Exam 1 2010
Plant Genetics CSS/Hort 430/530

Barley can produce seed which is hulled or hull-less. This trait is determined by one gene, hulled being the dominant phenotype and hull-less being the recessive. A barley plant which is homozygous dominant for this trait is crossed with one which is homozygous recessive. The F1 was then allowed to self-pollinate, producing a population of 100 F2 plants. In the F2, 70 plants were observed to be hulled and 30 were hull-less. Answer questions 1 - 5 *based on this information.*

1. This trait shows what kind of inheritance?
    a. Quantitative
    b. Qualitative

2. What ratio of hulled to hull-less would you expect in the F1?
    a. 1:1
    b. 2:1
    c. 3:1
    d. all hulled
    e. all hull-less

3. What ratio of hulled to hull-less would you expect in the F2?
    a. 1:1
    b. 2:1
    c. 3:1
    d. all hulled
    e. all hull-less

4. What is the chi square value $(X^2 = \Sigma(O-E)^2/E)$ for the F2?
    a. 1.333
    b. 1
    c. 0.5
    d. 0.333

5. At what level of probability do you accept the null hypothesis?
    a. 0.01-0.025
    b. 0.05-0.1
    c. 0.1-0.5
    d. 0.5-0.9

6. If alleles at seven loci determine a particular phenotype, the segregation and independent assortment of alleles at these loci in the doubled haploid progeny of a cross between two inbred individuals would be expected to give what type of phenotypic frequency distribution?
    a. Continuous
    b. Discontinuous
    c. Qualitative
    d. Dysfunctional

7. What is (currently) the simplest and most cost-effective way to determine if a plant has two contrasting alleles at a locus that determines flower color?
    a. Extract DNA and sequence the genome of the two parents
    b. Test for a 3:1 ratio in the F_2 progeny
    c. Asexually propagate the two parents
    d. test for a 9:3:3:1 ratio in the F2 progeny

8. If a Tt female is fertilized by a tt male, the expected genotypic ratio of the progeny will be:
    a. 1:1
    b. 1:2
    c. 1:3:1
    d. not enough information

9. What would be the expected phenotypic ratio if Tt plants are tall and tt plants are short?
    a. 1 tall: 1 short
    b. 1 tall:2 short
    c. all tall
    d. all short

10. The phenotype determined by a recessive allele will be observed if an individual is
    a. homozygous recessive
    b. homozygous dominant
    c. heterozygous
    d. none of the above

11. Cytoplasmic inheritance in angiosperms is usually maternal, but there are examples of paternal inheritance of organelles in some angiosperms.
    a. True
    b. False

12. The reason that the focus of this plant genetics class is on nuclear rather than cytoplasmic genes is because
    a. There are more genes in the nuclear genome
    b. There are more genes in the organelles
    c. Only genes in the organelles show segregation and independent assortment
    d. The nuclear genomes were once free-living cyanobacteria

13. *From the reading "Solving the maze"*. Sequencing the corn (maize) genome revealed that the plant has ~ how many genes?
    a. 5,000
    b. 10,000
    c. 15,000
    d. 30,000

14. *From the reading "Six-rowed barley originated from …"*
    a. There are many possible alleles at the *Vrs1* locus and any given barley plant will have between 1 and 5 alleles at this locus.
    b. *Vrs1* encodes a transcription factor that regulates another gene
    c. The source of new alleles is recombination
    d. Alleles at the *Vrs1* locus show independent assortment at meiosis

15. If a diploid plant is 2n = 20, how many chromosomes will there be in a gamete?
    a. 5
    b. 10
    c. 20
    d. 30

16. If a plant has a perfect flower, it is most likely
    a. Hermaphroditic
    b. Dioecious
    c. Monoecious
    d. Sterile

17. In the case of a dioecious plant with defined X and Y sex chromosomes, there will most likely be
    a. less (or no) recombination between sex chromosomes than between autosomes
    b. more recombination between sex chromosomes than between autosomes
    c. the same amount of recombination between sex chromosomes and autosomes

18. What are the benefits of outcrossing?
    a. promotes heterozygosity
    b. promotes genetic variability
    c. avoids inbreeding depression
    d. all of the above

