Thank for your Interest in the following set of genetics handouts we will be using this summer. Please pardon the extensive number of pages, but use the following guidelines to determine what pages need to be printed. Also, please understand that these worksheets do not include any answers, so as to encourage individual effort on answering the questions.

Exam 1 Pages 1-10
Exam 2 Pages 11-41
Final Exam 42-57

EXAM 1 PRACTICE

1. Assuming independent assortment, a cross between AaBBCcDdEE and AabbCCddEe is considered. What is the probability of producing a progeny AaB_CcddEE?

2. What does a 1:1:1:1 phenotypic ratio, in the progeny of the testcross of a doubly heterozygous individual, signify?

3. Identify the mode of inheritance in the following human pedigree:

4. Red green color blindness is an X-linked recessive trait. A normal female whose father is colorblind, marries a normal male. What is the probability that this couple will have a colorblind son?

5. A doubly heterozygous individual is test-crossed to yield 4 phenotypes in the progeny in the following frequencies: 191, 173, 241, 110. Use the chi-squared test to assess whether these two genes are assorting independently.

6. Identify the mode of inheritance in the following human pedigree, and determine the probability that individual IV-2 and a normal female from outside of the family have a child with the disorder.

7. The map distance between genes C and D was found to be 20 cM. What percentage of the progeny of the testcross would be expected to be a recombinant type?

(8-13) Consider the following three point cross data and answer the following questions.

<table>
<thead>
<tr>
<th></th>
<th>cv*</th>
<th>ct*</th>
</tr>
</thead>
<tbody>
<tr>
<td>v</td>
<td>530</td>
<td></td>
</tr>
<tr>
<td>v*</td>
<td>592</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>189</td>
<td></td>
</tr>
<tr>
<td>v*</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1448</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. What is the centrally located allele?

9. The map distance between v and cv?

10. The map distance between cv and ct?

11. The map distance between v and ct?

12. What is the coefficient of coincidence?

13. What is the interference value?

14. Identify the mode of inheritance in the following pedigree and determine the probability of individual IV-2 and a normal male from outside of the family having a child with the disorder.
15. Identify the mode of inheritance in the following pedigree:

```
       ●
      /   \
    ●     ●
   /     /\  \
  ●     ●  ●
 /     /   \
●     ||   ●
       ||   ●
       ||   ●
       ||   ●
       ||   ||
       ||   ●
       ||   ●
```

16. The selfing of yellow round pea plants produced the following: yellow round 315; yellow wrinkled 101; green round 108; green wrinkled 32. Calculate the chi squared value to determine whether to accept the null hypothesis.

17. Consider a cross between AaBbCcDdEe * AaBbCcDdEe. Assuming independent assortment, what is the probability of obtaining an individual that is AaBbCcDdEe?
18. An individual heterozygous for 4 genes, would produce how many different types of genotypes upon self-fertilization?
19. An individual AaBbCc is self-fertilized. What is the probability of producing an individual that is AaBbCc?
1. If the a and b loci are 40 cM apart and an AABB individual and an aabb individual mate: what will be the proportions of the gametes produced by the F1 individual that are a parental type?
2. CCDD and ccdd individuals were crossed to each other, and the F1 generation was backcrossed to the ccdd parent; 903 CcDd; 897 ccdd; 98 Ccdd and 102 ccDd offspring resulted. How far apart are the c and d loci?
3. Drosophila females heterozygous for each of three recessive autosomal mutations with independent phenotypic effects (thread antennae [th], hairy body [h] and scarlet eyes [st]) were testcrossed to males showing all three mutant phenotypes. The 1000 progeny of this testcross were:

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread; hairy; scarlet</td>
<td>432</td>
</tr>
<tr>
<td>Wild type</td>
<td>429</td>
</tr>
<tr>
<td>Thread; hairy</td>
<td>37</td>
</tr>
<tr>
<td>Thread; scarlet</td>
<td>35</td>
</tr>
<tr>
<td>Hairy</td>
<td>34</td>
</tr>
<tr>
<td>Scarlet</td>
<td>33</td>
</tr>
</tbody>
</table>

Calculate the coefficient of interference.

4. In Drosophila, three autosomal genes have the following map:

```
a <---20cM---b <---10cM---c
```

Provide the data, in terms of the expected number of flies in the following phenotypic classes, when a+ b+ c+ / a b c females are crossed to a b c / a b c males. Assume 1000 flies were counted and that there is no interference in this region.

The progeny include the following phenotypes: a+b+c+; abc; a+bc; ab+c; a+b+c; abc+; a+bc+; ab+c

7. The yeast gene encoding a protein found in the mitotic spindle was cloned by a laboratory studying mitosis. The gene encodes a protein of 477 amino acids. What is the minimum length in nucleotides of the protein-coding part of this yeast gene?

8. RNA polymerase in prokaryotic cells binds to the __________.

9. Concentration of cytosine in a sample of duplex DNA was found to be 22%. What would be the concentration of adenine?

10. What is the function of Shine-Delgarno sequences?

11. Describe the following aspects of the tRNA molecule: wobble, acceptor end, anticodon, charging process.

12. A recessive mutation of an X-linked gene in human beings results in hemophilia, marked by a prolonged increase in the time needed for blood clotting. Suppose that a phenotypically normal couple produces a normal daughter and a son affected with hemophilia. What is the probability that the normal daughter and a normal male have a child with the disorder?

13. Tall, red-flowered hibiscus is mated with short, white-flowered hibiscus. Both varieties are true breeding. All of the F1 plants were backcrossed with the short, white-flowered variety. This backcross yields 188 tall red, 203 tall white, 175 short red and 178 short white plants. Does the observed result fit the genetic hypothesis of 1:1:1:1 segregation as assessed by the chi squared test?

14. Assuming independent assortment, a cross between AaBbCcDdEe and AaBbCcDdEe is considered.

15. Calculate P(AaBbCcDdEe).

16. How many different types of gametes produced by the first parent?

17. How many different types of genotypes in the progeny?

18. How many different types of phenotypes in the progeny?

19. Given a cross between AaBbCcDdEe * AaBbCcDdEe, what is the probability of obtaining the following progeny:

   (a) AaBbCcDdEe (b) A_BbC_DdE_ (c) A_bbC_D_E_ (d) AaBbCcDdEe

19. Identify the mode of inheritance in the following pedigree and calculate the probability of individuals III-3 and III-4 having a child with the condition.
20. Identify the mode of inheritance in the following pedigree.

21. Identify the mode of inheritance in the following pedigree for the condition known as polydactyly.

**PART 2**

11. What is the centrally located allele? 12. What is the map distance between I and g? 13. What is the map distance between g and s? 14. What is the map distance between g and s? 15. What is the value of interference?

16. The following pedigree illustrates an autosomal recessive condition. Calculate the probability that individuals III-3 and III-5 have a child with the disorder.

17. Given that the following pedigree represents an X-linked recessive disorder, calculate the indicated probability.

18. Identify the mode of inheritance.
19. Identify the mode of inheritance.

Part 3

1. In a cross between a black and a white guinea pig, all members of the F1 generation are black. The F2 generation is made up of approximately ¾ black and ¼ white pigs.

(a) Diagram this cross, showing the genotypes and phenotypes.

(b) What will the offspring be like if two F2 white guinea pigs are mated?

(c) Two different matings were made between black members of the F2 generation with the results shown below. Diagram each of the crosses.

<table>
<thead>
<tr>
<th>Cross</th>
<th>Offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All black</td>
</tr>
<tr>
<td>2</td>
<td>¾ black, ¼ white</td>
</tr>
</tbody>
</table>

2. Albinism in humans is inherited as a simple autosomal recessive trait. For the following families, determine the genotypes of the parents and offspring. When two alternative genotypes are possible, list both. Represent the answer in the form of a pedigree.

a. Two normal parents have five children, four normal and one albino.

b. A normal male and an albino female have six children, all normal.

c. A normal male and an albino female have six children, three normal and three albino.

3. Pigeons may exhibit a checkered or plain pattern. In a series of controlled matings, the following data were obtained:

<table>
<thead>
<tr>
<th>F1 progeny</th>
<th>P cross</th>
<th>Checkered</th>
<th>Plain</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. checkered x checkered</td>
<td>36</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>b. checkered x plain</td>
<td>38</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>c. plain x plain</td>
<td>0</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

Then, F1 offspring were selectively mated with the following results. The P cross giving rise to each F1 pigeon is indicated in parentheses.

<table>
<thead>
<tr>
<th>F1 progeny</th>
<th>F1 x F1 crosses</th>
<th>Checkered</th>
<th>Plain</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. checkered (a) x plain (c)</td>
<td>34</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>e. checkered (b) x plain (c)</td>
<td>17</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>f. checkered (b) x checkered (b)</td>
<td>28</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>g. checkered (a) x checkered (b)</td>
<td>39</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

How are the checkered and plain patterns inherited? Select and define symbols for the genes involved and determine the genotypes of the parents and offspring in each cross.

4. a. Draw a pedigree from the following information: a couple consisting of an affected male and a normal female, have 4 children in the following order: normal female, affected male, affected female and normal male.

b. Determine the possible mode of inheritance of this genetic disorder.

Part 4

1. Mendel crosses peas having round seeds and yellow cotyledons with peas having wrinkled seeds and green cotyledons. All the F1 plants had round seeds with yellow cotyledons. Diagram this cross through the F2 generations using a Punnett square, and provide the F2 phenotypic and genotypic ratios.

2. In Drosophila, gray body color is dominant to ebony body color, while long wings are dominant to vestigial wings. Work the following crosses through the F2 generation and determine the genotypic and phenotypic ratios for each generation. Assume the P individuals are homozygous

a. gray, long x ebony, vestigial

b. gray, vestigial x ebony, long
3. How many different types of gametes can be formed by individuals of the following genotypes, and what would they be in each case?
   a. AaBb
e. AaBB
c. AaBbCc
d. AaBcCDdEEFGg

4. If an individual of the following genotype were self fertilized: an individual heterozygous for 7 genes, what would be the probability of producing the following individuals:
   a. A_B_CcddEEffG_
   b. AaBbCcDdE_F_Gg
   c. A_B_ccDDDeeFfGg

5. Given the following controlled mating,
   AaBbCcDdEeFFGg x AaBbCCDDEeFfGG
   a. AABBCcddE_FFGg
   b. AaBbCCDDEeFFGG
   c. AaBBC_D_EeFfGg

6. How many genotypes would be produced if the following individuals were self-fertilized?
   a. An individual heterozygous for 4 genes.
   b. An individual heterozygous for 5 genes.
   c. An individual heterozygous for 6 genes.

7. Consider a doubly heterozygous cell eukaryotic cell that is 2n=4. Chromosome 1 contains gene A, and chromosome 2 contains gene B. Chromosome 1 is larger than chromosome 2. Given this information, draw the cell undergoing meiosis I and II. Calculate the probability of the following gametes being produced: AB, aB, Ab, ab

8. Black fur color, in guinea pigs, is dominant to white fur color. Two black males were test crossed and the following data were obtained.
   A: 15 black, 16 white
   B: 31 black, 0 white
   What are the respective genotypes of A and B?

9. A husband and wife have normal vision, although both of their fathers are red-green color-blind, which is inherited as a sex-linked recessive condition. What is the probability that their first child will be
   a. a normal son?
   b. a normal daughter?
   c. a color-blind son?
   d. a color-blind daughter

10. In Drosophila, a sex-linked recessive mutation, scalloped (sd), causes irregular wing margins. Diagram the F1 and F2 results if:
    a. A scalloped female is crossed with a normal male.
    b. A scalloped male is crossed with a normal female.
    Compare these results to those that would be obtained if scalloped were not sex-linked.

11. Identify the mode of inheritance in the following pedigree.
1. A doubly heterozygous individual was self-fertilized to reveal the following progeny: 236, 94, 67, 21. What is the chi squared value and state an appropriate conclusion.

2. State the functions of the following enzymes: helicase, SSIP, DNA polymerase I, ligase.

3. How many potential mRNA sequences code for the polypeptide Ser-Arg-Gly-Thr-Phe?

4. The following true breeding individuals: AAbbCCDDee * aabbccDDEE were crossed to yield the F1 progeny. Upon self-fertilization of the F1 generation, what is the probability of producing an F2 individual that is phenotypically identical to the P individual on the left? What is the probability of producing an F2 individual that has a genotype identical to the P individual on the right?

5. What is the function of the enzyme aminoacyl tRNA synthetase? How many different types of this enzyme exist in a human cell?

6. State three similarities and differences between mitosis and meiosis.

7. H1 and FEN1 perform what function? And are analogous to what enzyme in prokaryotic DNA replication?

8. What are three differences between heterochromatin and euchromatin?

9. Identify the stage of meiosis in which of the following events occur, followed by ordering these events in the correct sequence:

10. What is the significance of the following measurements in DNA: 0.34 nm, 3.4 nm, 2 nm, 10 nm, 30 nm?

11. If the G+C content% of a particular DNA molecule that is 1 KB in length, was found to be 35%, what are the total number of hydrogen bonds expected?

12. Describe the C-value paradox.

13. Which of the following DNA molecules would be expected to have the highest denaturation temperature, if given their A+T% content?
   A. 12%  B. 92%  C. 38%  D. 57%  E. 88%

14. The concentration of T in double stranded DNA is found to be 16%, what is the concentration of C?

15. Indicate the product of each of the following RNA polymerases: I, II, III.

16. Describe the four levels of protein structure.

17. A single stranded DNA molecule is replicated in vitro by extending a primer oligonucleotide in the presence of nucleoside triphosphates whose two outermost phosphate groups (called the gamma and beta phosphates) are labeled with radioactive P-32 but whose innermost phosphate (the alpha phosphate) is not labeled. Is the resulting double stranded DNA labeled or unlabeled? Explain.

18. Consider a culture of E.coli cells grown for many generations in a N-15 containing medium. The cells are washed and transferred to a N-14 containing medium. After exactly two chromosome replications in the second medium, the DNA is extracted without any breakage whatsoever. What density bands would result?

19. In Drosophila, a sex-linked recessive mutation, scalloped (sd), causes irregular wing margins. Diagram the F1 and F2 results if: a. A scalloped female is crossed with a normal male. b. A scalloped male is crossed with a normal female.

20. Tall, red-flowered hibiscus is mated with short, white-flowered hibiscus. Both varieties are true breeding. All of the F1 plants were backcrossed with the short, white-flowered variety. This backcross yields 188 tall red, 203 tall white, 175 short red and 178 short white plants. Does the observed result fit the genetic hypothesis of 1:1:1:1 segregation as assessed by the chi squared test?

21. If the a and b loci are 40 cM apart and an AABB individual and an aabb individual mate: what will be the proportions of the gametes produced by the F1 individual that are a parental type?

Part 6

1. Consider a nitrogenous base containing a double ringed structure and capable of forming 2 hydrogen bonds. Identify.

2. If 30% of bases in human DNA are A, what percentage are C?

3. Choose the true statements. (A) A+C=T+G  (B) A+G=C+T  (C) A+T=G+C  (D) A/G=C/T  (E) A/G+T/C  (F) (C+A)/(G+T) = 1

4. Enzymes that prevent shortening of linear chromosomes:
5. State the enzymes in the correct order and their function in prokaryotic DNA replication.

6. Indicate the results you would expect in terms of the banding pattern in the ultracentrifugation experiment for the Meselson Stahl experiment if DNA replication was conservative after 2 rounds of DNA synthesis on N14.

7. A DNA molecule was observed to have 3 replication bubbles. How many replication forks?

8. The template strand of DNA contained a sequence 5' GTG 3' Identify the mRNA codon, tRNA anticodon, and amino acid coded for.

9. Identify the property of the genetic code. Multiple codons code for the same amino acid.

10. RNA polymerase binds to the promoter, specialized sequences near the start of gene where transcription will start.


12. Identify the phase of the cell cycle in which homologous chromosomes enter synopsis.

12. Define chiasmata.

13. A particular virus contains as its genetic material the following proportions of nucleotides: 20%A; 35%T; 25%G; 20%C. State the appropriate conclusion.

14. What is the function of Shine Delgarno sequences? Aminoacyl tRNA synthetases?

15. How does termination of translation occur in prokaryotic and eukaryotic cells?

16. State the properties of the genetic code and provide an example of each using the genetic code on page 70 of your textbook.

17. Order the following levels of DNA packaging from simplest to complex, and provide a dimension for each in nm: mitotic chromosome, solenoid, chromatin fiber, nucleosome.

