

BIOL A201
Genetics
Final Exam
Spring 1999

Fill in the bubble with lead pencil on the Scantron corresponding to the best answer and circle the letter on this sheet. (2 pt ea.)

1. The role of the centromere is
 - a. the primary constriction on the chromosome where the spindle attaches
 - b. to direct the contraction and coiling of chromosomes at prophase
 - c. the site of DNA replication initiation
 - d. to assure the proper pairing of homologous chromosome
 - e. the site of ribosomal attachment

2. One complete set of all the genes of a particular organism or species is known as a
 - a. genome
 - b. genotype
 - c. chromatid
 - d. chromosome
 - e. gene pool

3. During _____, chromosomes are known as dyads and consist of two chromatids that are not identical due to crossing over that occurred in an earlier stage.
 - a. telophase I
 - b. telophase II
 - c. early prophase I
 - d. anaphase II
 - e. interphase prior to meiosis

4. The house fly has a chromosome number of $2n = 12$. It would have ____ chromosomes in the nucleus of a normal, nondividing body cell, ____ bivalents in a late prophase I nucleus of meiosis, and ____ chromosomes in a metaphase II nucleus of meiosis.
 - a. 12, 6, 6
 - b. 12, 12, 12
 - c. 6, 6, 6
 - d. 12, 12, 6
 - e. 6, 12, 12

5. Which of the following is true regarding recombination during meiosis?
 - a. different gamete types are generated by independent segregation of homologous chromosome pairs
 - b. in women, the polar body is the only functional product of recombination
 - c. all maternal chromosomes move together to the same pole and all paternal chromosomes move to the opposite pole
 - d. crossing over is the only known mechanism of recombination during meiosis
 - e. the number of possible gamete types generated by recombination can be estimated by doubling the chromosome number

6. In human females, oocytes begin meiosis
 - a. while in the fetal stage of development
 - b. at the onset of puberty
 - c. at ovulation
 - d. upon sperm penetration of the oocyte
 - e. throughout the life of the female

7. In humans, the allele for curly hair is dominant to straight, but curly is the derived or mutant trait. Therefore, an individual with straight hair has the genotype,
 - a. ss
 - b. Ss
 - c. SS
 - d. SS or Ss
 - e. cc

8. When Mendel proposed his theory on inheritance he stated, "For every trait in an individual, there is a pair of factors that controls the expression of that trait." This became known as principle of
 - a. paired factors
 - b. dominance
 - c. segregation
 - d. linkage
 - e. co-dominance

9. A mother's blood type is O and her baby is also O. Which could not possibly be the father's blood type?
 - a. A
 - b. B
 - c. AB
 - d. O
 - e. None (i.e., all are possible blood types of the father)

10. A garden pea is homozygous dominant for round seeds and is crossed with a garden pea that is homozygous recessive for wrinkled seeds. Progeny resulting from this cross are then test crossed. The seeds resulting from this test cross would be expected to be
 - a. 100% round
 - b. 100% wrinkled
 - c. 50% round and 50% wrinkled
 - d. 75% round and 25% wrinkled

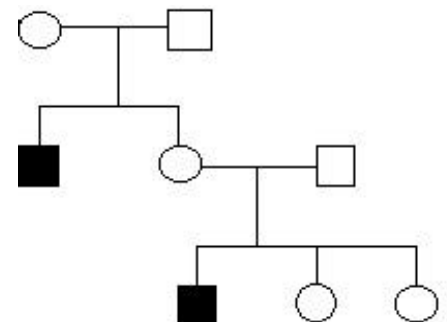
11. Achondroplasia (dwarfism) in humans is an autosomal dominant disorder. What is the probability that a child born to a normal man and an achondroplastic women will have achondroplasia?
 - a. 0
 - b. $\frac{1}{4}$
 - c. $\frac{1}{2}$
 - d. 1

12. Given the following cross: $AaBbC^1C^2 \times AaBbC^2C^2$, what is the probability of obtaining an offspring with the genotype, $AABbC^2C^2$ assuming all loci are independently assorting?
 - a. 0
 - b. $\frac{1}{32}$
 - c. $\frac{1}{16}$
 - d. $\frac{1}{8}$
 - e. $\frac{1}{4}$

