Heredity B: SSSS 2019

Answer all questions in the provided spaces in the test booklet. You will be given 50 minutes to complete the test. There will be no negative marking for incorrect answers. Multiple choice questions are worth 1 points and short answer questions are worth 2 points.

Part 1

Questions 1-4 are based on the following information:
A variety of rare flower can be blue or pink, and can be sensitive or resistant to hot temperatures. The allele for blue color (B) is dominant over the allele for pink color (b) and the allele for heat sensitivity (S) is dominant over the trait for heat resistance (h).

1. What is the phenotypic ratio of the offspring of two plants that are heterozygous for both color and heat response?
    a. 3:1
    b. 9:3:3:1
    c. 4:4:4:4
    d. 12:3:1:1
2. What is the appropriate name for the generation of the children of the two plants described in question 1?
    a. P
    b. F1
    c. F2
    d. F3
3. What is the genotypic ratio of these children?
    a. 1:2:2:4:1:2:1:2:1
    b. 1:1:1:1:1:1:1:1:1
    c. 1:2:4:8:8:4:2:1:1
    d. 1:1:4:16:4:1:2:1
4. Complete the cross described in question 1:

Questions 5-10 are based on the following information:
A man and woman have a female daughter and discover that she suffers from hemophilia. The mother does not suffer from hemophilia. The family history of the mother is unknown, but it is known that the father's parents do not have hemophilia. Hemophillia follows a sex-linked inheritance pattern.

5. Which chromosome is hemophilia linked to?
    a. Chromosome 13
    b. Chromosome 8
    c. X Chromosome
    d. Y Chromosome
6. If the parents had a son, what is the probability that he suffers from hemophilia?
    a. 0%
    b. 33%
    c. 50%
    d. 100%
7. If the parents had two more daughters, what is the probability that their next child is male?
    a. .50
    b. .67
    c. .95
    d. .98
8. Which of the following is a symptom that is characteristic of hemophilia?
    a. Breakdown of hemoglobin resulting in fluid buildup in the brain
    b. Excess formation of heme which causes iron toxicity in the blood
    c. Increased viscosity of blood due to hemoglobin misfolding that results in uneven blood flow
    d. Inability of blood to clot properly due to missing clotting factor proteins.

9. Does the father suffer from hemophilia (if there is sufficient information to know)? If so, why or why not? If there is insufficient information, what must be known before a conclusion must be drawn?

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10. Draw a small pedigree that includes the daughter, both parents, and the father's parents.

Questions 11-15 are based on the following information:
A type of wolf can be maroon, grey, or white in fur color. Fur color is controlled by two gene loci: B and M. A cross between two BbMm is as follows, with the color of each resulting box representing the offspring phenotype:

	BM	Bm	bM	bm
BM	BBMM	BBMm	BbMM	BbMm
Bm	BBMm	BBmm	BbMm	Bbmm
bM	BbMM	BbMm	bbMM	bbMm
bm	BbMm	Bbmm	bbMm	bbmm

11. What term best describes this phenomenon?

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12. If the protein coded by the *B* locus was not produced in a wolf, which of the following would most likely occur:
    a. The wolf would be exclusively white in color
    b. The wolf's color would be maroon or grey based on the genotype of the *M* gene
    c. The wolf would produce only maroon pigment
    d. The wolf would not grow fur
13. Which term best describes the relationship of the *M* locus to the *B* locus?
    a. Complementary
    b. Hypostatic
    c. Satalitic
    d. Biallelic
14. If two wolves with a *BB* genotype reproduce, what would be the phenotypic ratio of their offspring?
    a. 9:4:3
    b. 9:7:0
    c. 3:2:2
    d. 3:1:0
15. Briefly describe the phenomenon that results in this distribution of genotypes.

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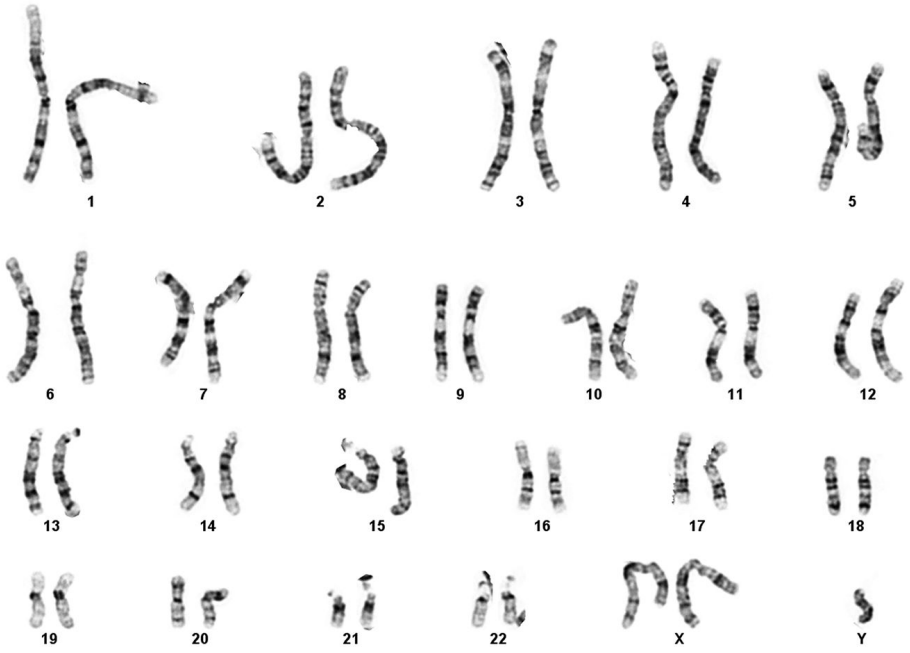
For questions 16-30, match the terms to the description by writing the letter corresponding to the correct definition in the box given.