18. Number of bases in a complete turn of the double helix: ____. Width of the double helix: _____. Length of the complete turn of the double helix: ________.

19. What are the core histones and linker histones?

20. Template strand: 5' ACA CGT CCG 3'. State the non-template, mRNA, anticodon, and amino acid sequences.

21. Identify what process, type of cell, and function each of the following have: N-formylmethionine, 5'cap, Shine-Delgarno sequence, theta structure, telomerase, poly A tail, introns, spliceosome, aminoacyl tRNA synthetase, rho protein

22. What are introns and the GU-AG sites?

23. What are three principal structural differences between DNA and RNA?

24. A double stranded DNA molecule contains 642 occurrences of the dinucleotide 5'GT3' in one of the paired strands. What other dinucleotide is also present exactly 642 times?

25. Twenty to thirty percent of histone proteins contain positively charged amino acids. What is the probable significance?

26. What is the physical basis of the law of independent assortment? Mendel’s law of segregation?

27. Consider a culture of E.coli cells grown for many generations in a N15 containing medium. The cells are washed and transferred to a N14 medium. After exactly two chromosomal replications in the second medium, the DNA is extracted and ultracentrifugated. What density band pattern would be observed?

28. How many different sequences of ribonucleotides would code for the amino acid sequence Met-His-Thr?

29. What RNA polymerase synthesizes eukaryotic mRNA?

30. How is transcription terminated in prokaryotic and eukaryotic cells?

31. Frameshift mutations are caused by the addition or deletion of bases. They are extremely harmful because:

32. Stop codons manifest their function by:

33. State three differences in the properties of prokaryotic and eukaryotic chromosomes.

34. DNA wrapped around histones form the basic unit of chromatin. Identify.
35. Sister chromatids line up at the equatorial plane. Identify the stage of meiosis.

36. Which of the following would be found and not found in a mature mRNA transcript: (more than one answer may apply) exons, introns, promoter, 5'utr, 3'utr, 5'cap, start codon, stop codon, poly A tail, polyadenylation signal.

37. Consider a diploid somatic cell containing 92 chromosomes. How many sister chromatids present at prophase of mitosis?

38. Silent mutations have no effect on the function of a protein. What property of the genetic code permits these type of mutations?

39. The following are several null mutations identified at their respective locations. Explain why each mutation was classified as null. A. promoter region B. 5' end of an intron C. 3' end of an intron D. exon

40. An enzyme in DNA replication is responsible for removing the RNA primer. Choose the answer choice that states both the correct name and enzymatic activity for accomplishing this function. (A) DNA polymerase III; 5' to 3' exonuclease activity (B) DNA polymerase I; 5' to 3' exonuclease activity (C) DNA ligase; 5' to 3' endonuclease activity (D) RNA primase; 5' to 3' exonuclease activity (E) topoisomerase; 3' to 5' endonuclease activity

41. Meiosis II is similar to mitosis in that: (A) sister chromatids separate during anaphase (B) DNA replicates before the division (C) the daughter cells are diploid (D) homologous chromosomes synapse (E) the chromosome number is reduced

42. In analyzing the number of different bases in a DNA sample, which result would be consistent with the base-pairing rules? (A) A = G (B) A + G = C + T (C) A + T = G + T (D) A = C (E) G = T

43. Which of the following is not true of RNA processing? (A) Exons are cut out before mRNA leaves the nucleus. (B) Nucleotides may be added at both ends of the mRNA. (C) Spliceosomes may function in RNA splicing. (D) RNA splicing involves the removal of introns and the joining together of the remaining exons. (E) A primary transcript is often much longer than the final RNA molecule that leaves the nucleus.

44. The anticodon of a particular tRNA molecule is: (A) complementary to the corresponding mRNA codon. (B) complementary to the corresponding triplet in rRNA (C) the part of the tRNA that bonds to the specific amino acid. (D) changeable, depending on the amino acid that attaches to the tRNA (E) catalytic, making the tRNA a ribozyme.

Genetics Tutorial 3315 TA: Syed Abbas

Chapter 2,3 Study Questions

1. Which of the following genes is(are) transcribed but not translated?
   I. mRNA  II. rRNA  III. tRNA  IV. snRNA
   A. I, II  B. I, III  C. II, III  D. II, IV  E. none of the above

2. RNA polymerases read DNA in a ________ direction and ribosomes read mRNA in a ________ direction.
   a. 5' to 3'; 5' to 3' b. 3' to 5'; 5' to 3' c. 3' to 5'; 3' to 5' d. 5' to 3'; 3' to 5' e. none of the above

3. The energy source for the charging of tRNA: a. glucose b. mRNA c. ATP d. GTP e. none of the above

4. Telomerase would be best described as a: a. DNA directed DNA polymerase b. DNA directed RNA polymerase c. RNA directed RNA polymerase d. RNA directed DNA polymerase e. none of the above

5. Stop codons summon which of the following? A. aminoacyl tRNA synthetase  B. tryptophanyl tRNA  C. release factors  D. discharged tRNA  E. none of the above

6. Consider the Meselson-Stahl experiment. What band pattern would you expect from the centrifugation of bacterial DNA that was isolated from cells grown in N-15 DNA for 1 generation?
   a. light density band only b. heavy density band only c. hybrid density band only d. light and hybrid density bands e. none of the above

7. The mRNA sequence isolated was 3' AGUCCAGACCCGAGG 5'. What is the template strand DNA sequence?

10. The diameter of a nucleosome: ________________

11. Enzyme responsible for charging of tRNA: ________________

12. What are 2 characteristics of eukaryotic chromosomes in contrast to prokaryotic chromosomes?

13. What are theta structures?
14. Identify the function of: DNA polymerase I and III, helicase, primase, topoisomerase, SSBP

15. The sequence of a template strand was found to be: 5' ATGCCGACATTTGCA3' What would be the amino acid sequence?

16. What plays a role analogous to the 5' cap of eukaryotic cells?

17. A mutation was isolated in an intron of a protein coding gene. The protein coded by the gene was found to be nonfunctional. Provide the best explanation possible.

20. In prokaryotic cells, a special ________ molecule, recognizing the _____ codon AUG and carrying the amino acid ________, provides the amino acid that begins a protein chain.

21. A ________ contains two binding sites for tRNA molecules: the ____ site which holds the tRNA molecule that is linked to the growing end of the polypeptide chain, and the ____ site which holds the incoming tRNA molecule charged with an amino acid.

22. Enzymes called _______ couple each amino acid to its appropriate tRNA molecule.

23. The active region of a chromosome involved in replication is a Y-shaped structure called a ________.

24. The enzyme that seals nicks in the DNA helix during DNA synthesis and repair is called ________.

25. During DNA replication, the daughter strand that is synthesized continuously is called the ____________, and the strand that is synthesized discontinuously is called the ____________.

26. Initiation of DNA synthesis on the lagging strand requires short primers made by an enzyme called ______________.

27. The unwinding of the DNA helix at the replication fork is catalyzed by a ________________, which uses the energy of ATP hydrolysis.

28. The total genetic information stored in the chromosomes of an organism is said to constitute its ____________.

29. A functional chromosome requires three DNA sequence elements: at least one ________ to permit the chromosome to be copied, one ____________ to facilitate proper segregation of its two copies at mitosis, and two ________________ to allow the chromosome to be maintained between cell generations.

30. The structure of eukaryotic chromosomes is dominated by a nucleoprotein particle, the ____________, which plays a major role in packing and organizing all of the DNA in the cell nucleus.

31. The five types of histones fall into two main groups: the ________ histones and the ________ histones.

32. The 3' end of most RNA polymerase II transcripts is defined by a modification, in which the growing transcript is cleaved at specific site and a ________________ is added by a separate polymerase to the cut 3' end.

25. In an analysis of the nucleotide composition of DNA, which of the following is true?
   A) A = C
   B) A = G and C = T
   C) A + C = G + T
   D) G + A = T + C
   E) both C and D

26. How many nucleotides are needed to code for a protein with 450 amino acids?

5. What is the function of each of the three RNA polymerases, and in which kinds of cells are they found?

6. A strand of RNA has the following sequence: 3' AUU GCC CGU 5'. What is the sequence of the template and non-template strand of DNA?

7. What do the terms upstream and downstream refer to?

9. Describe the process of mRNA processing.

10. What is the spliceosome?

11. What are exons and introns?

12. What are the four levels of protein structure, and describe each of them.

14. Ribosomes read the mRNA in a ________ direction.
15. Polypeptides are synthesized in what direction?

16. How is a peptide bond formed?

18. What is the function of aminoacyl tRNA synthetase?

19. What enzyme is responsible for catalyzing the formation of the peptide bond?

20. Describe the characteristics of the genetic code.
Study Questions-Exam 2 Genetics 3315 Tutorial TA: Syed Abbas

1. What is the function of restriction endonucleases?

2. What is the function of reverse transcriptase?

3. Indicate what type of chromosomal structural abnormality is characterized by each of the following: a. new arm ratios  b. loops  c. dicentric bridge  d. cross shaped structure  e. acentric fragment

4. What is the relationship between the position of an indel mutation and the severity of its effect?

5. What is the function of gel electrophoresis?

6. How is the difficulty of expressing eukaryotic genes in prokaryotic cells solved?

7. State a sequence that would likely be recognized by a restriction enzyme?

8. What is a vector?

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10. State the complementary sequence if the following sequence of bases tautomerized to their rare form: ATCGCA

11. What are silent mutations? What property of the genetic codes permits them?

12. What type of lesion is caused by UV radiation?

13. Consider the following locations of an indel mutation. Evaluate each in terms of its potential effect on protein function. A. near the start of an intron  b. middle of an exon  c. 5'UTR  d. promoter  e. near the 3' end of a gene

15. State the four steps in the Southern blotting procedure in the correct order and define each.

16. In terms of synopsis of structurally abnormal chromosomes what would we observe for deletions and duplications.

17. How does DNA polymerase III perform its proofreading function?

18. Base analogs typically cause what type of mutation?

19. Define the aneuploidy in each of the following disorders: Down syndrome, Turner syndrome, Patau syndrome, Edwards syndrome, Klinefelters disorder

20. What is tautomerization?

21. Consider the pBR322 vector. Describe in detail what the functions of the ampicillin gene, the tetracycline gene are? How do we determine whether transformation has occurred or not? How do we determine whether the donor DNA insert was incorporated into the plasmid or not? What is the purpose of replica plating?

22. Consider the pUC18 vector. Describe in detail the functions of the lacZ gene, ampicillin gene. How do we determine whether transformation has occurred or not? How do we determine whether the donor DNA insert was incorporated into the plasmid or not? Is replica plating needed or not?

23. What are CpG islands? What is unique about the frequency with which they are found in the human genome?

24. How is a physical map developed using clone fingerprinting?

25. What is responsible for the denaturation step in the PCR process? What temperature is needed?

26. How do bacterial cells protect against the action of their own restriction enzymes? What is the function of restriction enzymes in bacterial cells?

27. What is the function of FISH?
28. What is the difference between transitions and transversions?

29. What is the difference between cDNA and genomic libraries, in terms of their content?

30. What types of mutations or molecular lesions are created by each of the following compounds or phenomena: aflatoxin B1, UV, tautomerization of base analogs?

31. What type of chromosomal structural abnormality is associated with each of the following: new arm ratios, pseudodominance, cross shaped structures, dicentric bridge formation, acentric fragment formation, semisterility

32. Describe the two causes of Down’s syndrome. What is the incidence of each of these causes?

33. How do bacterial cells protect against the function of their own restriction enzymes?

34. What are reciprocal translocations?

35. What is problematic about the SOS repair system? Under what circumstances is it usually summoned?

36. Inactive copies of protein-coding genes that arise by retrotransposition are referred to as:

Exam 2 Practice Test  Genetics Tutorial

1. Individuals heterozygous for a deletion that possess a recessive allele in the deleted region of the normal chromosome express the recessive trait. This phenomenon is known as:
   a. constitutional expression
   b. semisterility
   c. pseudodominance
   d. synteny
   e. conditional mutation

2. Which of the following chromosomal mutations has the least effect on the individual’s phenotype?
   a. deletions
   b. duplications
   c. inversions
   d. translocations
   e. aneuploidy

3. All of the following require the hybridization of probes to their target sequences except:
   a. minisatellites
   b. microsatellites
   c. RFLP
   d. FISH
   e. all of the above require the designated feature

4. Aflatoxin b1 causes which of the following:
   a. apurinic site formation
   b. preferential addition of adenine complementary to damaged site
   c. SOS repair activation
   d. transversions
   e. all of the above

5. The prokaryotic vector capable of incorporating the largest sized DNA insert:
   a. YAC
   b. PAC
   c. BAC
   d. cosmids
   e. plasmid

6. Which of the following is uniquely required to prepare cDNA libraries?
   a. reverse transcriptase
   b. restriction endonuclease
   c. beta galactosidase
   d. DNA ligase
   e. Taq polymerase

7. Which of the following pairs of terms describes the difficulties associated with the preparation of minisatellites and microsatellites, respectively?
   a. probe, restriction endonuclease
   b. probe, PCR primer
c. PCR primer, probe
d. restriction endonuclease, probe
e. restriction endonuclease, PCR primers

8. Given the following Sanger sequence, determine the template strand in a 5' to 3' direction:

```
A     G     C     T
--    --    --    --
--    --    --    --
--    --    --    --
--    --    --    --
```

a. AACCTTCGA  
b. TCGAAGGTT  
c. TTGGAAGCT  
d. AGCTTCCAA  
e. none of the above

9. All of the following would be found in a cDNA library except:
a. poly a tail  
b. exons  
c. start codon  
d. regulatory sequences  
e. all of the above

10. What is the probability of finding a six base sequence assuming the distribution of DNA bases is random?
a. 1/256  
b. 1/65536  
c. 1/1024  
d. 1/4096  
e. none of the above

11. STS mapping is a procedure used to accomplish which of the following?
a. generate molecular based recombination frequencies  
b. generate a set of overlapping clones  
c. isolate appropriate PCR primers for microsatellites  
d. produce Southern blots of a set of BAC clones  
e. differentiate between bands of similar mobility patterns on the Sanger sequence

12. A probe was found to hybridize to a 20 base sequence which includes the ECORI site. A southern blot analysis of a patient affected with a rare autosomal recessive condition revealed two bands. A couple with a shared family history of the same condition both show 3 bands respectively. What is the probability of this couple conceiving a normal child?
a. 0  
b. ½  
c. 2/3  
d. ¾  
e. ¼

12. Which of the following is the template for reverse transcriptase?
a. cDNA  
b. mRNA  
c. DNA  
d. protein  
e. rRNA

13. Which of the following techniques creates physical maps by relying on shared mobility patterns of restriction digestions of a set of clones?
a. southern blot  
b. STS  
c. FISH  
d. clone fingerprinting  
e. minisatellite analysis

14. Assuming that the sequence distribution of DNA nucleotides is random, what is the expected frequency of a particular dinucleotide sequence?
a. ¼  
b. 1/8  
c. 1/16
15. Which of the following dinucleotide sequences displays a frequency less than expected if the distribution of DNA bases is assumed to be random?
   a. A-T
   b. C-T
   c. C-A
   d. G-C
   e. G_A

16. Develop a contig from the STS sites determined for the following 5 YAC clones:
A-1.2.7.8.11
B-9.12.13
C-3.7.11
D-5.9.10.13
E-2.4.6.8.10

a. ABCDE
b. BACDE
c. CAEBD
d. BDEAC
e. CABDE

17. Which of the following is used to reform phosphodiester linkages between adjacent nucleotide strands?
   a. TAQ polymerase
   b. ligase
   c. exonuclease
   d. reverse transcriptase
   e. beta galactosidase

18. The terms high stringency and low stringency determine which of the following?
   a. the strength of adhesion between the nitrocellulose blot and denaturing salt solution
   b. the best temperature to use during the annealing step of the PCR process
   c. the intensity of fluorescence produced during the FISH procedure
   d. the affinity of restriction endonucleases to their target sequences
   e. none of the above