13. Given the same cross in the previous problem, what is the proportion of the offspring are expected to be homozygous at all three loci?
 a. 0 b. 1/32 c. 1/16 d. 1/8 e. 1/4
14. Tall is dominant to short and red is dominant to white. A homozygous tall and homozygous red plant is crossed to a short, white plant. The F₁'s are testcrossed and produce the following results: 75 tall, red
 65 tall, white
 62 short, red
 78 short, white
 What would be the expected numbers of the four phenotypes if the two traits were independently assorting?
 a. 157.5 tall, red; 52.5 tall, white; 52.5 short, red; 17.5 short, white
 b. 105 tall, red; 35 tall, white; 35 short, red; 105 short, white
 c. 9/16 tall, red; 3/16 tall, white; 3/16 short, red; 1/16 short, white
 d. 50 tall, red; 50 tall, white; 50 short, red; 50 short, white
 e. 70 tall, red; 70 tall, white; 70 short, red; 70 short, white
15. Perform a chi-square analysis on the results in the previous problem to test the hypothesis of independent assortment. Check your calculated chi-square value in the table below. The best estimate of your chi-square **probability** would be
 a. p<0.05 b. p>0.05 c. p>0.2 d. p>0.5

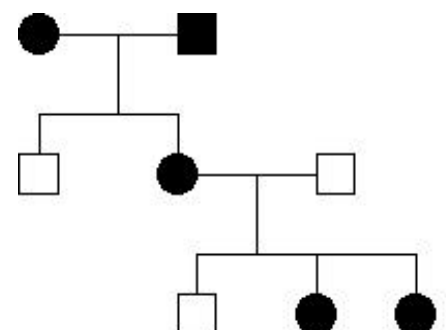
df	Probabilities (p)					
	0.90	0.50	0.20	0.05	0.01	0.001
1	0.02	0.46	1.64	3.84	6.64	10.83
2	0.21	1.39	3.22	5.99	9.21	13.82
3	0.58	2.37	4.64	7.82	11.35	16.27
4	1.06	3.36	5.99	9.49	13.28	13.47
5	1.61	4.35	7.29	11.07	15.09	20.52

16. The human pedigree below is following a genetic disorder. Which of the following best assesses the possible inheritance pattern(s) exhibited by this pedigree?



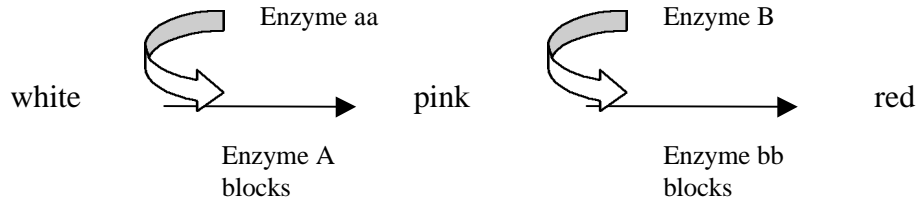
- a. autosomal dominant disorder
 b. autosomal recessive disorder
 c. sex-linked recessive disorder
 d. a or b
 e. b or c

17. The human pedigree below is following a genetic disorder. Which of the following best assesses the possible inheritance patterns exhibited by this pedigree?



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 b. autosomal recessive disorder
 c. sex-linked recessive disorder
 d. a or b
 e. b or c

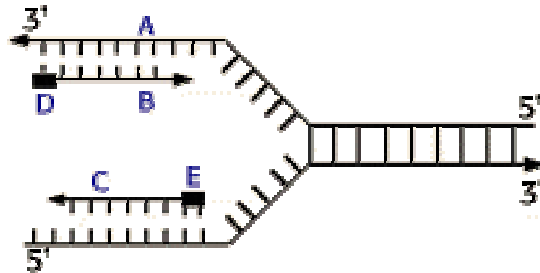
18. If you were told that the biochemical process below illustrates epistasis involving two, independently assorting gene loci (A/a and B/b) and their effect on eye color in fruit flies, which epistatic F₂ ratio discussed in class best fits this example?
- a. 9:7 b. 9:3:4 c. 13:3 d. 12:3:1



