth)

11. (4) You have isolated 2 plasmids which are diagrammed below. Predict transformation results for the following hypothetical situations (i.e., lawn/isolated colonies, and color):



	LB/Amp (No X-gal)	LB/X-gal
p1	white colonies	white lawn w/ blue spaces
p2	no growth	white lawn

Legend:
= Antibiotic Resistance Gene
= B galactosidase gene
= Human DNA

"Amp" refers to Ampicillin and "Kan" refers to Kanamycin. Both are antibiotics.

12. (2) The enzyme Hae III cuts the DNA sequence: 5'-GG CC-3' and generates blunt ends. What is the average size of DNA fragments generated when the entire human genome is cut with this enzyme? Assume that 20% of the nucleotides are C. (Hint: how big would the pieces be (on average) if every C was cut). Human DNA is double stranded. Show your work.

$(0.20)^4$

$\frac{1}{10} \times \frac{1}{10} = \frac{1}{100}$ (2 bp) $\times \frac{1}{10} = \frac{1}{1000}$ (3 bp) $\times \frac{1}{10} = \frac{1}{10,000}$ (4 bp) → each is 10,000 or 42 base pairs long

12.5 bp

Name _____ GSI Name Gary

13. (2) You discover a male fruit fly that has alleles for mutations for 2 different traits, one mutation is recessive, the other dominant. He is heterozygous for both mutations. Use the first letter of the English alphabet to represent the recessive mutant trait. Use the second letter of the English alphabet to represent the dominant mutant trait. The traits are not genetically linked. List ALL possible genotypes for this male. Use correct fruitfly notation (as used in the lab manual).

1st mutation: a (rec) mutant; a^+ (dom) wt

2nd mutation: B (dom) mutant; B^+ (rec) wt

$\frac{a}{a^+} \cdot \frac{B}{B^+}$ (2)

14. (5 pts) You have isolated 2 *Drosophila* mutations: L - large (excessively large size) & S - swift (excessive swift) **(dominant/recessive not implied).** A female from a population that is true-breeding wild-type for both traits is mated to a male from a population that is true-breeding for both mutations. The data for the F_1 are shown below.

F_1 Data

	Females	Males
large and swift	500	0
large and normal swiftness	0	0
normal size and swift	0	0
normal size and normal swiftness	0	500

Test-Cross Data (for part b)

Females	Males
150	150
350	350
350	350
150	150

a) Use the F_1 data and construct a Punnett square for the parental cross. Use correct fruitfly notation.

L = mut (dom); L^+ = wt (rec); S = mut (dom); S^+ = wt (rec)

♂ $X^{S\,L}Y$ × ♀ $X^{S^+L^+}X^{S^+L^+}$

	$X^{S^+L^+}$	$X^{S^+L^+}$
$X^{S\,L}$	$X^{S^+L^+}X^{S\,L}$	$X^{S^+L^+}X^{S\,L}$
Y	$X^{S^+L^+}Y$	$X^{S^+L^+}Y$

(2)

b) Later on, after many generations of random inbreeding in the F_1 and their descendants, you decide to do another experiment. You pick a female from the F_{200} generation that is displaying the dominant phenotype for both traits and decide to do a test-cross with a male displaying the recessive phenotypes for both traits. From the **test-cross data**, determine the genotype of the female and the map distance between the two traits. Remember to keep in mind the things that you learned from the original F_1 data. (2)

Genotype of heterozygous female, F_{200} = $\frac{X^{S+L}}{X^{S\,L^+}}$

dom phenotype = large + swift

Map distance = $\frac{300}{1000}$ = 30 m.u.

male $X^{S+L^+}Y$ (1)

	X^{S+L}	$X^{S\,L^+}$
X^{S+L^+}	$X^{S+L}X^{S+L^+}$	$X^{S\,L^+}X^{S+L^+}$
Y	$X^{S+L}Y$	$X^{S\,L^+}Y$

Name _____ GSI Name Gary

15. (6) Given the following genotypes of two parents, **predict the probability of getting an offspring with the indicated phenotype. Work must be shown.**

a = rec b = rec C = dom d = rec e = rec
a^+ = dom b^+ = dom C^+ = rec d^+ = dom e^+ = dom

a.: b^+; C; dе crossed with a^+; b.; C^+; d.e Map distance between d & e is 40.

a b C^+ d^+e^+ a^+ b C d^+e^+

$1 \times \frac{1}{2} \times \frac{1}{4} \times 0.16$

Indicated phenotype is: a^+ & b & C^+ & d^+ & e.

You do not need to do the math--just show the equation and your work.

