

Exam 2  
CSS/Hort 430  
2009

1. In the case of codominance,
  - a. the null allele is due to complete gene deletion.
  - b. the presence of both alleles in a heterozygote can be visualized via electrophoresis.
  - c. heterozygotes are more fit (stronger!) than dominant homozygotes or recessive homozygotes.
  - d. allelic interactions lead to new phenotypes and modifications of the expected 9:3:3:1 ratio.
  
2. You have two different varieties of cowpea in your germplasm collection. Both are resistant to a bacterial wilt disease. In order to determine if the two varieties have the same or different resistance genes, you cross them and test for the disease resistance phenotype in the F1 and F2 generations. You observe that all F1 plants are resistant and in the F2 there is a ratio of 15 resistant: 1susceptible. The most likely explanation for these observations is that
  - a. the alleles at the resistance locus show codominance.
  - b. the two varieties have the same resistance alleles at the same resistance locus.
  - c. there are two loci involved in disease resistance and the varieties have different alleles at these loci.
  - d. resistance is not under genetic control.
  
3. You have two accessions of a valuable ornamental in your collection. One accession was collected in California, the other in Oregon. You have successfully self-pollinated each of the two accessions for 10 generations. Both accessions have white flowers, and both have had white flowers each generation. You cross the two accessions and the F1 is red. The most likely explanation for this result is:
  - a. flower color is controlled by a gene in the mitochondrion.
  - b. flower color is an example how specific combinations of alleles at a single locus can cause lethality.
  - c. the alleles show incomplete penetrance
  - d. the two accessions have different alleles at two loci involved in flower color and these alleles complement in the F1.
  
4. In the case of partial dominance for a Naked Eye Polymorphism determined by alleles at a single locus, the homozygous dominant, heterozygote, and homozygous recessive individuals will
  - a. all look different.
  - b. all look the same.
  - c. occur in 1:1:1 ratio.
  - d. occur in a 9:3:7 ratio.

5. Komatsuda et al. identified six different recessive alleles at the *vrs1* locus. These recessive alleles confer a 6-row phenotype. Any given 6-row barley will have a maximum of how many of these different alleles?
- 1
  - 2
  - 3
  - 4
6. If a gene shows pleiotropy, the two alleles at the locus
- may show different types of allelic interaction (e.g. overdominance and partial dominance).
  - will not show any type of allele interaction.
  - will show epistasis.
  - cannot be encoding protein.

A toxic compound present in the roots of some *Datura* spp. is produced via a biosynthetic pathway. The pathway involves a precursor, an enzyme (1) which converts the precursor to an intermediate and another enzyme (2) which converts the intermediate to the toxin.



A mutation in either one of the enzymes results in no toxin production and makes the roots non-toxic. Enzyme 1 is encoded by alleles at the “A” locus (where A = functional enzyme 1; a = nonfunctional enzyme 1) and Enzyme 2 is encoded by alleles at the “B” locus (where B = functional enzyme 2; b = nonfunctional enzyme 2). The A and B alleles both show complete dominance at their respective loci. Use this information to answer questions 7 – 10.

7. An aaBB plant will
- not have roots.
  - accumulate precursor.
  - accumulate intermediate.
  - produce toxin.
8. An AABB plant will
- accumulate precursor.
  - accumulate intermediate.
  - produce toxin.
  - have roots but no shoots.
9. This example of a phenotype controlled by two loci showing inter-locus allelic interaction called
- codominance.
  - incomplete penetrance.
  - pleiotropy.
  - epistasis.

