

Biology 1A - Lab Exam #1 March 18, 2015

NAME _____ GSI NAME _____ LAB # _____
 (PRINT CLEARLY)

1. Sit in your assigned area. There should be at least one empty seat between each student; in some rooms there should be two empty seats. All books and papers should be placed on the floor. Put away all cell phones, pagers and calculators. You cannot use a calculator and your cell phone must be turned off and NOT be visible.
2. Write in your name. For "Date" write in your lab section #. If you don't know it, then put down day and time of your lab. For period write the name of your GSI. Be sure to write in and bubble in your SID in the top 8 boxes. Put 00 in the bottom two.
3. You will have 100 minutes, 8:20-10:00 PM.

SCANTRON® FORM NO. F-4391 © SCANTRON CORPORATION 2008 ALL RIGHTS RESERVED. M3 0108-999-12 To reorder online: www.scantronforms.com Customer Service: 1-800-SCANTRON

IMPORTANT
 USE NO. 2 PENCIL ONLY
 ● EXAMPLE: A B C D E
 ● ERASE COMPLETELY TO CHANGE

Write I.D. Number Here
 SIDE 1
 SID
 NAME
 TEST LAB
 DATE Sect. # PERIOD GSI NAME
 Mark I.D. Number Here
 0
 0

3. Use a #2 pencil. ERASE ALL MISTAKES COMPLETELY AND CLEARLY.
5. Leave your exam face UP. When told to begin, check your exam to see that you have 18 numbered pages.
6. Each multiple-choice question is worth 2 points unless indicated otherwise. Select only one answer- the best answer, amongst those listed. 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. Note that some of the multiple-choice questions have work area—we grade the scantron. This space is provided for your convenience only.
7. Do not talk during the exam. The exam is closed book. No calculator is permitted.
8. When told to STOP--STOP! If you do not stop when told to you then you will lose points, up to the maximum of 100 points.
9. Note that WORK AREAS will not be graded. They are provided so that you have space to work on various problems. The last page is a completely blank page you can use for work area. It can be separated from the exam but it must be turned in along with the exam.

**WHEN TOLD TO BEGIN, CHECK FOR 18 NUMBERED PAGES.
 DO NOT TURN OVER until told to begin!!!**

(Spring 2015)

READ EACH QUESTION CAREFULLY.

1. The species of yeast used in Bio 1AL (*Saccharomyces cerevisiae*) has two mating type alleles, A or alpha, at one locus. *Schizophyllum commune* is a mushroom that has two genetic loci that determine mating type, the A and B loci, which are genetically unlinked. There are 300 alleles at the A locus and 90 alleles at the B locus (in the general population). Two haploid (1N) cells must have different alleles at BOTH loci in order to fuse and make a mushroom (e.g. A1B1 with A2B2 is compatible, A1B1 with A1B2 is not). Based upon this information how many mating types exist? (Haploids mate to form diploids, similar to the yeast life cycle.)

- A) about 90
- B) about 300
- C) about 39
- D) about 27,000
- E) $2(300 + 90)$

2. The light reactions of photosynthesis create a proton gradient. The electron transport chain pumps protons into the _____. Protons from the _____ of water _____ the gradient.

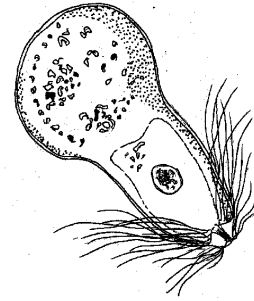
- A) Thylakoid lumen (thylakoid space); oxidation; decrease
- B) Thylakoid lumen (thylakoid space); oxidation; increase
- C) Thylakoid lumen (thylakoid space); reduction; decrease
- D) Stroma; oxidation; increase
- E) Stroma; reduction; increase

3. An object has a known length of $200\mu\text{m}$. When looking at it under 100X total magnification it is 20 ruler marks long. You then change the microscope to 200X total magnification and look at an object of unknown length. At 200X the unknown object is 15 ruler marks long. What is the length of the unknown object?

