Name: **ID:**

Midterm Exam: Elementary Genetics — Monday, March 7th, 2016

BIOL 206 — Instructor: Dr. Aida Abu-Baker

20 Multiple choice questions and **2** short answer questions.
Answers to multiple choice questions must be clearly indicated on the **scantron using a pencil.**

MULTIPLE CHOICE. Choose **only one answer** that best completes the statement or answers the question. (5 marks each)

1. Most genes come in alternative forms called:
A) chromosomes.
B) gametes.
C) dominants.
D) alleles.
E) recessives.

2. Alisha and Scott have two sons and three daughters. Each son has three daughters. Each daughter has one son. How many of the grandchildren will have Alisha's mitochondria?
A) 0
B) 3
C) 6
D) 12
E) This can't be answered with the information provided.

3. Regulatory sequences of DNA that are responsible for the speed at which a gene is transcribed are known as
A) enhancers
B) promoters
C) exons
D) repressors
E) 5'capG and 3' poly(A)tail

4. Why aren't all mutations that occur in DNA inherited by our offspring?
A) Only mutations in DNA contained in sperm and eggs will be inherited.
B) Each cell has different DNA in it, with only the genes that cell needs.
C) DNA that is mutated can't be inherited; cells correct it before passing it on.
D) DNA that is inherited can't have more than one mutation in it.
E) None of the above

5. Which of the following represents a similarity between RNA and DNA?
A) Both are double-stranded.
B) the presence of uracil
C) the presence of an OH group on the 2' carbon of the sugar
D) nucleotides consisting of a phosphate, sugar, and nitrogenous base
E) Both are found exclusively in the nucleus.

6. Which is the largest among the followings?
A) nucleotide
B) chromosome

C) nucleus
D) gene
E) phosphate

7. Most genetic diseases result from mutations that cause a gene to produce a non-functioning _____, which in turn blocks the functioning of a metabolic pathway.
A) enzyme
B) codon
C) polysaccharide
D) tRNA
E) histone

8. Mrs. Smith (40 years old) and her husband have an amniocentesis for advanced maternal age. They already have four healthy children. They receive results indicating a 47, XXY karyotype. What is the phenotypic sex of the fetus? How many Barr bodies will be found in each somatic cell?
A) Male, 0
B) Male, 1
C) Male, 2
D) Female, 1
E) Female, 2

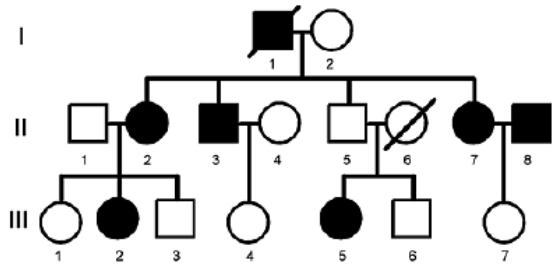
9. The sequence of one strand of DNA is 5' TCGATC 3'. The sequence of the complementary strand would be
A) 5' AGCTAG 3'
B) 5' TCGATC 3'
C) 5' CTAGCT 3'
D) 5' GCTAGC 3'
E) 5' GATCGA 3'

10. DNA is a macromolecule that stores information. Which component of DNA is the source of this information?
A) the sugar
B) the phosphate group
C) the base
D) the histone
E) the hydrogen bonds

11. Human chorionic gonadotropin (hCG)
A) promotes the development of the ovary.
B) stimulates the formation of the gonads.
C) is present in undetectable amounts throughout the pregnancy.
D) prevents the expulsion of the embryo.
E) is transported to the embryo through the umbilical cord.

12. Regulation of gene expression can be accomplished by controlling:
A) the rate of translation of mRNA.
B) the activity of a protein product.
C) the amount of mRNA that is available.
D) the rate of mRNA degradation.
E) All of these.