Part II Essay Questions
Exam 2 Practice Genetics 03042012
1. State the mechanism of retrotransposon.
2. State a sequence likely to be recognized by a restriction enzyme.
3. Define the function of reverse transcriptase.
4. What is the problem associated with the expression of eukaryotic genes in prokaryotic cells and how is it solved?
5. State the order of the Southern blotting procedure and briefly describe each step.
6. List at least 3 differences between in the content of genomic and cDNA libraries.
7. What are DNA probes and how are they able to recognize their target sequences?
8. In what circumstance would using a YAC vector be appropriate?
9. Lower stringency conditions are used in the PCR process for what reason?
10. What are the functions of the ampicillin and tetracycline genes in the pBR322?
11. What are the functions of the ampicillin and lacZ genes in the pUC18 vector?
12. Describe the procedure of gel electrophoresis.
13. Describe the components of gene cloning.
14. Describe the mechanism of base tautomerization. In a G-C base pair, if the G were to temporarily tautomerize to its rare form, after 2 rounds of replication, what net mutant base pair would be produced.
15. If all the bases in a sequence of TCGATAc were to tautomerize to their rare form, the antiparallel complementary sequence would be:
16. Cytosine can be deaminated to _____, which is then removed to form an _______ site. 5-bromouracil is a base analog of ____, its tautomeric form base pairs with ___ causing _____ mutations.
17. _____ distort DNA to induce single nucleotide pair insertions and deletions. Pyrimidine dimers are caused by________. What property of the genetic code permits silent mutations?
9. Consider the following template strand sequence of DNA with select base positions in bold:
   5' CCAGTATGGCAT3'
   The deletion of which of these selected bases would be least detrimental to the protein coded by the sequence?
10. What type of point mutation causes the early termination of translation?
11. Consider the following pair of wild-type and mutant template strand sequences.
w+:  5' CCAGTATGGCAT3'

15. M: 5’CCAGTACTGGCAT
Write the amino acid sequences coded by both strands.
12. What is the proofreading capacity of DNA polymerase III?
13. Consider the deaminated product of cytosine. State the correct sequence of enzymes involved in its repair.
14. Determining the incorrect strand in postreplication mismatch repair depends upon:
15. What function do restriction enzymes perform in bacterial cells?
16. The restriction enzyme ECORI is probably isolated from which organism?
17. What is the purpose of reverse transcriptase in retroviruses?
18. Reverse transcriptase synthesizes a DNA copy of the using a poly __ primer.
19. The effectiveness of the Southern blotting procedure depends on:
20. What component of the Southern blotting procedure acts as the substrate that the DNA fragments firmly bind to?
21. The binding of the probe to their complementary DNA sequences is readily detected by_________. Polymerase chain reaction requires special DNA polymerase characterized as being___________________
22. Regarding the pBR322 vector, the colonies containing the desired recombinant DNA will exhibit what property? What is the purpose of tetracycline in the PBR322 vector? What is utilized in preparing recombinant puc18 vectors?
23. Centromeres and telomeres are characteristic of which type of vector?
24. Differences in DNA fragment lengths produced by the presence or absence of the cleavage sites in DNA molecules are known as:
25. Two prospective parents are heterozygous for a recessive allele for cystic fibrosis(autosomal recessive disorder) and heterozygous for a RFLP. What is the probability of this couple having a child with the disorder?
26. Define the following terms: nondisjunction, Barr body, dosage compensation.
27. Devise a method of nondisjunction that would give rise to Klinefelter and Turner syndrome offspring following fertilization by a normal male gamete.
28. Indicate the expected number of Barr bodies in interphase cells of the following individuals: Klinefelter syndrome, Turner syndrome, and karyotypes 47XYY, 47XXX and 48XXXX.
29. The primrose, Primula kewensis, has 36 chromosomes that are similar in appearance to the chromosomes in two related species Primula floribunda (2n=18) and Primula verticillata (2n=18). How could P. kewensis arise from those species? How would you describe this species in genetic terms.
30. Varieties of chrysanthemums are known that contain 18, 36, 54, 72 and 90 chromosomes, where these are all multiples of a basic set of 9 chromosomes. How would you describe these varieties genetically? A variety with 27 chromosomes was discovered, but was found to be sterile why?
31. Determine the sequence of the template strand from the following Sanger sequence:

40. The segment of DNA shown below has restriction sites I and II, which create restriction fragments a, b, and c. Draw a diagram of the gel electrophoretogram representing the separation and identity of these fragments:

41. What purpose is served by the modification through methylation of bases within restriction sites for bacterial cells? What is the first enzyme used in the production of cDNA? Describe the DNA polymerase used in the PCR process?
42. Describe at least 2 limitations of CDNA libraries. If the first three nucleotides in a six nucleotide restriction site are CTG, what would the next 3 nucleotides most likely be?
43. As far as growth is concerned, a triploid is normal because: _______. One reason why polyploidy in animals is rare: _______. Commercial bananas are _______ examples of commercially important crops.

44. Describe the two causes of Down syndrome.

45. Draw a restriction map for the following restriction enzyme experiment that was performed on a 2.2 KB DNA molecule using enzymes A and B. Enzyme A produced 1.8 and 0.4 KB bands, Enzyme B produced 1.5 and 0.7 KB bands, both Enzyme A and Enzyme B produced 1.5, 0.4, and 0.3 KB bands.

7-18 11 GENETICS 3315 PRACTICE B FOR EXAM 2 SYED ABBAS

2. State the correct relative contig order for the YAC clones A – E using the STS data below.

<table>
<thead>
<tr>
<th>STS</th>
<th>YAC 1</th>
<th>YAC 2</th>
<th>YAC 3</th>
<th>YAC 4</th>
<th>YAC 5</th>
<th>YAC 6</th>
<th>YAC 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>+</td>
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<td>+</td>
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<td>C</td>
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<td>+</td>
</tr>
</tbody>
</table>

3. People with the chromosomal constitution 47, XXY are phenotypically males. A normal woman whose father had hemophilia (an X-linked recessive trait) mates with a normal man and produces an XXY son who also has hemophilia. What kind of nondisjunction can explain this result?

4. Down syndrome has two causes. Identify and explain.

5. The molecular basis of fragile X syndrome:

6. How many Barr bodies in an 49, XXXXX individual?

7. 45, XXY. This condition is classified as:

8. 45, X. classified as what type of aneuploidy?

9. Relative lengths of chromosomal arms do not change in paracentric inversions. Why?

10. Semisterility and cross shaped structures are characteristic of:

11. _______ cleave DNA molecules at specific sequences regardless of the source of the species.

12. Sticky ends are useful for what reason?

13. Gel electrophoresis separates DNA molecules on the basis of: _______

14. Identify the 4 steps in the Southern blotting procedure.

15. How is DNA denatured for the PCR process?

16. Silent mutations are the result of which property of the genetic code?

17. What is the difference between germline and somatic mutations?

18. Which of the following mutagens causes the formation of apurinic sites? A. UV radiation  B. aflatoxin B1  C. acridine orange  D. 5-


20. The following mechanisms of transposition may result in a net increase in genome size: a. retrotransposons b. replicative c. conservative d. a and b  e. b and c

21. SINES are also considered pseudogenes because: a. sines possess all of the genetic information necessary for transposition b. sines are sequences of mRNA that are translated to produce translational repressors c. sines do not possess the gene reverse transcriptase and must rely on autonomous transposons for duplication d. incorrect, since sines are not considered pseudogenes e. a and b

22. Consider four different kinds of human libraries: a genomic library, a brain cDNA library, a liver cDNA library. Assuming inserts of approximately equal size, which would contain the greatest number of different clones?

23. DNA copied from RNA by reverse transcriptase is referred to as: _______

24. Bacteria shield their DNA from digestion by their own restriction enzyme by what chemical modification?

25. It is inefficient to look for protein coding exons in genomic libraries because:

26. Inactive copies of protein coding genes that arise by retrotransposons:

27. Deamination of cytosine yields ________, and deamination of 5-

28. Deamination of cytosine may alter a C*G base pair to a _____ base pair which would be characterized as a ________ mutation.

29. Thymine dimers are caused by _______

30. The oxidized product of guanine pairs with _______ to create a _______ mutation that changes a G*C base pair to a _______ base pair.

31. The proofreading capacity of DNA polymerase is imparted by its _______ activity.

32. Any errors in DNA replication are often repaired after DNA replication by a methyl directed selection system. Identify.

33. 5-bromouracil is a base analog of _______. In its normal form, 5-bu pairs with _______ while in its rare form, it pairs with _______.

34. 5-bromouracil and 2-aminopurine are examples of _______, and when they undergo _______ to their rare forms, they cause _______ mutations.

35. Identify the mutagen that acts as a base pair to cause additions or deletions.

36. _______ are roughly the same size and the same shape as a nitrogenous base-pair and can cause indel mutations.

37. Order the following events correctly in base excision repair: 1. DNA ligase  2. DNA exonuclease  3. DNA polymerase  4. AP endonuclease  5. DNA uracil glycosylase

38. Mismatch repair relies upon?

39. A distinctive feature of the SOS repair system:

40. Identify whether each of the following missense mutations is the result of a transition or transversion. (Assume that only a single base pair substitution occurred) A. Ile to Thr  B. Ser to Arg  C. Phe to Leu  D. Cys to Trp  e. His to Gln
1. What is the function of restriction endonucleases?

2. What is the function of reverse transcriptase?

3. Indicate what type of chromosomal structural abnormality is characterized by each of the following: a. new arm ratios  b. loops  c. dicentric bridge  d. cross shaped structure  e. acentric fragment

4. What is the relationship between the position of an indel mutation and the severity of its effect?

5. What is the function of gel electrophoresis?

6. How is the difficulty of expressing eukaryotic genes in prokaryotic cells solved?

7. State a sequence that would likely be recognized by a restriction enzyme?

8. What is a vector?

9. Why is the SOS repair system considered problematic?

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36. Inactive copies of protein-coding genes that arise by retrotransposition are referred to as:

   Genetics 3315
   Supplemental Instruction
   Practice Test 1 for Exam 2

1. Which of the following lesions is created by ultraviolet radiation?
   a. transversions
   b. apurinic sites
   c. apyrimidinic sites
   d. pyrimidine dimers
   e. oxidative damage

2. The deamination of cytosine yields:
   a. adenine
   b. thymine
   c. uracil
   d. guanine
   e. 5-methylcytosine

3. The deamination of 5-methylcytosine yields:
   a. adenine
   b. thymine
   c. uracil
   d. guanine
   e. 5-methylcytosine

4. The deamination of 5-methylcytosine is more detrimental to a cell than the deamination of cytosine because:
a. the deaminated product of 5-methylcytosine yields uracil which cannot be repaired
b. the deaminated product of 5-methylcytosine yields apurinic sites
c. the deaminated product of 5-methylcytosine yields apyrimidinic sites
d. the deaminated product of 5-methylcytosine yields thymine which cannot be repaired
e. the deaminated product of 5-methylcytosine yields guanine which causes mismatched pairing

5. 5-Bromouracil is the base analog of ______________ and in its rare form, pairs with ________________.
   a. adenine, guanine
   b. thymine, cytosine
   c. adenine, thymine
d. thymine, guanine
e. none of the above

6. 2-Aminopurine is the base analog of ______________ and in its rare form, pairs with ________________.
   a. adenine, guanine
   b. thymine, cytosine
   c. adenine, thymine
d. thymine, guanine
e. none of the above

7. 5-Bromouracil is the base analog of ______________ and in its common form, pairs with ________________.
   a. adenine, guanine
   b. thymine, cytosine
   c. adenine, thymine
d. thymine, guanine
e. none of the above

8. 2-Aminopurine is the base analog of ______________ and in its common form, pairs with ________________.
   a. adenine, guanine
   b. thymine, cytosine
   c. adenine, thymine
d. thymine, guanine
e. none of the above

9. Which of the following is true regarding indel mutations?
a. They cause frameshift mutations at the level of the polypeptide.
b. They may cause premature stop codons to appear in the transcript.
c. They are less harmful if they occur in multiples of three nucleotides.
d. Intercalating agents are mutagens that cause indel mutations.
e. all of the above

10. How does mismatch repair occur?
a. Mismatch repair relies on blue wavelength of light to cause the appropriate repair.
b. Mismatch repair relies on the difference in methylation between the parental and daughter strands to effect the repair.
c. Mismatch repair uses restriction endonucleases to remove a small segment of the damaged DNA.
d. Mismatch repair relies on alkyltransferases to repair lesions.
e. none of the above

11. Compounds such as ethylmethanesulfonate and nitrosoguanidine are examples of:
a. intercalating agents
b. base analogs
c. alkylating agents
d. oxidizing reagents
e. fungal toxins

12. Compounds such as acridine orange and proflavin are examples of:
a. intercalating agents
b. base analogs
c. alkylating agents
d. oxidizing reagents
e. fungal toxins

13. Aflatoxin B1 causes which of the following point mutations?
a. transversions
b. transitions
c. apyrimidinic sites
d. alkylated nitrogenous bases
e. oxidative damage

14. Consider the following pairs of template strands:
Wildtype: 5' ATCGGCTCTTTATGATAGACGCTTTATTAG 3'
Mutant: 5' ATCGGCTCTTTTAGATAGACGCTTTATTAG 3'
What type of mutation has occurred?

a. transition
b. transversion
c. addition
d. deletion
e. frameshift

15. In regards to question 14, how would this mutation manifest itself at the level of the polypeptide?

a. synonymous
b. conservative missense
c. nonconservative missense
d. frameshift
e. none of the above

16. Consider the following pairs of template strands:
Wildtype: 5' ATCGGCTCTTTATGATAGACGCTTTATTAG 3'
Mutant: 5' ATCGGCTCTTTTAGATAGACGCTTTATTAG 3'
What type of mutation has occurred?

a. transition
b. transversion
c. addition
d. deletion
e. frameshift

17. In regards to question 16, how would this mutation manifest itself at the level of the polypeptide?

a. synonymous
b. conservative missense
c. nonconservative missense
d. frameshift
e. none of the above

18. Adenine, in its common form, pairs with ____________, while in its rare form, would pair with ________________.

a. adenine, guanine
b. thymine, cytosine
c. adenine, thymine
d. thymine, guanine
e. none of the above

19. Thymine, in its common form, pairs with ____________, while in its rare form, would pair with _____________.
a. adenine, guanine
b. thymine, cytosine
c. adenine, thymine
d. thymine, guanine
e. none of the above

20. Guanine, in its common form, pairs with ____________, while in its rare form, would pair with _____________.
a. adenine, guanine
b. thymine, cytosine
c. adenine, thymine
d. thymine, guanine
e. none of the above

21. Cytosine, in its common form, pairs with ____________, while in its rare form, would pair with _____________.
a. adenine, guanine
b. thymine, cytosine
c. adenine, thymine
d. thymine, guanine
e. none of the above

22. The effects of compounds such as nitrosoguanidine would be reversed by:
a. photolyase
b. SOS repair
c. recombinational repair
d. alkyltransferase
e. mismatch repair

Exam 2 Practice 2 06232012
1. What compound plays an important role in the Sanger sequencing method?
A. deoxyribonucleoside triphosphate
B. deoxyribonucleoside diphosphate
C. deoxyribonucleoside monophosphate
D. dideoxynucleoside triphosphate
E. ribonucleoside triphosphate

2. All of the following statements regarding open reading frames are true except:
A. ORF’s represent potential protein coding genes within the genome
B. ORF’s begin with the sequence AUG in DNA
C. ORF’s conclude with the stop codon
D. ORF’s can be found in both strands of the DNA
E. all of the above are true

3. How many ways can a double stranded DNA sequence be read when looking for open reading frames?
A. 2
B. 3
C. 4
D. 6
E. 9

4. Consider the following Sanger sequence electropherogram:

```
A T G C
-
-
-
-
-
-
-
-
```

What is the sequence of the template strand?

5. A 3.1 kb linear fragment of DNA was digested with PSTI and produced a 2.0 kb fragment and a 1.1 kb fragment. When the same 3.1 kb fragment was cut with HindIII, it yielded a 1.5 kb fragment, a 1.3 kb fragment and a 0.3 kb fragment. When the 3.1 kb molecule was cut with a mixture of the two enzymes, fragments of 1.5, 0.8, 0.5 and 0.3 kb resulted. Draw a restriction map of the original 3.1 kb fragment.

