

**Biol 3301: Genetics**  
**Exam #3**  
**Practice questions**

1. (9) Match the word or phrase that best defines each statement:

- |  |                         |
|--|-------------------------|
| <u>h</u> _____ Mutation in which a purine is substituted by a pyrimidine                     | a) Nonsense mutation    |
| <u>g</u> _____ Mutation caused by the addition of a base in a protein coding region          | b) Silent mutation      |
| <u>a</u> _____ A base change resulting in a stop codon                                       | c) Conditional mutation |
| <u>e</u> _____ Type of mutation that causes mutant sectors to appear on a flower petal       | d) Auxotrophic          |
| <u>b</u> _____ A base change resulting in a codon specifying the same amino acid             | e) Somatic mutation     |
| <u>i</u> _____ Mutation in which a pyrimidine is substituted for a pyrimidine                | f) Lethal               |
| <u>c</u> _____ Mutation that causes a mutant phenotype only under restrictive conditions     | g) Frameshift           |
| <u>d</u> _____ A biochemical mutant that must be supplied with a certain nutrient for growth | h) Transversion         |
| <u>f</u> _____ Mutation that causes death of the zygote                                      | i) Transition mutation  |

2. (3) What principle did the fluctuation test of Luria and Delbruck establish?  
 That mutations pre=exist within a population rather than being somehow induced by the  
 Selecting agent.

3. (3) What is the difference between mutation rate and mutation frequency?  
 Mutation rate is the number of mutations per unit of biological time (*i.e.* generation)  
 Mutation frequency is the number of mutations per unit of population.

4. (4) The rare enol form of thymine pairs with guanine. If a thymidine within the DNA helix shifts to the enol  
 form during replication, base pairing would change from a \_\_\_\_\_T-A\_\_\_\_\_ base pair to a  
 \_\_\_\_\_C-G\_\_\_\_\_ base pair.

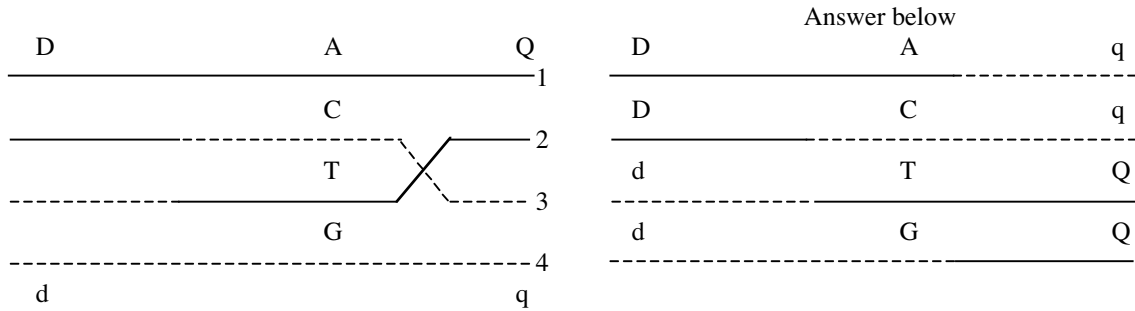
5. (2) Tautomerization, depurination, deamination and oxidative damage are all sources of  
 \_\_\_spontaneous\_\_\_ mutations.

6. (2) In *E. coli*, a region flanked by two repeats of a sequence such as GTGGTGTAA is prone to  
 answer - a  
 a) Deletion      b) Missense mutation      c) Duplication      d) Inversion      e) Frameshift mutation

7. (2) The ionized form of 5-bromouracil will hydrogen bond to which base  
 answer - c  
 a) adenine      b) cytosine      c) guanine      d) thymine      e) uracil

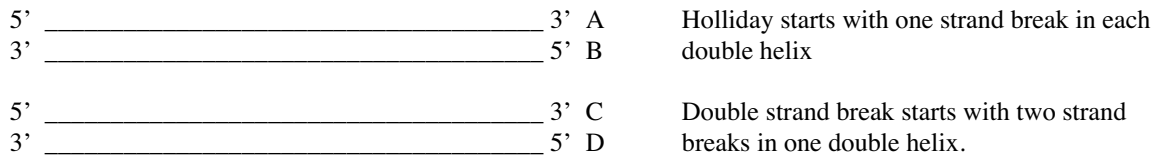
8. (2) The Ames test determines whether a compound is mutagenic by measuring \_\_reversion\_\_\_\_ frequencies of two different types of auxotrophic histidine mutations.
9. (3) Acridine orange is an intercalating agent that causes \_\_\_\_frameshift\_\_\_\_ mutations by inserting between \_\_\_\_bases\_\_\_\_ within the DNA double helix.
10. (3) How does the mismatch repair system tell the newly replicated strand from the template strand? By determining which strand is methylated. The old (template) strand will be methylated.
11. (3) Once damaged bases are removed by \_\_DNA glycosylases\_\_\_\_, the resulting AP sites are repaired by \_\_\_\_base excision repair/AP repair\_\_\_\_.
12. (3) Name two reasons why heterozygous deletions are often lethal.  
 1) Because recessive lethal mutations will be uncovered on the non-deleted homolog.  
 2) Because of an alteration of gene dosage in the region of the deletion.
13. (2) Through what process are tandem duplications generated?  
 1) Unequal crossing-over.  
 2) Slippage of repeats on the template strand.
14. (2) A wild-type chromosome can be represented as ABC\*DEFGH, and from this a chromosomal aberration arises that can be represented as ABC\*DEGFH. This is known as a:  
 (\* = centromere) answer - d  
 a) Deletion      b) Duplication      c) Translocation      d) paracentric inversion      e) pericentric inversion
15. (2) A crossover within the inverted region of \_\_paracentric\_\_\_\_ inversion will give rise to an acentric fragment and a dicentric fragment.
16. (2) In a translocation heterozygote, what type of segregation will give rise to two complete and viable chromosome complements?  
 Alternate segregation
17. (4) What is the difference between an allopolyploid and an autopolyploid?  
 An autopolyploid contains additional copies of the entire genome from the same species.  
 An allopolyploid contains additional copies of the genome from another species.
18. (3) Monosomics and disomics are generated because \_\_non-disjunction\_\_\_\_ occurred during either meiosis I or meiosis II.
19. (2) What effect does age of the mother have on the probability of having a child with Down syndrome?  
 Older mothers will have a higher probability of having a child with Down syndrome.
20. (3) In a haploid cross of  $m \times +$ , which of the following linear octads shows the occurrence of gene conversion?  
answer - c  
 a) +++++mmmm    b) ++mmmm++    c) +++++mmm    d) mm++++mm    e) mmmm++++

