BIO 304 Genetics Fall 2000

Name.	
SSN	

Select from the following terms, the one that best fits the phrases in questions 1-15 (2 points each):

P site	consensus	hydrogen bond	introns	peptide
A site	spliceosome	covalent bond	S phase	uracil
euchromatin	tRNA	metaphase	thymine	aminoacyl tRNA synthetase
snRNA	anaphase I	cytosine	leaky	RNA polymerase
mRNA	polyadenylation	adenine	release factors	hydrophobic bond
nucleotide	genotype	rRNA	splicing	heterochromatin
primer	acrocentric	genome	capping	kinetochore
metacentric	exons	hairpin loop	homologous	auxotrophic
ORF	silent	recessive	dominant	haplo-insufficient
prophase I	metaphase II	anaphase II	phosphodiester	heterochromatin
null	primase	histone H1	scaffold	missense

- 1. <u>genome</u> A complete set of the DNA of an organism.
- 2. <u>phosphodiester</u> Nucleotides are linked together in a single strand of DNA by this bond.
- 3. <u>thymine</u> In DNA, the complementary pairing partner of adenine is this base.
- 4. <u>introns</u> In eukaryotes, these segments of RNA primary transcripts are removed by splicing.
- 5. <u>homologous</u> Pairs of very similar chromosomes found in diploid cells.
- 6<u>. metacentric</u> A chromosome with the centromere located in the center of the chromosome.
- 7. <u>heterochromatin</u>Highly compacted regions of eukaryotic chromosomes that stain densely.
- 8. <u>scaffold</u> A central core of non-histone proteins in the eukaryote chromosome from which loops of DNA project.
- 9. <u>snRNA</u> This class of RNA is involved in pre-mRNA splicing in eukaryotes.
- 10. primer_____ A short nucleic acid fragment that is extended at its 3' end in DNA synthesis.
- 11. <u>P site</u> The region of a ribosomal large subunit to which peptidyl tRNA binds. aminoacyl tRNA
- 12. <u>synthetase</u> The enzyme that is responsible for coupling specific amino acids with specific anticodons (and, thus, with codons).
- 13. <u>auxotrophic</u> A microorganism that is unable to synthesize a particular, important compound.
- 14. <u>leaky</u> A mutation that reduces, but does not completely block, function of a protein.
- 15. <u>anaphase I</u> Meiotic stage at which, in the absence of crossing over, alleles segregate.

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For each of the following, fill-in the blank with the term that best fits the meaning of the sentence or phrase. (2 points each)

16. If the A+T content of a DNA sample is 40%, what are the relative concentrations of each nitrogenous base in this sample?

A<u>20%</u> T<u>20%</u> G<u>30%</u> C<u>30%</u>

17. <u>46</u>	How many DNA molecules are there in the nucleus of a human skin cell during G1 of the cell cycle?				
18. <u>all but bacte</u>	erium Which of the following have a mitochondrial genome: a fish, a moss, a palm tree, baker's yeast, a bacterium?				
19. <u>diabetes</u>	Which of the following phenotypes shows discontinuous variation in humans: adult height, diabetes, birth weight, intelligence, running speed?				
20. <u>8</u>	How many histone molecules are located within the core of each nucleosome?				
21 <u>I</u>	The form of RNA polymerase that transcribes rRNA genes in eukaryotes.				
22. <u>20</u>	The number of amino acids encoded by sixty nucleotides.				
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Consider the following segment of one strand of a DNA molecule: 5' CTACCTGGATCC 3'					
24. <u>5' GGATCCA</u>	<u>GGTAG 3'</u> What is the sequence of the complementary DNA strand? (be sure to note 5' and 3' ends)(4 points)				
25. <u>5' GGAUCCA</u>	GGUAG 3' If the given strand serves as template for RNA synthesis, what is the sequence of the RNA segment that will be transcribed? (be sure to note 5' and 3' ends)(4 pts.)				
26. <u>N – GlySerA</u>	rgStop - C If this RNA segment is translated, what will be the amino acid sequence of the polypeptide product? (be sure to note N and C termini)(4 pts.)				
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The following pedigree concerns inheritance of a rare human disease:

27. Describe the causative gene as autosomal/sex-linked and recessive/dominant. (4 points)

autosomal, recessive

28. What is the likelihood that individual A is a carrier for the disease-causing allele? (4 points)

2/3 (both of his parents are heterozygous; he is not homozygous)

likelihood of getting recessive allele from A: $\frac{1}{2} \times \frac{2}{3}$ likelihood of getting recessive allele from B: $\frac{1}{2} \times \frac{1}{2}$ therefore, $\frac{1}{3} \times \frac{1}{4} = \frac{1}{1}$	his disease? (4 points)
likelihood of getting recessive allele from B: $\frac{1}{2}$ X $\frac{1}{2}$ therefore, $\frac{1}{3}$ X $\frac{1}{4}$ = $\frac{1}{1}$	
	erefore, 1/3 X 1⁄4 = <u>1/12</u>
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30. An albino plant mutant is obtained that lacks red anthocyanin pigment, normally made by an enzyme P. Tissue of the mutant plant lacks detectable activity for enzyme P. However, an immunological study shows clearly that a

protein with the identical properties of enzyme P is present in the cells of the mutant. What is the most likely explanation for this mutation? (provide a brief answer)(5 points)

enzyme P is catalyically inactivated by the mutation but the mutant protein accumulates within the cells

31. Duchenne muscular dystrophy is a rare X-linked recessive disorder. A young woman is worried about having a child because her mother's only brother had this disorder. The young woman herself has no siblings. What is the likelihood that the young woman's first child will have Duchenne muscular dystrophy? (5 points)

her grandmother was heterozygous; likelihood that her mother was heterozygous is $\frac{1}{2}$;

likelihood that she received the allele from her mother is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$;

likelihood that her first son receives the allele from her is $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$;

likelihood that her first child is a son and affected is $\frac{1}{12} \times \frac{1}{18} = \frac{1}{16}$

32. A plant heterozygous at gene A (A/a) and at gene B (B/b) is testcrossed to determine the linkage of A and B. Four classes of progeny are obtained: Aa Bb, Aa bb, aa Bb and aa bb. If approximately one-fourth of the progeny consist of each class, what do you conclude regarding the linkage of A and B? (3 points)

A and B are not linked (assorted independently)

33. If the cross described in question #32 resulted in 32 Aa Bb, 18 Aa bb, 19 aa Bb and 31 aa bb individuals, what would you conclude regarding the linkage of A and B? (3 points)

A and B are linked

34. If you obtained the results presented in question #33, how far apart would you estimate the genes A and B to lie? (3 points)

37 map units (centimorgans) [37 of 100 progeny are recombinant]

35. The maize genes *sh* and *bz* are linked and are 40 centimorgans apart. If a plant $sh^+ bz / sh bz^+$ is allowed to self-pollinate, what proportion of the progeny will be *sh bz / sh bz*? (5 points)

these progeny must receive *sh bz* from each gamete; half of the recombination products are *sh bz*; likelihood of a *sh bz* gamete being formed is $0.4 \times \frac{1}{2} = 0.2$; likelihood of getting this combination in both gametes is $0.2 \times 0.2 = 0.04$

36. By starting with cells that contained uniformly dense DNA and following replication through two cell generations, the Meselson & Stahl experiment used dense nitrogen (N^{15}) to determine whether *E. coli* replicated its DNA in a conservative, semiconservative or dispersive manner. If you did this experiment for a longer period, what proportion of the DNA molecules would you expect to contain N^{15} at the end of <u>three</u> cell generations? (5 points)

after one generation, all DNA molecules contained N¹⁵;

after the second generation, one-half of DNA molecules contained N^{15} ; after a third generation, one-fourth of DNA molecules would contain N^{15}

(3 free points)