

Name KEY

Student ID # _____

**BIO SCI 97 FALL 2004
FINAL EXAMINATION**

**DO NOT OPEN EXAM UNTIL TOLD TO DO SO
BEFORE BEGINNING:**

1. Write your **name** and **ID** number in the upper right corner of **this page**
2. Write your **name** and **ID** number on your **Scantron** card, and fill out the code box for your ID
3. Write your exam version number (see top of this page) on the Scantron right after your name
4. **SIGN THE BACK** of your Scantron card in the large white space
5. Write your **name** and **ID** number and exam version number on the answer sheet for Part II

DURING THE EXAM:

1. Choose the **SINGLE** best answer to each question. If none of the answers seem correct, or if more than one seems correct, choose the one that seems **most correct**.
2. For Part I, Mark your Scantron card with a dark **PENCIL**.
3. For Part II, answers that are not clearly and carefully written will be marked wrong.

VERY IMPORTANT:

1. You must sit in your assigned seat unless given permission to do otherwise. If you are not sitting in your assigned seat you may be given a zero on the exam.
2. This is a closed book test - no notes of any type are allowed.
3. Do not talk to another student. Do not look at another student's answers.
4. On desk - ID, Scantron, exam, answer sheet, pencil, calculator (calculator is optional).
5. If you are seen with a cell phone or pager you may be given a zero on the exam.

NOTES for all questions:

- Affected = has the disease
- Unaffected = does not have the disease (but may be a carrier if the disease is recessive)
- Normal = does not have the disease and is not a carrier.
- For all questions, assume any trait or disease mentioned has 100% penetrance, unless it is stated otherwise
- For inheritance questions, assume no new mutations, unless it is stated otherwise.
- All diseases mentioned are genetic diseases, unless it is stated otherwise.
- Pedigrees will only show you if someone is affected (black symbol) or unaffected (white symbol). If someone is a heterozygous carrier of a recessive disease, they will be depicted as unaffected.

PART 1 – MULTIPLE CHOICE – ANSWER ON YOUR SCANTRON CARD

Each question is worth one point.

1. Which **one** of the following statements regarding reproductive cloning is the most correct?:
 - A. Many human clones have lived to adulthood.
 - B. Only a few human clones have lived to adulthood.
 - C. Some attempts at human cloning have been made, but these individuals have died as embryos or shortly after birth.
 - D. There have been a few claims of successful human cloning, but none of them has been scientifically verified.**
 - E. No vertebrate animal has ever been cloned.

2. The term “Somatic Gene therapy” refers to...
 - A. DNA repair
 - B. A relaxing herbal tea made of nucleic acid
 - C. Putting cloned genes into some of a patient’s cells to treat that patient’s disease**
 - D. Genetic counseling
 - E. The detection of somatic mutations for the early diagnosis of cancer

3. Which of the following statements are true:
 - A. In x-linked dominant inheritance, it is possible for an unaffected woman to have an affected son
 - B. In x-linked dominant inheritance, it is possible for an affected man to have an affected daughter**
 - C. In x-linked recessive inheritance, it is possible for an affected woman to have an unaffected son
 - D. In x-linked recessive inheritance, it is possible for an unaffected man to have an affected daughter
 - E. None of the above are true

4. Which of the following statements is FALSE?:
 - A. It is more likely that a new mutation will create a loss-of-function allele than a gain-of-function allele
 - B. Loss-of-function alleles are more likely to be dominant than recessive**
 - C. A new mutation is more likely to inactivate a protein’s function than to create a new function for that protein
 - D. It is quite unlikely that a new mutation will exactly reverse the sequence change caused by a prior mutation
 - E. All of the above are false

5. A segment of a chromosome has five genes (V, W, X, Y and Z) in the following order: VWXYZ
 Shown below are three rearrangements involving this region:

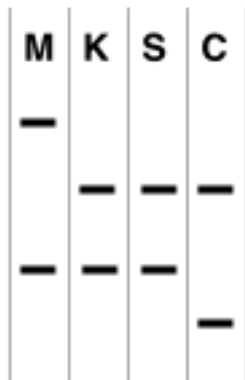
VWXYXYZ	VWYZ	VWYXZ
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 These rearrangements are (in no particular order):
 - A. translocation, duplication, inversion
 - B. deletion, inversion, translocation
 - C. deletion, inversion, duplication**
 - D. deletion, translocation, duplication
 - E. preconception, interception, misperception

6. Which of the following diseases can be described as a genetic disease where the mutation originates in somatic cells?:
 - A. Huntington’s Disease
 - B. Cystic Fibrosis
 - C. Cancer**
 - D. Sickle-Cell Anemia
 - E. All of the above

