CSS/Hort 430/530 Exam 2 2011

Given the following DNA sense template (antisense) strand sequence
3’ tac ctg tgt atc 5’

1. Which is the correct sense strand sequence?
    a. 5’ tac ctg tgt atc 3’
    b. 3’ tac ctg tgt atc 5’
    c. 3’ atg gac aca tag 5’
    d. 5’ atg gac aca tag 3’
2. Which is the correct mRNA sequence?
    a. 5’ aug gac aca uag 3’
    b. 5’ uac cug ugu auc 3’
    c. 3’ uac cug ugu auc 5’
    d. 3’ aug gac aca uag 5’
3. Which is the correct amino acid sequence (assume left is N terminal end of the polypeptide)? See table on page 9!
    a. Thr Asp Met
    b. Met Asp Thr
    c. His Phe Val
    d. None of the above
4. The concept of “one gene: one polypeptide” is
    a. Absolutely true
    b. is a generalization that needs to be qualified by adding that not all genes encode polypeptides
    c. is a generalization that needs to be qualified by adding that some genes may encode multiple polypeptides due to alternative splicing
    d. B and C above
5. RNA differs from DNA in that
    a. It is usually single stranded
    b. It contains ribose rather than deoxyribose
    c. It contains the base uracil rather than thymine
    d. All of the above
6. mRNA is an example of informational RNA
    a. True
    b. False
7. tRNA consists of 28S and 5.8S subunits
    a. True
    b. False

8. The ribosome is a complex of RNA subunits and proteins required for translation
    a. True
    b. False
9. There are different types of RNA polymerases and they have specialized roles in transcribing DNA for rRNA, tRNA, and mRNA
    a. True
    b. False
10. When RNA has a regulatory role, as in RNAi, this involves
    a. Removing genes from the DNA
    b. Methylating the DNA
    c. Degrading mRNA transcripts
    d. Removing 3' caps and 5' tails
11. Where would you expect to find a TATA box?
    a. Intron
    b. Exon
    c. 5'UTR
    d. Promoter
12. The DNA sequence between the transcription start site and the start codon is the
    a. Promoter
    b. 5'UTR
    c. ORF
    d. 3'UTR
13. You are interested in the sequence of the introns in the BAD2 gene of rice. You retrieve from a database two types of sequence: CDS and ORF. Where will you find the intron sequences you seek?
    a. In ORF
    b. In CDS
    c. In both ORF and CDS
    d. Somewhere else, since neither CDS nor ORF sequences include introns
14. Both transcription and translation terminate when a stop codon is encountered
    a. True
    b. False
15. The stop codons specify dideoxy-tRNAs that prevent further synthesis of the primary polypeptide
    a. True
    b. False
16. Introns are usually longer than exons
    a. T
    b. F

17. Your local supplier of useful genetic information offers you SNPs based on ESTs. What is she referring to?
    a. INDELs based on microsatellites
    b. Consensus promoter sequences
    c. Probes labeled with 32P
    d. Single nucleotide differences between two or more individuals based on sequencing of transcribed genes
18. In the case of the *BAD2* gene of rice, the evidence provided is that
    a. Aromatic rice has a complete functional copy of the gene
    b. Aromatic rice has a premature stop codon in the gene
    c. The transcript encoded by the aromatic rice allele is degraded by a double stranded RNA
    d. Aroma is determined by a prion
19. The following example showing sequence and codon alignments, as well as the translated protein, is an example of what type of mutation?
    a. Frameshift
    b. Missense
    c. Nonsense
    d. Silent

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*** CTGGGAGATTATGGCTTTAAG***
*** CTGGGA- - - - - - - - - -TAAG***   11 bp deletion, alignment

 *** CTG GGA GAT TAT GGC TTT AAG
 *** CTG GGA TAA  G                   codon alignment

      Leu Gly Asp Tyr Gly Phe Lys
      Leu Gly STOP G                  translation
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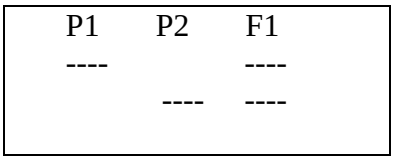
20. The functional properties of a protein are determined only by its primary structure
    a. True
    b. False
21. Certain plant proteins can have very different effects on different people – for example, the wheat endosperm storage proteins. Which of the following best describes principal advantages and disadvantages of these proteins?
    a. Key source of antioxidants: cause mad cow disease
    b. Allow bread dough to rise: can cause celiac disease
    c. Make wheat semi-dwarf: require excessive applications of nitrogen
22. The best definition of overdominance is
    a. The alleles at a locus show epistasis
    b. Homozygotes are more fit (have high phenotypic value) than heterozygotes
    c. Heterozygotes are more fit (have high phenotypic value) than homozygotes
    d. Both alleles at the locus have the same effect