19. The F₂ phenotype in the highest expected proportion in the epistasis example above would be
- a. white eyes b. pink eyes c. red eyes
20. A male can only inherit a sex-linked trait from his mother, not his father.
- a. true b. false
21. It is not possible for a female (with normal sex chromosomes) to express an inherited sex-linked recessive condition unless her father also expresses the condition.
- a. true b. false
22. The following cross is made: IIDD x iidd. The F₁'s are testcrossed and produce the following progeny:
- | | |
|------|-----|
| I-D- | 431 |
| I-dd | 63 |
| iiD- | 67 |
| iidd | 439 |
- Assuming the two loci are linked, the calculated map distance between them in map units is
- a. 13 map units
 b. 37 map units
 c. 87 map units
 d. 130 map units
 e. 870 map units
23. In the experiment by Avery, MacLeod, and Mc Carty, they treated extract from heat-killed, virulent *Streptococcus* bacteria with three different enzymes. They were able to conclude from this study that
- a. DNA has a certain periodicity and helical structure
 b. the genetic material is DNA
 c. a "transforming principle" of a chemical nature exists in bacteria
 d. replication is semi-conservative
 e. replication is bidirectional

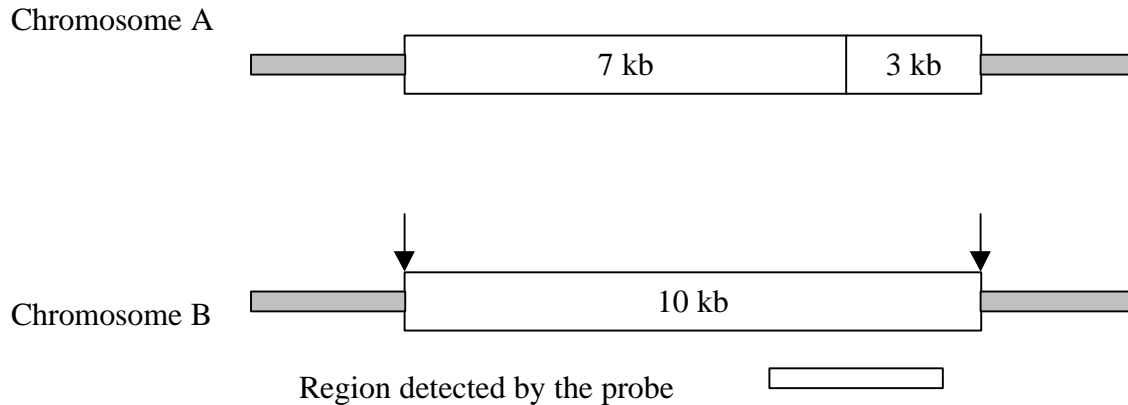
24. Thanks to the work by two groups: Taylor and his co-workers on *Vicia faba* chromosomes, and Meselson and Stahl on *E. coli*, both were able to provide strong evidence that led to the conclusion that
- DNA has a certain periodicity and helical structure
 - the genetic material is DNA
 - a “transforming principle” of a chemical nature exists in bacteria
 - replication is semi-conservative
 - replication is bidirectional

25. In this diagram of a DNA replication fork, the activity of DNA polymerase I would most likely be found on which strand?
- A
 - B
 - C



26. In the replication diagram above, strand "C" is best described as
- the template strand
 - the parental strand
 - the leading strand
 - the lagging strand
27. The ribosome structure is best described as
- two subunits composed of rRNA and proteins
 - RNA polymerase and the sigma subunit
 - A large subunit with an upstream promoter
 - Alternating introns and exons
 - A large subunit consisting of DNA polymerase I, DNA polymerase III and RNA polymerase
28. If the template strand of a DNA molecule consists of the sequence, 3'-ATAGCGTAAGCC-5', what will be the RNA strand sequence produced from this piece of DNA?
- 3'-AUAGCGUAAGCC-5'
 - 5'-AUAGCGUAAGCC-3'
 - 3'-UAUCGCAUUCGG-5'
 - 5'-UAUCGCAUUCGG-3'
29. Assuming the previous problem is referring to an mRNA, potentially how many codons are present?
- 4
 - 6
 - 12