21. (3) Show the resulting products for the Holliday structure shown below if it is resolved by breakage of strands 1 and 4.



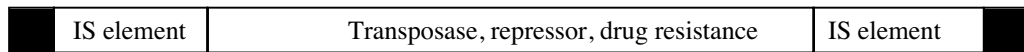
22. (3) Which of the following is a feature of the Meselson-Radding model, but not the Holliday model?  
 a) Two cut strands initiate the process. answer - c  
 b) Branch migration  
 c) Strand invasion  
 d) Holiday structure  
 e) Resolution

23. (4) Both the Holliday and double strand break-repair models for recombination begin with a double strand break. Describe where do these double strand breaks occur in each model. Use the diagram below if it helps, but make sure to clearly label the diagram.



24. (2) Indicate which of the statements below represent common features of bacterial and corn transposons (Note: more than one answer is possible). answer – a, c, d, e.  
 a) Both may cause unstable mutations  
 b) Both may carry drug resistance genes in natural populations  
 c) Both may have inverted repeats at their termini  
 d) Both may move to new loci  
 e) Both may cause rearrangements

25. (4) Draw and label the structure of a bacterial transposon that has integrated into the chromosome.



Black boxes are direct repeats in genomic flanking sequences. IS elements are inverted or tandem.

26. (2) Retrotransposons move via an intermediate that is answer - d  
 a) A double strand DNA circle      b) A retrovirus      c) Double-strand RNA  
 d) Single-strand RNA                  e) Single-strand DNA
27. (3) What protein does a P-element transposon encode and what is the function of this protein?  
 It encodes transposase, which interacts with the inverted repeats at the termini of the transposon to mediate transposition.

28. (2) Which of the following violate the assumptions of Hardy-Weinberg equilibrium?  
 a) Little or no migration    b) No selection    c) Small population size    answer - c  
 d) random mating    e) No mutation

29. (2) In an human population, the genotype frequencies at one locus are 0.5 AA, 0.4 Aa, and 0.1 aa. The frequency of the A allele in this population is    answer - d  
 a) 0.20    b) 0.32    c) 0.50    d) 0.70    e) 0.90

30. A population of rats in a Houston restaurant is measured for resistance to ebola virus.  
 $R_1$  = resistant     $R_2$  = sensitive

Genotypes	$R_1R_1$	$R_1R_2$	$R_2R_2$
Phenotypes (Probability of infection upon exposure to $10^6$ virions)	0	0.5	1.0
Observed numbers (n = 100)	20	45	35

- (2) What are the genotype frequencies?  
 $R_1R_1 = 20/100$  or 0.20,  $R_1R_2 = 45/100$  or 0.45,  $R_2R_2 = 35/100$  or 0.35.

- (2) What are the allele frequencies?  
 $R_1 f = 0.20 + 0.5(0.45) = 0.425$ .  
 $R_2 f = 0.35 + 0.5(0.45) = 0.575$

- (3) What are the expected genotypic frequencies?  
 $R_1R_1 = (0.425)^2 = 0.181$   
 $R_1R_2 = 2(0.425)(0.575) = 0.489$   
 $R_2R_2 = (0.575)^2 = 0.331$

- (2) Assuming that the population is in Hardy-Weinberg equilibrium if observed genotypic frequencies are within 15% of expected frequencies, is this population in Hardy-Weinberg equilibrium?  
 Yes

31. (2) What two forms of variability lead from strict determination of phenotype by genotype to continuous variation?  
 1) Genotypic variation  
 2) environmental variation

32. (3) Why is additive genetic variance the only type of variation relevant to selection?  
 Because it predicts how well a phenotype passes from parent to offspring.

33. (2) Narrow heritability ( $h^2$ ) is a quantification of the proportion of total variance due to  
 a) phenotypic variance    b) total genetic variance    c) additive genetic variance    answer - c  
 d) dominance variance    e) environmental variance