Name: **ID:**

Midterm Exam: Elementary Genetics — Tuesday, Feb.27th, 2018

BIOL 206 — Instructor: Dr. Aida Abu-Baker

8:45-10:00 am

20 Multiple choice questions and **2** short answer questions. Answer **ALL questions**. Total **6 pages**. 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. (30 marks each)

1. Which of the following statements about DNA replication is NOT correct?
A) Replication occurs as each base is paired with another exactly like it
B) Unwinding of the DNA molecule occurs as hydrogen bonds break
C) One old strand is conserved in each new molecule
D) DNA polymerase catalyzes DNA replication

2. A threshold trait is one which:
A) is expressed on a continuous scale (such as blood pressure)
B) is present in a few discrete classes, but is influenced by both genetics and the environment (such as diabetes or schizophrenia)
C) is caused by only a single gene, with no environmental influence
D) is present in a very low frequency in the population

3. Thomas's biological mother and father are both gifted athletes. He was adopted by a couple who had no interest in him being involved in sports. Although Thomas likely inherited athletic ability, it was never expressed in his _____.
A) genotype
B) phenotype
C) genes
D) alleles

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

5. Ian and Joan are both carriers for two autosomal recessive disorders, PKU (chromosome 12) and cystic fibrosis CF (chromosome7). They are expecting a daughter. What is the probability that she will have PKU but not CF?
A) 3/4
B) 9/16
C) 3/16
D) 1/4

6. Gonadal sex is determined
A) at fertilization.
B) at birth.
C) when the presence or absence of the *SRY* gene determines the formation of testes or ovaries.
D) when either testosterone or estrogen is produced.

7. All genetically normal humans have:
A) 46 autosomes.
B) 44 autosomes.
C) Two pairs of 22 autosomes, a Y chromosome, and an X chromosome.
D) 23 chromosomes.

8. Free ear lobes (E) are dominant to attached ear lobes (e). Dimpled chin (D) is dominant to a smooth chin (d). What is the probability that the offspring of the cross EeDd X EEdd will have free ear lobes and a smooth chin?
A) 0
B) 1/16
C) 1/2
D) 1/4

9. A woman is phenotypically normal, but her father had the sex-linked recessive condition of red-green colorblindness. If she has children with a man with normal vision, what is the probability that their first child will have normal vision and their second child will be colorblind?
A)1/16
B)3/8
C)3/16
D)3/6

10. 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.

11. Epigenetics involves changes in
A) the sequence of DNA.
B) the expression of genes.
C) the base pairing in the DNA helix.
D) DNA replication.

12. What would be the best way to distinguish between two alleles and two genes?
A) Determine their chromosomal location; alleles will be on different chromosomes, but genes will be on different copies of the same chromosome.
B) You can't; there's no actual difference between alleles and genes.
C) Examine their DNA; the DNA sequences of two different alleles would be more similar than the sequences of two different genes.
D) Examine the proteins they produce; most genes would produce very similar proteins, but two alleles would produce very different proteins.

13. If cytosine makes up 22% of the nucleotides in a sample of DNA from an organism, then adenine would make up what percent of the bases?
A) 44%
B) 28%
C) 56%
D) It cannot be determined from the information provided.

14. If you were to design a research study that examines depression in relation to concordance rate, which of the following are the best groups to use for comparison?
A) identical twins and fraternal twins
B) college students and the general public
C) brothers and sisters
D) parent(s) and children

15. Number of Barr bodies in XXXX female is
A) 1
B) 2
C) 3
D) 4

16. Offspring inherit from parents
A) Gametes, that then fuse to form the new individual.
B) Pure information provided in a sequence of codons that replicate the parents' genome.
C) Genes, a set of coded information that guides the orderly sequence of development.
D) The phenotype, since only this is expressed in the new organism.

17. The sequence of one strand of DNA is 5' TCGATC 3'. The sequence of the complementary strand would be
A) 3' AGCUAG 5'
B) 3' CTAGCT 5'
C) 5' GAUCGA 3'
D) 5' GATCGA 3'

18. To produce an individual with Kleinfelter syndrome (47, XXY),
A) a nondisjunction event must have occurred during spermatogenesis.
B) a nondisjunction event must have occurred during oogenesis.
C) this must have been caused by uniparental disomy.
D) a nondisjunction event could have occurred during spermatogenesis or oogenesis.

19. 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

Table 1. Nucleotides at 17 Different Loci in Two Groups of Dogs.