19. In the case of the T cytoplasm source of male sterility, susceptibility to the Southern Corn Leaf Blight disease is an example of
    a. Mueller's ratchet
    b. segregation
    c. pleiotropy
    d. independent assortment

20. In both angiosperms and gymnosperms, an effective strategy for limiting pollen transmission of transgenes is to put the transgenes into the chloroplast genome rather than the nuclear genome.
    a. True
    b. False

21. Autosomal inheritance refers to traits encoded by genes that are in
    a. chloroplast genomes
    b. sex chromosomes
    c. mitochondrial genomes
    d. nuclear chromosomes, except for sex chromosomes

22. *From the reading "Evolution of animal pollination"*. The hermaphroditic condition is ancestral in angiosperms and therefore the co-evolution of plants and insect pollinators only began ~ 10,000 years ago when plants were first domesticated.
    a. T
    b. F

23. Supermale asparagus plants (YY) are created by
    a. Crossing XY (male) with XY (male)
    b. Crossing XX (female) and XY (male)
    c. Asexually propagating XY males
    d. Creating doubled haploids from a male (XY) plant

24. *From the reading "A primitive Y chromosome in papaya marks incipient sex chromosome evolution"*. Mueller's ratchet, in the context of Y chromosome evolution, refers to
    a. An increase in genome size each generation
    b. The accumulation of deleterious recessive alleles
    c. The failure of spindle fibers to form in mitosis
    d. Phosphorylation of H2A

25. *From the reading "Sex chromosomes in flowering plants"*. Dioecy in angiosperms
    a. always involves clearly defined sex chromosomes
    b. is due to multiple alleles at the SI locus
    c. is not as prevalent as in animals
    d. is due to selective abortion of archesporial cells

26. *From the reading "The Texas cytoplasm of maize"*. The genetic basis of male sterility in the case of the T cytoplasm is due to an unusual gene in the
    a. centromere
    b. chloroplast
    c. nucleolus organizer region
    d. telomere
    e. mitochondrion

27. *From the reading "Evolution of the Brassica self-incompatibility locus"*. Many loci, each with two alleles, are thought to determine self-incompatibility
    a. T
    b. F

28. *From the reading "Directing the centromere guardian".*
    Which of the following proteins is the substrate for the enzyme Bub1?
    a. Kinetochore
    b. Synaptonemal complex
    c. Histone 2A
    d. Gluten

29. Meiosis has more stages than mitosis, but it does not take any longer.
    a. True
    b. False

30. The nucleolus, the site for the assembly of ribosomes, is not part of the chromosome.
    a. True
    b. False

31. Heterochromatin is more compact than euchromatin. Therefore the regions of the genome most likely to contain lots of genes would be in constitutive heterochromatin.
    a. True
    b. False

32. The synaptonemal complex is
    a. the protein matrix that surrounds the centromere
    b. observed during Pachynema between paired homologous chromosomes
    c. the end of the chromosome
    d. the point of attachment of spindle fibers

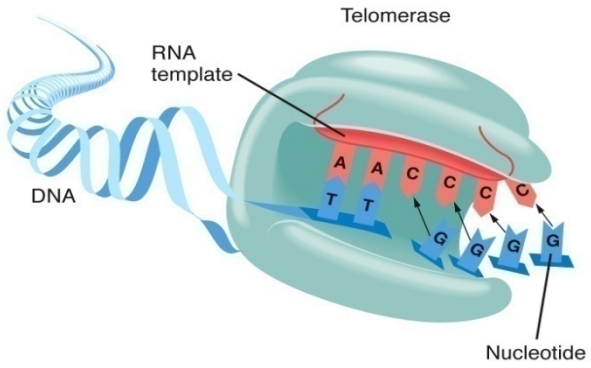
33. In a eukaryotic chromosome, the DNA is
    a. highly compacted
    b. complexed with histone proteins to make up the nucleosome structure
    c. a single molecule
    d. all of the above

34. Three “landmarks” of a nuclear chromosome are
    a. centromere, telomere, nucleolus
    b. nucleus, telomerase, DNA
    c. RNA, DNA, mRNA
    d. chloroplast, nucleolus, mitochondrion

35. Which of the following events produces two identical daughter cells?
    a. mitosis
    b. meiosis
    c. phosphorylation
    d. S phase