30. All the following are true regarding mRNA processing except
- this process involves the addition of a 7MG "cap" on the 5' end
 - this process involves the addition of a poly-adenine "tail" to the cleaved 3' end
 - this process involves the excision of introns and the splicing of exons
 - this process takes place in all eukaryotes and prokaryotes
 - this process takes place after transcription is completed
31. The role of aminoacyl tRNA synthetase is
- to ensure that the proper amino acid is covalently bound to the proper tRNA
 - to catalyze the formation of the peptide bond between amino acids at the ribosome
 - to ensure the proper codon and anticodon binding at the ribosome
 - to catalyze the synthesis of tRNA during transcription
 - to digest the "older" tRNAs in the cell to ensure proper translation
32. Which of the following tools of recombinant DNA technology is INCORRECTLY paired with its use?
- restriction endonuclease - production of DNA fragments for gene cloning
 - DNA ligase - cuts DNA, creating sticky ends
 - Taq polymearse - copies DNA sequences in the polymerase chain reaction
 - Reverse transcriptase - produces cDNA from mRNA
 - Electrophoresis - RFLP analysis
33. DNA from a eukaryotic organism is digested with a restriction endonuclease and the resulting fragments cloned into a plasmid vector. Bacteria transformed by these plasmids collectively contain all of the genes of the organism. This culture of bacteria is refered to as a:
- restriction map
 - DNA fingerprint
 - Nonrecombinant colony
 - Genomic library
 - Southern blot
34. Which of the following is NOT part of the normal process (discussed in class) of cloning recombinant DNA in bacteria?
- restriction endonuclease digestion of cellular and plasmid DNA
 - production of recombinant DNA using DNA ligase and a mixture of cellular and plasmid DNAs
 - separation of recombinant DNAs by electrophoresis using the Southern technique to determine where the desired recombinant migrates
 - transformation of the bacteria by the recombinant plasmids and selection using ampicillin
 - performing colony hybridization using radioactive DNA probes complementary to the desired gene
35. An RFLP analysis was performed on two individuals. You are given the following restriction site (arrows) information for chromosome A and chromosome B and the region detected by the probe: (next page)



Individual #1 is homozygous for chromosome A and individual #2 is heterozygous. The corresponding Southern blot would have ___ bands for individual #1, ___ bands for individual #2.

- a. 1, 2
- b. 2, 2
- c. 2, 3
- d. 3, 1
- e. 1, 3

36. Individual #3 is homozygous for chromosome B (in the previous problem), and, therefore would have how many bands on the Southern blot?

- a. 1
- b. 2
- c. 3

37. The key to successfully cloning a gene or gene fragment using PCR is

- a. selecting a good thermal cycler
- b. providing a sufficient quantity of the genomic DNA
- c. immediately analyzing the PCR products using agarose electrophoresis
- d. selecting a good hybridization filter for the Southern blot
- e. selecting the specific pair of primers that will flank your gene of interest

38. The most frequently used cloning vector used in DNA cloning (pUC18) possesses

- a. the gene for ampicillin resistance and the gene for lacZ
- b. two antibiotic resistance genes
- c. the gene for the antibiotic, ampicillin, and the gene for the restriction endonuclease, EcoRI
- d. the gene for RNA polymerase and the gene for DNA polymerase
- e. the gene for RNA polymerase and the gene for the antibiotic, kanamycin

39. Near the end of the videotape, "Children by Design," a young boy, David, was abnormally short for his age group. What genetic technology was applied in this case?