- A) $15\mu\text{m}$
- B) $20\mu\text{m}$
- C) $40\mu\text{m}$
- D) $75\mu\text{m}$
- E) $100\mu\text{m}$

4. An image of an organism that you should have seen in lab is shown to the right. Identify the organism (genus only).

- A) *Anabaena*
- B) *Elodea*
- C) *Nitella*
- D) *Trichomonas*
- E) *Trichonympha*



5. You start with one 2N cell. It completes the cell cycle, mitosis and cytokinesis. All resulting daughter cells also complete the cell cycle, mitosis and cytokinesis. Then, ALL daughter cells complete the cell cycle, meiosis and cytokinesis. How many TOTAL cells are present at the end and what is the ploidy of EACH cell? Assume that meiosis and cytokinesis produce sperm cells of equal sizes.

- A) 4 cells, 1N
- B) 8 cells, 2N
- C) 8 cells, 1N
- D) 16 cells, 1N

6. In a diploid organism, when 2 alleles are the same, the organism is _____. When 2 alleles are different, the organism is _____. And if only one allele is present, the organism is _____.

- A) Homogenous, heterogenous, hemigenous
- B) Homozygous, heterozygous, unizygous
- C) Homogenous, heterogenous, semigenous
- D) Homozygous, heterozygous, hemizygous
- E) Homologous, heterologous, semiologous

7. In the Bioinformatics exercise a consensus sequence should have been generated. This sequence should have been generated using _____ and the consensus sequence is based on _____.

- A) BLAST; 16SrRNA forward and rpoB forward sequences
- B) BLAST; 16SrRNA forward and 16SrRNA reverse sequence
- C) PubMed; 16SrRNA forward and 16SrRNA reverse sequence
- D) PubMed; 16SrRNA forward and rpoB forward sequences
- E) CLC sequence viewer; 16SrRNA forward and 16SrRNA reverse sequence

8. In lab, you examined a slide containing a hollow glass tube and a solid glass rod. The hollow tube comes into focus first while raising the stage. In this example, you would expect to see image _____, and the hollow tube is on _____.

- A) Image 1 top.
- B) Image 2 top.
- C) Image 1 bottom.
- D) Image 2 bottom.

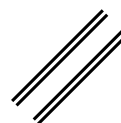


Image 1

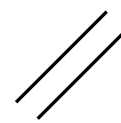


Image 2

Questions 9 & 10. (1 pt each)

What happens to each of the following when you switch from a 20X objective to a 40X objective? For each bubble in choice A, B or C. Assume proper microscope use. Each letter may be used once, more than once, or not at all.

9. The amount of light emerging from the ocular lens.

10. The depth of focus.

- A) Decreases
- B) Remains the same
- C) Increases

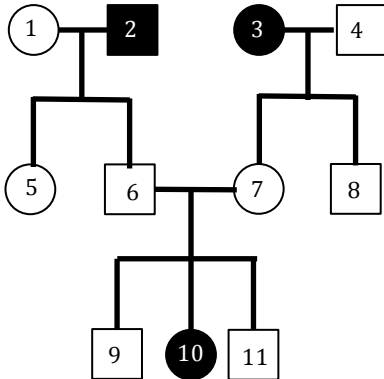
11. Miniature wings are an X-linked recessive phenotype where fruit flies have small wings. If a miniature winged female breeds with a normal winged male, what phenotype will their offspring have?

- A) All offspring have normal wings.
- B) 50% of male and all female offspring will have miniature wings.
- C) All males have normal wings and all females will have miniature wings.
- D) All females have normal wings and $\frac{1}{2}$ of the males will have miniature wings, $\frac{1}{2}$ will have normal wings.
- E) All females have normal wings and all males will have miniature wings.

