

PBG430/530
Exam 2 2016

1. Non-sister chromatid exchange
 - a. Leads to significant addition and losses of genetic information
 - b. Is one the principal causes of genome expansion (the C-value paradox)
 - c. **Does not lead to the loss or addition of chromatin**
 - d. Occurs in both mitosis and meiosis

2. Assuming that there is no loss or gain of chromatin with sister chromatid exchange, there will no consequences in terms of meiosis generating new combinations of alleles at linked loci.
 - a. **T**
 - b. F

3. Which meiotic phenomenon would you hypothesize to be most related to the synaptonemal complex?
 - a. Spindle fiber formation
 - b. Cytokinesis
 - c. Alignment of paired homologous chromosomes at Metaphase I
 - d. **Crossing over**

4. If you calculate a recombination value of 30% between two loci and convert this value to centiMorgans (Haldane or Kosambi)
 - a. **The cM value will be larger than the % recombination value**
 - b. The cM value will be smaller than the % recombination value
 - c. The cM value will be the same as the % recombination value

5. If you calculate a recombination value of 3% between two loci and convert this value to centiMorgans (Haldane or Kosambi)
 - a. The cM value will be larger than the % recombination value
 - b. The cM value will be smaller than the % recombination value
 - c. **The cM value will be the same as the % recombination value**

6. Regions around the centromere are generally heterochromatic and therefore will have, on average, more Mb/cM than euchromatic regions with higher recombination rates.
 - a. **T**
 - b. F

7. Assuming you have sufficient markers to generate a medium density linkage map with an average spacing of 3 cM in a species that is $2n = 2x = 30$, how many linkage groups would you expect?
- 10
 - 15
 - 20
 - 30
8. In linkage maps based on different crosses within the same species, locus orders will usually be consistent but estimates of distance will vary
- T
 - F
9. 2 strand double crossovers, 3 strand double crossovers, and 4 strand double crossovers will lead to different outcomes in terms of parental and non-parental combinations of alleles at linked loci
- T
 - F

Consider two loci. One locus (Y) controls flower color. A second locus (F) determines flavor. YY and Yy = yellow; yy = white. FF and Ff = no flavor; ff = flavor. One parent is YYFF and the other parent is yyff. You score the two traits in 100 doubled haploid progeny and record the following data:

Yellow and no flavor	Yellow and flavor	White and no flavor	White and flavor
46	6	4	44

10. The non-parental classes are
- 46 and 44
 - 6 and 4
 - Not identifiable given these data
11. Because the two loci are reported to be on the same chromosome, you want to see if they are linked in your cross. To do so, you would divide
- The parental classes/100
 - The non-parental classes/100
 - The non-parental + parental classes/100

12. Which of the following are the best examples of utility of linkage maps for plant geneticists?
- Gene discovery
 - Measuring transcription rates of specific genes
 - Understanding synteny
 - All of the above
 - A and C
13. Alleles at loci on different chromosomes should always show independent assortment, if they do not, one should very carefully check the data
- T
 - F
14. Loci “far enough” apart on same chromosome show independent assortment – due to “sufficient” crossovers between the loci in a population of individuals
- T
 - F
15. If a linkage map has an average marker density of 5 cM, it is safe to assume that there was complete interference between adjacent linked markers
- T
 - F
16. You observe that in a very large ($n = 1000$) F₂ population derived from the cross of two completely homozygous parents, two specific combinations of traits are always inherited together: all purple-flowered progeny are susceptible to a fungal disease and all white-flowered progeny are resistant to the fungal disease. This is most likely a case of
- Pleiotropy
 - Linkage (with 15% recombination between genes)
 - Codominance
 - Epigenetics
17. Synteny is best defined by which of the following?
- Alternative intron splicing, leading to more than one protein being specified by the same gene
 - The situation where multiple loci with similar functions are found in the same order on chromosomes, or sections of chromosomes in two different organisms (e.g. oats and rice)
 - The situation where genes in two different species (e.g. barley and rice) have in common a single ancestral gene

18. One of the features of DNA that makes it an ideal genetic material is that it is capable of change. Which of the following terms best describes the “capability for change”?
- Semiconservative replication
 - Information content
 - Mutation
 - None of the above
19. In the following sketch of a deoxyribonucleotide, the 3' and the 5' carbons are labeled correctly. *In the sketch, the carbon with the phosphate group attached was labeled as 1 and the rest of the carbons were labeled in consecutive order, clockwise.*
- T
 - F
20. Which of the following is **not** essential for DNA synthesis?
- A promoter
 - dNTPs
 - Template DNA
 - DNA polymerase
21. There is one origin of replication in each eukaryotic chromosome and it is located at the centromere
- T
 - F
22. During DNA replication in the S phase of mitosis, the primers that initiate replication consist of
- DNA
 - RNA
 - Transcription factors
23. DNA polymerases exist in only one form and their single function is to add nucleotides to the 3' end of a developing strand of DNA.
- T
 - F
24. At a bidirectional replication fork, lagging strands are
- Where the daughter strands are synthesized 3' to 5'
 - Always on top
 - Where Okazaki fragments occur
 - Responsible for selective abortion of floral organs