10. The A and B loci show independent assortment. In the F<sub>2</sub> generation of the cross between AAbb x aaBB, you would expect the following phenotypic ratio of toxic to non-toxic:
- 3:1
  - 1:1
  - 9:3:3:1
  - 9:7
11. The situation where heterozygotes at a locus are most fit - e.g. they have the highest phenotypic value - is called:
- overdominance
  - underdominance
  - codominance
  - dominance
12. Epistasis
- is the consequence of alleles at distinct loci failing to assort independently.
  - is very rare.
  - never occurs with linked loci.
  - could involve a transcription factor encoded by locus "x" repressing locus "y".
13. DNA polymerase synthesizes new deoxyribonucleotide chains in which direction?
- 5' to 3' in both the leading strand and the lagging strand.
  - 3' to 5' in the leading strand.
  - 3' to 5' in the lagging strand.
  - 5' to 3' in the leading strand and 3' to 5' in the lagging strand.
14. Which of the following best describes three key attributes of DNA:
- usually single stranded, ribose, U instead of T
  - deoxyribose, information in codons, occasional errors in replication
15. In higher plants, each chromosome has a single bidirectional origin of DNA replication located at the telomere.
- T
  - F
16. The RNA primers that initiate DNA replication in the S phase of mitosis
- are found only on lagging strands.
  - are eventually removed and replaced with the corresponding DNA nucleotides.
  - remain in the daughter strands until the organism dies.
  - are the sites where chromatid exchange occurs.

17. Telomerase is an enzyme responsible for
- breaking phosphodiester bonds.
  - ensuring that chromosomes in some types of cells do not shorten at every mitotic division.
  - making cuts in double stranded DNA at specific recognition sequences.
  - degrading DNA in a 3' to 5' direction.
18. What process gives rise to new alleles?
- levitation
  - recombination
  - translation
  - mutation
19. What process gives rise to new combinations of alleles at different loci?
- recombination
  - translation
  - levitation
  - mutation
20. The RNA primers that initiate DNA replication are the same as those that initiate transcription.
- T
  - F
21. DNA replication is semiconservative because
- both parental strands serve as templates for transcription.
  - only one parent strand serves as a template for transcription.
  - DNA polymerase is socially liberal but fiscally responsible.
  - promoters have consensus sequences.
22. In a deoxyribonucleotide, 5' and 3' refer to the
- carbons where (respectively) the pyrimidine and purine bases are attached.
  - short pieces of RNA that initiate DNA replication.
  - carbons where (respectively) the phosphate and hydroxyl groups are attached.
  - the number of nucleosomes in homologous chromosomes.
23. One RNA primer is sufficient for initiating replication of the leading strand whereas a new primer is needed for each Okazaki fragment on the lagging strand.
- T
  - F
24. An RNA primer is required to initiate DNA replication because
- DNA polymerase can only add nucleotides to a free 3' OH.
  - the RNA primer opens up the helix and makes single stranded DNA.
  - the RNA primer joins Okazaki fragments and remains in the daughter strands.

25. Which of the following steps is **not** associated with PCR of genomic DNA?
- Hybridization of DNA to RNA
  - Denaturation of target DNA
  - Addition of single stranded oligonucleotides
  - Hybridization of primers to the DNA template
26. Southern hybridization refers to:
- A cross between red and white magnolias, made in New Orleans
  - DNA: RNA hybridization
  - DNA: DNA hybridization
  - Protein: antibody hybridization
27. Which of the following is the best example of a SNP-based marker that would be useful for mapping a flowering-time gene in progeny of the cross between two inbred parents?
- A 20 nucleotide deletion in the first intron of the gene in one parent vs. the presence of 20 nucleotides at the corresponding positions in the second parent.
  - A “T” in one parent vs. a “C” in the other parent, at the same nucleotide position, in the first exon of the gene.
  - Twenty “AT” repeats in the 3’UTR of one parent vs. 10 “AT” repeats in the 3’ UTR of the other parent.
  - Complete deletion of the gene in one parent vs. presence of the gene in the other parent.
28. The two underlying principles of molecular marker design are
- duplication and deletion.
  - amplification and hybridization.
  - sense and antisense.
  - linkage and pleiotropy.
29. For DNA marker analysis, electrophoresis is used to
- increase the number of desired fragments.
  - extract DNA from the target organism.
  - radioactively label fragments.
  - separate DNA fragments by size.
30. The primers that are used for a PCR reaction to amplify genomic DNA consist of
- mRNA.
  - Taq polymerase.
  - deoxyribonucleotides.
  - amino acids.
31. Which of the following restriction enzymes will cut most often in double stranded genomic DNA?
- An enzyme with a four base recognition site.
  - An enzyme with a six base recognition site

