1. If a peptide is 2 amino acids long, but does not contain tryptophan. How many different peptide sequences remain possible?

A) 38 B) 72 C) 361 D) 400 E) 524288

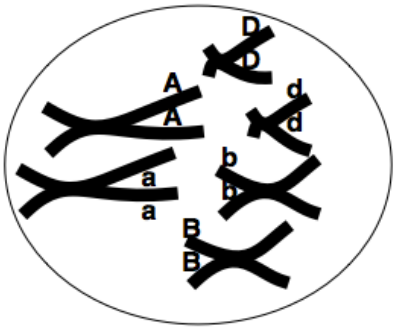
2. If an RNA sequence was determined to be 5'-UUCGGC-3', what peptide would this encode?

A) N-Phe-Arg-C
B) N-Leu-Arg-C
C) N-Arg-Leu-C
D) N-Leu-Gly-C
E) N-Phe-Gly-C

THE GENETIC CODE

FIRST (5') LETTER	SECOND LETTER: U	SECOND LETTER: C	SECOND LETTER: A	SECOND LETTER: G	THIRD (3') LETTER
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA *Ochre* (terminator)	UGA *Opal* terminator	A
	UUG Leu	UCG Ser	UAG *Amber* (terminator)	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ileu	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ileu	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ileu	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met (initiator)	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val (initiator)	GCG Ala	GAG Glu	GGG Gly	G

3. The cell shown on the right is from a diploid organism, 2n=6, with genotype of AaBbDd. If there were only one gene on each chromosome, how many genotypically distinct *gametes* can this organism produce following meiosis?

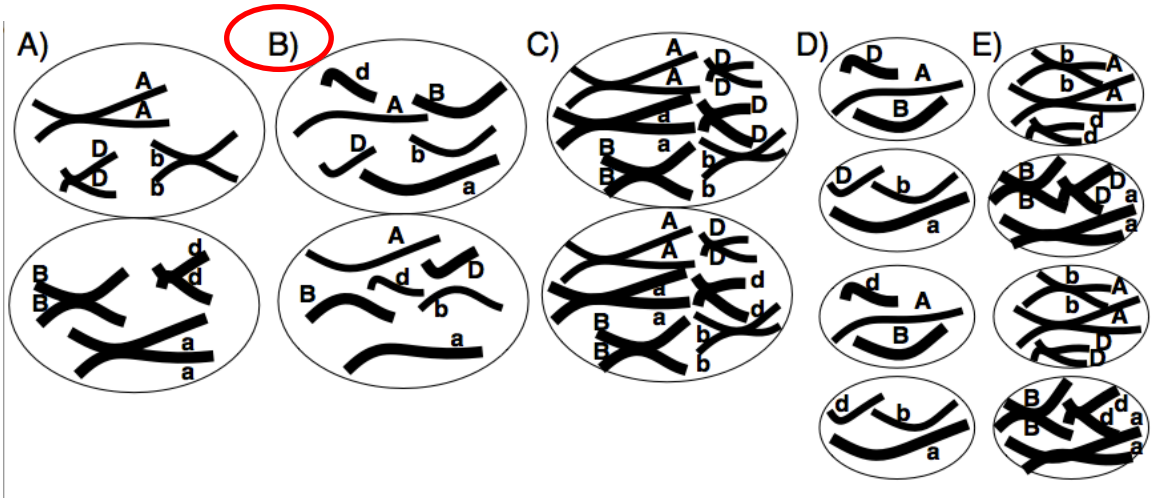


A) 4 B) 6 C) 8 D) 12 E) 16

4. How many double strand DNA molecules does the cell to the right contain?

A) 3 B) 6 C) 12 D) 24 E) 48

5. If the cell shown on the right underwent *mitosis*, the products, at the beginning of telophase would look like:



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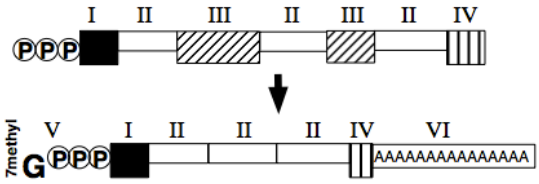
Questions 21 - 23 refer to the diagram depicting an mRNA transcript before and after processing:



6. Which segment(s) represent the exons?

A) I B) II C) III D) IV E) VI

7. Which segment(s) are translated into protein?

A) I B) II C) II & III D) II, III & IV E) I, II, IV, VI

8. The region that contains the polyadenylation signal can be found in which segment?

A) I B) II C) V D) IV E) VI

9. Mating of two organisms produces a 1:1 ratio of phenotypes in the progeny. The parental genotypes are

A) *Aa* x *Aa*. B) *Aa* x *aa*. C) *AA* x *aa*. D) *AA* x *AA*. E) *AA* x *Aa*

10. A *testcross* with a *dihybrid* would be expected to produce progeny with a phenotypic ratio of

A) 3:1 B) 1:1 C) 9:3:3:1 D) 1:1:1:1 E) all would be phenotypically identical

11. A cross between two plants having genotypes AAbb x aaBB would be expected to produce progeny with a phenotypic ratio of

A) 3:1 B) 1:1 C) 9:3:3:1 D) 1:1:1:1 E) all would be phenotypically identical

Questions 4-6 refer to the following family.

The *P*, *Q*, *R, S* loci are all on different autosomes in a certain mammalian species and are completely dominant alleles. The following cross was made:

female ***Pp Qq Rr SS*** × male ***pp Qq rr SS***

12. With respect to these four genes, what proportion of progeny will *genotypically* resemble their father?

A) 1/32 B) 1/16 C) 1/8 D) 3/16 E) 3/8

13. With respect to these four genes, what proportion of progeny will *phenotypically* resemble their father?

A) 1/32 B) 1/16 C) 1/8 D) 3/16 E) 3/8

14. How many *phenotypically* distinct progeny could be produced by this male and female?

A) 4 B) 8 C) 12 D) 16 E) 256

Questions 4-6 refer to the following family.

A male and female are both heterozygous for the autosomal recessive allele for albinism. They have three children.

15. What is the probability that their first child has albinism?

A) 1/4 B) 9/64 C) 27/64 D) 28/64 E) 54/64.

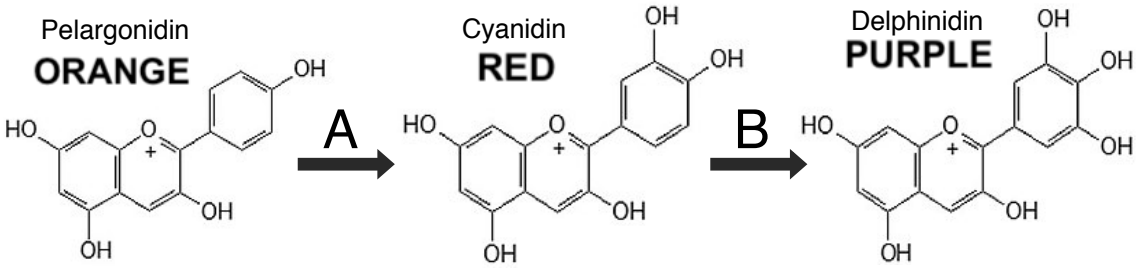
16. What is the probability that exactly two of their children have albinism?

A) 1/8 B) 9/64 C) 10/64 D) 27/64 E) 54/64.

17. What is the probability that at least two of their children have albinism?

A) 2/3 B) 9/64 C) 10/64 D) 28/64 E) 54/64.

Questions 7-11 refer a biochemical pathway in which enzyme A and B control flower color in plants.



18. In a plant missing enzyme A, what color would the flowers be?

A) Orange B) Red C) Purple D) Between Orange and Red E) Between Red and Purple

19. A true breeding plant with red flowers could have which of the following genotypes:

A) aaBB B) AaBb C) AAbb D) aabb E) Either C or D

20. When a true breeding flower that is missing Enzyme A is crossed with a true breeding flower that is missing Enzyme B, the following ratio of orange:red:purple flowers would be produced in the offspring:

A) 1:2:1 B) 1:3:12 C) 4:3:9 D) 7:0:9 E) 0:0:1

21. A dihybrid flower crossed to itself would produce the following ratio of orange:red:purple flowers:

A) 1:6:9 B) 1:3:12 C) 4:3:9 D) 7:0:9 E) 0:0:1

	AB	**Ab**	**aB**	**ab**
AB	**AABB**	**AABb**	**AaBB**	**AaBb**
Ab	**AABb**	**AAbb**	**AaBb**	**Aabb**
aB	**AaBB**	**AaBb**	**aaBB**	**aaBb**
ab	**AaBb**	**Aabb**	**aaBb**	**aabb**

22. A colleague sends you a pure breeding Red flowered plant and wishes to know if it contains the same mutation as your own pure breeding Red flowered plant. You cross the new red-flowered plant with your own red flowered plant and observe that all the plants are purple. What can you say about the mutations in the two plants?

