Exam 1 CSS/Hort 430/530 2011

1. Considering the case of "Roundup Ready" sugarbeet seed production in the Willamette Valley, which of the following gene flow mechanisms is of greatest concern?
    a. Pollen
    b. Eggs
    c. Leaves
    d. Sugar

2. If a Roundup Ready sugarbeet does cross with a non-Roundup Ready beet, the phenotype of the F1 generation will be (assuming both parents are completely homozygous):
    a. All Roundup susceptible
    b. All Roundup resistant
    c. Segregating 1:1 for Roundup resistance: susceptibility
    d. Segregating 3:1 for Roundup resistance: susceptibility

3. If a non-Roundup Ready sugarbeet plant has ~ 30,000 genes, a Roundup Ready sugarbeet plant will have ~30,001 genes.
    a. T
    b. F

4. In most angiosperms, the chloroplasts are maternally inherited. Which of the following do you expect to see in terms of inheritance of genes encoded by the chloroplast genome?
    a. Segregation
    b. Independent assortment
    c. Crossovers at pachynema
    d. All progeny will be like the mother plant

5. Autosomal inheritance is expected
    a. in the case of mitochondrial genes
    b. in the case of sex chromosomes in the nucleus
    c. in the case of chloroplast genes
    d. in the case of non-sex chromosomes in the nucleus

6. If a diploid organism is said to have 30,000 genes (which by convention is the number of genes at the "n" level), which of the following is the following is most correct?
    a. The organism has 30,000 loci
    b. The organism has 60,000 loci
    c. In a leaf cell nucleus the organism will have 30,000 genes
    d. The organism has 30,000 alleles at each locus

7. The expected segregation in the F1 generation from the cross of two completely inbred parents will be different from the segregation expected in the F1 generation of the cross between two completely heterozygous parents.
    a. T
    b. F

8. Which of the following is the most important determinant of the degree of heterozygosity in a plant species?
    a. Genome size – e.g. species with genomes larger than 1000 Mb are most likely to be cross-pollinated
    b. Numbers of chromosomes – e.g. species with 2n = 20 and higher are most likely to be highly homozygous
    c. Mating biology – e.g. is the species dioecious, monoecious, or hermaphroditic
    d. The number of mammalian pollinators present

9. If you are studying the inheritance of a trait determined by alleles at two loci using the F2 and F3 generations of the cross between two completely inbred parents with contrasting alleles at both loci you expect:
    a. Different ratios in each generation
    b. The same ratios in each generation
    c. Continuous variation in the F2 generation and discontinuous variation in the F3 generation
    d. The same ratios you would observe with doubled haploids

10. The expected phenotypic and genotypic segregation ratios for a single locus are the same in the testcross progeny and doubled haploid progeny of the cross between two completely inbred parents.
    a. T
    b. F ambiguous question – dropped.

11. The two alleles at a locus
    a. May be identical in DNA sequence
    b. May differ in DNA sequence for only one nucleotide
    c. May differ in DNA sequence for multiple nucleotides
    d. May differ in that the gene is present on one homolog and completely missing on the other homolog
    e. All of the above

12. Segregation refers to alleles at a single locus and independent assortment to alleles at two or more loci.
    a. T
    b. F

13. The source of new alleles (as defined by difference in DNA sequence) is
    a. Mutation
    b. Recombination between loci
    c. Epigenetics
    d. None of the above

14. Transcription factors never show qualitative (Mendelian) inheritance
    a. T
    b. F

Information for Questions 15 & 16

You have 100 barley plants in your garden. You observe that the plants vary for two traits: the color of the spike and the height of the plants. You record the following data:

21 black and tall plants
28 black and dwarf plants
26 white and tall plants
25 white and dwarf plants

15. Which of the following do you need to know before formulating a correct hypothesis regarding the inheritance of spike color and plant height?
    a. Degree of homozygosity of the parents
    b. Generation in which the data were recorded
    c. Genome size of barley
    d. A and B
    e. A, B, and C

16. If you calculate a chi square test for the barley color/height data, how many degrees of freedom would you use to determine if you will accept or reject your hypothesized ratio?
    a. 1
    b. 2
    c. 3
    d. 4

17. 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

18. 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

19. In plants, the ancestral condition was dioecious. Monoecious and hermaphroditic plans evolved through the progressive elimination of sex chromosomes.
    a. T
    b. F

20. Outcrossing (e.g. cross-pollination) has only disadvantages. That is why so many plants are hermaphrodites.
    a. T
    b. F

