BIO 304 Genetics **Exam #1** **Name_____KEY_____**
SSN_____

semi-conservative	conservative	segregation	meiocyte	heterozygote
globular	fibrous	enzyme	aminoacyl-tRNA synthetase	
haplo-insufficient	null	prototrophic	auxotrophic	mutation
virus	continuous	discontinuous	eukaryote	developmental noise
norm of reaction	polymorphism	transcription	translation	prokaryote
ribozymes	introns	exons	consensus sequences	polypeptides
quantitative	plasmid	organelle	karyotype	crossing over
heterochromatin	homologs	nucleosome	kinetochore	histone
topoisomerase	initiation	helicase	Okazaki fragments	ligase
elongation	termination	promoter	polypeptide	transcript
tRNA	scRNA	rRNA	independent assortment	
replication	genotype	phenotype	reporter gene	anaphase I
telophase	metaphase I	prophase II	anaphase II	anaphase
chromatids	alleles	genes	wild type	mutant
cytosine	guanine	adenine	uracil	thymine
recessive	dominant	leaky	gain-of-function	phosphodiester
5'	3'	amino	carboxyl	promoter
primary	secondary	tertiary	quaternary	maternal inheritance
haploid	diploid	polyploid	purine	pyrimidine
nitrogenous base	nucleotide	deoxyribose	ribose	complementary

Use one of the above terms to best complete each sentence #1-15 below. (2 pts. each)

1. Purine bases commonly found in DNA are guanine and ____adenine_____.

2. The normal phenotype that is typical of most individuals in a population is called __wild type_____.

3. A mutation of an enzyme-encoding gene that completely abolishes activity of the enzyme is called a ___null_____ mutation.

4. Small, circular chromosomes in bacteria that often carry drug-resistance genes are called __plasmid_____.

5. A ___auxotrophic / mutant_ strain of *Neurospora* is one that requires a particular medium additive which is not required by wildtype mold.

6. ____eukaryote__ are organisms whose cells have nuclei and membrane-bound structures.

7. ____replication_____ is another term for DNA-dependent DNA synthesis.

8. Phenotypic variation within a species can be due to environmental effects, developmental noise and ____genotype_____.

9. ___anaphase II__ is a stage of meiosis in which the sister chromatids separate to opposite poles of the meiotic spindle.

10. If a functional protein is composed of more than one polypeptide chain, we refer to this higher order of protein structure as its ___quaternary___ structure.

11. _topoisomerase is a protein found ahead of the DNA replication fork that relaxes supercoiling which develops ahead of the advancing DNA polymerase.

12. The Meselson & Stahl experiments with *E. coli* showed that DNA is synthesized by a _semi-conservative_ process.

13. Processing of pre-mRNA in eukaryotes includes polyadenylation (polyA addition) at the ____3'_____ end of the molecule.

14. Chiasmata are visible during the __prophase I / metaphase I_ stage of meiosis.

15. _nucleosome_ are a basic organizational structure of eukaryotic chromosomes, consisting of DNA wrapped around a histone protein core.

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Fill-in the blanks of questions #16-21 with the best term or number (2 pts. for each blank):

16. The diploid chromosome number in voles is 2n=14. In the space provided, give the number of indicated structures that should be present in a single cell at the indicated time during oogenesis:

    a. chromosomes in a Metaphase I cell _____14_____

    b. centromeres in a Prophase II cell _____7_____

    c. chromatids in a Prophase II cell _____14_____

    d. chromosomes in a Metaphase II cell _____7_____

17. By freely substituting bases within a nine-nucleotide segment of RNA (three codons), how many different peptide sequences could be encoded?__20^3 = 8000 (or nonsense→fewer)_

18. In mRNA, UUA codes for leucine. What anticodon sequence must occur in leucyl-tRNA to recognize this codon? ____UAA_____

19. How many centromeres are there in a human lymphocyte in metaphase of mitosis? __46____

20. Name three types of noncovalent chemical interactions that contribute to the stability of the double-stranded helix formed by DNA.

    a. ____hydrogen bonds between bases_____

    b. ____hydrophobic interactions between bases____

    c. ____hydrophilic interactions of PO_4 and water_____

21. Consider the following piece of messenger RNA and respond to each question (3 pts. each):

5´-GGGCAGCAAUACUUUUAA-3´

a) Draw both strands of the segment of DNA from which this mRNA was transcribed, and identify the ends of each strand.