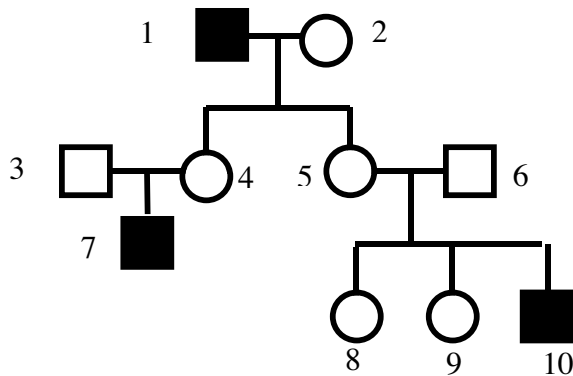
7. Which of the following is true?:
- A. All stem cells are germline cells
 - B. All somatic cells are stem cells
 - C. All germline cells are somatic cells
 - D. All of the above (A-C) are true
 - E. None of the above are true**
8. Which of the following statements is TRUE?:
- A. It is better to have a metastatic tumor than a benign tumor
 - B. Many types of chemotherapy work by targeting rapidly dividing cells**
 - C. The polymerase chain reaction is carcinogenic
 - D. Smoking cigarettes helps prevent lung cancer
 - E. Most cases of cancer are the result of an inherited genetic predisposition
9. Gleevec is a new drug used in the treatment of chronic myelogenous leukemia (CML). Gleevec binds to the Abl protein and inhibits its activity. Gleevec also shows promise in the treatment of gastrointestinal stromal tumors (GSTs), but has no effect on lung cancer.
- A. GSTs must be a type of CML that has been misclassified
 - B. Lung cancers have the "Philadelphia" chromosomal translocation
 - C. Abl activation is probably one of the genetic changes that results in GSTs**
 - D. Lung cancers and GSTs probably have mutations in the same oncogenes.
 - E. Lung cancers and GSTs must have no genetic changes in common.
10. Lissencephaly results from haploinsufficiency of the LIS1 gene. The disease has 100% penetrance and 100% lethality. Affected individuals die before or shortly after birth. What is the best explanation for the existence of disease-causing LIS1 alleles in the gene pool?
- A. Delayed age of onset
 - B. New mutations**
 - C. Inefficient selection
 - D. Heterozygote superiority
 - E. A and B
11. Mutation is thought to provide raw material for evolution. The ozone layer is eroding, and as a consequence, more UV radiation is reaching our skin, resulting in an increase in UV-induced mutagenesis. As a result of this it can be predicted that...
- A. We will evolve into a race of superbeings
 - B. Most of our proteins will become non-functional
 - C. the incidence of autosomal recessive diseases will increase**
 - D. We will all have awesome tans
 - E. No worries, the mutations will be fixed
12. Which of the following is most true of eugenics?
- A. It is a pseudo-science that is now greatly disfavored**
 - B. Although it has been practiced in Nazi Germany, it has never been practiced in the United States
 - C. It is currently in clinical trials at several major medical centers
 - D. It has the potential to cure many currently incurable diseases
 - E. A and B

13. A woman claims that either basketball stars Shaq O'Neil or Coby Bryant is the father of her child. DNA samples are taken from her (M), her kid (K), Shaq (S) and Coby (C), and typed for a polymorphic locus on chromosome 3. The figure shows the banding pattern obtained by the Southern blot procedure.



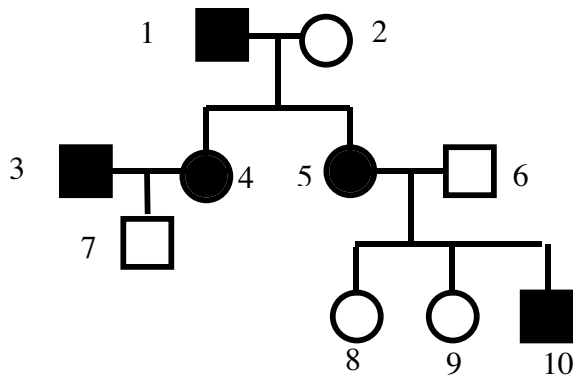
- A. Shaq may be the father, but Coby cannot be
 B. Shaq cannot be the father, but Coby may be
 C. Shaq cannot be the father, and Coby cannot be the father either
D. Either man could be the father
 E. The kid is a clone of Shaq
14. Which one of the following statements is TRUE?:
 A. Germline gene therapy is routinely practiced in the U.S., although it is not always covered by medical insurance
B. The widespread use of genetically modified crops poses a potential risk to farmland ecology
 C. There is strong evidence that Roundup-resistant soybeans are carcinogenic
 D. To date, genetic engineering has not resulted in the development of any medically useful drugs or treatments
 E. B and C
15. A single nucleotide substitution that results in the introduction of a premature stop codon into an open reading frame is called:
A. a nonsense mutation
 B. a silent mutation
 C. a stop mutation
 D. a missense mutation
 E. a frameshift
16. Klinefelter syndrome is most commonly associated with the karyotype 47, XXY, but it can also be caused by the karyotype 48,XXYY. How could the karyotype 48,XXYY occur?
A. Meiosis I or II non-disjunction in the mother and Meiosis II non-disjunction in the father
 B. Successive non-disjunctive meiotic divisions in the father (that is, non-disjunction in meiosis I followed by non-disjunction(s) in meiosis II)
 C. Successive non-disjunctive meiotic divisions in the mother
 D. Meiosis I or II non-disjunction in the mother and Meiosis I or II non-disjunction in the father
 E. None of the above.