21. According to the Nasrallah paper on self-incompatibility, in *Brassica* species pollen (of the same species) delivered to the stigma (of the same species) always germinates, forms a pollen tube, and achieves successful fertilization.
    a. T
    b. F

22. Self-incompatibility is a perfect mechanism for ensuring that plants never self-pollinate, as demonstrated in hazelnuts by Mehlenbacher et al.
    a. T
    b. F

23. In plants, the basis of sex differentiation is
    a. A defined sex chromosome system, as in mammals, where the male Y chromosome is always distinguishable from X chromosomes by light microscopy
    b. The difference in genome size: females have larger genomes than males
    c. Selective abortion of floral organs
    d. Determined during the S phase of meiosis

24. If you studied the genetics of monoecious flower development vs. hermaphrodite flower development in maize you would expect to see
    a. Qualitative inheritance
    b. Quantitative inheritance
    c. Maternal inheritance

25. As described in the reading by Leavings et al. on the maize T cytoplasm, only genes in the nucleus can show pleiotropy
    a. T
    b. F

26. In asparagus, supermale (YY) plants are produced by
    a. Self-pollinating male plants
    b. Self-pollinating hermaphroditic plants
    c. Deriving doubled haploids from female plants
    d. Deriving doubled haploids from male plants

27. Sex determination in the papaya provides an example of
    a. Some combinations of alleles being lethal
    b. Defined X and Y chromosomes
    c. Incipient sex chromosome development
    d. A and B above
    e. A and C above

28. Each chromosome during the G1 stage of meiosis consists of
    a. A single DNA molecule
    b. Histone proteins
    c. Only dark matter
    d. 100 centiMorgans, which equals exactly 500 Mb of DNA
    e. A and B

29. Histone proteins are
    a. What spindle fibers are made of
    b. Formed in the nucleolus
    c. Involved in the nucleosome structure of chromatin
    d. Not encoded by genes

30. The centromere is
    a. a separate organelle added to the chromosome so that sister chroamtids can separate at mitosis but not in meiosis
    b. an excellent example of euchromatin
    c. the molecular machine responsible for DNA replication
    d. site of attachment of spindle fibers

31. The nucleolus is
    a. a prominent organelle in the cytoplasm
    b. the site of assembly of ribosomes
    c. the membrane surrounding the nucleus
    d. responsible for epigenetic silencing of genes

32. A good example of facultative heterochromatin is
    a. An autosome
    b. One of the sex chromosomes in XX females
    c. A centromere
    d. A telomere

33. Homologous chromosomes pair in both mitosis and meiosis
    a. T
    b. F

34. The cell cycle of mitosis involves Prophase, Metaphase, Anaphase, Telophase, G1, G2, and the S phase.
    a. All of the above, in the order given
    b. All of the above, but not in the order given

35. A plant = 2n = 2x = 30. The total number of chromatids migrating to <u>each</u> pole at Anaphase of mitosis will be
    a. 15
    b. 30
    c. 45
    d. 60

36. A plant = 2n = 2x = 30. The total number of pairs of homologous chromosomes at Pachynema of meiosis will be
    a. 15
    b. 30
    c. 45
    d. 60

37. A plant = 2n = 2x = 30. The total number of chromosomes in each of the four daughter cells produced by meiosis will be
    a. 15
    b. 30
    c. 45
    d. 60

38. Crossing over between non-sister chromatids occurs at
    a. S phase
    b. Pachynema
    c. Metaphase I
    d. Anaphase II

39. The segregation of alleles at a locus in not determined in meiosis
    a. T
    b. F

40. Independent assortment of alleles at two or more loci can be determined by
    a. Random alignment of non-homologous chromosomes at Metaphase I
    b. Crossover between homologous chromosomes at Pachynema
    c. Orientation of non-sister chromatids at Anaphase II
    d. A and B
    e. A, B, and C

41. The Dark Matter article described how
    a. Epigenetics leads to changes in DNA sequence and thus difference in gene expression
    b. RNAi is caused by telomerase
    c. DNA not coding for genes can have very important regulatory functions
    d. Plants with different genome sizes have very different numbers of genes

42. If an organism is 2n = 2x = 20, and you have data from 2,000 markers providing complete genome coverage scored on a population of 100 doubled haploid plants, you should show how many linkage maps?
    a. 5
    b. 10
    c. 20
    d. 40

Information for Questions 43 - 46

Chromosome 2 is reported to be 200 centiMorgans long and two loci are shown at opposite ends of the chromosome 2 linkage map. One locus controls flower color (alleles W and w determine white and red, respectively) and the other controls resistance to a foliar pathogen (alleles R and r determine resistance and susceptibility, respectively). One parent is WWRR and the other is wwrr. Assume complete dominance at each locus. You score the two traits in 100 test-cross progeny and record the following data:

White and Resistant	White and Susceptible	Red and Resistant	Red and Susceptible
27	23	27	23

43. The non-parental classes are
    a. White/Resistant and Red/Susceptible
    b. White/Susceptible and Red/Resistant
    c. Not identifiable given these data

44. 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
    a. The parental classes/100
    b. The non-parental classes/100
    c. The non-parental + parental classes/100

45. If you calculated that the frequency of non-parental combinations was 50% would you conclude that the report of the two loci being on the same chromosome is wrong?
    a. Yes
    b. No

46. If you had data on loci every 5 cM on chromosome 2, would you be more confident that the W and R loci show independent assortment but are located on the same chromosome?
    a. Yes
    b. No

47. Double crossovers describe the situation where one chromatid has breakage and reunion events with two other non-sister chromatids at the same time.
    a. T
    b. F

48. Crossing over is such a potent source of genetic variation because it always leads to the gain or loss of chromatin.
    a. T
    b. F

49. The X and Y sex chromosomes typically show
    a. Higher levels of recombination than autosomes
    b. The same levels of recombination as autosomes
    c. Less recombination than autosomes

50. Linkage maps are useful for a number of things including synteny, which can be defined as
    a. The situation where genes in two different species (e.g. barley and rice) have in common a single ancestral gene
    b. 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)

51. Recombination in the dark matter of the genome is the principal source of new alleles for each of the ~30,000 genes in a diploid organism.
    a. T
    b. F

52. In the following cartoon of a deoxyribonucleotide, the carbons are labeled correctly
    a. T
    b. F

53. The nitrogen-containing bases (A,T,C, and G) are attached to which carbon?
    a. 1’
    b. 2’
    c. 3’
    d. 5’

54. DNA is such an ideal genetic material because it carries information and can initiate replication in the S phase *de novo*, i.e. without a template strand.
    a. T
    b. F

55. 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.
    a. T
    b. F

56. DNA is an ideal genetic material because it is capable of change. A structural change involving heritable change in DNA sequence is best described as:
    a. Epigenetic event
    b. Mutation
    c. Methylation event
    d. Chiasma

57. Mutations caused by DNA replication errors are relatively rare because
    a. Helicases have endonuclease activity and remove incorrect bases at replication forks
    b. Some polymerases have exonuclease activity and can remove incorrect bases from the 3’ end of a developing strand
    c. Arsenic is only substituted for phosphorous under lacustrine conditions

58. In eukaryotes, DNA replication is initiated at the centromere and telomere of each chromosome
    a. T
    b. F

59. At a bidirectional replication fork, lagging strands are
    a. Where new strands are synthesized 3’ to 5’
    b. Always on top
    c. Where Okazaki fragments occur
    d. Responsible for selective abortion of floral organs

60. The loss of DNA at telomeres during mitosis is due to
    a. Telomerase gnawing at the ends of chromatids
    b. Unequal sister strand crossovers
    c. DNA replication issues
    d. Colchicine interfering with the formation of spindle fibers

The following 5 questions are required for those registered in CSS/Hort 530. They are optional extra credit questions for those registered in CSS/Hort 430.

Every year it costs less to add more loci to linkage maps. For example, in 2009 Szucs et al., developed a barley linkage map with over 2,000 loci distributed across seven linkage groups. In 2011, a researcher added an additional 10,000 loci to the same set of chromosome linkage maps.

61. As maps become progressively denser (e.g. any pair of loci will show less than 10% recombination) the issue of interference will not be as important as it was in lower-density maps. In other words, for any given pair of loci,
    a. the % recombination value will be equal to the cM value
    b. the % recombination value will be less than the cM value
    c. the % recombination value will be higher than the cM value

62. In dense linkage maps, LOD scores are used to test the hypothesis that there is no linkage against the alternative hypothesis that there is linkage. At a LOD score ~ $\geq$ 3, you will conclude that
    a. Loci are linked
    b. Loci are not linked
    c. Loci show pleiotropy

63. As more loci are added, determining the correct order of loci becomes
    a. Trivial
    b. More complicated
    c. Density has no issue on the difficulty of determining order

64. An advantage of higher density linkage maps is that you can more accurately convert cM to Mb.
    a. T
    b. F

65. You determine that the linkage maps of barley chromosome 2H and wheat chromosomes 2A, 2B, and 2D have many of the same marker loci in the same order. This is an example of
    a. Homology
    b. Homoeology
    c. Orthology
    d. Cosmology