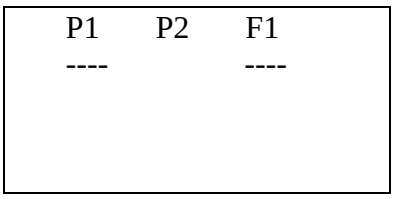
23. Which of the following is the best example of incomplete (partial) dominance?
    a. Cross red flower x white flower and obtain red flower
    b. Cross red flower x white flower and obtain white flower
    c. Cross red flower x white flower and all progeny are red in all subsequent generations as long as the red flower individual is the female
    d. Cross red flower x white flower, F1 is pink, and the F2 ratio is 1 red: 2 pink: 1 white

The following diagram illustrates the results of electrophoresis of PCR products, representing two possible alleles at a marker locus, from genomic DNA of Parent 1(P1), Parent 2 (P2), and the F1 derived from crossing P1 x P2. Use this diagram to answer questions 24 and 25.



24. The electrophoresis of these PCR products reveals marker alleles that show
    a. Complete dominance
    b. Overdominance
    c. Codominance
    d. Incomplete penetrance
25. Regarding the "bands" for P1 and P2, which one represents the smaller amplicon (i.e. shorter in terms of number of base pairs)?
    a. P1
    b. P2
    c. Neither one – they are the same size

The following diagram illustrates the results of electrophoresis of PCR products, representing two possible alleles at a marker locus, from genomic DNA of Parent 1(P1), Parent 2 (P2), and the F1 derived from crossing P1 x P2. Use this diagram to answer questions 26 and 27.



26. The electrophoresis of these PCR products reveals marker alleles that show
    a. Complete dominance
    b. Overdominance
    c. Codominance
    d. Incomplete penetrance

27. The lack of a band in Parent 2, and the lack of the parent 2 band in the F1, would be expected if Parent 1 was a Roundup Ready plant with the EPSPS gene and Parent 2 was a non-Roundup Ready plant without the EPSPS gene.
    a. True
    b. False
28. In the case of the epistatic interaction between *VRN2* and *VRN1* the hypothesis is that, in the absence of a period of cold treatment (vernalization),
    a. A premature stop codon in *VRN1* prevents expression of the gene in winter types
    b. A repressor encoded by *VRN2* binds to *VRN1*, thus preventing the expression of *VRN1*
    c. The mRNA transcribed from *VRN1* is degraded by *VRN2*
    d. All of the above
29. Recessive alleles can be due to
    a. Gene deletion
    b. Changes in gene sequence leading to altered transcription
    c. Changes in gene sequence leading to altered translation
    d. All of the above
30. In the case of two-locus epistasis (assume the loci show independent assortment), which of the following ratios would NOT be expected in an F1-derived doubled haploid population?
    a. 2:2 (= 1:1)
    b. 3:1
    c. 1:2:1
    d. 9:7
31. Epistasis is a very rare condition and it never applies to linked loci
    a. True
    b. False
32. If epistasis is known to exist for two loci, altered patterns would be observed in what type(s) of progeny?
    a. F2
    b. Testcross
    c. Doubled Haploid
    d. All of the above
33. Genotyping by sequencing (GBS) will become be so cheap and accessible that in the future the sections on “linkage mapping” and “genes to phenotypes” can be dropped from this class because they will be irrelevant and useless.
    a. True
    b. False

34. A bacterial artificial chromosome (BAC) vector is best defined as
    a. A plasmid that transmits infectious diseases
    b. A technique for asexually transferring genes from bacteria to plants
    c. A tool for cloning whole plant chromosomes
    d. A tool for cloning relatively large (~ 200 kb) fragments DNA
35. If you were interested in obtaining intron and "dark matter" DNA sequence, what type of library would be most suitable?
    a. cDNA
    b. Benton
    c. Genomic
36. PCR
    a. Technique based on hybridization of labeled single strand DNA probe and single strand target DNA
    b. Technique for specifically amplifying a target sequence of DNA
37. Restriction enzyme
    a. Thermostable DNA polymerase
    b. Cuts DNA at specific recognition sequence
38. TAQ
    a. Thermostable DNA polymerase
    b. Non-thermostable DNA polymerase
39. A dideoxy nucleotide
    a. Stops DNA synthesis because a phosphate group cannot attach to the 5' carbon
    b. Accelerates DNA synthesis because it has two 3' OH groups
    c. Has two phosphate groups – one attached to the 5' carbon and one to the 1' carbon
    d. Is useful for DNA sequencing because it lacks a 3'OH
40. The current (2011) cost of sequencing the genome of a plant with a genome size of 300 Mb is approximately $1,000
    a. True
    b. False
41. The genome sizes of cocoa and strawberry fall into which of the following ranges
    a. 100 - 500 Kb
    b. 100 - 500 Mb
    c. 1,000 – 5,000 Mb
    d. 10,000 – 50,000 Mb
42. The genome sizes of plants are directionally proportional to their physical sizes: e.g. small plants have small genomes and big plants have big genomes
    a. T
    b. F