32. In the case of a codominant molecular marker, the expected phenotypic ratio in the F<sub>2</sub> progeny of the cross between two completely inbred lines will be
- 1:1
  - 1:2:1
  - 3:1
  - 9:3:3:1
33. The highest temperature steps in a PCR reaction are necessary for
- denaturation of the DNA.
  - primer annealing.
  - primer extension.
  - cutting at palindromic sequences.
34. RFLPs are
- a type of vector.
  - a type of morphological marker.
  - identified by using the same restriction enzyme and clone to visualize fragments of different lengths in two or more genotypes.
  - based on a combination of restriction enzyme and oligonucleotides as adapters and amplification agents.
35. RNA is different from DNA in that
- RNA has the base uracil whereas DNA has the base thymine.
  - RNA is always single stranded whereas DNA is always double stranded.
  - RNA is transcribed 3' → 5'.
  - RNA is found only in prokaryotes.
36. A promoter is
- a specific sequence in the 3'UTR.
  - translated as methionine.
  - the site of assembly of ribosomes.
  - a binding site for RNA polymerase.
37. If there is a change in the promoter of a gene leading to a loss of the TATA sequence, this could lead to a recessive allele due to:
- failure of transcription of the gene to a mRNA.
  - failure to add a 3' tail to the mRNA corresponding to this gene.
  - failure of translation of the mRNA corresponding to this gene.
  - failure of the protein to assume its three-dimensional configuration.
38. The transcription of mRNA from the template DNA stops when
- a stop codon is encountered.
  - the telomere is reached.
  - the polymerase encounters the promoter.
  - a specific sequence in the DNA template is reached that serves as a signal for termination.

39. mRNA processing in eukaryotes refers to
- 3' caps, 5' tails, and exon removal.
  - 5' caps, 3' tails, and intron removal.
  - transport of the mRNA to the cytoplasm.
  - coupling of the 35S and 18S ribosomal subunits.
40. Exons are always longer than introns.
- T
  - F
41. One of the explanations for the fact that in eukaryotes ~ 25,000 genes can specify ~ 100,000 proteins is
- alternative 5' capping.
  - alternative use of 3' and 5' promoters.
  - alternative removal of introns and splicing of exons.
  - each gene is transcribed 5' to 3' and 3' to 5' on leading and lagging strands.
42. Transfer RNAs (tRNAs)
- are weighed and the average weight is used to calculate Svedberg units.
  - are very specialized, with each tRNA able to carry a specified amino acid.
  - are very generic, with each tRNA able to carry any of a number of amino acids.
  - are coded for by sequences in introns.
43. The point of attachment of an amino acid to a tRNA is
- at the anticodon.
  - at the 5' end.
  - at the 3' end.
  - at either the 5' or 3' end.
44. Ribosomes are
- coded for by nuclear genes.
  - specific to each type of mRNA.
  - formed by exon shuffling.
  - double stranded RNA molecules.
45. The mechanism by which a stop codon stops translation is that
- tRNAs with affinity to the stop codon always bring methionine.
  - polymerases have exonuclease activity.
  - there are no tRNAs with anticodons matching the stop codon.
  - the ribosomes pinch off the completed sequence of amino acids.

A DNA **sense** strand is: 5' ATG GCC TGG ACT TCA 3'. Based on this information, answer questions 46-48.

46. Which is the corresponding DNA antisense strand?

- a. 3' TAC CGG ACC TGA AGT 5'
- b. 5' TAC CGG ACC TGA AGT 3'
- c. 3' UAC CGG ACC UGA AGU 5'
- d. 5' UAC CGG ACC UGA AGU 3'

47. Which is the corresponding mRNA?

- a. 3' UAC CGG ACC UGA AGU 5'
- b. 5' UAC CGG ACC UGA AGU 3'
- c. 5' AUG GCC UGG ACU UCA 3'
- d. 3' AUG GCC UGG ACU UCA 5'

48. Which is the correct translation?

- a. Tyr Arg Thr Stop Ser
- b. Thr Ser Gly Pro Val
- c. Met Ala Trp Thr Ser
- d. Ser Thr Trp Ala Met

49. If you know the amino acid sequence of a polypeptide you can deduce the exact DNA code of the corresponding gene.

- a. T
- b. F

50. The primary structure of a protein refers to

- a. the linear amino acid sequence.
- b. its 3- dimensional configuration.
- c. multiple components of a protein coming together.
- d. the DNA sequence.