BIO 304 Genetics	Exam #2	Name SSN	<u>KEY</u>
incomplete dominance	conditional mutation	penetrance	expressivity
Southern blotting	hybridization	epistasis	co-dominance
nonsense mutation	translocation	syngamy	transformation
missense mutation	clone	vector	crossover
electrophoresis	nitrocellulose	â-galactosidase	ampicillin
transduction	silent mutation	prototroph	polymerase
reverse transcriptase	heterokaryon	bacteriophage	duplication
auxotroph	plasmid	probe	restriction enzyme
lytic	transversion	episome	suppression
lysogeny	complementation	stringency	dideoxy sequencing
Northern blotting	library	inversion	F factor
pleiotropy	PCR	ligase	polymorphism
frameshift	Prozac	expression vector	independent assortment
conjugation	reversion	cDNA	Ti plasmid
sister chromatids	RFLP	biotechnology	heteroduplex DNA
complementation	nonsense suppressor	transition	tautomeric shift
thymine dimers	intercalating agent	polyploid	aneuploid
temperate phage	prophage	loss-of-function	gain-of-function

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

1. Crossing two mutants to determine whether the mutations are in the same gene is called a <u>complementation</u> test.

3. <u>Ti plasmid</u> is a chromosomal element from *Agrobacterium* that is used to genetically engineer plants.

4. A <u>missense</u> mutation results in substitution of one amino acid for another in a protein.

5. <u>penetrance</u> is the measure of the frequency with which a particular genotype results in its corresponding phenotype.

7. <u>pleiotropy</u> is the phenomenon whereby a change of one gene has multiple phenotypic consequences.

8. <u>transduction</u> is transfer of genes among organisms by viruses or virus particles.

9. ______ RFLP______ is a polymorphism in which distance between two restriction sites varies, which can be used to map other genes.

10. <u>Southern blotting</u> is the technique whereby DNA fragments are transferred from an electrophoretic gel to a nitrocellulose membrane.

11. Some viruses can integrate and maintain their genomes in host cell genomes, a process we call <u>lysogeny</u>.

12. <u>reverse transcriptase</u> is a DNA polymerase that utilizes an RNA template.

13. A karyotype that lacks a chromosome (2n - 1) is a type of <u>aneuploid</u> genome.

14. Most recombinant DNA clones consist of a <u>vector</u> sequence (for propagation in a host cell) and the DNA fragment that has been "cloned".

15. A <u>library</u> is a collection of DNA clones.

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16. Consider the following two non-homologous chromosomes I and II, with genes a-j and centromeres represented by the small white squares:



Draw a diagram of each of the following chromosome rearrangements (2 pts. each):



17. Two phenotypically wild-type fruit flies were crossed, resulting in 88 females and 43 male progeny. Provide a brief explanation of this result. (4 pts.)

The female was heterozygous for a sex-linked lethal gene, resulting in lethality of half of her sons.

18. Damage that results in distortion of the DNA helix is often repaired by the *general excision repair pathway*, that involves at least three distinctive steps. Briefly describe the steps of this pathway. (5 pts.)

a. The repair components recognize the distortion and create endonucleolytic cleavages on either side of the defective DNA strand; the fragment is removed.

b. DNA polymerase synthesizes a replacement strand, using the "good" strand as template.

c. DNA ligase covalently closes the gap at the 3[°] end of the new DNA.

19. The following pedigree records transmission of two genes in dog: the *dod* gene, responsible for a recessive genetic disease, and an RFLP locus with haplotypes producing an 8 kb or 6+2 kb DNA fragments. A cross was carried out between a phenotypically *dod* female and male from a pure-breeding normal strain. F₁ males and females were crossed, producing an F₂ that included 12 puppies.



a. Are the dod and RFLP loci linked? (3 pts.)

Yes (most *dod* individuals are 6+2 / 6+2; most *dod*⁺ individuals received the 8 haplotype)

b. What is the most likely genotype (for both *dod* and the RFLP locus) for dog #12? (3 pts.)

Probably dod / dod+ and certainly 8 / 6+2

c. What advice would you provide the owner of dog #11 pertaining to the likelihood that this animal is a carrier for *dod*? (3 pts)

Probably not a carrier, but there is some chance that he is, due to crossingover

You are called in as an expert witness in a legal case to determine whether a man of blood group A is the father of a child of blood group B. The child's mother is blood group B. Do you advise the court that the father <u>is</u> / <u>could be</u> / <u>cannot be</u> the father of this child? Using diagrams, explain your conclusion. (5 pts.)

Man <u>could be</u> the father, if he is heterozygous I^{A} / i and contributed the *i* allele to the child. The cross could have been:



- 21. What are the karyotopes associated with each of the following syndromes in humans, and what are the primary sexual phenotypes associated with each: (2 pts. each)
 - a. Turner syndrome XO female
 - b. Klinefelter syndrome XXY male
 - c. Down syndrome trisomy-21; can be either sex, depending upon sex chromosomes

22. From a single F⁺ strain of *E. coli* that was entirely wild-type for most genes, five different Hfr strains are obtained. Each strain was crossed to a multiple-mutant F⁻ strain, using the conjugation-disruption technique. It was found that each Hfr strain transferred genes in the order shown:

Hfr strain A	mal⁺	strs	ser+	ade⁺	his+
Hfr strain B	ade⁺	his⁺	gal⁺	pro⁺	met+
Hfr strain C	pro+	met+	xyl⁺	mal⁺	strs
Hfr strain D	pro+	gal⁺	his+	ade⁺	ser+
Hfr strain E	his+	gal⁺	pro+	met+	xyl⁺

a. Draw a map that reflects these results. (5 pts.)



b. Indicate the site of insertion of F and its orientation in each Hfr strain. (5 pts.)

23. The restriction endonuclease *Nrul* cuts DNA at the sequence TCGCGA. If you digest total genomic DNA from a caterpillar with *Nrul*, what is the <u>average</u> length of the DNA molecules that you can expect to obtain? (4 pts.)

4⁶ = 4096; the site occurs on average every 4096 bp; average fragment size would be 4096 bp

24. A bacterial plasmid that contains a tetracycline resistance gene (tet^{R}) is digested with EcoRI, with HindIII, and with a combination of EcoRI plus HindIII. These three reaction mixtures are then electrophoresed on an agarose gel, resulting in the following restriction fragments: EcoRI, a single 14 kb band; HindIII, two bands of 2.5 and 11.5 kb; EcoRI plus HindIII, three bands of 2.5, 5.5, and 6 kb.

a. Draw a map of the plasmid, including the sites of the three restriction sites and the distances between them. (5 pts.) EcoRI tet^{R} (includes EcoRI site) 6 kb 5.5 kb HindIII 2.5 kb

b. A Southern blot is prepared from the gel described above and it is probed with a

DNA fragment containing the tet^{R} gene. Hybridization is observed to the 14 kb *Eco*RI band, the 11.5 kb *Hin*dIII band, and to both the 5.5 and 6 kb *Eco*RI plus dIII bands. Indicate the location of the tet^{R} gene in your map above. (5 pts.)