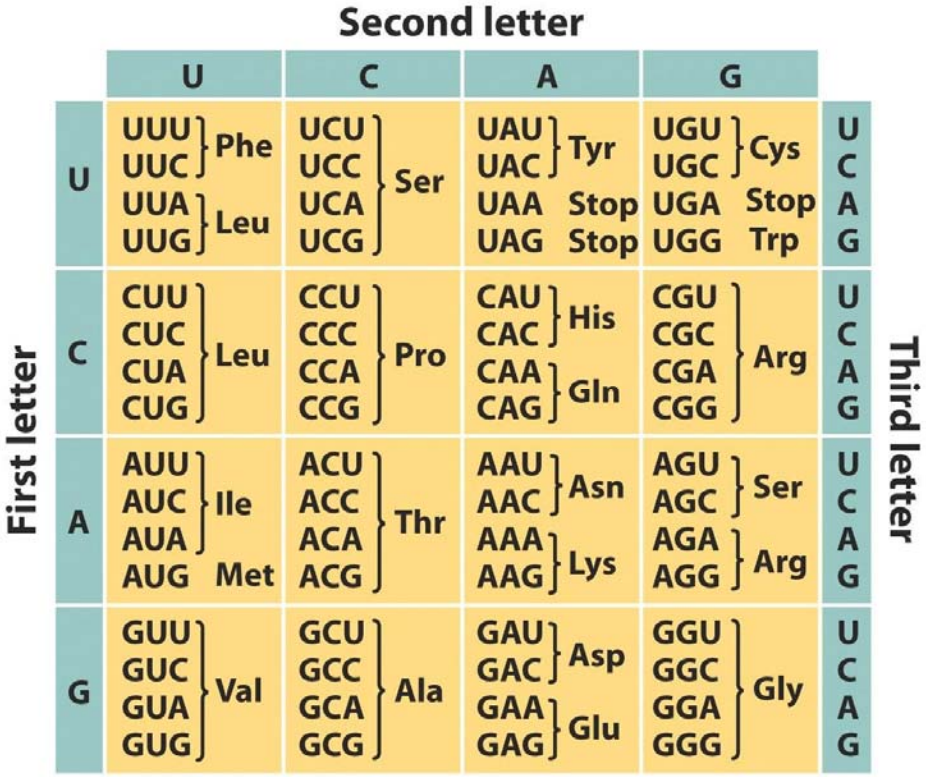
43. A “perfect” molecular marker is one that
    a. Is tightly linked to the target gene of interest
    b. Interacts epistatically with the target gene of interest
    c. Is always monomorphic
    d. Is located in the target gene of interest
44. Molecular markers can be based on
    a. Single nucleotide polymorphisms (SNPs)
    b. Insertions/deletions (InDels)
    c. Restriction sites
    d. All of the above
45. A constitutive promoter is one that allows
    a. a transgene to be expressed only in a specific tissue and at a specific stage of plant development
    b. a transgene to be expressed in all tissues all the time
    c. a transgene to engage in gene flow
    d. a transgene to be detected under ultraviolet light
46. One of the principal limits to transgenic technology in plants is that the genes, and portions of genes (e.g. promoters, coding sequences, introns, terminators) must originate (i.e. be obtained from) plants.
    a. T
    b. F
47. The Tnos terminator sequence specifies a stop codon.
    a. T
    b. F
48. Which of the following is an example of a reporter gene?
    a. Hygromycinphosphotransferase (nptII)
    b. EPSPS
    c. Green fluorescent protein (GFP)
    d. Tnos
49. A principal advantage of the Agrobacterium method of gene transfer is
    a. there is no need to use selectable markers
    b. the technology is not subject to any government regulation
    c. scientists can choose exactly where on the chromosome the DNA will be inserted
    d. none of the above
50. The Pray ‘n’ Sray chemical company puts an herbicide resistance gene (originating from a bacterium) into sugarbeet. A sugarbeet plant homozygous for the herbicide resistance gene cross-pollinates with an edible beet plant homozygous for the lack of the herbicide resistance gene to produce and F1. You would expect the doubled haploids derived from this F1 to segregate
    a. 3 resistant: 1 susceptible
    b. 1 resistant: 1 susceptible
    c. 3 susceptible: 1 resistant
    d. 1 resistant: 2 moderately resistant; 1 susceptible