36. Which of the following events produces 4 daughter cells, each of which may be genetically different?
    a. mitosis
    b. meiosis
    c. phosphorylation
    d. S phase

37. What is happening in this picture?



    a. telomerase is destroying a centromere
    b. telomerase is 'reconstructing' the telomere
    c. telomerase is unraveling DNA to make a sister chromatid
    d. telomerase is creating a double strand break in prepartion for a crossover in meiosis

38. Which of the following events takes place in meiosis II but not meiosis I?
    a. crossing over
    b. contraction of chromosmes
    c. separation of homologous chromosomes
    d. separation of sister chromatids

39. Which is the correct order of stages in the cell cycle?
    a. G_1, S, G_2,prophase, metaphase, anaphase
    b. S, G_1, G_2,prophase, metaphase, anaphase
    c. prophase, S, G_1, metaphase, anaphase, G_2
    d. S, G_1, G_2, anaphase, prophase, metaphase

40. Which of the following is the most appropriate definition of a locus?
    a. one copy of a gene that encodes a specific trait
    b. one of two alleles
    c. the specific place on each of two homologous chromosomes where allelles of the same gene are located
    d. the constricted region on a chromosome where spindle microtubules attach

41. Single crossovers, two-strand double crossovers, and three-strand double crossovers
    a. Are more prevalent in organellar than nuclear genomes
    b. Occur at equal frequencies between loci that show < 10% recombination
    c. Lead to the same proportions of parental and non-parental combinations of alleles at 2 linked loci
    d. Lead to different proportions of parental and non-parental combinations of alleles at 2 linked loci

42. The maximum frequency of recombination is 50%, therefore linkage groups can only be 50 cM long.
    a. True
    b. False

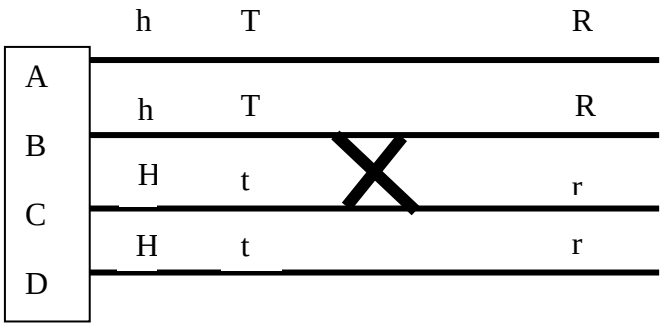
43. Crossing over always results in recombination (as documented by non-parental combination of alleles).
    a. True
    b. False

44. Which statement regarding crossovers is false?
    a. There may be multiple crossovers between non-sister chromatids.
    b. Only two chromatids are involved in any given crossover event.
    c. There is an equal probability of crossovers occurring at any point on the chromosome.
    d. Crossing over occurs after chromosome replication.

45. If recombination between two genes is 50% this means that
    a. The two genes are very far apart on the same chromosome or on different chromosomes.
    b. The two genes are very close together on the same chromosome.
    c. The two genes are exactly 50 cM apart.
    d. These genes are pleiotropic.

46. A plant geneticist observes 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 blue-seed progeny are susceptible to a fungal disease and all white-seed progeny are resistant to the disease. This is most likely a case of
    a. Linkage (with 10% recombination between genes)
    b. Pleiotropy
    c. Unequal sister chromatid exchange
    d. Segregation distortion

Use the following figure to answer 47-48.



47. Which chromatids will have the non-parental combinations of alleles after the crossover that is shown?
    a. A and B
    b. A and D
    c. B and D
    d. B and C

48. This type of crossover is called a
    a. 4 strand double crossover
    b. 3 strand double crossover
    c. 2 strand double crossover
    d. Single crossover

49. hhTTRR and HHttrr parents are crossed to give an HhTtRr F1. From this F1, 100 doubled haploid plants were derived. Considering alleles at the T and R loci, the following numbers of plants were observed.

Gametes	TR	Tr	tR	tr
Doubled haploids				
Number of plants	43	7	8	42

What is the percent recombination between the T and R loci?

a. 5
b. 10
c. 15
d. None of the above

50. If the % recombination in question #49 were converted to centiMorgans (cM)

a. The cM value would be smaller than the % recombination value
b. The cM value would be larger than the % recombination value
c. The cM value would be the same as the % recombination value