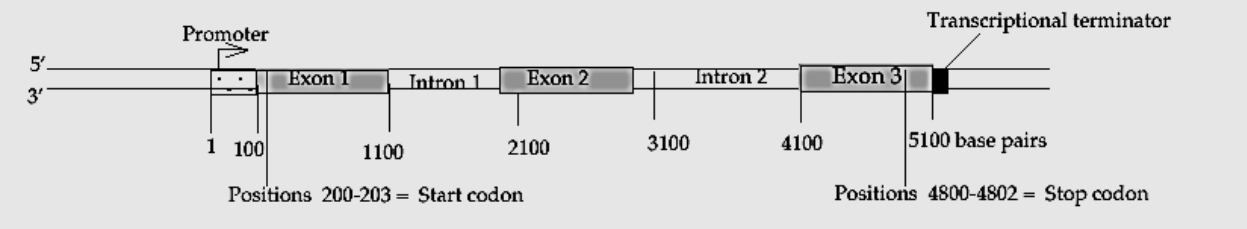
13. Individual II-5 in the pedigree shown below is:
A) A male who does not exhibit the trait.
B) A father.
C) Has three affected siblings.
D) Has two children.
E) All of the above.



14. The three-dimensional shape of a protein is determined by the
A) order of amino acids.
B) temperature of the cells.
C) amount of protein present.
D) number of amino acids the organism possesses.
E) the length of the protein.

15. Which refers to the loss of a complete chromosome?
A) inversion
B) translocation
C) deletion
D) duplication
E) monosomy

16. Below is a schematic of gene Hemoglobin beta subunit (HBS), which encodes protein HBS. The promoter region is indicated by the dotted box. Transcription begins immediately following the promoter.



The mature mRNA produced by this gene would be approximately how many nucleotides long?
A) 100
B) 200
C) 3000
D) 5000
E) 7000

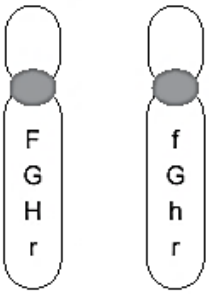
17. When a triplet of bases in the coding sequence of DNA is GCA, what is the anticodon for the tRNA that would be used in translation?
A) GCA

B) GCT
C) CGT
D) CGU
E) CGA

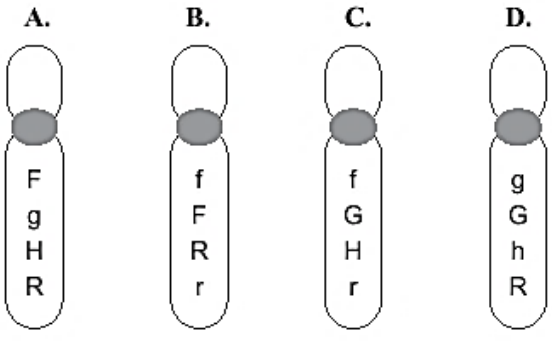
18. A duplicated homologous chromosome pair at the beginning of meiosis contains how many copies of each gene?
A) 92
B) 46
C) 2
D) 4
E) 8

19. Diane has distal symphalangism- her fingers and toes are stiff, with tiny nails. She looks it up and finds it is an autosomal dominant trait. Since her parents do not have it, she reasons she is a new mutation. However, if she has children, each of them, has a(n) ____ probability of inheriting the condition. (assume her partner does not have the condition)
A) 0
B) 1/8
C) 1/4
D) 1/2
E) 3/8

20.
A pair of homologous chromosomes involved in normal meiosis in an ovary carries the alleles shown.



Chromosomes detected in eggs produced would include



E. All the above.

C. is the correct answer

Short Answer Question 1:

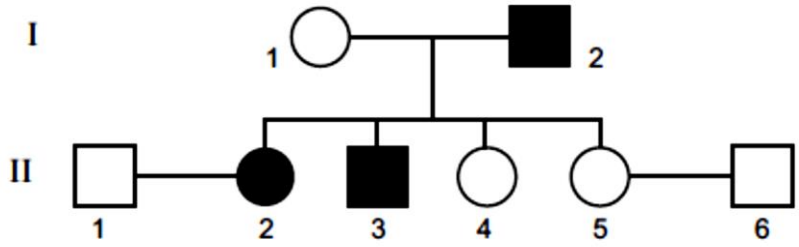
Haemophilia is an X-linked recessive condition. The following pedigree shows a portion of a family in which some members have haemophilia. Those on the pedigree with haemophilia are shaded.