3'-CCCG TCG T TATGAAAATT-5'
5´-GGGCAGCAAT ACT T TTAA-3´

b) Indicate which of the DNA strands served as template for RNA synthesis.

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c) Using the codon chart, give the amino acid sequence of the protein that would be produced by translation of the mRNA, assuming that he ribosome moved along the mRNA from left to right, beginning with the leftmost nucleotide.

GlyGlnGlnTyrPhe(STOP)

d) Label the amino and carboxyl ends of this amino acid chain.

amino left, carboxyl right

22. A plant is heterozygous *Aa Bb* at two unlinked genes. Answer each of the following: (4 points each) **8 FREE POINTS**

a) For a given pollen grain, what is the probability that it is *A b*?

½ X ½ = ¼

b) If the plant is allowed to self-pollinate, what proportion of seeds do you expect to be *Aa Bb*?

chance of Aa = ½; chance of Bb = ½; chance of Aa Bb = ½ X ½ = ¼

23. Barley is a self-fertilizing plant that can be cross-fertilized and you are given two strains with pale green leaves. In strain A, the trait is caused by a chloroplast gene; in strain B, the trait is caused by a recessive nuclear gene. Predict the phenotypes and proportions that will result from the following crosses: (2 points each)

a) strain A egg with strain B pollen. All pale (maternal effect)

b) strain B egg with pollen from the zygote resulting from the previous cross (a)

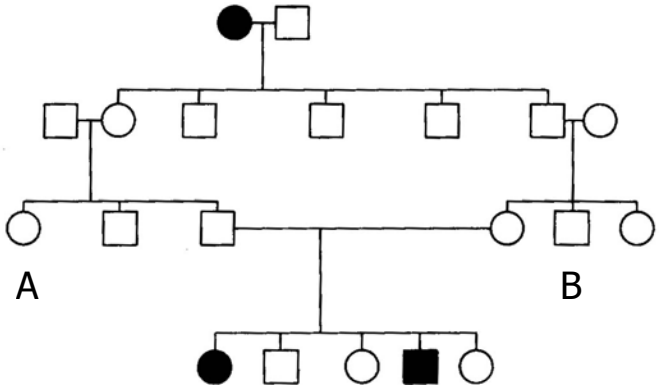
Bb X Bb → ½ pale, ½ dark (chloroplast pale gene in pollen will not affect progeny)

c) strain B egg with strain B pollen. bb X bb → all pale

24. In domestic fowl (*Gallus domesticus*) the gene for plumage color is sex-linked and females are the heterogametic sex (ZW) while females are homogametic (ZZ). The dominant allele G determines gold coloration and its recessive allele g determines silver plumage. A cross is made between a silver male and a gold female, then the progeny are allowed to mate, producing an F2 generation. Give the genotypes, phenotypes and proportions you expect for among the F1 and F2 animals (1 point each):

	Genotype(s)	Phenotype(s)	Percentage
F1 males	Gg	gold	100%
F1 females	g	silver	100%
F2 males	Gg, gg	gold, silver	50%, 50%
F2 females	G, g	gold, silver	50%, 50%

23. Consider the following human pedigree of the rare condition *microphthalmia* (small, nonfunctional eyes), which occurs equally frequently in males and females within the general population. In responding to the questions below, assume that all people marrying into the pedigree do not carry the abnormal allele. (3 pts. each)



a) What is the mode of inheritance of this trait (*e.g.*, linkage, dominant/recessive)?

autosomal, recessive

b) If individuals A and B have a child, what is the probability that the child will be microphthalmic?
probability that A is heterozygous = ½; probability that B is heterozygous = ½
If both are heterozygous, probability that child is homozygous recessive = ¼
Overall: ½ X ½ X ¼ = 1/16

c) If the first child of A × B is normal, what is the probability that their second child will be microphthalmic?
Same as b, 1/16

d) If the first child of A × B has the disease, what is the probability that their second child will be microphthalmic? Now you know that A and B *are* heterozygous;
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