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**MULTIPLE CHOICE** (5 points each) CIRCLE LETTER BY **BEST ANSWER**.

401. A kind of regulatory element that acts far from its target gene by making a diffusable protein product is a(n)

- a enhancer
- b transcription factor gene
- c promoter
- d operator
- e operon

402. The reason VNTR's (microsatellites) are the DNA markers of choice for forensic and paternity tests is that

- a they are highly variable among human populations.
- b they are highly variable among individuals.
- c they can be easily detected by in situ hybridization.
- d repeat sequences are common in the human genome.
- e none of the above

403. Some lizards have parthenogenetic (all-female) species because

- a parthenogenesis is a form of vegetative reproduction.
- b hybrid animals are always infertile.
- c all-female species are evolutionarily superior, since daughters are genetically identical to their mothers.
- d it is a way of maintaining reproduction in triploid hybrids that are unable to form balanced gametes.
- e hybrids cannot find suitable mates.

404. “Knockout” mice are very useful in studies of gene function because

- a they show what happens to the phenotype when a specific gene is nonfunctional.
- b they show what happens to the phenotype when a specific allele is lost from the population.
- c they show how a random mutation is expressed in the phenotype.
- d if they die as embryos, they tell us about developmental genes.
- e they usually have uncontrolled cell proliferation (cancer).

405. A promoter mutation (P-) results in

- a no transcription
- b no translation
- c inducible transcription
- d constitutive transcription
- e transcription but no translation

406. Suppose that an exceptional girl is born who has three copies of chromosome 22, and she survives to early adulthood. Which of the following characteristics would you NOT expect to find in this woman?

- a Lower than average fertility
- b Health problems involving multiple organ systems
- c Uneven pairing of some chromosomes during meiosis
- d Two Barr bodies per cell
- e Production of some unbalanced gametes (eggs)

407. Which of the following statements about excision repair is incorrect?

- a Excision repair is always initiated by specific enzymes that recognize damaged DNA.
- b Excision repair removes a region of DNA that extends beyond the damaged bases on either side.
- c The gap resulting from an excision must be filled in by special repair enzymes (e.g. endonucleases).
- d Excision repairs all require an undamaged template strand.
- e Excision repair usually results in a perfectly restored DNA helix.

408. Lambda phage ( $\lambda$ ) will follow the \_\_\_\_\_ lifestyle if \_\_\_\_\_.

- a lysis; the lysogeny operon is always expressed
- b lysogeny; all the promoter sites are defective
- c lysis; all of its operons are repressed
- d lysis; the 1st gene of the lysis operon makes enough repressor to block lysogeny
- e lysogeny; the lysis operon is making lots of repressor protein

409. Which of the following factors will have NO effect on whether a population is in Hardy Weinberg equilibrium?

- a lots of mutations
- b lots of migration
- c assortative mating
- d many polymorphic loci

e small population size

410. In bacteria, enzymes used for anabolism (building up of molecules) are usually made by \_\_\_\_\_ genes or operons, while enzymes used for catabolism (breakdown of molecules) are usually made by \_\_\_\_\_ genes.

- a positively controlled; negatively controlled
- b negatively controlled; positively controlled
- c structural; control
- d repressible; inducible
- e inducible; repressible

411. Eukaryotes have fewer different kinds of DNA repair systems than prokaryotes because

- a they have larger and more complex promoters.
- b they mutate less often because their cells are more protected from the environment.
- c they are not totally dependent on the survival of any one cell.
- d their repair systems are more sophisticated, and so require fewer backups.
- e unlike prokaryotes, they can use some of the same DNA polymerases and ligases that are involved in normal replication.

412. Eukaryotic transposons (DNA elements) are different from eukaryotic retrotransposons (RNA elements) in what way?

- a They are structurally more like viruses than are retrotransposons.
- b They are always smaller.
- c They can occur many times in the host genome.
- d Their movement is dependent on the presence of specific enzyme.
- e Some of them can move by excising and reinserting the original element.