A) Use appropriate allele symbols from X^H, X^h and Y to **indicate the genotype of each of the following two individuals**: (5 marks)

I1 XX^h

I2 X^hY

B) The couple II1 and II2 have a son. **What is the probability that the child has haemophilia?** (5 marks) **100%**



C) A couple comes to a genetic councilor about their chances of having a baby with Tay Sachs disease. The husband had a sibling die of the disease, which is inherited as an autosomal recessive trait. **What are the chances that he is a carrier?** (5 marks)

2/3 (66.66%)

D) How siblings can look so very different? **List all genetic answers.** (10 marks)

Mendel's two laws: The principle of segregation (First Law): The two members of a gene pair (alleles) segregate (separate) from each other in the formation of gametes. Half the gametes carry one allele, and the other half carry the other allele: (Segregation, Random Alignment and Independent Assortment (during meiosis))

Cross over (genetic recombination) (during meiosis)

Mutations

Different Gene Versions (dominant versus recessive)

Environmental effects on gene expression

Structural variations (chromosomal changes due to non disjunction)

Short Answer Question 2:

The following DNA coding strand represents a segment of beta globin gene (first exon):

5' ATGGCGCAGAACTAA 3' (coding strand)

A) **What is the sequence of the complementary DNA strand?** (5 marks)
3' TACCGCGTCTTGATT 5'

B) **Transcribe this segment into mRNA.** (5 marks)

5' AUGGCGCAGAACUAA 3'

C) **Use the genetic code table to determine the amino acid sequence of the resulting polypeptide chain.** (5 marks)

Met (start codon)--Ala—Gln—Asn

You do not need to put the stop codon as it does not encode amino acid (I did not reduce any mark if you added it).
But you need to put Met as a first amino acid in this polypeptide chain.

D) Shown below is a schematic of the production of a polypeptide. At the top is the chromosomal arrangement found in the cell; a schematic of the polypeptide is shown below it.

i. **Label the process indicated by each arrow.** (5 marks)

Transcription

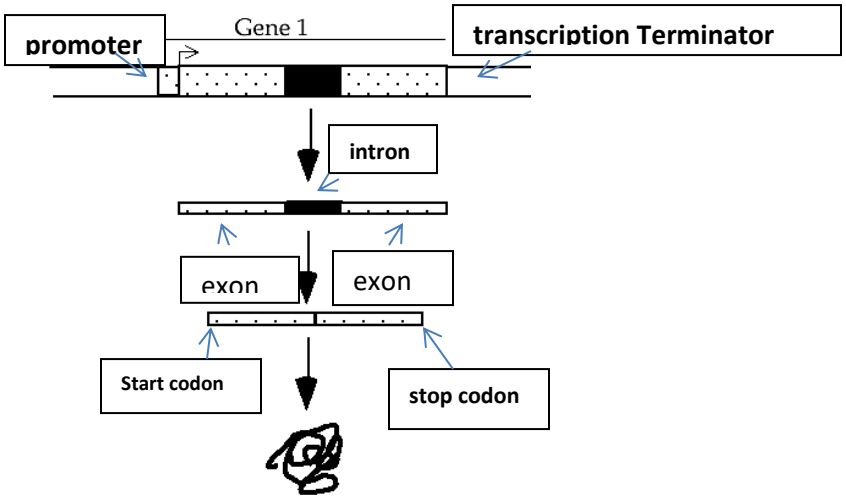
RNA Processing (or post-transcription modifications)

Translation (protein production)

