

Answer Key for amk578's SSSS Heredity Test

Section 1:

1. D
2. B
3. E
4. C
5. D
6. A
7. C
8. B
9. E
10. B
11. A
12. A

13. D
14. B
15. C
16. E
17. C
18. D
19. C
20. A
21. E
22. B
23. A
24. E
25. C

Section 2: Short Answer/Applications

1. For the following template strand of DNA:

3'-TACGACACCGAGTGGACCACTGAGTTACAG-5'

List the corresponding mRNA strand: (2 points)

5'-AUGCUGUGGCUCACCUGGUGACUCAAUGUC-3'

List the corresponding tRNA strand: (2 points)

3'-UACGACACCGAGUGGACCACUGAGUUACAG-5'

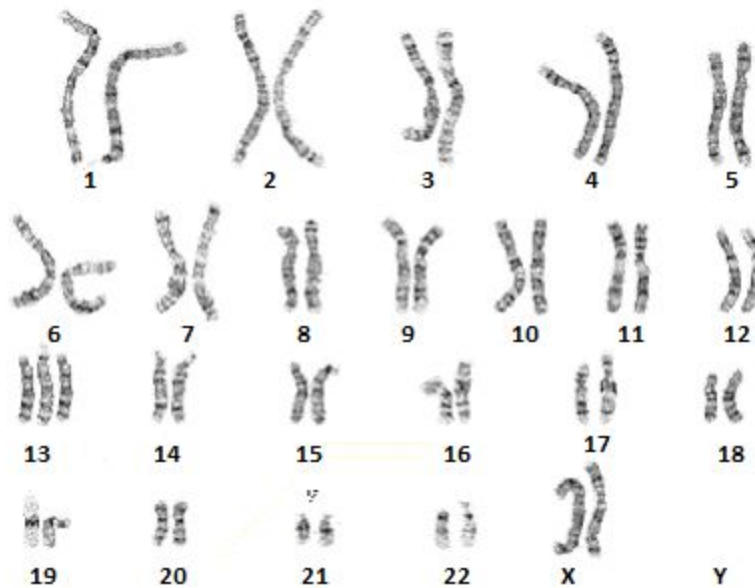
List the corresponding amino acid chain: (4 points)

5'-Met-Leu-Trp-Leu-Thr-Trp-STOP-3'

2. Explain the difference between meiosis and gametogenesis. (2 points)

In males, gametogenesis and meiosis are essentially the same; both processes result in 4 functioning sperm cells. However in females, meiosis still results in 4 haploid cells, oogenesis results in 1 gamete and 3 polar bodies that do not function in fertility.

3. Analyze the following karyotype:



What is the gender of this individual? (1 point)

Female

What is the condition of this individual? (1 point)

Patau syndrome

List ONE symptom of this condition. (1 point)

Complex organ defects, seizures, hernias, etc.

How many autosomes does this individual have? (1 point)

45

4.

List four of the seven traits that Mendel studied in pea plants, and explain the three laws of genetics he discovered. Give an exception to one of the laws. (8 points)

For the first part: 0.5 point per trait identified, 2 points max

- Any of the following can be accepted: Pea shape, Pea color, Flower color, Flower position, Plant height, Pod shape, and/or Pod color

For the second part: 6 points max, 1 point for identifying each law and 1 point for correctly describing what each law entails. Deduct 1 point if the exception given is incorrect.

- Law of independent assortment: States that genes for different traits are inherited independently of each other
 - Exceptions include: gene linkage, pleiotropy, etc.
- Law of segregation: States that every individual has two alleles of each gene and when gametes are produced, each gamete receives one of these alleles
 - Exceptions include: the y-chromosome in males, etc.
- Law of dominance: States that one of the factors for a pair of inherited traits will be dominant and the other will be recessive
 - Exceptions include: codominance, incomplete dominance, etc.

5.

Identify the 3 types of RNA involved in transcription/translation and briefly describe their processes. (6 points)

mRNA- Encodes amino acid sequence of a polypeptide

tRNA- Brings amino acids to ribosomes during translation

rRNA- With ribosomal proteins, it makes up the ribosomes that translate mRNA

1 point each for identifying the type of RNA, 1 additional point for correctly describing the process of each RNA

6. Define aneuploidy. (2 points)

The condition of the presence of an abnormal number of chromosomes in a cell.