The pedigree shows the inheritance of a genetic disease in three generations of a family



17. Based on the pedigree, the mode of inheritance of this disease could be
- Autosomal recessive
 - X-linked recessive
 - Autosomal dominant
 - X-linked dominant
 - A or B**
18. Assume that the frequency of disease causing alleles in the general population, including those (#3 and #6) who married into the family, is very low. Given that assumption, then the mode of inheritance of this disease is most likely...
- Autosomal recessive
 - X-linked recessive**
 - Autosomal dominant
 - X-linked dominant
 - Y-linked dominant
19. Y-linked conditions are very rare and are associated with male sterility. However, assume a man is affected with a Y-linked disease called beergutitis that is not associated with sterility. If he marries a normal woman, then it can be predicted that
- All of his male children will be affected with beergutitis**
 - Half of his male children will be affected
 - All of his female children will be affected
 - Half of his female children will be carrier
 - None of his male children will be affected
20. The reason that trisomies of only chromosome 21 and the sex chromosomes are observed in adults is that:
- Chromosome 21 and the sex chromosomes are more prone to non-disjunction
 - Trisomies or monosomies of any other chromosomes have such detrimental effects that they do not allow development to adulthood**
 - There are no genes for fundamental life processes located on chromosome 21
 - Chromosome 21 contains modifier genes for sex determination
 - Aneuploidies of the remaining chromosomes exist but are not recognized because they cause have a normal phenotype

The pedigree shows the inheritance of a genetic disease in three generations of a family



21. Based on the pedigree, the mode of inheritance of this disease could be
- Autosomal recessive
 - X-linked recessive
 - Autosomal dominant
 - X-linked dominant
 - C or D**
22. Assume that #10 marries an unaffected woman, and they have an unaffected daughter. Given that assumption, then the mode of inheritance of this disease is most likely...
- Autosomal recessive
 - X-linked recessive
 - Autosomal dominant**
 - X-linked dominant
 - Y-linked dominant
23. There is 24% percent recombination between genes A and B.
There is 11% percent recombination between genes A and D.
There is 15% percent recombination between genes B and D.
The order of these genes is most likely:
- A-B-D
 - A-D-B**
 - D-B-A
 - B-A-D
 - All three genes cannot be on the same chromosome
24. A tall man and a short woman mate and have an average sized kid. This is consistent with the concept that...
- Mendel was wrong – alleles don't segregate, they blend together
 - Height is a multifactorial trait**
 - height is subject to heterozygote superiority
 - the kid has a sex chromosome aneuploidy
 - height is determined by the environment, not by genes

25. All of the following statements are FALSE except:
- A. Monozygotic twins arise from a single egg fertilized by two sperm
 - B. The variance of a trait is determined either by environmental or genetic variance, and never by both together
 - C. Athletic parents usually have athletic kids, hence the variation in athletic ability must be solely determined by genes
 - D. Complex traits can be categorized as either sex-linked or autosomal.
 - E. Simple genetic mechanisms involving a small number of genes can lead to a quantitative trait having an approximately normal distribution**

PART II - Short Answer Questions – Not Scantron – Write on Part II Answer Sheet
20 points total. Questions are worth 2 points each unless stated otherwise.