	1	2	3	4	5	6	7	8	9	10	11	12	13
	C C	A T	C C	G G	A A	T C	T T	C C	G G	A A	T T	G T	A G
	C C	A T	A C	G G	G G	T T	T T	C C	G G	A G	T T	G G	A G
	C C	A A	A C	C G	G G	T T	T T	C T	G G	A A	T T	G T	A G
	C C	A A	A C	G G	A G	T T	T T	C T	G G	G G	T T	G G	A G
	C C	A T	C C	C G	A A	T T	A A	C T	G G	A A	T T	G T	A A
	C C	A T	C C	G G	A A	T T	A A	T C	G G	A A	T T	G G	A G
	C C	A T	C C	G G	A A	T T	A A	C C	G G	A A	T T	G G	A A
	C C	A A	C C	G G	A G	T T	A A	T C	G G	G G	T T	G G	A A

20. Table 1 (above) displays SNPs at 13 different positions in the genome sequences of eight different dogs (four with white fur and four with black fur). Each SNP locus has two nucleotides, one from each chromosome. You are interested to determine whether the SNPs in the table are associated with white fur. What is the locus number (or numbers) for the 100% associated SNP(s)?

A) 3
B) 4
C) 7
D) 3, 4, and 13

Short Answer Question 1

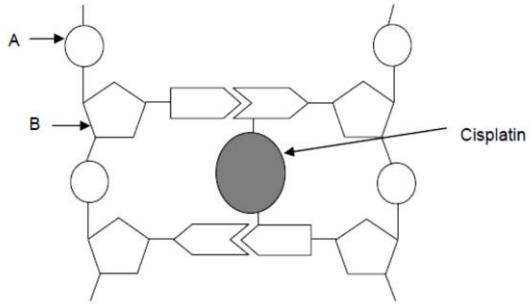
a) How many unique gametes could be produced through independent assortment by an individual with the genotype AaBbCCDdEE? *Provide number only.* (30 marks)

8

b) A duplicated homologous chromosome pair at the beginning of meiosis contains how many copies of each gene? *Provide number only.* (30 marks)

4

c) Cisplatin is a substance used to treat some forms of cancer. Inside cells, each cisplatin molecule forms two chemical bonds with a DNA molecule. The diagram below shows part of a DNA molecule with cisplatin attached.



i) **Name A and B** (30 marks)

A phosphate group……..

B…**deoxyribose sugar……..**

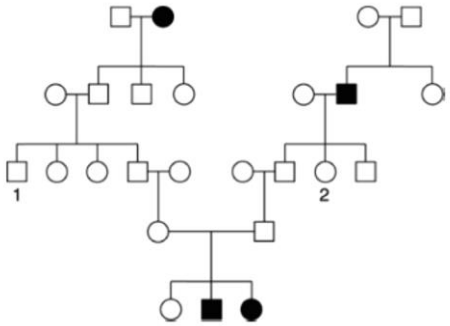
ii) **With which parts of the DNA molecule does cisplatin form chemical bonds?** (30 marks) **nitrogenous bases**

iii) Cisplatin inhibits the division of cancer cells. Suggest how**?** *(maximum two sentences).* ***Refer to the above figure & your knowledge from the course.*** (30 marks)

It inhibits DNA replication as it prevents the DNA polymerase from synthesizing the new DNA strand.

Short Answer Question 2

A) The following pedigree was obtained for a rare genetic kidney disease. *Remember that the trait is rare and thus people coming into the pedigree are not considered carriers or affected unless there is evidence to the contrary.*



i) Deduce the inheritance of this condition, **stating your reasons**. *(30 marks)*

Autosomal recessive: affected individuals inherited the trait from unaffected parents and a daughter inherited the trait from an unaffected father

ii) If persons 1 and 2 marry, **what is the probability that their first child will have the kidney disease**? **Show your calculations at different steps**. *(60 marks)*

Both parents must be heterozygous to have a 1/4 chance of having an affected child. Parent 2 is heterozygous, since her father is homozygous for the recessive allele and parent 1 has a ½ chance of being heterozygous, since his father is heterozygous because 1's paternal grandmother was affected. Overall, 1 X 1/2 X 1/4 = 1/8.

B) Male house cats are either black or orange; females are black, orange, or calico.
If these coat-color phenotypes are governed by a sex-linked gene,
How can these observations be explained? ***Write down the genotypes + phenotypes of these males and females***. Use the following symbols: *B* = black and *b* = orange. *(60 marks)*

This problem involves **X inactivation**. Let *B* = black and *b* = orange.

Females	Males
X^BX^B = black	X^BY = black
X^bX^b = orange	X^bY = orange
X^BX^b = calico	

At a certain point in the embryonic development of every female mammal (including cats), one of the two X chromosomes in each cell *inactivates* by supercoiling into a structure known as a **Barr Body**. This irreversible process is known as **Lyonization**; it leaves only ONE active X chromosome in each cell of the female embryo. Only the alleles on the active (uncoiled) X chromosome are expressed.

- In a patch of skin in which the X chromosome carrying the B allele is inactivated, that patch of skin will express only the b allele (orange fur).
- In a patch of skin in which the X chromosome carrying the b allele is inactivated, that patch of skin will express only the B allele (black fur).

A heterozygous cat will be a patchwork of these two types of cells.