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19/26

**Midterm II Version 1** **Name:** John Patterson

In the snail, *Cepaea nemoralis*, an autosomal allele causing banded shells, *b*, is recessive to the allele *B* for unbanded shells. Another autosomal gene controls the background colour of the shell with allele *y* producing yellow shells and allele *Y* producing brown shells. A dihybrid snail is test-crossed. Use this information to answer the following 3 questions.

B unband
b band
Y brown
y yellow

by/by x by/by

1. If the genes that control banding and colour are very tightly linked, which of the following results represent the offspring of a dihybrid test-cross? Assume the alleles are in the *trans* configuration in the dihybrid.

By 40
bY 40
BY 10
by 10

a) 100 with banded, yellow shells and 100 with unbanded, brown shells. X
b) 100 with banded, brown shells and 100 unbanded, yellow shells. X
c) 50 with banded, yellow shells, 50 with banded, brown shells, 50 with unbanded, yellow shells and 50 with unbanded brown shells. X
d) 115 with unbanded, brown shells, 38 with unbanded, yellow shells, 38 with banded, brown shells, and 15 with banded, yellow shells.
e) None of the above

2. If the genes that control banding and colour are 20 map units apart on chromosome 1, which of the following results represent the offspring of a dihybrid test-cross? Assume the alleles are in the *cis* configuration in the dihybrid.

X

a) 160 with banded, yellow shells, 160 with unbanded, brown shells, 40 with unbanded, yellow shells and 40 with banded, brown shells.
b) 100 with unbanded, brown shells and 100 banded, yellow shells. X
c) 40 with banded, brown shells, 40 with unbanded, yellow shells, 10 with unbanded, brown shells and 10 with banded, yellow shells.
d) 40 with banded, yellow shells, 40 with unbanded, brown shells, 20 with unbanded, yellow shells and 20 with banded brown shells.
e) None of the above

3. If the gene that controls shell banding maps to chromosome 3 and the gene that controls shell colour maps to chromosome 7, which of the following results represent the offspring of a dihybrid test-cross?

BbYy x bbyy

BbYy 0,5
bbYy 0,25
bbyy 0,25
Bbyy 0,25

0.5 0.5

a) 100 with banded, yellow shells and 100 with unbanded, brown shells
b) 100 with banded, brown shells and 100 unbanded, yellow shells.
c) 50 with banded, yellow shells, 50 with banded, brown shells, 50 with unbanded, yellow shells and 50 with unbanded brown shells.
d) 115 with unbanded, brown shells, 38 with unbanded, yellow shells, 38 with banded, brown shells, and 15 with banded, yellow shells.
e) None of the above



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B 13
E 18
D 21

T X—
K XXY

In cucumbers, the allele controlling heart-shaped leaves, *hl*, is recessive to normal leaves, *Hl*. Another allele, *sp*, controls the presence of numerous spines and is recessive to the allele, *Sp*, for the absence of spines. Both genes are autosomal. Dihybrid plants were test-crossed. The following offspring were produced:

| Phenotype | Numbers |
|---|---|
| Spiny, heart-shaped leaves | 133 |
| Spiny, normal leaves | 64 |
| Spineless, normal leaves | 136 |
| Spineless, heart shaped leaves | 67 |
| | (Total progeny =400 ) |

The next 3 questions refer to the above information.

4. What is/are the genotype/s of the above dihybrid parents?

a) $\frac{Sp\ Hl}{sp\ Hl}$ b) $\frac{Sp\ hl}{sp\ Hl}$ c) $\frac{Sp\ Hl}{Sp\ hl}$ d) $\frac{Sp\ Hl}{sp\ hl}$ e) more than one of the foregoing

5. What is/are the genotype/s of the offspring with normal leaves and no spines?

a) $\frac{Sp\ Hl}{sp\ hl}$

b) $\frac{Sp\ hl}{Sp\ Hl}$

c) $\frac{sp\ Hl}{Sp\ hl}$

d) $\frac{Sp\ Hl}{Sp\ Hl}$

e) more than one of the above

6. The distance between genes *Sp* and *Hl* would be

a) more than 45 map units
b) between 35 and 45 map units
c) between 25 and 35 map units
d) between 15 and 25 map units
e) less than 15 map units

7. The disease Retinoblastoma is associated with tumours in the eye. It is controlled by a single gene, *RB*, which maps to chromosome 13. Tumours develop in eye cells that are homozygous for recessive alleles of the *RB* gene. A child is heterozygous *RB rb*. What events would cause this child to develop Retinoblastoma?

