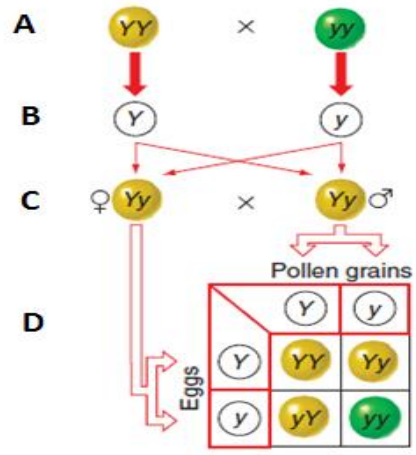
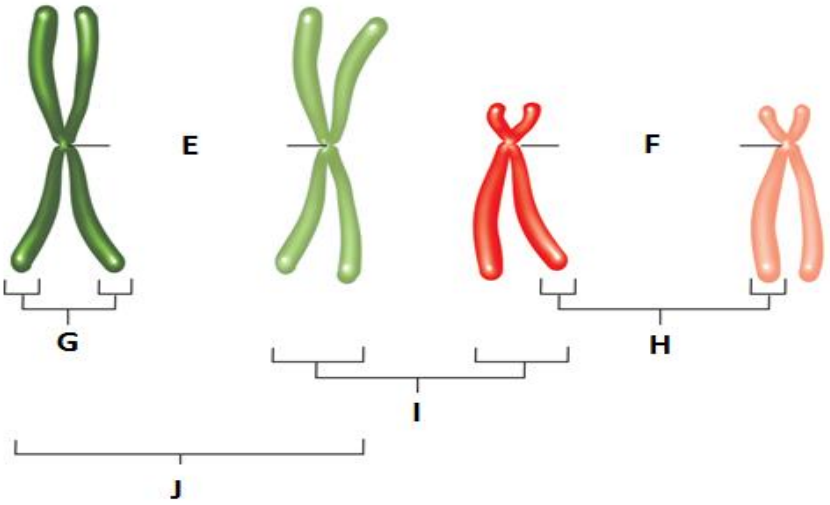
BIOL2107 (fundamentals of genetics)

Midterm 1

February 5th, 2018

A. Matching, 10 choices worth 0.75 mark each. Please match alphabetic choices in each figure to the written statements. There are 4 extra statements which do not match.





1- Chromosome
2- Chromatids
3- F1 **C**
4- F2 **D**
5- F3
6- Parents (P) **A**
7- Gametes (G) **B**
8- Metacentric Centromere **E**
9- Acrocentric Centromere **F**
10- Sister Chromatids **G**
11- Non-Sister Chromatids **H**
12- Homologous Chromosomes **J**
13- Non-Homologous Chromosomes **I**
14- Mutated Chromosomes

B. Multiple choices, 15 questions worth 3.5 mark each. Please answer multiple choice questions on the answer sheet (scantron) provided.

1. _____ are alternate forms of a gene.

a. alleles
b. mutations
c. genotypes
d. Phenotype
e. chromosomes

2. What is the phenotype of fruit flies (Drosophila melanogaster) carrying two copies of the X chromosome and 1 copy of the Y chromosome?

a. normal female
b. normal male
c. hermaphrodite
d. klinefelter syndrome
e. dies before hatching.

3. How many sister chromatids are present at metaphase of mitosis in Drosophila have 2n=8 chromosomes?

a. 2
b. 4
c. 8
d. 16
e. 32

4. Generally speaking, what is the longest step in cell cycle?

a. S1
b. G1
c. G2
d. interphase
e. cytokinesis

5. _____ is a form of cell division that typically gives rise to 2 identical daughter cells.

a. meiosis
b. prophase
c. telophase
d. cytokinesis
e. mitosis

6. _____ refers to the interaction of two alleles at a single locus in which the heterozygotes do not resemble either homozygote.

a. codominance
b. incomplete dominance
c. pleiotropy
d. polymorphism
e. multimorphic

7. Sickle cell anemia is a recessive genetic disorder occurring in individuals carrying two copies of the HBß^{S} allele of the ß-globin gene. The wild type Hbß^{A} allele of the ß-globin gene_____.

a. is dominant to HBß^{S}.
b. is recessive to HBß^{S}.
c. is codominant with HBß^{S}.
d. is incompletely dominant to HBß^{S}.
e. exhibits a variety of dominance relationships with HBß^{S}.

8. Pure breeding sweet pea plants with white flowers are crossed to yield an F1 generation with all purple flowers. Following a F1 self-cross, a ratio of 9 purple to 7 white flowers in the F2 generation was observed. What is the most plausible explanation?

a. this is an example of incomplete dominance involving 2 loci.
b. alleles at two independent assorting genes are exhibiting complementary gene action.
c. flower color is controlled by two genes that are linked.
d. this represents a monohybrid cross with incomplete dominance.
e. this represents an example of dominant epistasis.