25. The loss of DNA at telomeres during mitosis is due to
- Colchicine interfering with the formation of spindle fibers
 - Unequal sister strand crossovers
 - DNA replication issues**
26. The different types of RNA can be classified as informational, functional, and regulatory. Which of the following is an example of a functional RNA?
- mRNA
 - rRNA**
 - fRNA
 - RNAi
27. Given the following DNA sense strand–5' ATG GCC TGG ACT TCA 3', which is the corresponding DNA antisense strand?
- 5' TAC CGG ACC TGA AGT 3'
 - 5' UAC CGG ACC UGA AGU 3'
 - 3' TAC CGG ACC TGA AGT 5'**
 - 3' UAC CGG ACC UGA AGU 5'
28. In a eukaryotic cell, a gene such as *BAD2* in rice, is transcribed in the cytoplasm and translated in the nucleus.
- T
 - F**
29. Which of the following components of a gene would be the start site for transcription?
- Promoter**
 - Start codon
 - Intron
 - Exon
30. Which of the following UTRs will be involved in the addition of the poly A tail during mRNA processing?
- 5'
 - 3'**
31. Introns are always removed at exactly the same places in the DNA code and that is why each and every gene encodes one and only one protein
- T
 - F**

32. An example of the degeneracy of the genetic code is:
- The same codon can specify more than one amino acid
 - UUU and UUC both specify phenylalanine
 - Of the 64 codons, 61 are stop codons
33. During translation, incoming tRNAs transporting amino acids arrive at the
- A site
 - P site
 - E site
34. Using the DNA code table on the last page of this exam, which type of mutation is shown in the following aligned sequences (substitution of G for T at nucleotide position 12)? Sense strands are shown.
- CTG GGA GAT TAT GGC TTT AAG
CTG GGA GAT TAG GGC TTT AAG
- Silent
 - Pretense
 - Missense
 - Nonsense

Please indicate which of the following definitions or statements of relationships between alleles at a locus are true and which are false:

35. Complete dominance = heterozygote advantage
- T
 - F
36. Complete dominance = homozygote recessive phenotype could be due to premature stop codon
- T
 - F
37. Codominance = heterozygotes can be distinguished from homozygous dominant and homozygous recessive using electrophoresis
- T
 - F
38. Incomplete dominance at a locus = example of epistasis
- T
 - F

39. Using codominant markers for linkage map construction would be most advantageous in which type of population?
- F₂
 - Doubled haploid
40. Using a dominant molecular marker has the disadvantage that heterozygotes cannot be distinguished from recessive homozygotes
- T
 - F
41. If inbred lines of maize can be developed that are good as F₁ hybrids why do seed companies persist in selling F₁ hybrid seed?
- It is an excellent business proposition because if farmers save F₁ seed, the next generation will be F₂ and nothing like the F₁
 - It is easier to produce hybrid seed than inbred seed
42. If the overdominance theory of heterosis, and only that theory were correct, it should be possible for plant breeders to develop inbreds as good as F₁ hybrids
- T
 - F
43. According to Schnable and Springer (2013), which of the following genetic phenomema are involved in heterosis?
- SNPs
 - INDELs
 - Copy number variation
 - Structural variation
 - All of the above
44. Epistasis is a very unusual genetic phenomenon that is observed only in squash (*Cucurbita pepo*).
- T
 - F
45. In the example of cyanide content in clover (duplicate recessive epistasis where a dominant allele is necessary at each locus in order to have the cyanide phenotype), one would expect a 9 cyanide:7 no cyanide ratio in the F₂ and a 1 cyanide:3 no cyanide ratio in a doubled haploid population.
- T
 - F

46. Epistasis occurs only when there are two loci involved and the loci show independent assortment.
- T
 - F**
47. Vernalization sensitivity in barley (and other cereals) is most related to which of the following?
- Disease resistance
 - Low temperature triggering a vegetative to reproductive transition**
 - The number of fertile florets per rachis node
 - High temperature tolerance
48. In the assigned reading on vernalization genetics, which of the following is most true?
- In homozygotes, only 1/16 of the possible combinations of alleles leads to facultative growth habit
 - In homozygotes only 1/8 of the possible combinations of alleles leads to vernalization sensitivity**
49. Which of the following tools was used by Cuesta-Marcos et al. (2015) use to build on the work of Takahashi and Yasuda (1971)?
- Light microscopy to see where crossovers occurred in each chromosome
 - RNAi
 - CRISPER-cas 9
 - SNPs in linkage map order to define the location and extent of the chromosome segments transferred to the winter recurrent parent from the spring allele donors.**
50. Cuesta Marcos et al.(2015) provide evidence that if there are winter alleles at *VRN-H1* and *VRN-H3* and *VRN-H2* is deleted, the resulting isogenic line is
- Susceptible to low temperature and requires vernalization
 - Resistant to low temperature and does not require vernalization**
 - Resistant to low temperature and requires vernalization
 - Susceptible to low temperature and does not require vernalization

Extra credit:

You read in a journal article that two loci are on the same chromosome according to a map made in a doubled haploid population. But when you calculate the % recombination between the two loci in an F2 population derived from the same cross it is 50%. Which of the following is the most likely explanation?

- There were 25 crossovers between the two loci in the F1 and 25 crossovers between the two loci in the F2.
- Linkage cannot be calculated from F2 data.
- The authors of the journal article probably had more markers available to make their map than you do, and these markers are between the two loci in question.**
- If you converted your % recombination estimate to Haldane cM, it would give a value less than 50.