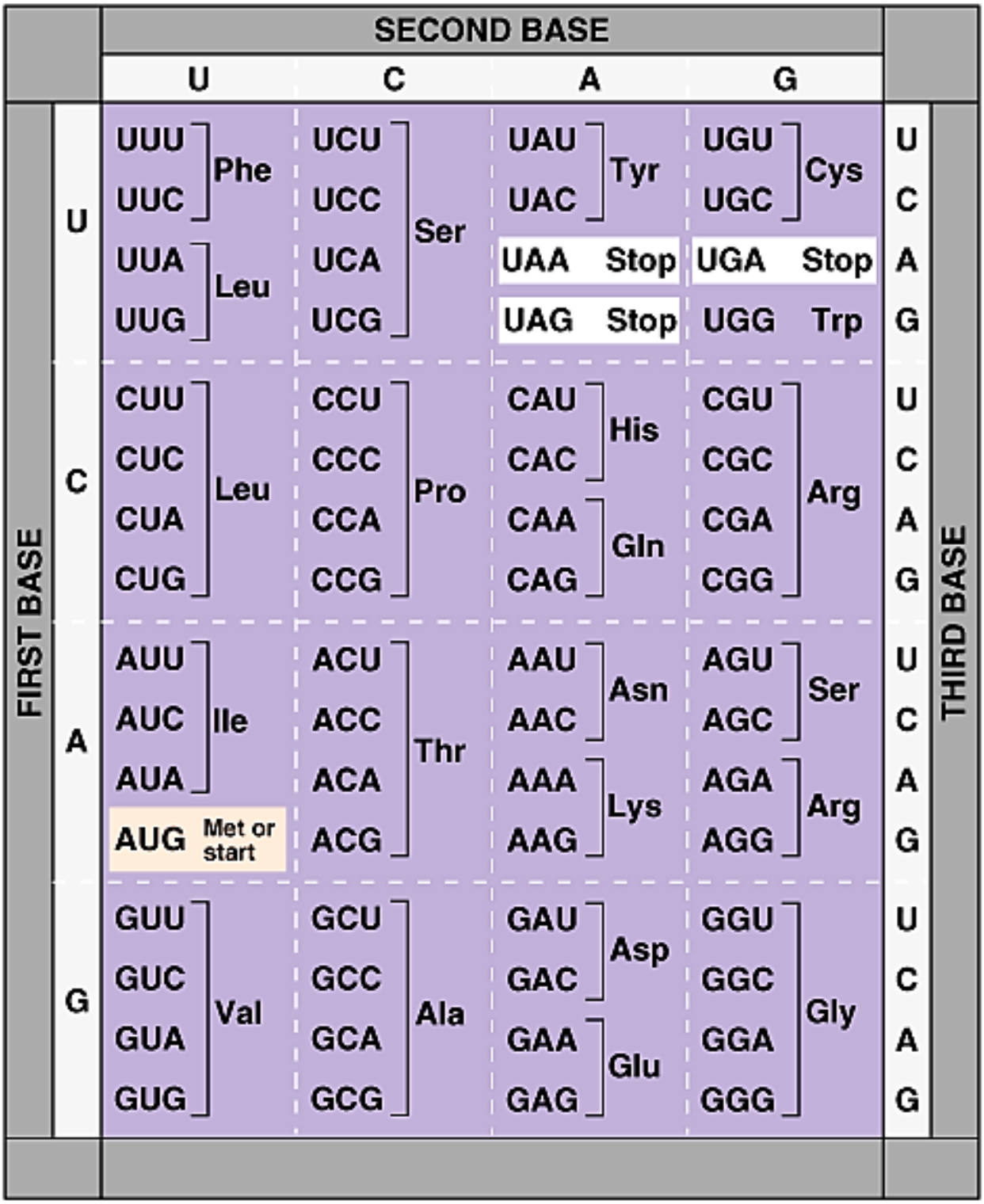
ii. Indicate on the diagram below **where you would expect to find each of the following components**: (5 marks)

(Note: the arrow indicates the transcription start site)

- **Promoter**
- **Transcription terminator**
- **Start codon**
- **Stop codon**
- **Introns**
- **Exons**



Codon Table


SECOND BASE
U
C
A
G
FIRST BASE
THIRD BASE
U
C
A
G
UUU Phe
UUC Phe
UUA Leu
UUG Leu
UCU Ser
UCC Ser
UCA Ser
UCG Ser
UAU Tyr
UAC Tyr
UAA Stop
UAG Stop
UGU Cys
UGC Cys
UGA Stop
UGG Trp
CUU Leu
CUC Leu
CUA Leu
CUG Leu
CCU Pro
CCC Pro
CCA Pro
CCG Pro
CAU His
CAC His
CAA Gln
CAG Gln
CGU Arg
CGC Arg
CGA Arg
CGG Arg
AUU Ile
AUC Ile
AUA Ile
AUG Met or start
ACU Thr
ACC Thr
ACA Thr
ACG Thr
AAU Asn
AAC Asn
AAA Lys
AAG Lys
AGU Ser
AGC Ser
AGA Arg
AGG Arg
GUU Val
GUC Val
GUA Val
GUG Val
GCU Ala
GCC Ala
GCA Ala
GCG Ala
GAU Asp
GAC Asp
GAA Glu
GAG Glu
GGU Gly
GGC Gly
GGA Gly
GGG Gly