7.

In a species of unicorns, the trait for a straight/pointed horn is dominant and denoted by the allele H, while the trait for a curved/irregular horn is recessive and denoted by the allele h. Also, the trait for pink fur is dominant (F) while the trait for blue fur is recessive (f). A male unicorn with a curved horn and pink fur mates with a female unicorn that has a straight horn and pink fur. Assume both unicorns are true-breeds.

What are the gametes for the male unicorn? What about for the female? (2 points)

Male: hF, hF, hF, hF

Female: HF, HF, HF, HF

Create a dihybrid cross demonstrating this situation. Give the genotypic and phenotypic ratios. (4 points)

	hF	hF	hF	hF
HF	HhFF	HhFF	HhF F	HhF F
HF	HhFF	HhFF	HhF F	HhF F
HF	HhFF	HhFF	HhF F	HhF F
HF	HhFF	HhFF	HhF F	HhF F

Genotypic ratio: HhFF; 1

Phenotypic ratio: Straight horn, pink fur; 1

2 points for filling in the table correctly, 1 point for each ratio

The two unicorns have a child that has a straight horn and pink fur. This child mates with a unicorn that has a curved horn and blue fur. Create a dihybrid cross demonstrating this situation. Give the genotypic and phenotypic ratios. (4 points)

	HF	hF	HF	hF
hf	HhFf	hhFf	HhFf	hhFf
hf	HhFf	hhFf	HhFf	hhFf
hf	HhFf	hhFf	HhFf	hhFf
hf	HhFf	hhFf	HhFf	hhFf

Genotypic ratio: HhFf:hhFf; 1:1

Phenotypic ratio: Straight horn, pink fur: Curved, pink; 1:1

8. Here are some questions regarding bonds:

What kind of bond is between adenine and thymine? (1 point)

Double hydrogen bonds

What kind of bond is between guanine and cytosine? (1 point)

Triple hydrogen bonds

What kind of bond joins together nucleotides? (1 point)

Phosphodiester bonds

What kind of bond links amino acids? (1 point)

Peptide bonds

9.

A population of zebras are at Hardy-Weinberg equilibrium. The allele for stripes is dominant and has an allele frequency of 0.73. The allele for no stripes is recessive and has an allele frequency of 0.27. What percentage of the population is the heterozygous? Show all work. (2 points)

$$p^2 + 2pq + q^2 = 1$$

$$(0.73)^2 + 2pq + (0.27)^2 = 1$$

$$2pq + .5329 + .0729 = 1$$

$$2pq = .3942$$

39.42% is heterozygous

10.

Dwight, who has Type A blood, has a child with Angela, who has Type B blood. However, their child has Type O blood.

Create a Punnett square modeling this situation. Determine the probability of their next child having Type B blood. (3 points)

	A	i
B	AB	Bi
i	Ai	ii

25% chance

2 points for filling out table correctly, 1 point for correct probability

In another scenario, two people that have Type AB blood have a child. Create a Punnett square to model this scenario. Determine the probability that their child will have Type A blood. (3 points)

	A	B
A	AA	AB
B	AB	BB

25% chance

2 points for filling out table correctly, 1 point for correct probability

11. Elaborate the difference between a transition and transversion mutation. (4 points)

Transition - purine substitutes for purine or pyrimidine for pyrimidine

Transversion - purine substitutes for pyrimidine or pyrimidine for purine

2 points each for correct definition

12.

Two flowers produce an offspring. One flower has red petals and the other has white petals. However, the trait for the color of petals displays incomplete dominance and their offspring has pink petals.