16		Exome	A	A chromosomal abnormality occurring when a portion of a chromosome breaks off and migrates to a different chromosome
17		Polymorphism	B	A genetic phenomenon in which an organism or tissue is made up of two or more genetically distinct cell lines
18		CpG island	C	The natural variation in DNA fragment lengths created using a restriction enzyme
19		Transcription	D	The creation of a protein from an mRNA sequence
20		Deamination	E	A type of mutation where a single base pair is substituted and results in the production of a different amino acid
21		Proband	F	The proportion of a population with a certain genotype that also expresses that respective phenotype
22		Translocation	G	When an individual heterozygous for two alleles expresses both phenotypes together
23		Nonsense	H	A process that can convert methylated cytosine into thymine
24		Mosaicism	I	The collective protein-coding region of the human genome
25		Translation	J	A type of mutation where a protein is terminated early
26		Codominance	K	When an individual heterozygous for two alleles expresses a phenotype that is a blend of the two other phenotypes
27		Missense	L	The creation of mRNA from DNA
28		RFLP	M	A stretch of DNA that tends to be unmethylated and often surrounds housekeeping genes
29		Penetrance	N	The presence of two or more genetic phenotypes in a population that do not occur due to repeated mutation
30		Incomplete dominance	O	The first member of a family affected by a genetic disorder to come under study

Part 2

Questions 1-6 refer to the following figure:



1. What is the name of this type of chart?

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2. What unusual feature is visible in this chart?
   a. Two autosomes
   b. Two allosomes
   c. Three autosomes
   d. Three allosomes
3. What is the sex of the individual that this chart refers to?
   a. Male
   b. Female
   c. Depends on the cell that the chart refers to
   d. Cannot be determined from this type of chart
4. What is the common name for the disorder? (hint: begins with a ‘K’)

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5. Which of the following is a symptom for this disorder?
    a. Unusually pale skin
    b. Poor blood clotting
    c. Flaccid muscles
    d. Excess body hair
6. What is the term used to describe an inactivated X-chromosome?
    a. Barr body
    b. Harris body
    c. Vries body
    d. Tatum body

Questions 7-10 refer to the following information:

A child is born with an extra 13th chromosome. The child suffers from a low weight at birth and has an unusually small head.

7. What is the common name for this disorder?
    a. Patau syndrome
    b. Down syndrome
    c. Edwards syndrome
    d. Warkany syndrome 2
8. Which occurrence could cause this disorder?
    a. Point mutation
    b. Nondisjunction
    c. X-inactivation
    d. Synaptonemal complex
9. What is the approximate median survival time for a baby with this disorder?
    a. 7 days
    b. 7 weeks
    c. 7 months
    d. 7 years
10. Name one symptom of this disorder other than the ones mentioned above.

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Questions 11-20 refer to the following information:

A teenage boy enters a hospital emergency room with an open wound alongside his parents and is in immediate need of blood. Unfortunately, the hospital is out of O-negative blood and has incredibly limited time to save the boy's life. The administrators decide to take their chances and give the patient A-negative blood, as the parents are B-negative and A-negative. Soon after, the child reports feelings of dread, suffers from incredible discomfort, and reaches a high fever.

11. What does the "positive" or "negative" in a blood type indicate the presence of?
    a. Microglobulin
    b. Rh factor
    c. Factor VIII
    d. Troponin
12. There are two possible crosses for blood type that could model this situation with both parents and the child. Draw one of the crosses and circle all outcomes that could match the genotype of the child:

13. Draw the second possible cross and circle all outcomes that could match the genotype of the child:

14. The child has a sister. What is the probability that she has type B blood?
    a. ½
    b. ¼
    c. ⅜
    d. ¾

15. Which chromosome does the ABO gene lie on?
    a. 3
    b. 5
    c. 7
    d. 9
16. What does the letter “i” in blood genotyping stand for?
    a. Isoagglutinogen
    b. Immunodeficiency
    c. Immunoglobulin
    d. Inulin
17. Which inheritance pattern can the A and B alleles demonstrate?
    a. Codominance
    b. Incomplete dominance
    c. Multi-gene inheritance
    d. Pleiotropy

Questions 18-19 refer to the following additional information:
Blood can be “positive” or “negative” and follows simple Mendellian inheritance, where the positive D allele is dominant over the negative d allele.

18. Draw cross that represents the scenario described above, with two parents with negative blood.

19. What is the probability that the daughter has positive blood?

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20. Briefly explain why the doctors chose to use A-negative blood.

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