12. Which of the following will most likely LEAST affect the rate of an enzymatic reaction?

- A) Increasing the concentration of substrate of a reaction in which the enzymes are currently working at maximum velocity
- B) Increasing the concentration of enzyme of a reaction in which the enzymes are currently working at maximum velocity
- C) Adding a non-competitive inhibitor to the reaction.
- D) Changing the pH of the reaction environment from pH 7 to pH 3.
- E) Changing the temperature of the reaction environment from 30° C to 75° C.

13. Here is a pedigree for a human family for a certain disease. The affected individuals have optic nerve break down that leads to blindness. What pattern of inheritance does this pedigree reveal? (Square = male, circles = females, filled in means affected). Individuals are numbered 1-11.



- A) Autosomal dominant
- B) Autosomal recessive
- C) X-linked recessive
- D) Y-linked
- E) Either B or C would explain the pedigree.

14. One can use $Abs=cIz$ to determine concentration. A substance Y has a molar extinction coefficient of $4M^{-1}cm^{-1}$. You took 1mL from the stock of solution Y, added it to 4mL of water. The new diluted solution Y has a measured value of 1% Transmittance (after being properly blanked). The path length (l) is 1cm. What is the concentration of the substance Y in the stock?

- A) 0.01%
- B) 0.2M
- C) 0.5M
- D) 2.0M
- E) 2.5M

15. Which of the following WAS NOT an ingredient in OUR negative control reaction in PCR?

- A) dNTPs
- B) Forward and Reverse primer
- C) TAQ polymerase
- D) Template
- E) Both B and C.

16. The OH⁻ concentration in your solution is 0.01 micromoles/ L. What is the pH of this solution?

- A) 2
- B) 4
- C) 6
- D) 10
- E) 12

17. Wild type fruit flies have 6 legs. Some flies with four legs were found. True breeding populations for both types were established. Females from a true breeding population for 4 legs when crossed to a male from a true breeding population for 6 legs produced male flies with 4 legs and female flies with 6 legs. What is the genotype of a female from true breeding population with 4 feet?

- A) $X^F//X^F$
- B) $X^{F+}//X^f$
- C) $X^f//X^f$
- D) $X^{f+}//X^{f+}$
- E) $X^{F+}//X^{F+}$

18. You have two isoenzymes that catalyze the same reaction. You measure the K_m value of each under identical conditions. The K_m of Isoenzyme 1 is 0.4 mole/L and the K_m of Isoenzyme 2 is 0.3 mole/L. Which enzyme, 1 or 2, has a higher affinity?

- A) Enzyme 1
- B) Enzyme 2

19. *Anabaena torulosa* is a species of cyanobacteria. This species is photosynthetic. Which of the following would most likely not be present in this species?

- A) Cytoplasm.
- B) Cell membrane.
- C) Ribosomes.
- D) Thylakoid membrane.
- E) Circular DNA.

20. Mary has a biological mother and father. How much DNA does Mary share with her mother's mother (i.e., her grandmother)? None of her parents or her grandparents were genetically related (i.e., no inbreeding in the family).

- A) 50%
- B) 25%
- C) 12.5%
- D) 6.75%

21. The Belly Button Biodiversity Project at North Carolina State (this is real) is assessing the diversity of bacteria present on the skin of the human belly button (navel). Which of the following methods would most likely best allow them to analyze the diversity of bacteria?

- A) Swabbing and then growing cultures and then using light microscopy to identify the bacteria.
- B) Swabbing and then using electron microscopy to identify the bacteria.
- C) Swabbing and then using PCR to amplify the 16 srRNA locus and then sequencing.
- D) Swabbing then use Gram staining.