0.5 de 0.5 d^+e^+ 0.2 d^+e 0.2 de^+

0.5 de

0.5 d^+e^+

0.2 d^+e

0.2 de^+

$0.2 \times 0.2 = 0.04$

$0.5 \times 0.5 = 0.25$

$0.2 \times 0.2 = 0.04$

for d^+e need $\frac{d^+e}{de^+}$ or $\frac{d^+e}{d^+e}$

$0.04 + 0.04 + 0.04 = 0.16$

for a^+ need a^+a^+ or a^+a

for b need b^+

for C^+ need C^+C^+

100% 50% 25%

16. You mate a male fly that has normal antennae and short bristles with a female fly that has normal antennae and normal bristles. Two thousand offspring are produced as follows. Write the genotype of both the male fly and female fly used in this cross. The mutations are recessive.

Phenotype	Male	Female
Normal antennae, normal bristles	375	375
Normal antennae, short bristles	375	375
Short antennae, normal bristles	125	125
Short antennae, short bristles	125	125

$\frac{375}{+375}$ ♀ $\frac{sa^+}{sa^+}\ \frac{sb^+}{sb^+}$

$\frac{125}{+125}$ ♂ $\frac{sa^+}{sa^+}\ \frac{sb}{sb}$

a) (2) Are these traits genetically linked? If so, calculate the map distance.

$\frac{250}{1000} = 25$ m.u.

not linked

b) (2) Use correct fruit fly notation to write the genotype of the male fruit fly.

female → normal antennae, normal bristles

male → normal antennae, short bristles

normal antennae (dom) wt = sa^+

short antennae (rec) mutation = sa

short bristles (rec) mut = sb

normal bristles (dom) wt = sb^+

male

$\frac{sa^+}{sa}\ \frac{sb}{sb}$

 pts this page 6 1/2 total pts 38.25

Name _____ GSI Name Gary

17. (3) A researcher interested in the pathway for the biosynthesis of a compound, X, collects six strains of haploid yeast, numbered 1 through 6, that have mutations in this pathway. The researcher does pair-wise crosses to determine the number of genes (or complementation groups) that encode for proteins involved in this pathway.

The results of these pair-wise crosses--1 X 2, 1 X 3, . . . 5 X 6--are tabulated below. A "-" sign means that there is "no production" of compound X. A "+" sign means that there is "production" of compound X. What is the **least** number of genes involved in the biosynthesis of compound X?

Results of Pair-wise Crosses:

	1	2	3	4	5	6
1	-	-	+	+	+	+
2		-	+	+	+	+
3			-	-	+	+
4				-	+	+
5					-	-
6						-

3

Show your work here:

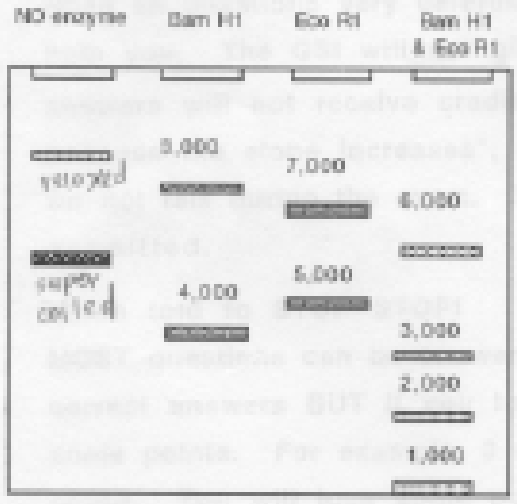
1, 2 same gene (same mutation)

3, 4 same gene (same mut)

5, 6 same gene (same mut)

⇒ at least 3 genes

18. (3) Reconstruct a restriction map of a piece of DNA using the data provided in the gel. The size of each fragment is included. Remember: The DNA can be circular or linear, but it must agree with the data. **ASSUME COMPLETE DIGESTION. All bands represent the same number of molecules of DNA. The piece of DNA is 12,000 nucleotides long.**



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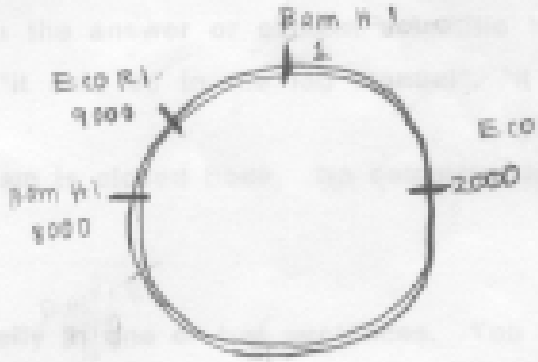
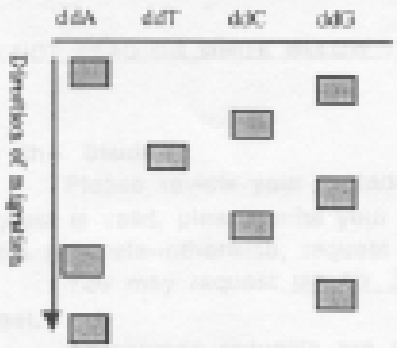


19. (3) The following autoradiogram was obtained from a sequencing reaction. **Determine the sequence of the template strand and indicate 5' and 3' ends.**



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

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

9 of 9 pages pts this page 9 total pts 47.25