413. Which statement about microarray experiments is FALSE?

- a They are based on DNA:DNA hybridization
- b They are based on competitive hybridization using two different pools of nucleic acids
- c They used fluorescent labeling
- d They can be used to scan the expression of many genes simultaneously
- e They can be useful in screening for genetic diseases

414. The Luria-Delbrueck fluctuation test showed that

- a mutations arise in response to environmental induction.
- b mutations occur more frequently in some strains of E. coli
- c phage T1 can cause E. coli DNA to mutate more often than normal.
- d more resistant E. coli cells arise in large cultures than in small cultures.
- e E. coli cells can mutate randomly at any time.

415. It is impossible to breed a deleterious recessive allele completely out of a population because

- a mutation creates new deleterious alleles faster than natural selection can eliminate them.
- b migration will continually reintroduce that allele into the population.
- c as an allele gets rarer, it is more likely to be "hidden" inside unaffected heterozygotes.
- d most genetic disorders are due to sex-linked alleles, and therefore only males can be selected against.
- e mating is not really random.

416. Which of the following statements about the phenotypic effects of mutations is TRUE?

- a Genes can have multiple mutated alleles that are all equally functional.
- b A mutation in a mammal's skin cell is never harmful because it is not passed on to offspring.

- c In eukaryotes, silent mutations usually have severe deleterious effects.
- d If a mutation occurs in a somatic cell, the mutant phenotype will be passed on to the offspring of that organism.
- e Null alleles are generally dominant.

**FILL IN THE BLANK** (5 points each)

417. Answer the following questions by choosing items from the list below and placing the appropriate letter in the blank space. (One letter per blank, use each letter only once)

- |                           |                               |
|---------------------------|-------------------------------|
| a. UV light               | f. Thymine dimer              |
| b. Intercalating dyes     | g. Nonsense base substitution |
| c. Tautomeric shifts      | h. Ionizing radiation         |
| d. Breaks in DNA backbone | i. Tandem duplication         |
| e. Base analog chemicals  | j. Depurination               |

- A. Which kind of mutation cannot readily be induced? \_\_\_\_\_
- B. Which kind of mutagenizing agent is most likely to cause frameshift mutations? \_\_\_\_\_
- C. Which kind of mutation can be completely reversed by photoreactivation? \_\_\_\_\_
- D. Which kind of mutation is most likely to be beneficial for an organism? \_\_\_\_\_
- E. Which kind of mutagenizing agent is most likely to cause severe damage to the DNA backbone? \_\_\_\_\_

418. Match the phrases about gene regulation in prokaryotes to the terms in the list by putting a single letter in each blank. Not all letters need to be used, and a particular letter may be used more than once.

- |                     |                      |
|---------------------|----------------------|
| a. Positive control | f. Constitutive      |
| b. Activator        | g. Operator          |
| c. Negative control | h. Repressor         |
| d. Inducible        | i. Effector molecule |
| e. Noninducible     | j. Operon            |

- 1. Small molecule that binds to a regulatory protein to change its action \_\_\_\_\_
- 2. Binding site for regulatory proteins \_\_\_\_\_
- 3. Regulatory molecule that binds to operator region in DNA \_\_\_\_\_

4. Regulatory protein that promotes transcription \_\_\_\_\_

419. List three different mechanisms for regulating gene expression that can be done by eukaryotes but not by prokaryotes.

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420. Name or describe two kinds of mobile elements that contain functional genes.

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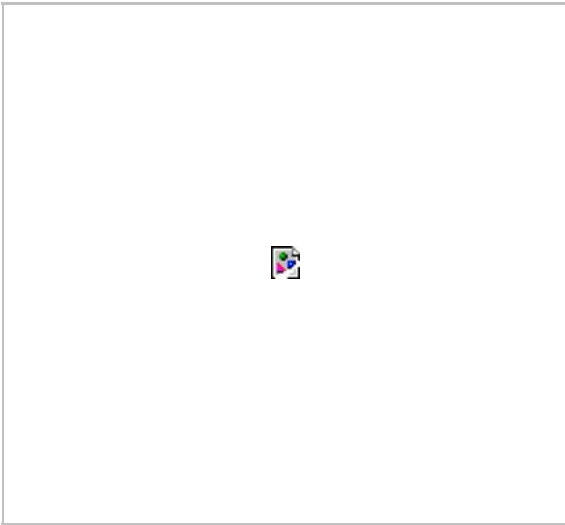
421. The bobble plant normally has  $2n = 18$  chromosomes. How many chromosomes will a bobble plant have in each leaf cell if it is