22. Which of the following is the best definition of an ortholog?

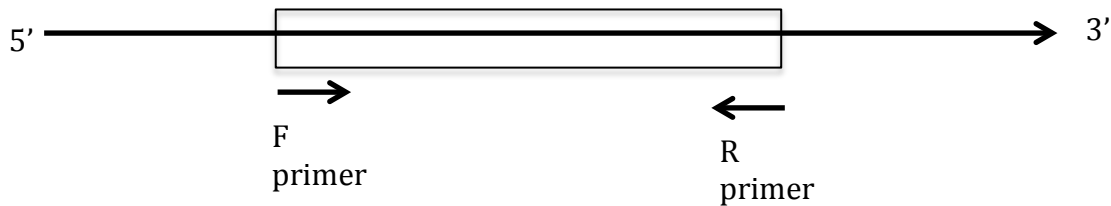
- A) Genes produced via gene duplication within a genome
- B) Genes from different species that have diverged from a single gene in a common ancestor
- C) Alleles of a gene that have lost their protein-coding ability or are otherwise no longer expressed in the cell.
- D) Genes in different species that evolved independently but result in the same function.
- E) Alleles of a gene that have moved (translocated) to a non-homologous chromosome.

23. A reaction center in photosystem II is excited but there is no electron acceptor present. How (most likely) does the reaction system photosystem revert back to ground state?

- A) a longer wavelength of light is emitted
- B) a shorter wavelength of light is emitted
- C) heat is released
- D) Both A and C
- E) Both B and C

24. (3 pts) You find a population of zombies. The DNA in these zombies is single stranded DNA. You decide to use PCR (30 rounds) to amplify a particular locus from one cell and then sequence the PCR product. The diagram below illustrates the DNA and primers. You will need at least a million molecules. Select the answer that would allow you to generate and sequence a million molecules.

- A) Use only the R primer for PCR, for sequencing use only the R primer.
- B) Use only the R primer for PCR, for sequencing use only the F primer.
- C) Use both the F and R primer for PCR, for sequencing use either the R primer or F primer in a given reaction, but NOT both at same time in a given sequencing reaction. .
- D) Either B or C would work.
- E) None of the above would work as it is impossible to amplify single stranded DNA.



25. You measure the kinetics of an enzyme and calculate that it has a K_m of 1.0 mM substrate. You correctly measure the optical density of the reaction to be 0.4 O.D. units when using 1.0 mM substrate. What is the expected optical density at V_{max} under similar conditions (same buffers, same amount of enzyme) except excess substrate is present?

- A) 1.0 mM
- B) 2.0 mM
- C) 0.4 O.D. units
- D) 0.8 O.D. units
- E) Cannot solve this problem with the information given.

26. You have 200 starch molecules in solution. Each starch molecule is 40 glucose units long. You add amylase and get complete cleavage (only maltose units produced). What is the NET overall increase in the number of reducing units?

- A) 1,950
- B) 3,800
- C) 4,000
- D) 7,800
- E) 8,000

27. (3 pts) 5 μ l of a PCR product is run out on a gel along with standards. See the gel for results. The average molecular weight of a nucleotide is 300 grams/mole. Approximately how many molecules of double stranded DNA are present in the 5 μ l of a PCR product?

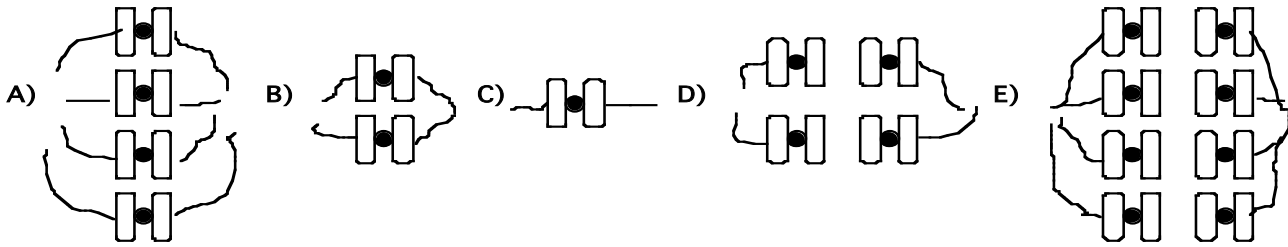
- A) about 2.4×10^{11} molecules
- B) about 4.8×10^{11} molecules
- C) about 9.6×10^{11} molecules
- D) about 2.0×10^{12} molecules
- E) about 2.4×10^{12} molecules