Create a Punnett square displaying this situation. (2 points)

	R	R
W	RW	RW
W	RW	RW

2 points for filling out table correctly

The pink flower crosses with a red flower. Create a Punnett square and provide the genotypic and phenotypic ratios. (4 points)

	R	W
R	RR	RW
R	RR	RW

Genotypic ratio: RR:RW; 1:1

Phenotypic ratio: Red:Pink; 1:1

2 points for filling out table correctly, 1 point for each correct ratio

The trait for plant height is a recessive epistatic trait, in which if the plant is short, the plant will have rainbow flowers. A tall plant with pink flowers is crossed with a tall plant with white flowers. If both plants are heterozygous for the tall gene, what is the probability that they will produce a short plant? Show work. (5 points)

	RT	Rt	WT	Wt
WT	RWT T	RWTt	WWT T	WWT t
Wt	RWTt	RWtt	WWTt	WWtt
WT				

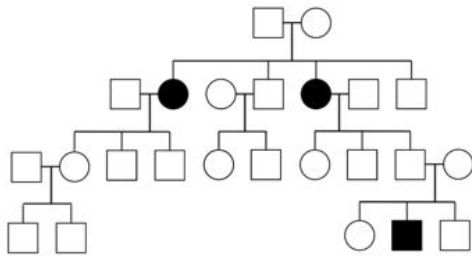
Wt	RWT T	RWTt	WWT T	WWT t
	RWTt	RWTt	WWTt	WWTt

25% chance

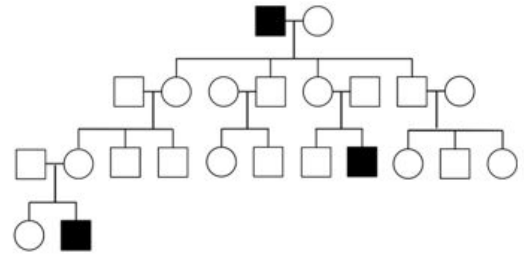
3 points for filling out the table correctly, 2 points for correct probability

13.

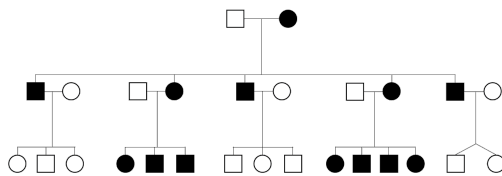
For the following pedigrees, list what pattern of inheritance each pedigree displays: autosomal dominant, autosomal recessive, X-linked dominant, X-linked recessive, Y-linked, or maternal. (6 points)



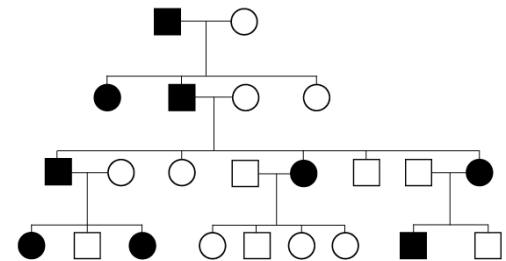
Autosomal recessive



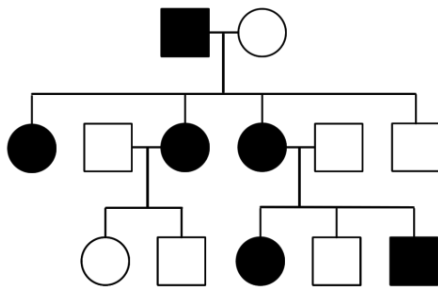
X-linked recessive



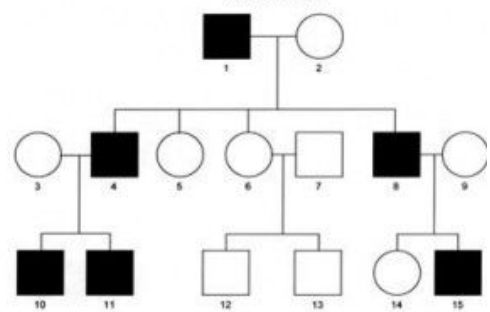
Maternal



Autosomal dominant



X-linked dominant



Y-linked

14. Explain how maternal inheritance works. (2 points)

Maternal inheritance is also known as mitochondrial inheritance, in which genes from the mitochondrial DNA of the offspring originate only from the mother. This is simply because following fertilization, the egg destroys the sperm cell along with its organelles (e.g. the mitochondria).

1 point for identifying mitochondria, 1 point for explaining the fertilization aspect correctly.