6. What is a probe?

7. Which of the following is not involved in the Southern blotting procedure?
A. gel electrophoresis
B. nitrocellulose filter
C. autoradiogram
D. DNA polymerase
E. all of the above are involved

8. Which of the following is a key characteristic of the PCR process?
A. probe that is radioactively labeled
B. Taq polymerase
C. gel electrophoresis
D. autoradiogram
E. dideoxyribonucleoside triphosphate

9. Which of the following is true regarding restriction enzymes?
A. defense mechanism against foreign DNA
B. classified as endonucleases
C. recognize palindromic sequences
D. may create sticky ended fragments
E. all of the above

10. Transposition that occurs through an RNA intermediate:
A. replicative transposition
B. conservative transposition
C. duplicative transposition
D. retrotransposition  
E. asymmetric transposition

11. One of the major disadvantages of using clone fingerprints to establish physical maps is or are:
   a. clone fingerprints use sequence tagged sites  
   b. two bands at the same relative position may not possess the same nucleotide sequence  
   c. clone fingerprints use X-rays to fragment chromosomes  
   d. clone fingerprinting uses PCR to amplify the fragments  
   e. all of the above

12. Microsatellites:
   a. dinucleotide repeats  
   b. utilize PCR to amplify appropriate region  
   c. finding primers for the PCR process may be difficult  
   d. developing the probe is relatively easy  
   e. all of the above

13. The restriction site PSTI was found to be linked to the normal allele for an autosomal recessive condition. The mutant allele has a mutation at the expected restriction site. A prospective couple displayed three and two bands respectively in the RFLP analysis that was completed. What is the probability of this couple having a child with the condition?
   a. 0  
   b. 1  
   c. 1/2  
   d. 1/4  
   e. none of the above

14. Presence or absence of restriction sites leads to molecularly defined alleles.
   A. microsatellites  
   B. minisatellites  
   C. PCR  
   D. RFLP  
   E. cDNA

15. FISH. Identify the false statement.
   A. chromosomes are fixed to a glass slide  
   B. fluorescently labeled probes  
   C. restriction enzyme digestion  
   D. denaturation of chromosomes  
   E. all of the above

16. The template for reverse transcriptase:
   A. DNA  
   B. protein  
   C. cDNA  
   D. mRNA  
   E. tRNA

17. Denaturation in PCR is performed by:
   a. helicase  
   b. Taq polymerase  
   c. thermal energy  
   d. RNA primers  
   e. RNA polymerase

18. *Thermus aquaticus*:
   a. PCR  
   b. Sanger sequencing  
   c. cDNA  
   d. Southern blot  
   e. Northern blot

19. PUC18 – Transformation of cells with recombinant plasmid:
   a. blue colonies  
   b. white colonies  
   c. growth on ampicillin but not tetracycline  
   d. growth on tetracycline but not ampicillin  
   e. growth on both ampicillin and tetracycline

20. pBR322 - Transformation of cells with recombinant plasmid:
   a. blue colonies
b. white colonies
c. growth on ampicillin but not tetracycline
d. growth on tetracycline but not ampicillin
e. growth on both ampicillin and tetracycline

21. PUC18 – Transformation of cells with no insertion:
a. blue colonies
b. white colonies
c. growth on ampicillin but not tetracycline
d. growth on tetracycline but not ampicillin
e. growth on both ampicillin and tetracycline

22. cDNA libraries. Identify the exception(s)
a. promoter
b. exon
c. poly A tail
d. intron
e. regulatory sequences

23. If a thermal cycle takes 5 minutes, starting with one DNA molecule, how many would be produced after 30 minutes?
a. 4
b. 8
c. 16
d. 64
e. none of the above

24. Largest inserts can be incorporated:
a. BAC
b. YAC
c. plasmid
d. cosmid
e. phage

25. Contain features of eukaryotic chromosomes:
a. BAC
b. YAC
c. plasmid
d. cosmid
e. phage

26. If the first three nucleotides in a six nucleotide restriction site are CTG, what would the next 3 nucleotides be?
a. AGG
b. GTC
c. CTG
d. CAG
e. GAC

27. Hybridization of nucleic acids not involved:
a. PCR
b. gel electrophoresis
c. Southern blotting
d. microsatellites
e. DNA chips

28. First enzyme in production of cDNA:
a. restriction enzyme
b. reverse transcriptase
c. ligase
d. Taq polymerase
e. RNA polymerase

29. Heat stable enzyme in PCR:
a. restriction enzyme
b. reverse transcriptase
c. ligase
d. Taq polymerase
e. RNA polymerase

30. Seals phosphodiester linkages
a. restriction enzyme
b. reverse transcriptase

c. ligase
d. Taq polymerase
e. RNA polymerase

31. Nitrocellulose filter participates in:
a. DNA sequencing
b. gel electrophoresis
c. Southern blotting
d. DNA microarray
e. cDNA preparation

32. The problem of expressing eukaryotic genes in prokaryotic cells:
a. insufficient amino acids
b. lack of translational capability
c. lack of post-transcriptional processing
d. presence of allosteric inhibitors
e. presence of exo-ribonucleases

33. Genomic libraries:
a. identical for all cell types
b. contain promoters
c. contain coding sequences
d. contain regulatory sequences
e. all of the above

34. Sticky ended fragments are produced by:
a. restriction exonucleases
b. restriction endonucleases
c. ligases
d. reverse transcriptase
e. Taq polymerase

35. How do bacterial cells protect against the action of their own restriction enzymes?
a. ubiquitination
b. cleaving of cellular DNA
c. phosphorylation
d. methylation
e. ligation of viral DNA

36. Which of the following would not be an appropriate probe to use for locating a gene on a chromosome?
a. cDNA made from the mRNA transcribed from the gene
b. a portion of the amino acid sequence of the protein
c. mRNA transcribed from the gene
d. a piece of the restriction fragment on which the gene is located
e. a sequence of nucleotide bases determined from the genetic code needed to produce a known sequence of amino acids found in the protein product of the gene

37. A genetic counselor is examining a family in which both parents are known to be carriers for a CFTR mutation, which causes cystic fibrosis (autosomal recessive). Their first child was born with the disease, and the parents have come to the counselor to assess whether the new fetus inside the mother is also diseased, is a carrier or is completely wild type at the CF locus. DNA samples from each family member and the fetus are tested by PCR and gel electrophoresis for a microsatellite marker within one of the CFTR gene’s introns. The following results are obtained:

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Which microsatellite markers are linked to the disease causing allele?
a. 1 and 2
b. 2 and 3
c. 3 and 4
d. 4 and 2
e. none of the above

38. What is the difference between somatic mutations and germline mutations?
a. somatic mutations only affect the gametes
b. germline mutations affect the progeny of the mutant
c. somatic mutations affect the F2 generation but not the F1
d. somatic mutations affect both the F1 and F2 generations
e. germline mutations affect the body tissues of the mutant individual but not its descendents

39. Which of the following is a transition?
   a. A*T to G*C
   b. T*A to A*T
   c. C*G to G*C
   d. A*T to C*G
   e. T*A to G*C

40. Which of the following is a transversion?
   a. A*T to G*C
   b. C*G to T*A
   c. T*A to C*G
   d. G*C to T*A
   e. G*C to A*T

41. Which of the following would be caused by aflatoxin B1?
   a. A*T to G*C
   b. C*G to T*A
   c. T*A to C*G
   d. G*C to T*A
   e. G*C to A*T

42. Which of the following could be caused by a transversion (Assume that only one base is substituted)?
   a. Phe to Leu
   b. Thr to Ala
   c. Tyr to Cys
   d. His to Arg
   e. Phe to Ser

43. Silent mutations occur due to what property of the genetic code?
   a. nonlinear
   b. commaless
   c. redundant
   d. unambiguous
   e. universal

44. Frameshift mutations occur due to what property of the genetic code?
   a. nonlinear
   b. commaless
   c. redundant
   d. unambiguous
   e. universal

45. A mutation in an intron resulted in a nonfunctional protein. Choose the best explanation possible.
   a. Introns are the binding sites for ribosomes.
   b. Introns are the binding sites for RNA polymerases.
   c. Introns contain splicing sites important for proper RNA processing.
   d. Introns code for amino acid sequences, and are interspersed amongst noncoding exons.
   e. Introns are important for translation termination.

   a. Promoters are the binding sites of RNA polymerase.
   b. Promoters are the binding sites of DNA polymerase.
   c. Promoters indicate the location of the 5’ cap.
   d. Promoters are important in translation initiation, since they contain the Shine-Delgarno sequences.
   e. Promoters participate in exon splicing.

47. Which of the following indel mutations would be most detrimental to a gene?
   a. The addition of 1 base immediately downstream of the stop codon.
   b. The deletion of 1 base immediately downstream of the stop codon.
   c. The addition of 2 bases immediately downstream of the start codon.
   d. The addition of 3 bases immediately downstream of the start codon.
   e. The addition of 3 bases immediately downstream of the stop codon.

48. Which of the following point mutations would be least harmful to a gene?
   a. 5' end of intron
   b. 3' end of intron
   c. middle of intron
   d. promoter
49. Which of the following indel mutations would be least harmful to a gene?
   a. addition of 3 bases
   b. deletion of 2 bases
   c. addition of 1 base
   d. deletion of 1 bases
   e. addition of 2 bases

50. If all of the bases in a sequence of TCGATAC were to tautomerize to their rare form, the complementary sequence would be:
   A. CATGATC
   B. GATCGCA
   C. ATCGATC
   D. TCGATAC
   E. ATGCTAC

51. Cytosine can be deaminated to ______, which is then removed to form an ______ site.
   A. adenine, apyrimidinic
   B. 2-aminocytosine, apurinic
   C. uracil, apurinic
   D. guanine, apurinic
   E. thymine, apyrimidinic

52. In a T.A base pair, if the T were to temporarily tautomerize to its rare form, after 2 rounds of replication, a mutant ____ base pair would be produced.
   A. G.C
   B. A.T
   C. C.G
   D. T.A
   E. U.A

53. A base substitution can have all of the following effects except one. Identify the exception.
   a. no effect on protein function
   b. conservative missense mutation
   c. nonconservative missense mutation
   d. synonymous mutation
   e. frameshift mutation

54. What is the effect of a nonsense mutation in a gene?
   A) It changes an amino acid in the encoded protein.
   B) It has no effect on the amino acid sequence of the encoded protein.
   C) It introduces a stop codon into the mRNA.
   D) It alters the reading frame of the mRNA.
   E) It prevents introns from being expressed.

55. A frameshift mutation could result from
   A) a base insertion only.
   B) a base deletion only.
   C) a base substitution only.
   D) deletion of three consecutive bases.
   E) either an insertion or a deletion of a base.

56. Which of the following DNA mutations is the most likely to be damaging to the protein it specifies?
   A) a base-pair deletion
   B) a codon substitution
   C) a substitution in the last base of a codon
   D) a codon deletion
   E) a point mutation

57. Which point mutation would be most likely to have a destructive effect on the functioning of a protein?
   A) a base substitution
   B) a base deletion near the start of a gene
   C) a base deletion near the end of the coding sequence, but not in the terminator codon
   D) deletion of three bases near the start of the coding sequence, but not in the initiator codon
   E) a base insertion near the end of the coding sequence, but not in the terminator codon

58. Base-pair substitutions involving the third base of a codon are unlikely to result in an error in the polypeptide. This is because
   A) substitutions are corrected before transcription begins.
   B) substitutions are restricted to introns.
   C) the base-pairing rules are less strict for the third base of codons and anticodons.
   D) a signal-recognition particle corrects coding errors.
E) transcribed errors attract snRNPs, which then stimulate splicing and correction.

59. Which of the following mutations would be most likely to have a harmful effect on an organism?
A) a base-pair substitution
B) a deletion of three bases near the middle of a gene
C) a single nucleotide deletion in the middle of an intron
D) a single nucleotide deletion near the end of the coding sequence
E) a single nucleotide insertion downstream of, and close to, the start of the coding sequence

60. These portions of the genome are nonfunctional nucleotide sequences that are quite similar to the functional genes.
A. transposons
B. simple sequence DNA
C. multigene family
D. methylated DNA
E. pseudogenes

61. What do pseudogenes and introns have in common?
A) They code for RNA end products, rather than proteins.
B) They both contain uracil.
C) They have multiple promoter sites.
D) They both code for histones.
E) They are not expressed, nor do they code for functional proteins.

62. Which of the following techniques allows the amplification of a small quantity of DNA without the use of living cells?
A) RFLP analysis
B) polymerase chain reaction
C) electroporation
D) gel electrophoresis
E) Southern hybridization

63. Somatic cells from Klinefelter males contain how many Barr bodies?
A. 4
B. 3
C. 2
D. 1
E. 0

64. How is the calico coat pattern in cats explained?
A. Temperature variations during embryonic development.
B. Random inactivation of X chromosomes during embryonic development
C. Sex linked activation of differential gene expression
D. Autosomal recombination
E. Epigenetic repression

65. The synapsis of chromosomes that contain reciprocal translocations is unique compared to other chromosomal abnormalities because
A. Proper crossing over requires the formation of loops
B. They involve the formation of inversion loops
C. Synapsis of homologous chromosomes occurs at the telomeres instead of the centromeres
D. The translocations are between nonhomologous chromosomes
E. Synapsis cannot occur, therefore these meiotic products will be lost.

66. How is aneuploidy different from polyploidy?
   a. aneuploidy involves multiple sets of chromosomes
   b. aneuploidy involves a total number of chromosomes that is not an exact multiple of the basic set
   c. aneuploidy leads to polyploidy
   d. aneuploidy involves treatment of human gametes with colchicine
   e. aneuploidy is identical to aberrant euploidy

67. Triploids are generated from the cross between:
   a. 2 tetraploid organisms
   b. 2 hexaploid organisms
   c. a tetraploid and a diploid organism
   d. a triploid and a hexaploid
   e. two triploids

68. How many chromosomes would be present in the gamete produced by a plant, that is tetraploid with 48 chromosomes in its somatic cells?
69. Cri du chat syndrome is caused by a(n):
   a. deletion
   b. duplication
   c. nonreciprocal translocation
   d. reciprocal translocation
   e. inversion

70. Psuedodominance is a phenomenon associated with which of the following chromosomal structural abnormalities?
   a. deletion
   b. duplication
   c. nonreciprocal translocation
   d. reciprocal translocation
   e. inversion

71. Commercially grown bread wheat is characterized as 6n=42. Its gametes would be:
   a. n=42
   b. n=84
   c. n=7
   d. n=21
   e. none of the above

72. Polyploidy in humans:
   a. results in larger sized progeny
   b. results in balanced gametes
   c. is always lethal
   d. survive beyond gestation
   e. produces diploid gametes

73. Triploids:
   a. are usually sterile
   b. are propagated through asexual reproduction
   c. can be generated from a cross between a tetraploid and diploid organism
   d. produce unbalanced gametes
   e. all of the above

74. Monoploids are usually sterile because:
   a. each chromosome has only a single homolog to pair with resulting in unbalanced gametes
   b. each chromosome has no homolog to pair with resulting in unbalanced gametes
   c. each chromosome has two homologs to pair with resulting in unbalanced gametes
   d. are produced from the self fertilization of triploids
   e. all of the above may be a potential explanation

75. Human cells contain how many chromosomes?
   a. 48
   b. 23
   c. 46
   d. 92
   e. none of the above

76. Polyploids created by chromosome duplication within a species are called:
   a. aneuploids
   b. autopolyploids
   c. allopolyploids
   d. triploids
   e. amphidiploids

77. The karyotype 47, XXY is also known as:
   a. Down syndrome
   b. Klinefelter syndrome
c. Turner syndrome  
d. Patau syndrome  
e. Edwards syndrome

78. A ______ inversion is when the centromere is included in the inversion of the chromosome segment.
   a. paracentric  
b. reciprocal  
c. pericentric  
d. telocentric  
e. metacentric

79. A reciprocal translocation is when:
   a. homologous chromosomes exchange DNA segments with no net loss of genetic material  
b. nonhomologous chromosomes exchange DNA segments with no net loss of genetic material  
c. homologous chromosomes exchange DNA segments with a net loss of genetic material  
d. nonhomologous chromosomes exchange DNA segments with a net loss of genetic material  
e. none of the above

80. When nonhomologous chromosomes fuse at their centromeres, we call this structure:
   a. reciprocal translocation  
b. Robertsonian translocation  
c. deletions  
d. duplications  
e. none of the above

81. ______ can occur in either the first or second meiotic division to produce abnormal gametes.
   a. segregation  
b. nonreciprocal translocation  
c. nondisjunction  
d. separation of homologous chromosomes  
e. independent assortment

82. Transitions are base pair substitutions where:
   a. a guanine is replaced with a cytosine  
b. an adenine is replaced with a thymine  
c. a cytosine is replaced with a thymine  
d. a thymine is replaced with a guanine  
e. an adenine is replaced with a cytosine

83. Base-pair additions and deletions are collectively referred to as ______ due to their changes in base-pair triplets.
   a. null mutations  
b. silent mutations  
c. frameshift mutations  
d. missense mutations  
e. suppressor mutations

84. ______ are enzymes that make cuts at specific sites in DNA molecules. DNA fragments can be separated by gel electrophoresis and transferred to nylon membranes to produce _______.
   a. primases, Northern blots  
b. DNA polymerases, STS sites  
c. RNA polymerases, cDNA  
d. restriction endonucleases, Southern blots  
e. reverse transcriptases, Western blots

85. Huntington’s disease is caused by:
   a. unstable trinucleotide repeats  
b. deletions  
c. inversions that are paracentric  
d. inversions that are pericentric
e. syntenies

86. A _________ produces RNA molecules that are reverse-transcribed into DNA molecules.
   a. conservative transposons
   b. replicative transposons
   c. nonconservative transposons
   d. retrotransposons
   e. reverse transcriptase

87. Eukaryotic genomes contain transposable elements that depend on the reverse transcription of RNA into DNA. Scientists called these:
   a. conservative transposons
   b. replicative transposons
   c. nonconservative transposons
   d. retrotransposons
   e. reverse transcriptase

88. Which of the following chromosomal rearrangements would you expect to have the least phenotypic effect on the organism?
   a. paracentric inversions
   b. pericentric inversions
   c. deletions
   d. duplications
   e. translocations

89. A frameshift mutation could be caused by:
   a. deletion
   b. insertion
   c. retrotransposition
   d. errors in RNA splicing
   e. all of the above

90. Which of the following would be an example of a germline mutation?
   a. Exposure to excessive UV radiation causes changes in the DNA of a skin cell, leading to basal cell carcinoma (skin cancer).
   b. In a very early human embryo, a mistake in mitosis causes loss of a Y chromosome in one daughter cell. The resulting child is a fertile male who is chromosomally partially male (XY) and partially female with Turner's syndrome (XO).
   c. A man with normal chromosomes has a hip X-ray without a protective shield. Ten months later, his wife gives birth to a child with a chromosomal deletion.
   d. An embryo missing one copy of the third chromosome is miscarried very early in pregnancy.