a) In the eye cells of the child, a second mutation occurs in the mutant *rb* allele.
b) A mitotic recombination event (involving the *RB* genes) occurs in the eye cells of the child.
c) In the eye cells of the child, a mutation occurs in the normal *RB* allele.
d) In the germ-line cells of the child a mutation occurs in either the *rb* allele or *RB* allele.
e) More than one of the above

Two X-linked recessive alleles in *Drosophila* are *sn* and *y*. Flies homozygous or hemizygous for the allele *y* have yellow bodies. Flies homozygous or hemizygous for *sn* have singed bristles (bristles curled and short). Wildtype flies have grey bodies and normal bristles. The *sn* locus is closer to the centromere than the *y* locus. (Map order: *centromere....sn.....y*) Use this information to answer the following question.

8. A female fly has the genotype *sn y //+ +*. Mitotic recombination occurs between 2 chromatids by means of a cross-over between gene *sn* and the centromere. The two cells produced by this event could genotypically be

a) *sn + //+ +* and *+ y//+ +*
b) *sn + //sn +* and *+ y// + y*
c) *+ +//+ +* and *sn y // sn y*
d) *+ y// sn y* and *sn + // sn y*
e) more than one of the above is possible

9. A variety of limes called "Tahiti" is a sterile autotriploid with 3N=27. What could be observed in cells undergoing meiosis I?

a) 3 trivalents, 6 bivalents, and 6 univalents
b) 1 trivalent, 11 bivalents, and 2 univalents
c) 13 bivalents and 1 univalent
d) 5 trivalents, 5 bivalents and 2 univalents
e) more than one of the above

10. If the diploid number of an organism is 2N=52, then there would be 78 chromosomes in a trisomic.

a) Above statement is true
b) Above statement is false

11. Unfertilized eggs obtained from a hen (a female chicken) have 39 chromosomes. Which of the following statements is/are true?

a) This bird is 2N=78.
b) After S phase of the cell cycle, this bird's somatic cells contain 156 chromosomes.
c) 78 bivalents are formed during meiosis I in this bird.
d) All of the gametes produced by this bird have a Z chromosome.
e) More than one of the above

12. A researcher is studying three closely related species of ferns. Species A has 12 chromosomes in its somatic cells and species B has 24 chromosomes in its somatic cells. Species C has 36 chromosomes in its somatic cells. The researcher hypothesizes that species C is an allotetraploid produced by crosses that occurred between A and B. What piece of evidence would ***best*** support his hypothesis?

a) Species C is completely infertile.
b) Species C always produces 12 trivalents during meiosis I.
c) Hybrids between species A and species C form 6 bivalents and 12 univalents and hybrids between species B and species C form 12 bivalents and 6 univalents.
d) Species C always produces 9 tetravalents during meiosis I.
e) Species A and species B cannot produce seeds.

13. Transduction is the process by which viruses take up exogenous DNA fragments.

a) Above statement is true
b) Above statement is false

14. Some members of a family have a very rare mtDNA disorder called Leigh Syndrome (LS). A man from this family is severely affected with LS. He marries a woman who has no family history of LS and they consider having children. What is the probability that their first child will affected with LS?

a) 100% if the child is a female; 0% if the child is a male.
b) 0% if the child is a female; 100% if the child is a male.
c) 50%
d) 0%
e) none of the above