51. Selectable markers, such as antibiotic resistance genes, are included in a transgene construct because
    a. the transgenic plants are more resistant to *Agrobacterium tumefaciens*.
    b. it is an effective mechanism for limiting gene flow.
    c. it is a convenient way to distribute human vaccines in transgenic fruits.
    d. it is more efficient to select for transformed cells *in vitro* than at the whole plant level.
52. Reporter genes are included in transgenic constructs in order to
    a. enhance the level of expression of the transgene.
    b. ensure inducible expression of the transgene.
    c. provide a mechanism for localizing and/or quantifying gene expression.
    d. enhance public awareness of transgenic technology via a free press.
53. The minimal requirements for a transgene construct are
    a. promoter, coding region, and terminator
    b. coding region only
    c. selectable marker only
    d. start and stop codon
54. If you use a promoter that is expressed only in floral tissue it would be best described as
    a. 35S
    b. Ribosomal
    c. Constitutive
    d. Tissue-specific
55. If you wanted to use a reporter gene to determine at what stages and in what tissues a particular promoter regulates gene expression, you would use
    a. GUS or GFP
    b. The 35S promoter
    c. Golden rice as your test plant
    d. The EPSPS gene
56. A genetic engineering technique that involves microprojectile bombardment of tissues with small particles coated with transgene DNA is known in the popular press as
    a. the gene gun method
    b. the agrobacterium method
    c. the pollen pathway method
    d. the sexual reproduction method
57. The principal drawback to the Agrobacterium method of gene transformation is that all the transformed plants also have crown gall disease.
    a. T
    b. F
58. The creeping bentgrass (*Agrostis stolonifera*) case study presented in class was of particular interest because
    a. it is a success story because the EPSPS gene was completely contained
    b. it is an example of using transgenic technology to improve human health via higher vitamin A content in a species that lacks the biosynthetic pathway
    c. it resulted in significant gene migration outside the containment area
    d. it is an example of there being no way to determine if transgenes can migrate

You grow a certified organic crop that is diploid and has perfect flowers. Although usually self-pollinated, the crop can cross-pollinate. Your farm is surrounded by farms growing a transgenic variety that is resistant to herbicide "X". You would like to know if there is gene flow from the homozygous transgenic variety to your homozygous non-transgenic variety. You save (F1) seed from your plants that you suspect were pollinated by the transgenic variety. Use this information to answer questions 59 and 60.

59. You spray the F1 plants with herbicide "X". If there has been gene flow from the transgenic to the non-transgenic variety you would expect the F1 to all be resistant to herbicide "X" because the F1 plants are
    a. Homozygous for the herbicide resistance gene
    b. Hemizygous for the herbicide resistance gene
60. Assume you have PCR primers specific for the herbicide resistance gene. Electrophoresis reveals a dominant molecular marker: a band is observed only when the transgene is present. You run this diagnostic test on DNA from each of 100 F2 plants derived from a self-pollinated F1 plant that was resistant to herbicide "X'. What F2 ratio do you expect (based on bands in the gel)? + = band present; - = band absent
    a. ~ 75+: 25-
    b. ~ 25+:75-
    c. ~ 50+:50-
    d. ~ 100+

For use in answering Question # 3.



Extra credit: You would like to develop an aromatic variety of rice using marker assisted selection. Assume you have (1) a population of 100 doubled haploids derived from the F1 of the cross between an aromatic x a non-aromatic variety and (2) PCR primers that reveal codominant polymorphisms for contrasting alleles at *BAD2* and at two molecular markers linked to *BAD2*. The linkage map in your doubled haploid population looks like this:

_____Marker 1 _____10cM_____*BAD2*_____10cM_____Marker 2 ___

61. If you select for the target allele at *BAD2* using PCR primers specific the gene, how many aromatic doubled haploids would you expect?
    a. ~1
    b. ~10
    c. ~50
    d. ~100
62. If you select for aroma using linked marker 1 only, approximately how many doubled haploids would ***not*** have the expected aroma phenotype?
    a. ~1
    b. ~10
    c. ~50
    d. ~100
63. If you select for aroma using linked markers 1 ***and*** 2, approximately how many doubled haploids would ***not*** have the expected aroma phenotype?
    a. ~1
    b. ~10
    c. ~50
    d. ~100