28. Suppose we create a suspension of chloroplasts from spinach leaves. We are repeating the light reactions (no DCMU, no methylamine). The concentration of chloroplasts is similar (0.1 mg chlorophyll/ml) to that in lab but we are, instead using 3.5 ml of sodium phosphate buffer with sucrose (in lab, the 3.5 ml of sodium phosphate buffer had no sucrose). What would you expect to happen to absorbance after about 3 minutes of exposure to light? The set-up is similar to lab, except for the presence of sucrose, and you should compare the data to that in lab (similar light levels, distance from lamp, etc., but for the change in buffer).

- A) Little change in absorbance over the 3 minutes--- almost like the dark reactions from lab.
- B) About the same change in absorbance over the 3 minutes as found in the light reactions from lab.
- C) About the same change in absorbance over the 3 minutes as found in the light plus methylamine reactions from lab.
- D) Unlike the data in lab, the absorbance would increase and the percentage change would resemble that found in the light reactions from lab, BUT the inverse (an increase).

29. Which figure corresponds to metaphase of mitosis of animal cell with $1N = 2$?



30. A researcher studying the biosynthesis of lysine, an essential amino acid, collects ten strains of haploid yeast. The researcher does pair-wise matings. The mutations are all recessive. The results are below (“+” signs indicate growth and “-” signs indicate no growth).

	1	2	3	4	5	6	7	8	9	10
1	-	-	-	+	+	+	+	+	+	+
2		-	-	+	+	+	+	+	+	+
3			-	+	+	+	+	+	+	+
4				-	+	-	+	+	+	+
5					-	+	-	+	-	+
6						-	+	+	+	+
7							-	+	-	+
8								-	+	-
9									-	+
10										-

Based upon this limited data set, what is the least number of genes involved for lysine biosynthesis?

- A) 3
- B) 4
- C) 5
- D) 6
- E) 7

31. Imagine that a different scientist studies the same pathway (lysine biosynthesis) in the same species of yeast and finds even more recessive mutants. She finds 10 mutants in a complementation group. She numbers the mutant strains as mutant 1,001, mutant 1,002, mutant 1,003, through mutant 1,010. She expected the 10 mutants to map to the same location, but four of them map to chromosome 4 and the remaining six map to chromosome 6. Other scientists get the same data as well (for the same species) and even confirm these loci encode for mRNA.

Select the answer that explains these results. Select either D or E if you think there are two possible explanations.

- A) This is to be expected as the complementation group was those mutants that complemented.
- B) The affected step in the pathway consists of an enzyme with two different polypeptides (subunits) in the functional enzyme.
- C) There is alternative splicing of the pre-mRNA such that two different mature forms are produced and translated.
- D) Both A and C.
- E) Both B and C.

32. For this question assume you start with the exact same number of identical chloroplasts and that the solutions are similar to the ones you used in the photosynthesis lab. Which of the following solutions/suspensions would you expect to have the most fluorescence when illuminated with UV light?

- A) 1,000 chloroplasts placed into 0.5 ml sucrose phosphate buffer
- B) 1,000 chloroplasts placed into 0.5 ml phosphate buffer
- C) 1,000 chloroplasts placed into 0.5 ml acetone
- D) All of the solutions would be equal since you have the same number of chloroplasts.

33. The protonation state of the carboxylic acid on the amino acid aspartic acid can vary with pH. Salivary amylase has aspartic acid at the 121st amino acid position (which is solvent accessible, i.e. it undergoes changes in protonation state with changes in pH). The pKa of this acid is 4.5. Which form, protonated or unprotonated, would predominate in the presence of DNS? The DNS solution was the same one used in lab.