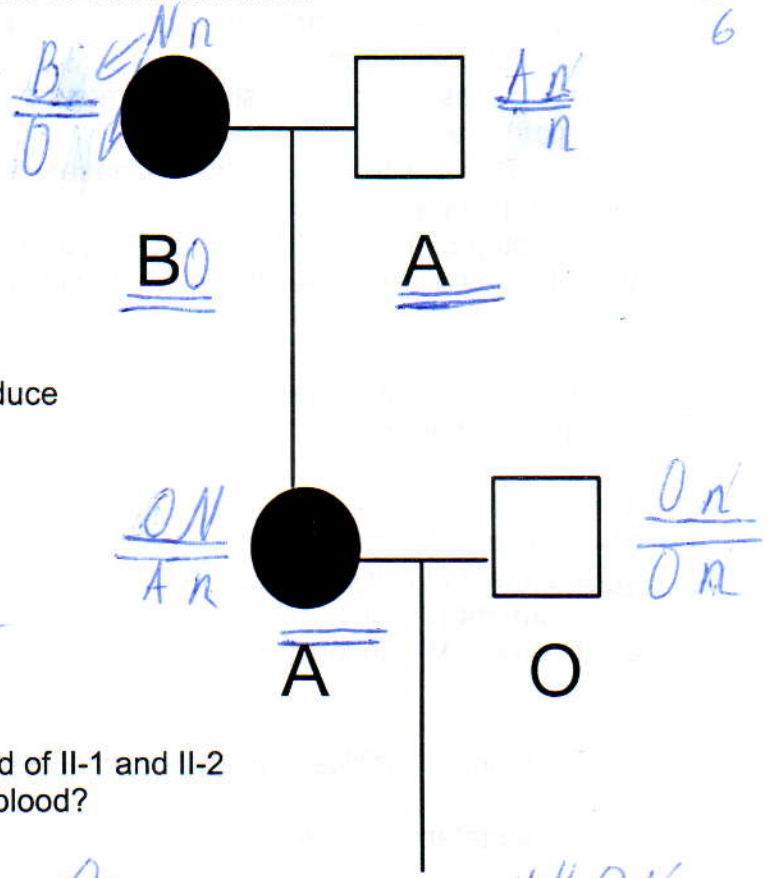
15. Lysogens are bacteria with viral (bacteriophage) DNA integrated within the bacterial chromosome.

a) Above statement is true
b) Above statement is false

16. A plant is 2N=32. How many chromosomes would be found in the leaves, endosperm and spores of this plant?

a) 32, 48, and 16 respectively
b) 32, 32 and 16 respectively
c) 64, 16 and 16 respectively
d) 32, 16 and 16 respectively
e) none of the above

The genes that control nail-patella syndrome and the ABO blood group map to chromosome 9. Imagine that these two genes are **12 map units** apart. Examine the pedigree below. (Note: individuals affected with nail-patella syndrome are indicated by solid symbols). The next three questions refer to this information.




17. What is the genotype of II-1?

a) $I^A\ n\ //\ i\ N$
b) $I^A\ N\ //\ i\ n$
c) $I^A\ n\ //\ I^A\ N$
d) $I^A\ N\ //\ i\ N$
e) more than one of the above is possible

18. What is the probability that II-1 will produce $\underline{I^A\ n}$ gametes?

a) 6%
b) 12%
c) 44%
d) 88%
e) none of the above

19. What is the probability that the first child of II-1 and II-2 will be phenotypically normal with Type O blood?

a) 6%
b) 12%
c) 44%
d) 88%
e) none of the above

20. Chloroplasts are found only in plant cells and mitochondria are found only in animal cells.

a) Above statement is true

b) Above statement is false

21. A student has a culture of tryptophan auxotrophs. These bacteria are able to survive in media that lacks tryptophan.

a) Above statement is true

b) Above statement is false

Read over the following statements.

I. Calico and tortoiseshell cats are typically females who are heterozygous for one sex-linked coat colour gene.
II. In prophase II of meiosis in humans there are 23 chromosomes in a secondary spermatocyte.
III. Individuals with Tay Sachs Disease are often homozygous for null alleles of the hexosaminidase gene.
IV. The stop codons (UAA, UGA, UAG) terminate transcription in the nucleus.
V. Wildtype bacteria are susceptible to antibiotics.

22. Of the above statements, only one statement is **incorrect** (false). Identify the incorrect statement.

a) Statement I is incorrect
b) Statement II is incorrect
c) Statement III is incorrect
d) Statement IV is incorrect
e) Statement V is incorrect

23. Epigenetic modifications always involve changes to the DNA sequence of a gene.

a) Above statement is true

b) Above statement is false

24. Individuals with Turner Syndrome

a) have somatic cells with 47 chromosomes.
b) have somatic cells with one copy of chromosome 21.
c) are females who lack ovaries.
d) have somatic cells with one heterochromatic X chromosome.
e) More than one of the above

25. Two phenotypically normal parents have a child who is $X^{cb}$ X Y. Which of the following statements describes the meiotic event/s that gave rise to this child?

a) A meiosis I nondisjunction occurred in the male parent.
b) A meiosis II nondisjunction occurred in the male parent.
c) A meiosis I nondisjunction occurred in the female parent.
d) A meiosis II nondisjunction occurred in the female parent.
e) More than one of the above is possible

26. Individuals with Down Syndrome typically have 3 copies of chromosome

a) 12.
b) 13.
c) 18.
d) 21.
e) 22.