Trisomic? \_\_\_\_\_ Pentaploid? \_\_\_\_\_

**SHORT PROBLEMS SHOW YOUR WORK!!!!**

422. (24) Below in the chart is the amino acid sequence for Exon 3 of the Drosophila *Metoo* gene. Four mutant flies have been found with single mutations in this exon, and their Exon 3 sequences are shown below the wildtype sequence in the chart. For each mutant, indicate what kind of mutation happened (frameshift, transition, transversion) and what its consequences are (silent, missense, nonsense). Use the codon chart if needed.

<u>Fly</u>	<u>Exon 3</u>						<u>Kind of mutation</u>	<u>Consequences</u>
Wildtype	Arg	Glu	Tyr	Val	Asn	Ile		
Mutant 1	Arg	Glu	Tyr				_____	_____
Mutant 2	Arg	Glu	Tyr	Ala	Asn	Ile	_____	_____
Mutant 1	Arg	Glu	Tyr	Val	Glu	His	_____	_____
Mutant 1	Arg						_____	_____



423. (12 points) Tay-Sachs disease is inherited as an autosomal recessive. Suppose that in Bulgaria, the frequency of Tay-Sachs disease is 1 percent.

A) If the Bulgarian population is assumed to be in Hardy-Weinberg equilibrium with respect to Tay-Sachs, what is the frequency of the Tay-Sachs allele?

B) What is the frequency of heterozygous carriers?

C) What is the probability that two heterozygotes will marry?

423. (14 points) A recessive sex-linked allele in the dwarf hamster causes a white spot to develop on top of the hamster's head. In a randomly breeding population of hamsters, 16% of the females have head spots.

A) What is the frequency of the head spot allele in the population?

B) What percentage of the FEMALES are heterozygous for the head spot allele?

C) If the hamster population is in equilibrium, how many of the MALES do you predict will have head spots in the NEXT generation?

### SHORT ANSWER

(20 points each) BRIEFLY answer **ONE** out of each **PAIR** of questions below (three to five sentences would be about right). Do not write down everything you know or think you know; I will take off points for incorrect information or excessive length. Make it legible—if I cannot read it, I will not grade it.

424. A) What are the characteristics of certain transposable elements that make us think they are related to retroviruses?

B) Explain why regulatory proteins are often allosteric. Why is this especially important for microbes?

425. A) Why do humans with aneuploidies of the sex chromosomes survive better than those with autosomal aneuploidies? Use at least two specific examples in your answer.

B) Why do translocations and inversions often have smaller effects on the phenotype of an organism than duplications or deletions? Why are translocations & inversions most significant during reproduction?

Key to Exam 4 Bot/Zoo 342 Fall 2003

401. b 402. b 403. d 404. a  
405. a 406. d 407. c 408. d  
409. d 410. d 411. c 412. e  
413. a 414. e 415. c 416. a

417. A. c      B. b      C. f      D. i      E. h

418. 1. i      2. g      3. h      4. b

419. hormones, gene amplification, transport regulation, alternative splicing, enhancer activity, histone condensation

420. IS elements, bacterial transposons, Ac elements, complete P elements, viral retrotransposons

421. 19; 45

422. 1. frameshift, nonsense; 2. transition, missense; 3. frameshift, missense; 4. transversion or frameshift, nonsense

423. A)  $q = \text{square root of } 0.01 = 0.1 = 10\%$   $p = 1 - q = 90\%$

B) heteros =  $2pq = 2(0.1)(0.9) = 0.18 = 18\%$

C)  $18\% \times 18\% = 3.24\%$

424. A)  $q = \text{square root of } 0.16 = 0.4 = 40\%$   $p = 1 - q = 60\%$

B) female heteros =  $2pq = 2(0.4)(0.6) = 0.48 = 48\%$

C) spot males =  $q = 40\%$