- A) COOH would predominate over COO⁻.
- B) COO⁻ would predominate over COOH.
- C) COOH and COO⁻ would each be equal; that is, each would be at 50%.

34. All reactions require an input of energy! (True or False) Endergonic reactions_____.

- A) FALSE; release a net amount of energy
- B) TRUE; require a net input of energy
- C) TRUE; release a net amount of energy
- D) FALSE; require a net input of energy

35. An oligopeptide, 20 amino acids is shown below. It is written from the N terminus to C terminus. "N terminus MRF~~A~~WTVLLLLCAPPQAGQRL- C terminus". One variant (allele) found in humans is known as T6Q. Which of the following sequences corresponds to that allele? Changes are italicized, underlined and increased font size to make it easy for you to find them.

- A) MRF~~A~~WTVLLLLCAPP **T**AGQRL
- B) MRF~~A~~W **Q**VLLLLCAPPQAGQRL
- C) MRF~~A~~W **Q**QQQQQVLLLLCAPPQAGQRL
- D) MRF~~A~~WTVLLLLCAPP **T**TTTTTAGQRL

36. You perform Gram staining on a particular species of bacterium. They are bacillus-shaped bacteria and Gram-negative. Based upon this information, you would expect the cells to be _____ shaped and be colored _____ after Gram-staining.

- A) round; red
- B) round; purple
- C) spiral; purple
- D) rod; purple
- E) rod; red

37. You need to determine how much chlorophyll is present per chloroplast. You have 5 grams of spinach leaves. There are 1 million chloroplasts per gram of spinach leaves. You blend them in a sucrose phosphate solution, centrifuge the sample, decant the supernatant, and re-suspend the pellet. Eventually you end up with 20 ml of a chloroplast suspension of 0.1 mg chlorophyll/ml. No chloroplasts were lost or lysed during the preparation. How much chlorophyll is present per chloroplast (mg/chloroplast)?

- A) 4.0×10^{-10} **mg** chlorophyll/chloroplast
- B) 1.0×10^{-6} **mg** chlorophyll/chloroplast
- C) 4.0×10^{-7} **mg** chlorophyll/chloroplast
- D) 2.5×10^{-6} **mg** chlorophyll/chloroplast
- E) 4.0×10^{-6} **mg** chlorophyll/chloroplast

38. You isolate sperm from a mammal and determine the number of chromosomes to be 14 and the amount of DNA per sperm cell to be 4.8×10^{-12} grams (ignore mitochondrial contribution). The average molecular weight of a base pair is 600 grams/mole. How many chromosomes are present in kidney cells (G1 phase) from this mammal and what is the genome size? Assume the life cycle of this mammal resembles that of humans.

- A) 14, 4.8×10^9 bp.
- B) 14, 9.6×10^9 bp.
- C) 28, 4.8×10^9 bp.
- D) 28, 9.6×10^9 bp.

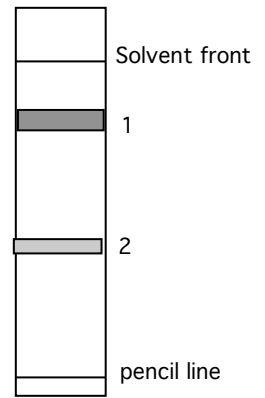
39. (3 pts) A scientist successfully isolates all of the chromosomes from the nuclei of 10 liver cells of a human (in G2 of the cell cycle). The cells were genetically identical. The scientist heats up the sample and successfully denatures the DNA (breaking H bonds, but not covalent bonds). What statement best describes the denatured DNA? Ignore any replication errors.