91. Which of the following forms of DNA repair does NOT require DNA polymerase?
   a. direct DNA repair
   b. mismatch repair
   c. postreplication recombinational repair
   d. nucleotide excision repair
   e. base excision repair

92. How is mismatch repair able to determine the strand with the correct DNA sequence?
   a. methylation of parental strand
   b. methylation of daughter strand
   c. excision of homologous strand
   d. sequence complementarity
   e. none of the above

93. An individual heterozygous for a chromosomal structural abnormality has the following genotype:
   w+ : ABC.DEFGH
Which of the following would not be a meiotic product (assuming crossing over occurs between D and E)?

a. ABC.DEFGH  
b. abgfed.ch  
c. ABC.Defgba  
d. HGFEd.ch  
e. abc.defgh

94. Cross shaped structures are associated with:

a. deletions  
b. duplications  
c. paracentric inversions  
d. pericentric inversions  
e. reciprocal translocations

95. New arm ratios are characteristic of all of the following except:

a. deletions  
b. duplications  
c. paracentric inversions  
d. pericentric inversions  
e. reciprocal translocations

96. The two causes of Down syndrome:

a. inversions and deletions  
b. deletions and aneuploidy  
c. aneuploidy and translocations  
d. duplications and deletions  
e. reciprocal translocations and inversions

97. An individual whose karyotype shows 3 X chromosomes would possess how many Barr bodies in their somatic cells?

a. 0  
b. 1  
c. 2  
d. 3  
e. 4

98. Monosomy for X chromosome:

a. Klinefelter syndrome  
b. Turner syndrome  
c. Down syndrome  
d. Patau syndrome  
e. Edwards syndrome

99. Aneuploidy for the sex chromosomes is more common than aneuploidy for autosomal chromosomes. Which of the following is a potential explanation?

a. Deletion of the SRY gene  
b. Multiple copies of the X chromosomes lead to increased fecundity.  
c. X chromosomes have greater gene density.  
d. Gene dosage compensation made possible by Barr body formation.  
e. Extra autosomal chromosomes are deactivated.

100. An individual is known to have at least one X chromosome in their somatic cells, yet appears phenotypically female. Choose the best possible explanation(s).

I. Turner syndrome  
II. Deletion of SRY region on Y chromosome  
III. Nonfunctional androgen receptors in primordial gonadal tissue cells.

a. I,II,III  
b. I,II  
c. I, III  
d. III only  
e. none of the above

101. An amphidiploid produced from a cross between the following species: 2n_a = 24 and 2n_b = 18 would possess a total chromosomal number of?

a. 24  
b. 42  
c. 18  
d. 21  
e. none of the above

102. Cytosine is deaminated to ______________, and 5-methylcytosine is deaminated to __________.
103. CpG islands can be characterized by which of the following statements?
   a. participate in gene regulation
   b. tend to attract gene repression protein, resulting in the deactivation of nearby genes
   c. cytosine tends to be a target for methylation
   d. are an example of dinucleotide repeats
   e. all of the above

104. Tandemly repeated coding sequences are important since they:
   a. code for essential products
   b. allow for the amplification of the gene products
   c. examples include histones, rRNA, tRNA
   d. a and b
   e. all of the above

105. Five percent of all cases of Down syndrome is referred to as familial Down syndrome. This condition is caused by:
   a. transition
   b. transversion
   c. translocation
   d. deletion
   e. trisomy

106. Fragile X syndrome is caused by:
   a. trinucleotide repeats
   b. trisomy
   c. monosomy
   d. frameshift mutations
   e. deletions

107. Consider the following normal nonhomologous chromosomes:

   \[\text{N1: ABC.DEFGHIJ}\]
   \[\text{N2: KMNO.PQRSTUVWXYZ}\]

   If these normal chromosomes were to experience a reciprocal translocation between D-E and S-T regions, to produce translocated chromosomes, T1 and T2, which of the following statements is or are true?
   a. viable gametes will contain N1 and N2
   b. inviable gametes will contain N1 and T1
   c. viable gametes will contain T1 and T2
   d. inviable gametes will contain N2 and T2
   e. all of the above

108. DNA uracil glycosylase removes uracil that has been spontaneously produced from the deamination of:
   a. A
   b. G
   c. C
   d. T
   e. U

109. Which of the following dinucleotide sequences displays a frequency less than expected if the distribution of DNA bases is assumed to be random?
   a. A-T
   b. C-T
   c. C-A
   d. C-G
   e. G-A

110. Turner syndrome is produced by:
   a. point mutation
   b. nondisjunction of an autosomal chromosome
   c. nondisjunction of an X chromosome
   d. trisomy for the X chromosome
   e. transposition

111. The separation of thousands of differently sized DNA fragments is performed by:
   a. probe molecules
b. DNA ligase
c. DNA chips
d. gel electrophoresis
e. autoradiogram

112. PCR requires all of the following EXCEPT
a. DNA polymerase
b. DNA ligase
c. primers
d. deoxyribonucleoside triphosphates
e. all of the above are needed

113. If you start with one double-stranded DNA molecule and you perform 8 cycles of PCR, how many double-stranded copies of the DNA will you have?
   a. 2
   b. 12
   c. 24
   d. 32
   e. none of the above

114. RFLPs are separated by
   a. Western blot
   b. antibody recognition
   c. probe hybridization
d. gel electrophoresis
e. nitrocellulose blot

115. Arrange the following events in the proper sequence for gene cloning.
   1 = Incorporate gene into plasmid vector
   2 = Isolate DNA from organism containing gene of interest
   3 = Incorporate cloned gene into bacterial cells
   4 = Fragment DNA with restriction enzyme
   a. 1234
   b. 2314
c. 4123
d. 3124
e. none of the above

116. Which of the following point mutations would be most likely to affect protein function?
   a. TAA to TGA
   b. CAA to TAA
c. AGG to AG
   d. CTT to CTC
e. All of these are likely to affect protein function

117. Which type of transposable element is only found in eukaryotes (not prokaryotes)?
   a. DNA transposons
   b. replicative transposons
c. conservative transposons
d. retrotransposons
e. none of the answers above apply

118. Formation of what type of chemical bond is catalyzed by DNA ligase?
   a. hydrogen
   b. phosphodiester
c. ionic
d. peptide
e. glycosidic

119. Somatic cells from Klinefelter males contain how many Barr bodies?
   a. 4
   b. 3
c. 2
d. 1
e. 0

120. How many total chromosomes does an individual with Turner syndrome have?
121. All of the following are examples of trisomies except:
   a. Down syndrome
   b. Patau syndrome
   c. Edwards syndrome
   d. Turner syndrome
   e. all of the above are examples of trisomies

122. Consider the following normal nonhomologous chromosomes:
   I. N1 ABCD.EFG
   II. N2 hij.klmnop
   If these normal chromosomes were to undergo a reciprocal translocation to produce the following translocated chromosomes:
   III. T1 ABlk.jih
   IV. T2 GFE.DCmnop
   Which of the following meiotic products would be considered inviable?
   a. I, III
   b. II, III
   c. II, IV
   d. I, IV
   e. all of the above

123. An individual heterozygous for a chromosomal structural abnormality has the following genotypes:
   W+: ABC.DEFGHIJ
   M: abc.dihgfej
   Which of the following would be a potential occurrence during the course of meiosis (assume that crossing over occurs between g and h)?
   a. ABC.DEFGhid.cba
   b. JIHgfej
   c. ABC.DEF
   d. ABC.DEFGHIJ
   e. all of the above

124. A male with Klinefelter syndrome expresses the red green color blindness trait as his father did, and his mother was a carrier. Which of the following is a potential explanation?
   1. primary nondisjunction during paternal gametogenesis
   2. secondary nondisjunction during maternal gametogenesis
   3. primary nondisjunction during maternal gametogenesis
   4. secondary nondisjunction during paternal gametogenesis
   a. 2, 3
   b. 1, 4
   c. 1, 2, 4
   d. 1, 4
   e. none of the above

125. Aneuploidy for the autosomal chromosomes that survive until gestation include chromosomes 13, 18 and 21. These chromosomes are uniquely suited since:
   a. They contain the SRY gene which is redundant in the human genome.
   b. They are relatively large chromosomes.
   c. They contain relatively few genes.
   d. They usually experience Barr body inactivation.
   e. all of the above
A. 2. Five percent of all cases of Down syndrome are caused by:
B. 3. Only two trisomies survive until gestation. Indicate the chromosomes and names of the disorders.
C. 4. What is the function of ampicillin and tetracycline in the pBR322 vector?
D. 5. Consider the following diagram and state which pairs of chromosomes (from those labeled #1-#4) if they segregate together to opposite poles of the cell will produce viable gametes:

E. 6. Which of the following would be found in a genomic and cDNA library respectively? A. exons  b. introns  c. regulatory sequences  d. promoter  e. intergenic DNA

F. 7. Two methods of generating contigs for physical maps are used. Which of these 2 methods utilizes restriction fragment digestion of clones?

G. 8. Which of the following vectors incorporates the largest inserts? Which includes the pBR322 and pUC18 vectors? A. YAC  B. BAC  C. PAC

H. 9. Write a 4 base sequence likely to be recognized by a restriction enzyme.

I. 10. What function do restriction enzymes have in bacterial cells?

J. 11. What is the function of transposition used by retrotransposons.

K. 12. Why do Barr bodies exist?

L. 13. A sequence of bases AGCTA all tautomerized to their rare form. The complementary sequence would be:

M. 14. Evaluate the potential effects of a point mutation occurring in each of the following locations:  a. promoter  b. exon  c. 5' end of an intron  d. 3' end of an intron  e. middle of an intron  f. branch point of intron

N. 15. Evaluate the relative severity of each of the following indel mutations  A. 3 bases near the 5' end of a gene  B. deletion of 2 bases near the 3' end of a gene  C. addition of 1 base near the 5' end of a gene  D. deletion of 3 bases near the 3' end of a gene  E. deletion of 1 base near the 5' end of a gene

O. 16. Aflatoxing B1 leads to the following consequencies placed in the correct order: 1. Transversion 2. Insertion of adenine 3. SOS repair system 4. Apurinic site

7-17-11 GENETICS 3315 EXAM 2 PRACTICE SYED ABBAS

1. State a sequence that would likely be recognized by a restriction endonuclease.

2. Consider a primary nondisjunction in a male for the sex chromosomes. What phenotypes would be produced upon merger with a normal female?

3. Predict the meiotic products produced when crossing over occurs between b and c in an individual heterozygous for the following inversion: ABC.DEF/aed.cbf

4. New arm ratios or a difference in relative lengths of the 2 arms of a chromosome are a likely characteristic for which of the following chromosomal structural abnormalities. (Note: More than one answer may apply.) i. duplications ii. Deletions iii. Reciprocal translocations iv. Paracentric Inversions v. pericentric inversions

5. _________ percent of microsatellites are inherited from each parent.

6. LINES and SINES arise by what mechanism of transposition?

7. DNA polymerase performs its proofreading function with its:

8. Replica plating is used in the _________ plasmid to determine

9. CDNA is generated in order to solve what difficulty presented by prokaryotic cells?

10. Oxidative damage of guanine typically causes:

11. Aflatoxing B1 leads to the following consequences placed in the correct order: 1. Transversion 2. Insertion of adenine 3. SOS repair system 4. Apurinic site
12. Trinucleotide repeats are generated by:
13. 5-Bromouracil is a base analog of _______. In its rare form, 5-BU pairs with _______. The conversion of the common form of 5-BU to its rare form is explained by _______.
14. Spontaneous deamination of 5-methylcytosine is a mutational hotspot because:
15. Describe the mechanism of postreplication mismatch repair.
16. Thymine dimers are repaired by the enzyme ________, which is activated in certain frequencies of light.
17. Develop a physical map using the following clone fingerprint obtained for BAC clones A-D.

A   |   |   |   |   |
B   |   |   |   |   |
C   |   |   |   |   |
D   |   |   |   |   |

18. How do intercalating agents cause mutations?
19. Why is the poly T tail an effective primer for reverse transcriptase?
20. How many Barr bodies in a 48, XXXX individual?
21. Tetraploid cells may be produced experimentally from diploid cells by:
22. Economically important _______ plants include commercial bananas and seedless watermelons.
(23-27) For a species with a diploid number of 18, indicate how many chromosomes will be present in the somatic nuclei of individuals who are:
23. haploid
24. Triploid
25. Tetraploid
26. Trisomic
27. Monosomic
28. A human female with Turner’s syndrome also expresses the sex linked trait, as her father did. Which parent underwent nondisjunction during meiosis, giving rise to the gamete responsible for the syndrome?
29. Consider varieties of chrysanthemums in which the haploid chromosomal number is 9. What type of polyploidy is a variety with 72 chromosomes?
30. Dideoxynucleotides are utilized in which process?
31. Starting with a single DNA molecule, 5 rounds of PCR would yield how many DNA molecules?
32. Indicate whether each of the following missense mutations was caused by a transition or transversion, where Tyr is coded by UAU. A. Tyr to Asp B. Tyr to Asn C. Tyr to Ser D. Tyr to His E. Tyr to STOP
33. Sites of cytosine methylation are considered mutational hotspots. The mutations that result are usually:
34. Histone genes are found in tandemly repeated copies in the genome. Explain.
35. Describe what is occurring in the diagram below:

36. _______ mutations have no effect on the amino acid composition of an encoded polypeptide and are caused by the _______ property of the genetic code.
37. Each somatic cell of a mammalian female was found to have 3 Barr bodies. What is the genotype of the sex chromosomes in this female?
38. If the wildtype chromosome of an individual heterozygous is heterozygous for a deletion, contains the mutant recessive allele, what will be the effect? What is the phenomenon known as?
39. Synapsis of chromosomes in individuals heterozygous for deletions and duplications require the formation of:
40. The loss of the acentric fragment and breakage of the dicentric chromatid results in genetically unbalanced gametes. This is characteristic of:
41. Viable gametes, arising from a reciprocal translocation are produced by the _______ segregation pattern.
42. Cross shaped structures are a cytological feature of _______.