A) they do not complement each other and are likely to be in different genes
B) they complement each other and are likely to be in different genes
C) they do not complement each other and are likely to be in the same gene
D) they complement each other and are likely to be in the same gene
E) they complement each other and must be located on separate chromosomes

23. A colleague also sends you a pure breeding orange flowered plant and wishes to know if it contains the same mutation as your own pure breeding orange flowered plant. You cross the new orange-flowered plant with your own orange flowered plant and observe that all the plants are orange. What can you say about the mutations in the two plants?

A) they do not complement each other and are likely to be in different genes
B) they complement each other and are likely to be in different genes
C) they do not complement each other and are likely to be in the same gene
D) they complement each other and are likely to be in the same gene
E) they complement each other and must be located on separate chromosomes

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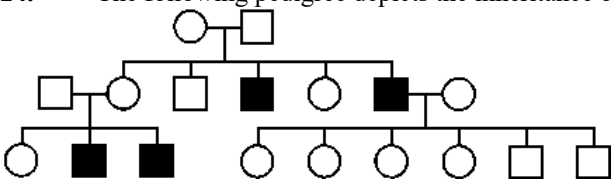
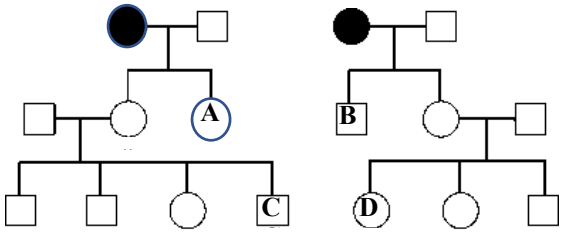
24. The following pedigree depicts the inheritance of a rare hereditary disease affecting muscles:



What is the *most* likely mode of inheritance of this disease?

A) Autosomal dominant
B) Autosomal recessive
C) X-linked dominant
D) X-linked recessive
E) Y-linked

Questions **12-16** refer to the following pedigree involving a rare disease:



25. What is the most likely mode of inheritance of this disease?

A) Autosomal dominant
B) Autosomal recessive
C) X-linked dominant
D) X-linked recessive
E) Y-linked

26. What is the genotype of **A**?

A) AA B) Aa C) 1/3 chance that it is Aa D) 1/2 chance that it is Aa E) 2/3 chance that it is Aa

27. What is the genotype of C?

A) AA B) Aa C) 1/3 chance that it is Aa D) 1/2 chance that it is Aa E) 2/3 chance that it is Aa

28. If individuals A and B have a child, what is the probability that the child will have the disease?

A) 1/2 B) 1/4 C) 1/6 D) 1/8 E) 1/16

29. If individuals C and D have a child, what is the probability that the child will have the disease?

A) 1/4 B) 1/9 C) 1/12 D) 1/16 E) 1/24

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Questions 21-24 refer to the following experiment

An experiment is carried out to determine if co-dominance governs flower color in snapdragons. A plant with red flowers is crossed to a plant with yellow flowers to produce plants with orange flowers. The orange flowered plants were then selfed and the following progeny were recovered from the cross:

20 plants had red flowers
45 had orange flowers
35 had yellow flowers.

30. If the hypothesis is that flower color in snapdragons follows a single gene, Mendelian pattern of inheritance (for co-dominance of a single gene), the expected number of progeny for each class would be?

A) 0 red, 100 orange, 0 yellow
B) 75 red, 0 orange, 25 yellow
C) 25 red, 0 orange, 75 yellow
D) 25 red, 50 orange, 25 yellow
E) 33.3 red, 33.3 orange, 33.3 yellow

31. What is the Chi-square value for the hypothesis that this trait follows a single gene Mendelian pattern of inheritance?