- A) 920 total strands, representing 46 unique DNA sequences (strands)
- B) 920 total strands, representing 92 unique DNA sequences (strands)
- C) 1840 total strands, representing 46 unique DNA sequences (strands)
- D) 1840 total strands, representing 92 unique DNA sequences (strands)
- E) 3680 total strands, representing 92 unique DNA sequences (strands)

40. You have two stock solutions of substance X, 6 M and 10 M. You add 4 ml of the 6 M solution to 6 ml of the 10 M solution to make solution A. You add 90 ml of deionized H₂O (no substance X in it) to solution A to make solution B. What is the final concentration of substance X in solution B?

- A) about 0.88 M
- B) about 0.84 M
- C) about 0.78 M
- D) about 0.74 M
- E) about 0.70 M

41. During the Photosynthesis Lab you used acetone to extract pigments. You then did the chromatography experiment. Imagine you repeat the procedure (acetone, same developing solvents, etc.) with a different plant using flower petals. You observe the results below.



Based on these results you would expect

- A) Pigment 1 to be found in the aqueous portion of the chloroplast and to be more hydrophobic than pigment 2.
- B) Pigment 1 to be found in the aqueous portion of the chloroplast and to be more hydrophilic than pigment 2.
- C) Pigment 1 to be found in the membrane of the chloroplast and to be more hydrophilic than pigment 2.
- D) Pigment 1 to be found in the membrane of the chloroplast and to be more hydrophobic than pigment 2.

Three genetically linked genes are A, B and C (mutations are dominant). An individual heterozygous for all 3 loci was crossed with another individual homozygous for all three wild type traits (wild type is recessive). The following phenotypes and numbers are seen. Use these data to answer questions 42 & 43.

ABC	8
A ⁺ B ⁺ C ⁺	8
ABC ⁺	90
A ⁺ B ⁺ C	90
A ⁺ BC	362
AB ⁺ C ⁺	362
AB ⁺ C	40
A ⁺ BC ⁺	40
Total	1,000

42. (1 pt) Which trait maps between the other two (i.e., which is in the middle)?

- A) A
- B) B
- C) C

43. What is the approximate map distance between the A and B loci?

- A) 1 map unit (Centimorgan)
- B) 10 map units (Centimorgan)
- C) 20 map units (Centimorgan)
- D) 50 map units (Centimorgan)
- E) 100 map units (Centimorgan)

44) Two individuals with the indicated genotype are crossed. The b and E loci are 20 map units apart.

$$\begin{array}{cc} b^+ & E \\ \hline b & E^+ \end{array} \quad \times \quad \begin{array}{cc} b^+ & E^+ \\ \hline b & E \end{array}$$

What is the probability of producing an offspring with the genotype?

$$\begin{array}{cc} b^+ & E \\ \hline b & E \end{array}$$

- A) (0.02)
- B) (0.16)
- C) (0.17)
- D) (0.33)
- E) None of the above.

45) **Crossing over**

- A) occurs commonly between non-homologous chromosomes during prophase I
- B) occurs commonly between non-homologous chromosomes during prophase II
- C) occurs commonly between homologous chromosomes during mitosis
- D) occurs commonly between homologous chromosomes during prophase I

46 & 47) Use the data in the table to answer questions 46 & 47.

46) Three genetic loci are studied. None are sex-linked. The phenotype of offspring from a particular cross is shown in the DATA table. The letter r indicates the recessive phenotype for a given trait, D indicates the dominant phenotype. Question style resembles those in the genetics section of the pre-labs/worksheets. T1 stands for Trait 1, T 2 for Trait 2, T 3 for Trait 3. Which statement best describes the three genetic loci?

- A) Trait 1 and trait 2 loci are genetically linked and trait 3 is NOT genetically linked (to either 1 or 2)
- B) Trait 1 and trait 3 loci are genetically linked and trait 2 is NOT genetically linked (to either 1 or 3)
- C) Trait 2 and trait 3 loci are genetically linked and trait 1 is NOT genetically linked (to either 2 or 3)
- D) All 3 genetic loci are genetically linked.

47) (3 pts) Select the genotype of the parent that is HETEROZYGOUS FOR THE GENETICALLY LINKED LOCI? An “r” means the recessive allele, “D” means dominant allele.

