BIO 304 Genetics	Exam #1		Name <u>KEY</u> SSN		
globular	fibrous	enzyme	aminoacyl-tRNA synthetase		
haplo-insufficient	null	prototrophic	auxotrophic	mutation	
random noise	continuous	discontinuous	eukaryotes	virus	
norm of reaction	polymorphism	transcription	translation	prokaryotes	
ribozymes	introns	exons	consensus sequences polypeptides		
replication	genotype	phenotype	reporter gene	genome	
telophase	metaphase I	prophase II	anaphase II	anaphase	
chromatids	alleles	genes	wild type	mutant	
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	
quantitative	plasmid	organelle	karyotype	crossing over	
heterochromatin	homologs	nucleosome	kinetochore	histone	
initiation	gyrase	helicase	Okazaki fragments	ligase	
elongation	termination	promoter	polypeptide	transcript	
†RNA	scRNA	rRNA	independent assortment		
semi-conservative	conservative	segregation	meiocyte	heterozygous	

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

1. The basic subunit of a nucleic acid polymer that consists of a phosphate, pentose sugar and a nitrogenous base is called a <u>nucleotide</u>.

2. <u>continuous</u> variation is the condition whereby a seemingly infinite spectrum of phenotypes exist in a population.

3. A mutation of an enzyme-encoding gene that completely abolishes activity of the enzyme is called a <u>null</u> allele.

4. Recombination occurs by <u>independent assortment</u> and by chromosome crossing over.

5. The DNA sequence at the 5' end of a gene what controls transcription initiation is called the \_\_\_\_\_\_.

6. A <u>auxotrophic</u> strain of *Neurospora* is one that requires a nutrient in the medium in addition to the basic medium that supports growth of wild-type.

7. The function of a protein is strongly dependent upon its <u>tertiary</u> structure that consists of prominent foldings of the polypeptide chain that are stabilized by non-covalent and, sometime, covalent interactions.

8. <u>eukaryotes</u> are organisms whose cells have membrane-limited nuclei.

9. <u>tRNA</u> contains an anticodon loop and can be charged with a specific amino acid.

10. A <u>diploid</u> cell contains two essentially identical sets of chromosomes.

11. <u>anaphase II</u> is a stage of meiosis in which centromeres replicate and separate.

12. Short DNA segments that are created during replication of the lagging strand of DNA are called <u>Okazaki fragments</u>.

13. Along a eukaryotic chromosome, highly condensed chromosome regions are called <u>heterochromatin</u>.

14. RNA splicing in eukaryotes consists of removing <u>introns</u> from pre-mRNA molecules.

15. Processing of pre-mRNA in eukaryotes includes capping (addition of 7-methyl guanosine) at the 5' end of the molecule.

#### \* \* \* \* \* \* \* \* \* \* \* \*

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

- 16. The haploid chromosome number in humans is n=23. 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. Chromatids in Prophase I <u>92</u>
  - b. Centromeres in Prophase II <u>23</u>
  - c. Chromosomes in Anaphase II <u>46</u>
- 17. In the genomic DNA of a Douglas fir tree, 23% of the nucleotides contain adenine (A). What percentage of nucleotides contain the pyrimidine base, thymine (T)? <u>23%</u>
- 18. How many bases are there in 30 kb of DNA? <u>60,000</u>
- 19. What anticodon sequence occurs in tRNA species carrying tryptophan? <u>5'CCA3'</u>
- 20. The most common elements in living organisms are carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur. Which of these is not found in DNA? <u>sulfur</u>
- 21. Name three types of chemical interactions that contribute to the stability of the doublestranded helix formed by DNA. a. <u>hydrogen bonds between complementary bases</u>
  - b. <u>hydrophobic interactions among interior bases</u>

c. hydrophilic interactions of exterior phosphates & water

- 22. Consider the following segment of RNA: 5' AUGGGCUGA 3'
  - a. What is the sequence of the single-strand of DNA that served as the template for this RNA segment (3 pts.)

# 5' TCAGCCCAT 3'

b. Label the 5' and 3' ends of the DNA strand you gave in a. (2 pts.)

c. Using the codon chart provided, what is the sequence of the amino acid chain that would be made from this RNA sequence? (3 pts.)

## N met-gly-stop C

d. Label the amino and carboxyl ends of this amino acid chain. (2 pts.)

23. Two black guinea pigs are mated and over several years produce 29 black and 9 white offspring. Explain these results, giving the genotypes of parents and offspring. (5 pts.)

Simple monohybrid inheritance of simple dominant and recessive alleles. Heterozygous parents (Ww x Ww) produced  $\frac{1}{4}$  WW,  $\frac{1}{2}$  Ww and  $\frac{1}{4}$  ww progeny

24. The recessive allele *r* causes *Drosophila* to have shortened, rudimentary wings, whereas the dominant  $r^+$  allele causes normal wings. This gene is located on the X chromosome. A rudimentary wing male is crossed with a homozygous  $r^+$  female. What are your predictions for each of the following: (5 pts. each)

a. What phenotypic ratio of rudimentary and normal wing males and females do you expect among the offspring?

All F1 males and females would have normal wings

b. If the F1 individuals are mated, what phenotypic ratio of rudimentary and normal wing males and females do you expect among the F2?

½ of F2 males would have normal wings
½ of F2 males would have rudimentary wings

### all F2 females would have normal wings

25. The following pedigree was obtained for a rare, genetically-determined kidney disease.



a. What is the mode of inheritance of this condition? (3 pts.) <u>autosomal, recessive</u>

b. What is the likely genotype of the rightmost male in the first generation of this pedigree? (3 pts.) <u>heterozygous</u>

c. If individuals 1 and 2 marry, what is the probability that their first child will have the kidney disease? (3 pts.)  $\frac{12 \times 12}{12 \times 12} = \frac{1/8}{12}$ 

d. What is the likelihood that the unaffected individual in the last generation is a carrier (heterozygous) for the kidney disease gene? (3 pts.)  $\underline{2/3}$ 

26. Six mutant strains of *Neurospora crassa* are isolated, each of which requires methionine for growth. Three other compounds homocysteine, cystathionine, and cysteine are known to be in the pathway leading to methionine biosynthesis. Each compound is tested for its ability to support the growth of each mutant strain (1-6). The following table indicates growth (+) or non-growth (-):

	methionine	Compound tested <u>homocysteine</u> <u>cystathione</u>		<u>cysteine</u>	none
Mutant 1	+	+	+	-	-
2	+	-	-	-	-
3	+	+	-	-	-
4	+	+	+	+	-
5	+	-	-	-	-
6	+	+	+	-	-

a. What is the order of these compounds in the pathway? (5 pts.)

 $\rightarrow$  cysteine  $\rightarrow$  cystathione  $\rightarrow$  homocysteine  $\rightarrow$  methionine

4 1,6 3 2,5

b. Which mutant strains are blocked in each step of the pathway? (5 pts.)