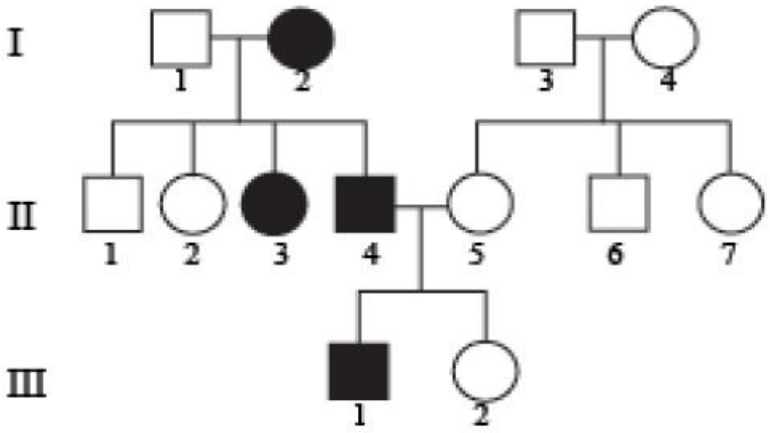
9. In a dihybrid cross, the “A” allele exhibits incomplete dominance over the “a” allele while the “B” allele similarly exhibits incomplete dominance over the “b” allele. The “A” allele controls seed color while the “B” allele controls flower color. The “A” and “B” genes sort independently. How many possible combinations of phenotypes can be generated?

a. 3
b. 4
c. 9
d. 16
e. 25

10. Which of the following items is <u>not</u> participating in mitotic cell division?

a. polar microtubules
b. kinetochore microtubules
c. ribosomal microtubules
d. astral microtubules
e. microtubules

Use the following pedigree to answer questions 11-13 and assume that the disease causing trait under consideration is not rare with 100% penetrance and that there is no consanguineous mating in previous generations.



11. What pattern of inheritance is most likely represented in the pedigree above?

a. recessive lethal
b. autosomal recessive
c. autosomal dominant
d. recessive x- linked
e. dominant x-linked

12. Using the same pedigree, what is the probability that the father of individual I-2 (1st generation #2) was unaffected?

a. 0 %
b. 25 %
c. 50 %
d. 75 %
e. 100 %

13. Using the same pedigree, what is the probability that the future children of individual III-1 (3rd generation # 1) will be affected by the disease?

a. 0 %
b. 75 %
c. 25 %
d. 50 %
e. 100 %

14. In a hypothetical cross, when offspring show traits from both parents, the genetic relationship is called _____.

a. complete dominance
b. incomplete dominance
c. sex-linked
d. modifier genes
e. codominance

15. A hypothetical gene, having more than one common allele is called _____.

a. linked
b. polymorphic
c. autosomal
d. monomorphic
e. gene pool

C. True or False, 5 questions worth 4 mark each. Please answer them on the answer sheet (scantron) provided.

16. In classical Mendelian dihybrid crosses, parental phenotypes have the highest ratio.

a. True
b. False

17. In classical Mendelian dihybrid crosses, 9:3:3:2 is the ratio of phenotype

a. True
b. False

18. The dihybrid cross generated the phenotype ratio of 9:7 represents complementary gene action.

a. True
b. False

19. Dominant epistasis I, represents the ratio of 9:3:4

a. True
b. False

20. In normal human, zygotes are diploid (2n) and gametes are haploid (n).

a. True
b. False

D. Please answer 2 of these 3 questions in the space provided. Each question worth 10 marks. DO NOT answer all three questions (If you do, the first two question will be marked)

1. The ABO blood system is controlled by 3 alleles at the "I" locus (I^A, I^B and I^O).

a. Indicate the known dominance relationships between each pair of alleles and then express these relationships as a dominance hierarchy (4 marks).
b. How many blood types can be produced from these 3 alleles alone? (2 marks)
c. Indicate the ABO blood types of potential donors and recipients that are compatible with each other (4 marks).

a. I^A codominant with I^B
I^A dominant over I^O
I^B dominant over I^O

$I^A = I^B > I^O$

b. 4 types: A ($I^A I^A$ or $I^A I^O$), B ($I^B I^B$ or $I^B I^O$), AB ($I^A I^B$) and O ($I^O I^O$)

c. O is the universal donor so O can donate to O, A, B or AB can be recipients
A can donate to A or AB
B can donate to B or AB
AB can only donate to AB (AB is the universal recipient)

2. You have been trying to determine the genetic interaction between 2 genes that control coat color in mice (B and C). In monohybrid experiments, you have found that B (black) is dominant over b (brown).Using other true breeding strains in a separate monohybrid experiment, you determined that C (black mice) is dominant over c (albino mice). To determine how these genes interact, you performed a dihybrid cross between true breeding albino mice and true breeding brown mice. The F1 progeny were all black.

a. Give the starting genotypes of the pure breeding parental albino and brown mice as well as their hybrid F1 progeny, assuming that the parental mice were both homozygous dominant at one of these genes (2 marks).
b. Use a Punnett square to visualize the genotypes produced in the F2 generation? (4 marks)
c. What interaction between C and B is most likely to exist if the F1 self-cross results in 18 black, 6 brown and 8 albino mice (2 marks).
d. What cross would you perform to explain the genotype of the albino mice? Include the genotypes in you answer (2 marks)

(a) parental: bbCC (brown) BBcc (albino)

F1: BbCc (black)

(b)

		male			
		BC	Bc	bC	bc
female					
	BC	BBCC	BBCc	BbCC	BbCc
	Bc	BBCc	BBcc	BbCc	Bbcc
	bC	BbCC	BbCc	bbCC	bbCc
	bc	BbCc	Bbcc	bbCc	bbcc

(c) 18:6:8 = 9:3:4. This is characteristic of a recessive epistatic relationship. In this case, cc (albino) is epistatic to bb (brown) or B- (black).

(d) The preferred testcross to unmask the epistatic relationship is to cross albino mice with bbCC. None will be albino and their B and b related phenotypes will be unmasked.

3. Let's imagine a diploid animal cell (2n=4).

a. Draw the five stages in mitosis assuming 2n=4 (5 marks).
b. Briefly explain each step (stage) in mitosis (5 marks).

Lecture 3 (22-01-2018).

Slides 49-55

You may need to consider the number of chromosomes as well.