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Genetics 3315
Practice Test 2 for Exam 2

1. An individual with the genotype 45, X would be diagnosed with:
   a. Klinefelter’s syndrome
   b. Turner’s syndrome
   c. Patau’s syndrome
   d. Edwards syndrome
   e. Down syndrome

2. A trisomy of chromosome 13:
   a. Klinefelter’s syndrome
   b. Turner’s syndrome
   c. Patau’s syndrome
   d. Edwards syndrome
   e. Down syndrome
3. A trisomy of chromosome 18:
   a. Klinefelter's syndrome
   b. Turner's syndrome
   c. Patau's syndrome
   d. Edwards syndrome
   e. Down syndrome

4. An individual with the genotype 47, XXY would be diagnosed with:
   a. Klinefelter's syndrome
   b. Turner's syndrome
   c. Patau's syndrome
   d. Edwards syndrome
   e. Down syndrome

5. A trisomy of chromosome 21 causes:
   a. Klinefelter's syndrome
   b. Turner's syndrome
   c. Patau's syndrome
   d. Edwards syndrome
   e. Down syndrome

6. Associated with a direct correlation between maternal age and incidence level:
   a. Klinefelter's syndrome
   b. Turner's syndrome
   c. Patau's syndrome
   d. Edwards syndrome
   e. Down syndrome

7. How many Barr bodies would the cells of an individual with Klinefelter's syndrome have?
   a. 0
   b. 1
   c. 2
   d. 3
   e. 4

8. How many Barr bodies would the cells of an individual 47, XXX have?
   a. 0
   b. 1
   c. 2
   d. 3
   e. 4

9. The existence of Barr bodies is attributed to:
   a. the gene dosage difference between males and females
   b. the deactivation of the SRY gene
   c. a small deletion of the p arm of chromosome 5
   d. an aneuploidy of chromosome 22
   e. all of the above

10. Primary nondisjunction occurs during:
    a. mitosis
    b. meiosis I
    c. meiosis II
    d. S phase
    e. G1 phase

11. Secondary nondisjunction occurs during:
    a. mitosis
    b. meiosis I
    c. meiosis II
    d. S phase
    e. G1 phase

12. In primary nondisjunction:
    a. the homologous chromosomes fail to separate properly
    b. the sister chromatids fail to synapse properly
    c. the sister chromatids fail to segregate properly
    d. A + B
    e. A + B + C
13. Multiple units of which amino acid is involved in Huntington's disease:
   a. arginine
   b. lysine
   c. tryptophan
   d. glutamine
   e. glutamic acid

14. Which of the following would be a possible meiotic product if synapsis were to occur between the following wild type and mutant chromosomes:
   wild-type:  A B C . D E F
   mutant:     A d . c b e f
   (Assume crossing over occurs between genes b and c)
   a. A B C . D E F
   b. A d . c b e f
   c. A B c . d A
   d. F E D , C b e f
   e. all of the above

15. What type of chromosomal abnormality is seen above in question 14?
   a. paracentric inversion
   b. pericentric inversion
   c. reciprocal transversion
   d. reciprocal translocation
   e. deletion

16. How many bases downstream of the initiation codon would be a frameshift mutation be most harmful, given that the total length of the mRNA transcript is 10000 bases?
   a. 375 b
   b. 436 b
   c. 764 b
   d. 9734 b
   e. 9899 b

17. Which of the following is false regarding CpG islands?
   a. They are dinucleotide repeats, in which the C and G are on the same sugar phosphate backbone.
   b. They play an important role in gene regulation.
   c. The cytosine may be methylated.
   d. Methylated CpG islands tend to activate nearby genes.
   e. CpG islands are important in vertebrate gene regulation.

18. Which of the following is a feature of paracentric inversion?
   a. dicentric bridge
   b. acentric fragment
   c. inversion loop
   d. deletions
   e. all of the above

19. Which of the following is a cytological characteristic of reciprocal translocations?
   a. deletion loop
   b. inversion loop
   c. cross-shaped structure
   d. deletion of small arm of chromosome 5
   e. none of the above

20. Trinucleotide repeats are implicated in which of the following disorders?
   a. Down syndrome
   b. Turner syndrome
   c. Klinefelter syndrome
   d. Patau syndrome
   e. none of the above

21. A male carrier for a particular autosomal recessive disorder experiences nondisjunction during meiosis I. If he fertilizes a homozygous wild type egg, what genotype would be observed in the progeny?
   a. AAA
   b. Aaa
   c. A A a
   d. a a a
   e. none of the above

22. Which of the following is a characteristic of pericentric inversions?
a. new arm ratios
b. deletions
c. duplications
d. inversion loop
e. all of the above
1. Which of the following lac merozygotes would constitutively express the Z gene?
   a. F' Oc Z+/ O+Z+
   b. F' Oc Z+/ Oc Z+
   c. F' I- Z+/ I+Z+
   d. F' I+Z+/ I- Z+
   e. F' Oc Z/ O+Z+

   a. 1, 3, 4
   b. 1, 2
   c. 2, 4, 5
   d. 3, 5
   e. 2, 3

2. Which of the following lac merozygotes would be noninducible?
   a. F'OcZ+/O+Z-
   b. F' Is Z+/I+Z+
   c. F'IsZ+/IsZ+
   d. F' P-Z+/P+Z+
   e. F' P+Z-/P-Z+

   a. 1, 4
   b. 2, 3, 4
   c. 1, 4, 5
   d. 2, 3, 5
   e. 1, 2, 3

3. The following molecule:

   ![Molecule Diagram](image)
   Plays an important role in the regulation of the lac operon. Choose the false statement regarding the regulatory role of this molecule.
   a. It is synthesized by adenyl cyclase
   b. Its concentration is inhibited by adenyl cyclase.
   c. It binds to the allosteric site of the lac repressor, thereby deactivating it.
   d. It is required by the CAP protein to facilitate the positive regulation of the lac operon.
   e. Its regulatory effect is independent of the concentration of lactose.

4. The repressor binds to the ____ and is an example of the _____ control of the lac operon.
   a. promoter, positive
   b. promoter, negative
   c. operator, negative
   d. regulatory gene, positive
   e. operator, positive

5. Cytosine in ____ dinucleotides are modified preferentially by ____ and may ______ transcription of nearby downstream genes.
   a. 5' AT 3', phosphorylation, stimulate
   b. 5' GA 3' acetylation, inhibit
   c. 3' TG 5', acetylation, inhibit
   d. 5' CG 3', methylation, inhibit
   e. 3' AC 5' ubiquitination, stimulate

6. A large category of transcription activators include a DNA binding motif called a _____ because the folded structure incorporates a metal ion.
   a. helix – turn – helix
   b. helix – loop – helix
   c. tetramer domain
   d. RTK dimer
   e. zinc finger motif

7. A highly conserved eukaryotic transcription factor _____ includes a _____ subunit that binds with the promoter at the _____.
   a. TFIID, TBP, TATA box
b. TFIIA, TBP, TATA box  
c. TFIIA, zinc finger, GC rich region  
d. TFIIIB, Hox sapiens, pyridine rich region  
e. TFIIIE, BCD, HB  

8. In the helix turn helix motif, which component forms hydrogen bonds with the bases in the major groove of the DNA?  
a. alpha turn  
b. beta loop  
c. stabilizing helix at the N terminal  
d. recognition helix at the C terminal  
e. TBP  

9. Hormones affect gene regulation in the following events. Order them in the correct sequence.  
2. Hormone receptor complex penetrates nucleus.  
3. Hormone diffuses across cytoplasmic membrane  
4. Hormone receptor complex binds to HRE sequences near the promoter of target gene  
5. Hormone forms complex with cytoplasmic receptor protein.  
   a. 35421  
   b. 35241  
   c. 35214  
   d. 32514  
   e. 31245  

10. The TBP protein facilitates eukaryotic transcription initiation by _______ of DNA.  
a. methylation  
b. degradation  
c. bending  
d. acetylation  
e. phosphorylation  

11. Why is the lac operon of E. coli not inducible in the presence of lactose?  
a. glucose binds to the allosteric site of the repressor  
b. glucose inhibits the concentration of cAMP  
c. glucose activates the super repressor  
d. glucose binds to the CRP protein resulting in deactivation.  
e. glucose binds to allolactose forming an insoluble precipitate  

12. When glucose is present in an E. coli cell, the concentration of cAMP and lac mRNA are _____ respectively?  
a. high, low  
b. low, high  
c. high, high  
d. low, low  
e. depends on the availability of lactose  

13. A mutant with either (1) an inactive adenyl cyclase gene or an (2) inactive CRP gene would express beta galactosidase:  
a. only if glucose is present in case (1)  
b. only if lactose is present in case (2)  
c. only if lactose is present in either case (1) or case (2)  
d. regardless of whether lactose is present in either case (1) or case(2)  
e. No expression of beta galactosidase would be detected.  

14. All of the following are examples of epistatic F2 phenotypic ratios except:  
a. 10:6  
b. 9:6:1  
c. 9:3:3:1  
d. 12:3:1  
e. 9:3:4  

15. Which of the following parental crosses could not yield a Type O child?  
a. AB x O  
b. B x B  
c. A x B  
d. A x O  
e. all of the above could potentially yield a Type O child  

16. Considering the relative amounts of starch binding enzyme I (SBEI), the enzyme level in the heterozygous genotype is about halfway between the levels in the homozygous genotypes. All of the following are true except:  
a. incomplete dominance  
b. F2 phenotypic ratio is 3:1
c. Mendel’s law of segregation is obeyed
d. heterozygotes display a phenotype intermediate of the homozygotes
e. all of the above are false

17. White Leghorn chickens are homozygous for a dominant allele, C, of a gene responsible for colored feathers, and also for a dominant allele, I, of an independently segregating gene that prevents the expression of C. The White Wyandotte breed is homozygous recessive for both genes. What proportion of the F2 progeny obtained from mating White Leghorn x White Wyandotte F1 hybrids would be expected to have colored feathers?
a. 3/16
b. 9/16
c. 1/16
d. 7/16
e. none of the above

18. Which of the following is established prior to fertilization in Drosophila eggs?
A) the anterior-posterior and dorsal-ventral axes
B) the position of the future segments
C) the position of the future wings, legs, and antennae
D) A and B only
E) A, B, and C

19. The product of the bicoid gene in Drosophila provides essential information about
A) the anterior-posterior axis.
B) the dorsal-ventral axis.
C) the left-right axis.
D) segmentation.
E) lethal genes.

20. Mutations in these genes lead to transformations in the identity of entire body parts.
A. homeotic genes
B. segmentation genes
C. maternal effect genes
D. morphogens
E. inducers

21. The bicoid gene product is normally localized to the anterior end of the embryo. If large amounts of the product were injected into the posterior end as well, which of the following would occur?
A) The embryo would grow to an unusually large size.
B) The embryo would grow extra wings and legs.
C) The embryo would probably show no anterior development and die.
D) Anterior structures would form in both sides of the embryo.
E) The embryo would develop normally.

22. What do gap genes, pair-rule genes, segment polarity genes, and homeotic genes all have in common?
A) Their products act as transcription factors.
B) They have no counterparts in animals other than Drosophila.
C) Their products are all synthesized prior to fertilization.
D) They act independently of other positional information.
E) They apparently can be activated and inactivated at any time of the fly’s life.

23. The region of a Drosophila embryo with the highest concentration of bicoid protein will develop into the
A) head.
B) ovaries.
C) vulva.
D) homeobox.
E) abdomen.

24. The bicoid gene is a type of ________ gene.
A) segmentation
B) pair-rule
C) segment polarity
D) maternal effect
E) gap

25. In Drosophila, which genes initiate a cascade of gene activation that includes all other genes in the list?
A) homeotic genes
B) gap genes
C) pair-rule genes
D) maternal effect genes
E) segment polarity genes
26. Absence of bicoid mRNA from a Drosophila egg leads to the absence of anterior larval body parts and mirror-image duplication of posterior parts. This is evidence that the product of the bicoid gene
A) is transcribed in the early embryo.
B) normally leads to formation of tail structures.
C) normally leads to formation of head structures.
D) is a protein present in all head structures.
E) leads to programmed cell death.

27. Homeotic genes
A) encode transcription factors that control the expression of genes responsible for specific anatomical structures.
B) are found only in Drosophila and other arthropods.
C) specify the anterior-posterior axis for each fruit fly segment.
D) create the basic subdivisions of the anterior-posterior axis of the fly embryo.
E) are responsible for the programmed cell death occurring during morphogenesis.

28. How does active CAP induce expression of the genes of the lactose operon?
A) It terminates production of repressor molecules.
B) It degrades the substrate allolactose.
C) It stimulates splicing of the encoded genes.
D) It stimulates the binding of RNA polymerase to the promoter.
E) It binds steroid hormones and controls translation.

29. A mutation that inactivates the regulatory gene of a repressible operon in an E. coli cell would result in
A) continuous transcription of the structural gene controlled by that regulator.
B) complete inhibition of transcription of the structural gene controlled by that regulator.
C) irreversible binding of the repressor to the operator.
D) inactivation of RNA polymerase.
E) both B and C

30. Which of the following is not a mechanism whereby a proto-oncogene is converted to an oncogene?
A) methylation of bases
B) point mutation
C) gene transposition
D) gene amplification
E) chromosome translocation

31. Which of the following statements concerning proto-oncogenes is false?
A) They can code for proteins associated with cell growth.
B) They are similar to oncogenes found in retroviruses.
C) They are produced by somatic mutations induced by carcinogenic substances.
D) They can be involved in producing proteins for cell adhesion.
E) They can code for proteins involved in cell division.

32. Which of the following is not a characteristic of the product of the p53 gene?
A) is an activator for other genes.
B) slows down the cell cycle.
C) causes cell death.
D) prevents cells from passing on mutations due to DNA damage.
E) slows down the rate of DNA replication by interfering with the binding of DNA polymerase.

33. Tumor suppressor genes
A) are frequently overexpressed in cancerous cells.
B) are cancer-causing genes introduced into cells by viruses.
C) can encode proteins that promote DNA repair or cell-cell adhesion.
D) often encode proteins that stimulate the cell cycle.
E) all of the above

34. The Ras protein is involved in ________, and cancer-causing forms of the protein are usually ________.
A) relaying a signal from a growth factor receptor; hyperactive
B) DNA replication; nonfunctional
C) DNA repair; hyperactive
D) cell-cell adhesion; nonfunctional
E) cell division; nonfunctional

1. The F2 genotypes of two independently assorting genes with complete dominance result in a __________ phenotypic ratio if there is no interaction between the genes.
a. 12:3:1
b. 9:3:3:1
2. The C and P genes control petal color in the flowers of a particular species of pea plant. C-pp and ccP- individuals exhibit the same mutant white phenotypes. A cross between two true breeding mutant parentals produced purple wild-type F1 individuals. A self-fertilization of the F1 individuals would result in a phenotypic ratio of:
   a. 12:3:1
   b. 9:3:3:1
   c. 9:6:1
   d. 9:4:3
   e. 9:7

3. In the genetic study of the color of the hull in oat seeds, it was determined that genes A and B control this phenotype and furthermore, A- individuals display the black hull phenotype whereas aaB- and aabb individuals display the gray hull and white hull phenotypes, respectively. The self-fertilization of a doubly heterozygous individual would yield a phenotypic ratio of:
   a. 9:6:1
   b. 9:4:3
   c. 9:7
   d. 12:3:1
   e. 10:6

4. White Leghorn chickens (CCII) and White Wyandotte chickens (ccii) have white feathers because the C allele is necessary for colored feathers but the I allele in White Leghorns is a dominant inhibitor of feather coloration. The self-fertilization of the doubly heterozygous individual would produce a phenotypic ratio of:
   a. 9:7
   b. 12:3:1
   c. 13:3
   d. 9:4:3
   e. 9:6:1

5. In the mouse, the grayish coat color called agouti is produced by the presence of a horizontal band of yellow pigment just beneath the tip of each hair. The agouti pattern results from the presence of the A allele, and in aa animals, the coat color is black. The C allele is necessary for the formation of hair pigments of any kind, and cc animals are albino. The F2 phenotypic ratio is:
   a. 12:3:1
   b. 9:3:3:1
   c. 9:6:1
   d. 12:4
   e. 9:4:3

6. Red coat color in Duroc-Jersey pigs requires the presence of two dominant alleles, R and S. Pigs that are recessive either gene display the sandy coat color, whereas individuals recessive for both genes display the white coat color. The F2 phenotypic ratio would be:
   a. 9:6:1
   b. 9:3:4
   c. 12:3:1
   d. 10:3:3
   e. 9:4:3

7. A genotype that is always is expressed has a penetrance of _______.
   a. 0%
   b. 50%
   c. 75%
   d. 100%
   e. 25%

8. Two genes control flower color in a particular species of pea plant. Three mutant recessive strains were isolated, and two crosses were performed between these mutant individuals:

   Cross A: Mutant 1 X Mutant 2
   Cross B: Mutant 1 X Mutant 3

   Cross A yielded wild-type individuals, whereas cross B yielded mutant individuals.