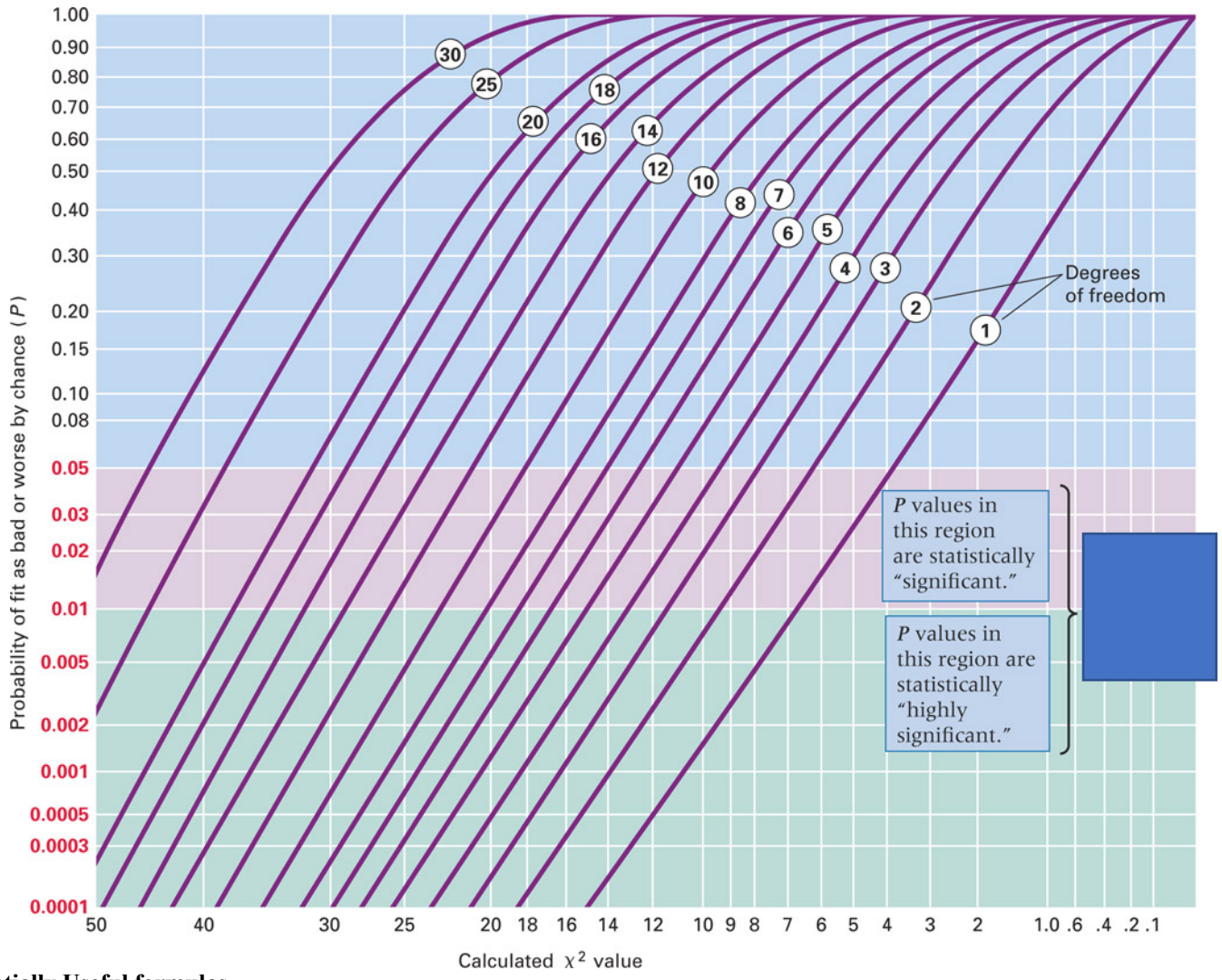
A) 0.00 B) 0.70 C) 1.33 D) 2.25 E) 5.50

32. How many degrees of freedom are involved in this experiment?

A) 1 B) 2 C) 3 D) 25 E) 4

33. Base on the P value, what can be said about the pattern of inheritance in the progeny of this experiment?

A) $P < 0.05$. The observed ratios are statistically consistent with a Mendelian pattern of inheritance
B) $P < 0.05$. We can reject the hypothesis that these progeny follow a Mendelian pattern of inheritance
C) $P > 0.05$. The observed ratios are statistically consistent with a Mendelian pattern of inheritance
D) $P > 0.05$. We can reject the hypothesis that these progeny follow a Mendelian pattern of inheritance
E) $P = 0.05$. There is a 5% chance that the progeny follow a Mendelian pattern of inheritance



Potentially Useful formulas

For n trials, the probability that A, having probability p, is realized s times and B, having probability q, is realized t times is equal to $(n!)/(s!t!) \times (p^s q^t)$

$$\chi^2 = \sum (\text{observed} - \text{expected})^2 / \text{expected}$$