If you selected D for Question 46, 3 linked loci, then select between A or B.
 If you chose A-C for Question 46, 2 linked loci, for then select between C or D.

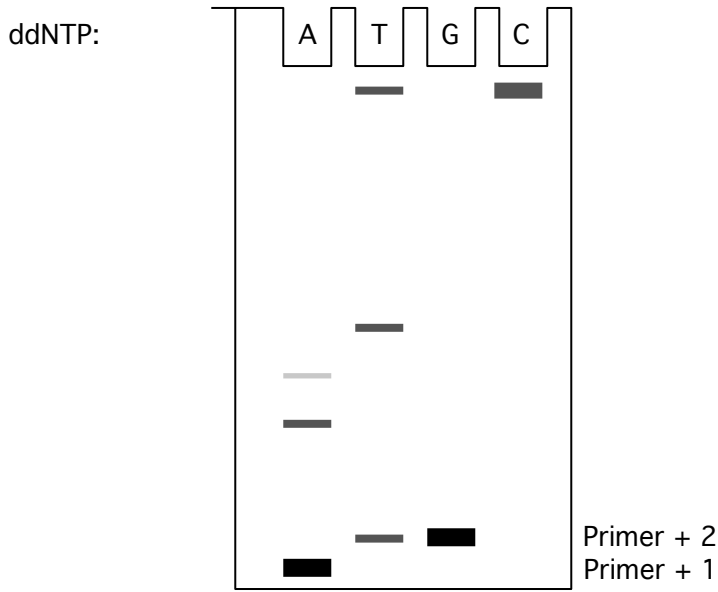
	Parental Genotype
A) All 3 loci are genetically linked.	r r r // D D D
B) All 3 loci are genetically linked.	r D r // D r D
C) For the two genetically linked traits the coupling is:	D r // r D
D) For the two genetically linked traits the coupling is:	D D // r r

PHENOTYPIC DATA

Trait 1	T 2	T 3	#
r	D	r	240
r	D	D	720
r	r	r	160
r	r	D	480
D	D	r	360
D	D	D	1080
D	r	r	40
D	r	D	120
Total			3,200

Below is a sequencing gel. The template is shown below and note that the primer (5'- CGT- 3') is radioactive. Quite a few mistakes were made when setting up the reactions. The presence of any molecules will expose the film.

TEMPLATE IS 5'- TGGCCATTCATACG - 3' Primer = 5'- CGT- 3' radioactive



48) Which of the following could explain the presence of only one band in the ddG reaction lane (the band is at the primer + 2 position)?

- A) dGTP, dATP, dTTP were all present but no ddGTP.
- B) dATP, dTTP were both present but only ddGTP and no dGTP.
- C) dATP and dTTP were present but no dGTP or ddGT were present
- D) dTTP and ddTTP were present in equal ratios and dATP, dCTP and dGTP were present
- E) both B and C

EXAM CONTINUES

49. (3 pts) Two groups of scientists (1 & 2) are studying the same species of birds. Unlike humans, in birds, females are ZW and males are ZZ. Normally the birds have narrow beaks. Each group independently finds mutants with wide beaks and generates true-breeding populations that have only this mutation (wild type for all other loci). They mate wide beaked males from Group 1 with wide beaked females from Group 2. Males have normal, narrow beaks but females have wide beaks.

From this they know:

- 1) The mutations are recessive.
- 2) There are two genetic loci involved (which complement each other in a complementation assay).
- 3) The two loci are genetically UNLINKED but physically linked on the Z chromosome.
- 4) There is NO crossing over between the Z and W chromosomes.

They allow the F1 females to mate with the F1 males to generate F2 birds. What percentage of the F2 birds have the normal narrow beak (ignore sex)?

- A) 75% (6/8).
- B) 50% (4/8).
- C) 37.5% (3/8).
- D) 25% (2/8).
- E) 0 %