   The best conclusion(s) would include which of the following?
   1. Cross A demonstrates complementation.
   2. Cross B demonstrates complementation
   3. Cross A demonstrates that the mutations in the parental strains are in alleles of different genes.
   4. Cross B demonstrates that the mutations in the parental strains are in alleles of the same gene.

   a. 1,2,3,4
   b. 1,3
9. In the shepherd’s purse, Capsella bursapastoris, the capsule containing the seeds can be either triangular or ovoid. A cross between true-breeding strains with triangular capsules yielded an F1 with triangular capsules. The observed F2 ratio was 15 triangular:1 ovoid. What genetic hypothesis can explain these results?

1. What is the function of the promoter? A mutation in the promoter would likely have what effect? Would it act cis or trans?

2. Discuss the lac repressor, in terms of its domains, functions, behavior in the induced and noninduced states. What is the super repressor?

3. What is the function of the operator? Describe the effects of a constitutive operator.

4. What is the difference between cis and trans acting elements?

5. What is the function of the CAP-cAMP complex? What are the optimal conditions for the expression of the lac operon? Is the CAP-cAMP complex an example of positive or negative control? Describe the effect of a null mutation in the gene coding the CAP protein.

6. Describe the helix turn helix motif and its purpose and structure. Which of the 2 helices serves as the recognition helix?

7. For each of the following lac operon merozygotes, indicate whether B-galactosidase and permease would be produced in the induced and noninduced states.
   a. I-P+O+Z+Y+/I+P+O+Z-Y+
   b. I-P+OcZ+Y+/I+P+O+Z-Y+
   c. IsP+O+Z+Y+/I+P+O+Z-Y+

8. Describe the two unique features of the TBP protein.


10. Pair rule genes have what function?

11. In Drosophila, X-chromosomes encode genes for the __________ proteins, and the autosomes contain genes for the __________ proteins. Which transcription factor complex is responsible for the expression of the Sxl gene from the early promoter?

12. What is the function of the Sxl protein? Describe the relationship between the Sxl protein, the tra gene and the DSX-F protein.

13. What effect does the acetylation of histones have on chromatin packaging and transcriptional control?

14. The sleek, shorthaired coat of Labrador Retrievers comes in 3 colors: black, chocolate brown, and golden. B_ individuals are black, and bb individuals are brown, however, ee individuals are golden regardless of the combination of the alleles of the B gene. Predict the F2 phenotypic ratio.

15. What is the difference between penetrance and expressivity?

16. Males have an X:A ratio of ____. Describe the pathway of genetic differentiation based upon the following components: NUM and DEM proteins, Sxl, tra, DSX.

17. Two genes have been implicated in causing deafness. Two deaf parents, whose exact genotypes are unknown, have hearing offspring. Deafness is caused by a recessive mutation. State the appropriate conclusion.

18. “Secretors” (genotype SS and Ss) secrete their A and B blood group antigens into their saliva and other body fluids, while nonsecretors (ss genotype) do not. What would be the apparent phenotypic blood group proportions among the offspring of an I^A_I^B_Ss female and an I^A_I^A_Ss male if typing was done using saliva.

19. What is the F2 phenotypic ratio for a monohybrid cross for the flower color gene?

20. What cross would be most efficient for generating pink flowers?


22. A Type A father and a Type B mother have a Type O child. What is the probability of this couple having a Type AB child?
23. What protein does the CDK kinase require in order to perform its function of ____________ of target proteins?

24. Oncogene mutations are ____________ and tumor suppressor gene mutations are ____________. Explain.

25. Order the following genes in order of their expression in Drosophila embryonic development.
   (1) Segment polarity genes (2) Gap genes (3) Pair Rule Genes (4) Maternal Effect Genes (5) Homeotic genes

26. What is the function of the p53 gene?

27. Mutations in these genes affect the identity of each segment, in terms of Drosophila embryonic development.

28. What is the homeodomain?

29. Which genes establish the anterior-posterior axis of the developing Drosophila embryo?

30. The first zygotically expressed genes in Drosophila embryonic development. Mutations in these genes may cause entire segments to be missing.

31. Place the following steps in the correct ordered sequence. A. Kinase cascade B. activation of a transcription factor C. hormone binds cell surface receptor D. Expression of target genes in the nucleus E. RAS molecular switch

32. Indicate whether the following mutations would result in excessive cell growth or decreased cell growth if the cell were either homozygous for the mutation or heterozygous for the mutation and a wild type allele. Assume that 50% of the normal activity of all these genes is sufficient for normal growth. 1. A null mutation in a phosphatase gene. 2. A null mutation in E2F gene. 3. A null mutation in the CDK gene. 4. A null mutation in the Apaf gene 5. A null mutation in the RB gene.

33. Describe the concentration gradients in terms of embryonic axes of the HB, BCD, and Nanos proteins.

34. In shorthorn cattle, coat color may be red, white, or roan. Roan is an intermediate phenotype expressed as a mixture of red and white hairs. The following data were obtained from various crosses:
   Red * Red -> all red
   White*white -> all white
   Red*white -> all roan
   Roan*roan -> 1/4 red, ½ roan, ¼ white

How is coat color inherited? State the genotypes of parents and offspring in each cross.

35. In foxes, two alleles of a single gene, P and p, may result in lethality (PP); platinum coat(Pp); or silver coat(pp). What ratio is obtained when platinum foxes are interbred? Is the P allele behaving dominantly or recessively in causing lethality? In causing platinum coat color?

36. With regard to the ABO blood types in humans, determine the genotypes of the male parent and female parent below:
   Male parent: Blood type B; mother type O
   Female parent: blood type A; father type B

Predict the blood types of the offspring that this couple may have and the expected proportion of each.

37. Pigment in the mouse is only produced when the C allele is present. Individuals of the cc genotype have no color. If color is present, it may be determined by the A, a alleles. AA or Aa results in gray(agouti) color, while aa results in black coats. What F1 and F2 genotypic and phenotypic ratios are obtained from a cross between AACC and aacc mice?

38. Identify the component of the eukaryotic promoter found 25-30 bp upstream of the transcription initiation site.

39. The sequence referred to in question 38 is recognized by the _______ subunit of the ________ transcription factor.

40. Identify the DNA binding domain. The interspersed cystein and histidine residues covalently bind metal atoms folding the amino acids into loops. The amino acids in the loop interact with and bind to specific DNA sequences

Final Exam 2  Genetics 3315  TA: Syed Abbas
1. In the regulation of the lac operon, positive control is exerted by:

2. What is the function of adenyl cyclase?

3. Transcriptional control in eukaryotic cells involves the interaction of DNA sequences adjacent to the regulated genes and DNA binding proteins known as _________.

4. Describe the effects of the oncogene form of RAS.

5. A cross between pure-breeding spotted lentils and pure breeding dotted lentils produced F1 heterozygotes that are both spotted and dotted. Self-hybridization of the F1 individuals would yield what F2 phenotypic ratio?

6. List all possible ABO genotypes.

7. HAT and HDAC enzymes participate in what process?

8. _______ drive the process of apoptosis by cleaving target proteins.

9. SXL protein has what function?

10. Genes encoded by the unfertilized oocyte genome that establish the anterior-posterior axis in the developing Drosophila embryo.

11. Rb is a ___________ tumor-suppressor gene.

12. The homebox codes for the ______________, an important DNA binding domain composed of _____ amino acids, and functions as a transcription factor in the activation of developmental genes.

13. Homeotic genes have what function?

14. Identify. Acts as the translational repressor of HB mRNA. Exists in a high to low, posterior to anterior gradient.

15. This mRNA is equally distributed from the anterior to posterior axis, but its protein product is expressed in a high to low, anterior to posterior axis.

16. What two maternally encoded proteins are present in a high to low anterior –posterior axis?

17. The first zygotically expressed segmentation genes in Drosophila.

18. Mutation of ______ results in loss of entire segments.

19. Expression of these genes has a 2 segment periodicity.

20. Order the following events: a. receptor hormone complex is translocated to the nucleus b. receptor hormone complex activates transcription of target genes c. hormone binds to specific receptor protein in cytoplasm d. hormones enter cell by passing through cytoplasmic membrane

21. Stimulation of transcription by binding of a regulatory protein is known as ___________; inhibition of transcription by binding of a regulatory protein is known as ___________.

22. The repressor protein, in the lac operon, binds to the _____________ site, and has the following effect?

23. Indicate whether the following statements are true or false. If false explain why. A. Allolactose, which is formed by the cell in the presence of lactose, derepresses the lac operon by binding to the operator and stimulating transcription. B. The superrepressor binds to a constitutive operator and inhibits transcript of the lac operon both in the presence and absence of lactose C. Both glucose and lactose need to be present in order to optimally express the lac operon. D. Lactose acts as a corepressor, binds to the allosteric site of the lac repressor, allowing it to attach to the operator, thereby activating transcription.

For each of the following genotypes of the lac operon, indicate whether B galactosidase and permease will be produced in the induced and noninduced states.

24. I+P+OcZ+Y+

25. I+P+O+Z+Y+

26. ISP-O+Z+Y+

27. I+P+O+Z-Y+

28. Why is the lac operon not inducible in the presence of glucose?

29. How do enhancers stimulate transcription of genes that may be relatively distant from the enhancers?
1. An enzyme in DNA replication is responsible for removing the RNA primer. Choose the answer choice that states both the correct name and enzymatic activity for accomplishing this function. (A) DNA polymerase III; 5' to 3' exonuclease activity  (B) DNA polymerase I; 5' to 3' exonuclease activity  (C) DNA ligase; 5' to 3' endonuclease activity  (D) RNA primase; 5' to 3' exonuclease activity  (E) topoisomerase; 3' to 5' endonuclease activity

2. The following enzymes participate in the removal and repair of uracil in DNA: (1) AP endonuclease  (2) ligase  (3) DNA uracil glycosylase  (4) exonuclease  (5) DNA polymerase. Which of the following states the correct sequential order of the activity of these enzymes? (A) 12345  (B) 23145  (C) 31245  (D) 31425  (E) 31452

3. Identify the stage of meiosis in which homologous chromosomes separate to opposite poles of the cell. (A) prophase I  (B) metaphase II  (C) anaphase I  (D) anaphase II  (E) telophase I

4. The concentration of thymine in a strand of double-stranded DNA was found to be 35 percent. What is concentration of guanine expected to be? (A) 35%  (B) 10%  (C) 15%  (D) 20%  (E) 30%

5. Aminoacyl tRNA synthetases: (A) link the two adjacent amino acids together using the dehydration reaction  (B) charge tRNA molecules to their appropriate amino acids  (C) remove introns and join together the remaining exons  (D) add a 5' 7-methylguanosine cap to primary mRNA transcripts  (E) remove faulty codons from nonfunctional mRNA molecules

6. Enzymes that cleave DNA at specific sites and are useful for recombinant DNA technology: (A) reverse transcriptase  (B) restriction endonuclease  (C) restriction exonuclease  (D) DNA ligase  (E) DNA primase

7. In the lac operon, cis-acting elements include the: (A) promoter  (B) operator (C) repressor (D) A and B  (E) B and C

8. The active transcription factor needed for the activation of transcription of the Sxl gene from its early promoter: (A) NUM-NUM heterodimer  (B) DEM-DEM heterodimer  (C) NUM-DEM homodimer  (D) NUM-NUM homodimer  (E) DEM-DEM homodimer

9. A type A mother has a type O child. Which of the following could not be a potential ABO blood type of the father? (A) Type A  (B) Type B  (C) Type AB  (D) Type O  (E) C and D

10. The width of a mitotic chromosome is: (A) 2 nm  (B) 10 nm  (C) 30 nm  (D) 300 nm  (E) 700 nm

11. Using fluorescently labeled probes, this technique locates the position of a gene in a cytogenetic map: (A) Southern blot  (B) gel electrophoresis  (C) STS mapping  (D) radiation hybrid mapping  (E) FISH

12. Histone acetylation is associated with which of the following? (A) kinase phosphorylation  (B) oncogene mutation  (C) transcriptional activation  (D) apoptosis initiation  (E) positive control of lac operon

13. Which of the following does not occur during mitosis? (A) condensation of the chromosomes  (B) replication of the DNA  (C) separation of sister chromatids  (D) spindle formation  (E) separation of the spindle poles

14. A human cell containing 22 autosomes and a Y chromosome is: (A) a sperm  (B) an egg  (C) a zygote  (D) a somatic cell of a male  (E) a somatic cell of a female

15. Meiosis II is similar to mitosis in that: (A) sister chromatids separate during anaphase  (B) DNA replicates before the division  (C) the daughter cells are diploid  (D) homologous chromosomes synapse (E) the chromosome number is reduced

16. Assuming independent assortment, consider a cross between AaBBCcDDEe and AABbCcddEe. What is the probability of producing an individual that has the genotype AaBBC_DdEe? (A) 1/16  (B) 9/32  (C) 1/8  (D) 27/128  (E) 3/32

17. Determine the sequence of genes along a chromosome based on the following recombination frequencies: A-B, 8 cM; A-C, 28 cM; A-D, 25 cM; B-C, 20 cM; B-D, 33 cM. (A) ACDB (B) BCAD  (C) CBAD  (D) DCBA  (E) CDAB

18. Economically important plants such as commercial bananas and seedless watermelons are classified as: (A) 2n  (B) 3n  (C) 4n  (D) 6n  (E) 8n

19. A man with hemophilia (an X-linked, recessive condition) has a daughter of normal phenotype. She marries a man who is normal for the trait. What is the probability that a son of this mating will be a hemophiliac? (A) ½  (B) ¼  (C) 2/3  (D) 1/8 (E) 1

20. How many Barr bodies would be present in each somatic cell of a 48, XXXX individual? (A) 0  (B) 1  (C) 2  (D) 3  (E) 4

21. In a nucleosome, the DNA is wrapped around: (A) polymerase molecules  (B) ribosomes  (C) histones  (D) a thymine dimer  (E) satellite DNA
22. In analyzing the number of different bases in a DNA sample, which result would be consistent with the base-pairing rules? (A) $A = G$ (B) $A + G = C + T$ (C) $A + T = G + T$ (D) $A = C$ (E) $G = T$

23. A biochemist isolates and purifies molecules needed for DNA replication. When she adds some DNA, replication occurs, but each DNA molecule consists of a normal strand paired with numerous segments of DNA a few hundred nucleotides long. What has she probably left out of the mixture? (A) DNA polymerase (B) DNA ligase (C) nucleotides (D) Okazaki fragments (E) primase

24. The spontaneous deamination of cytosine produces: (A) adenine (B) thymine (C) guanine (D) uracil (E) cytosine

25. Which of the following is not true of a codon? (A) It consists of three nucleotides. (B) It may code for the same amino acid as another codon. (C) It never codes for more than one amino acid. (D) It extends from one end of a tRNA molecule. (E) It is the basic unit of the genetic code.

26. Which of the following is not true of RNA processing? (A) Exons are cut out before mRNA leaves the nucleus. (B) Nucleotides may be added at both ends of the mRNA. (C) Spliceosomes may function in RNA splicing. (D) RNA splicing involves the removal of introns and the joining together of the remaining exons. (E) A primary transcript is often much longer than the final RNA molecule that leaves the nucleus.

27. Which of the following mutations would be most likely to have a harmful effect on an organism? (A) A base-pair substitution (B) a deletion of three nucleotides near the middle of a gene (C) a single nucleotide deletion in the middle of an intron (D) a single nucleotide deletion near the end of the coding sequence (E) a single nucleotide insertion downstream of, and close to the start of the coding sequence

28. Which component is not directly involved in translation? (A) mRNA (B) DNA (C) tRNA (D) ribosomes (E) GTP

29. The anticodon of a particular tRNA molecule is: (A) complementary to the corresponding mRNA codon. (B) complementary to the corresponding triplet in rRNA (C) the part of the tRNA that bonds to the specific amino acid. (D) changeable, depending on the amino acid that attaches to the tRNA (E) catalytic, making the tRNA a ribozyme.