- a. Some of his cells were removed from his body, the correct gene was inserted into the cells, and the engineered cells were transferred back into the patient
- b. The boy was given periodic injections of the human growth hormone, a drug produced by genetic engineering
- c. His mother, who wanted another child, used the genetic screening procedure to test her embryos so that only embryos with the correct gene for height were implanted in her uterus

- d. The boy's aunt was preparing to have a family and needed to decide if she wanted to be genetically screened for the height mutation
- e. The boy was one of the first to receive gene therapy via the adenovirus vector in which the "bad" genes of the virus were removed and replaced with the normal height gene. The engineered virus was taken up by the lung cells of the patient
40. Another gentleman in the videotape named "David" had an inherited form of Alzheimer's. What genetic technology was applied in this case?
- a. Some of his cells were removed from his body, the correct gene was inserted into the cells, and the engineered cells were transferred back into the patient
- b. The man was given periodic injections of the neurotransmitter, dopamine, a drug produced by genetic engineering
- c. His wife, who wanted a child, used the genetic screening procedure to test her embryos so that only embryos without the Alzheimer gene were implanted in her uterus
- d. His sister was deciding whether to be genetically screened for the Alzheimer gene, thereby determining what her fate would be
- e. He was one of the first to receive gene therapy via the adenovirus vector in which the "bad" genes of the virus were removed and replaced with the normal, non-Alzheimer gene. The engineered virus was taken up by the lung cells of the patient
41. To estimate the frequency of a homozygous genotype in a population in Hardy-Weinberg equilibrium, which figure would be most useful?
- a. $p + q$
- b. p^2
- c. $2pq$
- d. p
- e. $(q)^{1/2}$
42. The total genetic make up of a population is known as the
- a. Genome
- b. Genotype
- c. Hardy-Weinberg equilibrium
- d. random mating
- e. gene pool
43. In an isolated, island population of humans, 200 island inhabitants were tested for the MN blood type. 134 were MM, 33 were MN and 33 were NN. What are the expected numbers of the three genotypes if the population is in Hardy-Weinberg equilibrium?
- a. MM: 131.25, MN: 34.5, NN: 34.25
- b. MM: 50, MN: 100, NN: 50
- c. MM: 113.25, MN: 74.5, NN: 12.25
- d. MM: 100, MN: 50, NN: 50
44. If the population was determined to have an excessive number of both homozygous genotypes and a deficiency of the heterozygotes relative to Hardy-Weinberg expectations, which of the following assumptions did not likely hold true for this island population?
- a. random mating
- b. large population
- c. no selection
- d. no migration
- e. no mutation

45. Allele frequencies are expected to remain constant from one generation to the next in a Hardy-Weinberg population. One mechanism that may cause allele frequencies to change is called "genetic drift" and results when which of the following assumptions does not hold true?
- random mating
 - large population
 - no selection
 - no migration
 - no mutation
46. In most mammals, sex is determined by
- the Sry gene on the Y chromosome
 - the Odf gene on the W chromosome
 - the ratio of the number of X chromosomes to the number of sets of autosomes
 - the stage of maturity of the animal
 - the temperature of embryonic incubation
47. Evidence of X chromosome inactivation can be found in all the following except
- the Barr Body
 - a normal female
 - a normal male
 - a person with Klinefelter syndrome
 - a calico cat
48. Most cases of aneuploidy in humans arise as a result of nondisjunction
- during fertilization
 - during anaphase I in the mother
 - during anaphase in embryonic development
 - caused by exposure to chemicals or drugs during embryonic development
 - during anaphase II in the father
49. Which case of trisomy is likely to be the most severe and life threatening?
- Klinefelter syndrome
 - Down syndrome
 - Edwards syndrome
 - Turner syndrome
 - XYY condition
50. In your opinion, which of the following questions do you find the most intriguing?
- Why do scientists call it research when looking for something new?
 - If "con" is the opposite of "pro," then what is the opposite of progress?
 - Do married people live longer than single people or does it just SEEM longer?
 - Why do banks charge you a "insufficient funds fee" on money they already know you don't have?
 - Why is it you have a "pair" of pants and only one bra?