26. The following statements concern global (United Nations) policy on human cloning. Which, if any, of them is true? (you may choose none, or more than one):

- A. There is a global (United Nations) ban on therapeutic/research cloning, but not on reproductive cloning.
- B. There is a global ban on reproductive cloning, but not on therapeutic cloning.
- C. There is a global ban on both reproductive and therapeutic cloning.
- D. Most countries agree that reproductive cloning should be banned, but several countries maintain that therapeutic cloning should be allowed.**
- E. The current U.S. (Bush administration) policy is that both reproductive cloning and therapeutic cloning should be banned.**
- F. Currently, the U.S. (Bush administration) refuses to support a global ban on reproductive cloning unless therapeutic cloning is also included in the ban.**

+1 point each for D,E,F / -1 point each for A,B,C / Min 0 Max 2

27. The following statements concern genetically modified (GM) organisms. Which, if any, of them is true? (you may choose none, or more than one):

- A. GM organisms are banned in the U.S.
- B. GM crops are widespread in the U.S. food supply.**
- C. No GM vertebrate animals have been created, except mice for use in research.
- D. The reason that In-and-Out burgers taste so good is because the beef comes from a GM plant known as “cow-corn”.

+2 points for B / -1 point each for A,C,D / Min 0 Max 2

28. If you wanted to express a cloned human gene in the bacterium *E. coli*, so that you could grow up the bacteria in large batches and make the corresponding human protein, you would need to (you may choose none, or more than one):

- A. Remove the human introns**
- B. Swap the human promoter/enhancer for a bacterial promoter**
- C. Change the codons because otherwise the wrong amino acids would be specified
- D. Change the codons because bacteria use uracil instead of thymidine in DNA
- E. Insert the gene into a plasmid with a selectable marker and a bacterial origin of replication**

+1 point each for A, B, E / -2 points each for C or D / Min 0 Max 2

29. The genes Arrogance and Beauty are on the same chromosome. A test cross of a double heterozygote yielded the following numbers of progeny:

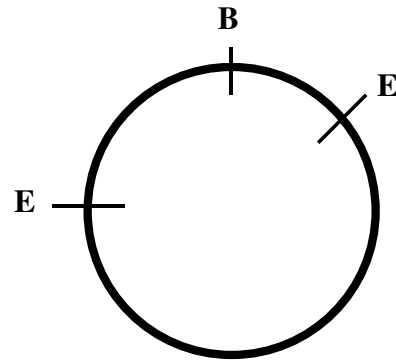
79 AB 81 ab
18 Ab 22 aB

29a. In the double heterozygote, were the recessive alleles in cis or in trans?

Cis

29b. What's the distance between Arrogance and Beauty? (give the distance and include the appropriate unit of distance in your answer, or answer "unlinked")

20 cM or centimorgans or map units



30. (3 points) The figure to the left shows a 5 kb plasmid molecule containing a single cleavage site for the BamHI (B) restriction endonuclease, and two EcoRI (E) cleavage sites.

30a. If the plasmid is cleaved with BamHI, how many fragments will there be? **1**

30b. If the plasmid is cleaved with EcoRI, how many fragments will there be? **2**

30c. If the plasmid is cleaved with BamHI + EcoRI, how many fragments will there be? **3**

31. Ben and Bob Brown are identical twin brothers. Jane and Joan Jones are identical twin sisters. Ben marries Jane and Bob marries Joan. Each couple has a son.

31a. How genetically similar are the two sons to each other (in terms of the percentage of alleles they share)? **1/2 or 50%**

31b. What would your answer to this question be if Ben and Bob were fraternal twins, and Jane and Joan were fraternal twins? **1/4 or 25%**

31c. What would your answer to this question be if Ben and Bob were just brothers (not twins), and Jane and Joan were just sisters (not twins)? **1/4 or 25%**

31d. What would your answer to this question be if Ben and Bob were just brothers (not twins), and Jane and Joan were not related to each other by blood? **1/8 or 12.5%**

1/2 pt. each, round down

32. A male carrier of cystic fibrosis marries a woman. The woman knows nothing about her families genetics, because she was adopted. What are the chances their first child will be affected with CF? Assume the incidence of CF in the general population is 1/2500.

1/100 or 1% or 0.01 (or 0.0098 to be precise)

33. The green hair trait is due to an X-linked recessive gene. In a large, randomly mating population, 1/1600 females has green hair.

34a. What is the frequency of carrier females?

1/20 or 5% or 0.05 (or 0.04875 to be precise)

34b. What is the frequency of males with green hair?

1/40 or 2.5% or 0.025

34. (3 points) When Dolly the sheep was cloned by nuclear transfer...

35a. was the transferred nucleus haploid or diploid? **diploid**

35b. was it taken from a somatic cell or a germline cell? **somatic**

35c. what type of cell was it put into, **egg or embryo or embryonic or embryonic stem cell** and what key manipulation had been done to that cell? **It was enucleated (its nucleus was removed)**