30. The functioning of enhancers is an example of: (A) transcriptional control of gene expression (B) a post-translational control mechanism for editing mRNA (C) the stimulation of translation by initiation factors (D) post-translational control that activates certain proteins (E) a eukaryotic equivalent of prokaryotic promoter functioning

31. Absence of bicoid mRNA from a Drosophila egg leads to the absence of anterior larval body parts and mirror-image duplication of posterior parts. This is evidence that the product of the bicoid gene: (A) is transcribed in the early embryo (B) normally leads to the formation of tail structures (C) normally leads to the formation of head structures (D) is a protein present in all head structures (E) leads to programmed cell death

32. Thymine dimers are caused by exposure of the DNA to: (A) aflatoxin B1 (B) 2-aminopurine (C) UV radiation (D) free radicals (E) ethylmethanesulfonate

33. Turner’s syndrome is characterized as: (A) a monosomy for an autosomal chromosome (B) a trisomy for an autosomal chromosome (C) a monosomy for an X chromosome (D) a trisomy for the Y chromosome (E) a trisomy for the X chromosome

34. Homeotic genes: (A) encode transcription factors that control the expression of genes responsible for specific anatomical structures. (B) are found only in Drosophila and other arthropods. (C) are the only genes that contain the homeobox domain. (D) encode proteins that form anatomical structures in the fly. (E) are responsible for patterning during plant development.

35. In the lac operon, positive control is exerted by: (A) operator (B) CAP-cAMP complex (C) RNA polymerase (D) repressor (E) A and D

36. CDK becomes activated only when they form a complex with: (A) caspases (B) p21 (C) E2F (D) cyclins (E) Rb

37. The SXL protein is a(n): (A) kinase (B) transcription factor (C) extracellular morphogen (D) RNA splicing protein (E) cytoskeletal element

38. The optimal conditions necessary for the expression of the lac operon include: (A) presence of lactose (B) absence of glucose (C) presence of glucose (D) A and B (E) A and C

39. What would occur if the repressor of an inducible operon were mutated so it could not bind to the operator? (A) continuous transcription of the operon’s genes (B) buildup of a substrate for the pathway controlled by the operon (C) complementary mutation in the operator (D) inhibition of structural gene expression (E) irreversible binding of the repressor to the promoter

40. Which of the following is an example of a possible step in the post-transcriptional control of gene expression? (A) the addition of methyl groups to cytosine bases of DNA (B) the binding of transcription factors to a promoter (C) the removal of introns and splicing together of exons (D) gene amplification during a stage in development (E) the folding of DNA to form heterochromatin
1. If a female has blood type O, what could be the genotypes and corresponding phenotypes of her parents?

2. In radishes, color and shape are each controlled by a single locus with 2 incompletely dominant alleles. Color may be red (RR), purple (Rr) or white (rr); and shape can be long (LL), oval (Ll), or round (ll). State the F2 phenotypic ratios given a parental cross between true breeding dominant and true breeding recessive parents.

3. For the determination of coat color in mice, the Ay (yellow) is dominant to A (agouti or gray). Individuals homozygous for the Ay allele perish before gestation. What F2 phenotypic ratio would result from the cross between two heterozygous yellow mice?

4. In summer squash, the dominant B allele causes white color and is sufficient to mask the effects of any combination of A and a alleles. As a result, yellow (A_) or green (aa) color is only expressed in bb individuals. Given a parental cross between two true breeding dominant individuals, what F2 phenotypic ratio would be expected?

5. In Siamese cats, the enzyme that synthesizes melanin, which determines coat color, exhibits what property?

6. Replicating structures in DNA can be observed in the electron microscope. Four replication bubbles were observed. How many replication forks are present?

7. A wild-type fruit fly (heterozygous for gray body color and normal wings) is mated with a black fly with vestigial wings. The offspring have the following phenotypic distribution: wild-type, 121; black-vestigial, 107; black-normal, 134; gray-vestigial, 88. What is the chi squared statistical value?

8. CCDD and ccdd individuals were crossed to each other and the F1 generation was backcrossed to the ccdd parent; 903 CcDd, 897 ccdd, 98 Ccdd, and 102 ccDd offspring resulted. How far apart are the c and d loci?

9. A paleontologist has recovered a bit of tissue from an extinct mammoth. The researcher would like to compare DNA from the sample with DNA from living mammals. Which of the following would be most useful for increasing the amount of mammoth DNA available for testing? (A) RFLP analysis (B) polymerase chain reaction (C) gel electrophoresis (D) electroporation (E) Southern blotting

10. Which of the following is most directly responsible for the lack of webbing between the fingers of most humans? (A) pattern formation (B) transcriptional regulation (C) apoptosis (D) cell division (E) induction

11. The development of Drosophila is somewhat unusual in that: (A) the early mitotic divisions proceed without cytokinesis (B) metamorphosis occurs during the larval stage rather than the pupal stage (C) homeotic genes are mutated (D) cell migration within the embryo does not occur (E) the initial cell divisions have lengthy G1 phases

12. In Drosophila, which genes initiate a cascade of gene activation that includes all other genes in the list? (A) homeotic genes (B) gap genes (C) pair rule genes (D) maternal effect genes (E) segment polarity genes

13. Phenylketonuria (PKU) is an autosomal recessive condition. A woman and her husband, both have siblings affected with PKU. However, both of their parents were normal. What is the probability that this couple has an affected child?

14. The Rho factor and hairpin loop formation is associated with: (A) eukaryotic transcription termination (B) prokaryotic translation termination (C) eukaryotic translation initiation (D) prokaryotic transcription termination (E) eukaryotic transcription initiation

15. Mechanism by which the presence of glucose inhibits transcription of the lac operon: (A) catabolite repression (B) DNA polymerase (C) induction (D) repression (E) translation

16. A mutagen that causes insertions: (A) 2-aminopurine (B) 5-bromouracil (C) nitrosoguanidine (D) intercalating agent (E) UV radiation

17. Delay in methylation of the daughter strand after DNA replication is the basis for which of the following repair systems? (A) mismatch repair (B) photoreactivation (C) SOS repair system (D) recombinational repair (E) proofreading by DNA polymerase

18. Which of the following missense mutations does not belong in this list? (Assume that only a single base pair substitution is responsible for the missense mutation.) (A) ser to tyr (B) asn to lys (C) asp to gly (D) pro to his (E) gln to pro

19. Transcription begins when RNA polymerase binds to the DNA at a site called the: (A) operator (B) enhancer (C) repressor (D) promoter (E) terminator

20. Which of the following DNA replication enzymes participates last? (A) DNA polymerase I (B) DNA polymerase III (C) ligase (D) SSBP (E) topoisomerase

21. How many amino acids serve as an example for the redundancy of the genetic code? (A) 20 (B) 19 (C) 18 (D) 17 (E) 64
22. How does the CAP-cAMP complex initiate transcription? (A) Competitively binding to the operator (B) binding to the promoter and facilitating the binding of RNA polymerase (C) phosphorylation of the lac repressor (D) binding to the allosteric site of the regulatory gene (E) acting as an RNA polymerase and amplifying the mRNA product

23. All of the following are features of prokaryotic cells except: (A) monocistronic mRNA (B) theta structures (C) circular chromosomes (D) haploid genome (E) all of the above are features of prokaryotic cells

24. Polyadenylation signal: (A) prokaryotic transcription termination (B) eukaryotic transcription termination (C) prokaryotic replication initiation (D) eukaryotic translation initiation (E) prokaryotic translation termination

25. In four o'clocks, the A allele (red phenotype) is incompletely dominant to the a allele (white phenotype). The F1 pink individuals can be self-fertilized to give what phenotypic ratio?

26. The proofreading capacity of DNA polymerase III is catalyzed by what enzymatic activity? (A) 5' to 3' endonuclease activity (B) 3' to 5' exonuclease activity (C) 5' to 3' exonuclease activity (D) 3' to 5' endonuclease activity (E) 3' to 5' polymerase activity

27. Dicentric bridge, acentric fragment, inviable gametes: (A) deletions (B) duplications (C) reciprocal translocations (D) paracentric inversions (E) pericentric inversions

28. An RNA primer is needed in DNA replication because: (A) RNA is a more stable molecule than DNA (B) the 3' OH group of ribose is more reactive than the 3' OH group of deoxyribose (C) DNA polymerase cannot synthesize DNA de novo (D) RNA primers are useful in base excision repair (E) RNA polymerase has a faster rate of reaction than DNA polymerase

29. You have a small gene that you want replicated by PCR. You add radioactively labeled nucleotides to the PCR thermalcycler. After three replication cycles, what percentage of the DNA single strands are radioactively labeled?

30. Theta structures are intermediates formed during: (A) prokaryotic translation (B) prokaryotic replication (C) eukaryotic transcription (D) eukaryotic translation (E) prokaryotic transcription

31. In order to prevent the gradual shortening of eukaryotic chromosomes, what enzyme is needed? (A) telomerase (B) primase (C) SSBP (D) topoisomerase (E) DNA polymerase

32. What is the function of the poly A tail? (A) digested by the cytoplasmic exonucleases (B) maintain the stability of the mRNA (C) anchor to the aminoacyl tRNA synthetases (D) binding site for the polyadenylation signal (E) recognition region for the spliceosome

33. The molecular basis for fragile X syndrome, one of the most common forms of human mental retardation, is (are): (A) unequal crossing over (B) transposable elements (C) mismatch error (D) trinucleotide repeats (E) exposure to X-rays

34. What DNA repair system is most likely to be involved in repairing the damage caused by exposure of DNA to aflatoxin B1? (A) mismatch repair (B) SOS repair system (C) methyl-directed nucleotide excision repair (D) recombinational repair (E) post-replication base excision repair

35. If the a and b loci are 20 cM apart in humans and an AB/ab woman mates with an ab/ab man, what is the probability that their child will be Ab/ab?

36. An individual that has the genotype AaBbCcDdEeFfGgHh would produce how many different types of gametes?

37. An individual that has the genotype AaBBCcDdEeffGgHH is self-fertilized. What is the probability of this cross producing a child, whose phenotype is identical to one of the parents?

38. Hb and bcd mRNA are coded by which of the following genes? (A) maternal effect genes (B) gap genes (C) homeotic genes (D) cardinal genes (E) pair-rule genes

39. What is the function of E2F?

40. What is the function of RB?

1. What is the function of the promoter? A mutation in the promoter would likely have what effect? Would it act cis or trans?

2. Discuss the lac repressor, in terms of its domains, functions, behavior in the induced and noninduced states. What is the super repressor?

3. What is the function of the operator? Describe the effects of a constitutive operator.

4. What is the difference between cis and trans acting elements?
5. What is the function of the CAP-cAMP complex? What are the optimal conditions for the expression of the lac operon? Is the CAP-cAMP complex an example of positive or negative control? Describe the effect of a null mutation in the gene coding the CAP protein.

6. Describe the helix turn helix motif and its purpose and structure. Which of the 2 helices serves as the recognition helix?

7. For each of the following lac operon heterozygotes, indicate whether B-galactosidase and permease would be produced in the induced and noninduced states.
   a. I-P+O+Z+Y+/I+P+O+Z-Y+
   b. I-P+OcZ+Y+/I+P+O+Z-Y+
   c. IsP+O+Z+Y+/I+P+O+Z-Y+

8. Describe the two unique features of the TBP protein.

9. What determines gender in Drosophila? How is the X:A ratio "monitored"?

10. Pair rule genes have what function?

11. In Drosophila, X-chromosomes encode genes for the ____________ proteins, and the autosomes contain genes for the ____________ proteins. Which transcription factor complex is responsible for the expression of the SxI gene from the early promoter?

12. What is the function of the SxI protein? Describe the relationship between the SxI protein, the tra gene and the DSX-F protein.

13. What effect does the acetylation of histones have on chromatin packaging and transcriptional control?

14. The sleek, shorthaired coat of Labrador Retrievers comes in 3 colors: black, chocolate brown, and golden. B_ individuals are black, and bb individuals are brown, however ee individuals are golden regardless of the combination of the alleles of the B gene. Predict the F2 phenotypic ratio.

15. What is the difference between penetrance and expressivity?

16. Males have an X:A ratio of ______. Describe the pathway of genetic differentiation based upon the following components: NUM and DEM proteins, SxI, tra, DSX.

17. Two genes have been implicated in causing deafness. Two deaf parents, whose exact genotypes are unknown, have hearing offspring. Deafness is caused by a recessive mutation. State the appropriate conclusion.

18. "Secretors" (genotype SS and Ss) secrete their A and B blood group antigens into their saliva and other body fluids, while nonsecretors (ss genotype) do not. What would be the apparent phenotypic blood group proportions among the offspring of an I^A_I^B_Ss female and an I^A_I^A_Ss male if typing was done using saliva.

(19-20) In four o’clocks, the allele for red flower color is incompletely dominant over the allele for white flower color.

19. What is the F2 phenotypic ratio for a monohybrid cross for the flower color gene?

20. What cross would be most efficient for generating pink flowers?

21. Which of the following crosses could not yield a Type O child? (More than one answer may apply.) i. A * B ii. A * A iii. A'O iv. AB * O v. B'B

22. A Type A father and a Type B mother have a Type O child. What is the probability of this couple having a Type AB child?

23. What protein does the CDK kinase require in order to perform its function of ____________ of target proteins?

24. Oncogene mutations are ____________ and tumor suppressor gene mutations are _____________. Explain.

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Final Exam 2  Genetics 3315  TA: Syed Abbas

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3. Transcriptional control in eukaryotic cells involves the interaction of DNA sequences adjacent to the regulated genes and DNA binding proteins known as _________.

4. Describe the effects of the oncogene form of RAS.

5. A cross between pure-breeding spotted lentils and pure breeding dotted lentils produced F1 heterozygotes that are both spotted and dotted. Self-hybridization of the F1 individuals would yield what F2 phenotypic ratio?

6. List all possible ABO genotypes.
7. HAT and HDAC enzymes participate in what process?

8. ___________ drive the process of apoptosis by cleaving target proteins.

9. SXL protein has what function?

10. Genes encoded by the unfertilized oocyte genome that establish the anterior-posterior axis in the developing Drosophila embryo.

11. Rb is a _______________ tumor-suppressor gene.

12. The homeobox codes for the ______________, an important DNA binding domain composed of _____ amino acids, and functions as a transcription factor in the activation of developmental genes.

13. Homeotic genes have what function?

14. Identify. Acts as the translational repressor of HB mRNA. Exists in a high to low, posterior to anterior gradient.

15. This mRNA is equally distributed from the anterior to posterior axis, but its protein product is expressed in a high to low, anterior to posterior axis.

16. What two maternally encoded proteins are present in a high to low anterior–posterior axis?

17. The first zygotically expressed segmentation genes in Drosophila.

18. Mutation of ______ results in loss of entire segments.

19. Expression of these genes has a 2 segment periodicity.

20. Order the following events:  a. receptor hormone complex is translocated to the nucleus  b. receptor hormone complex activates transcription of target genes  c. hormone binds to specific receptor protein in cytoplasm  d. hormones enter cell by passing through cytoplasmic membrane

21. Stimulation of transcription by binding of a regulatory protein is known as ___________; inhibition of transcription by binding of a regulatory protein is known as _______________.

22. The repressor protein, in the lac operon, binds to the _____________ site, and has the following effect?

23. Indicate whether the following statements are true or false. If false explain why.  A. Allolactose, which is formed by the cell in the presence of lactose, derepresses the lac operon by binding to the operator and stimulating transcription.  B. The superrepressor binds to a constitutive operator and inhibits transcript of the lac operon both in the presence and absence of lactose  C. Both glucose and lactose need to be present in order to optimally express the lac operon.  D. Lactose acts as a corepressor, binds to the allosteric site of the lac repressor, allowing it to attach to the operator, thereby activating transcription.

For each of the following genotypes of the lac operon, indicate whether B galactosidase and permease will be produced in the induced and noninduced states.

24. I+P+OcZ+Y+

25. I+P-O+Z+Y+

26. ISP-O+Z+Y+

27. I+P+O+Z-Y+

28. Why is the lac operon not inducible in the presence of glucose?

29. How do enhancers stimulate transcription of genes that may be relatively distant from the enhancers?