Exam 1 Plant Genetics 430/530 2012

1. Gene flow between Roundup Ready sugar beets and organic table beets is currently a concern in the Willamette Valley. What is the most likely vehicle by which genes will flow?
   a. Eggs
   b. Exploding centromeres
   c. Pollen
   d. Water

2. Gene flow only happens between Roundup Ready sugar beets and organic table beets. It does not occur between non-Roundup Ready sugar beets and conventionally grown sugar beets.
   a. T
   b. F

3. If a Roundup Ready sugar beet pollinates an organic Swiss chard, the F2 progeny are expected to segregate for Roundup resistance vs. Roundup susceptibility in what ratio?
   a. 1:1
   b. 1:2:1
   c. 3:1
   d. 9:3:3:1

4. If you graphed the phenotype data from question # 3, you would expect a
   a. Discontinuous distribution indicative of qualitative inheritance
   b. Continuous distribution indicative of qualitative inheritance
   c. Discontinuous distribution indicative of quantitative inheritance
   d. Continuous distribution indicative of quantitative inheritance

5. Autosomal inheritance refers to
   a. Self-pollination
   b. Genes in organelle genomes
   c. Cross-pollination
   d. Genes in the nuclear genome

6. If a plant has maternal inheritance of organelles, genes in the mitochondrial genome are expected to
   a. Not segregate
   b. Segregate 3:1
   c. Segregate 1:2:1
   d. Segregate 9:3:3:1

7. A gene is 1 kb long. Three different single nucleotide polymorphisms are known to confer the same recessive phenotype. Only one DNA sequence confers the dominant phenotype. Given this information, how many alleles do you expect to find at this locus in a population of diploid organisms?
    a. 1
    b. 2
    c. 3
    d. 4

8. Dioecious plants are more likely to be homozygous at multiple loci than plants with perfect flowers.
    a. T
    b. F

9. Expected monohybrid ratios for the selfed progeny of an F1 plant are expected to be the same at the F2 and F3 generations.
    a. T
    b. F

10. Considering the assigned reading of Komatsuda et al., the source of new Vrs1 alleles is
    a. Mutation
    b. Colchicine
    c. Recombination
    d. Spontaneous generation

11. A transcription factor is a gene whose protein product
    a. Regulates the expression of other genes
    b. Encodes a protein found in the endosperm of seeds
    c. Makes hair and scalp shiny
    d. Causes celiac disease

12. Chi square tests can be used to test hypotheses regarding the inheritance of morphological traits (Naked Eye Polymorphisms) but they cannot be used to test hypotheses regarding the inheritance of DNA polymorphisms (e.g. Single Nucleotide Polymorphisms).
    a. T
    b. F

13. In a chi square test, a very large difference between the observed and expected ratios (e.g. a calculated chi square value of 10.7 with 1 df) will cause you to
    a. Accept the null hypotheses
    b. Reject the null hypotheses

14. If you expect a 9:3:3:1 ratio, how may df will you use for your chi square test?

    a. 1
    b. 2
    c. 3
    d. 4

15. Doubled haploid and testcross dihybrid ratios for loci showing independent assortment are expected to be
    a. 1:1
    b. 3:1
    c. 1:1:1:1
    d. 9:3:3:1

16. A genome is reported to be 5,000 Megabases in size. This means that
    a. There are 5,000 picograms of DNA in a haploid genome
    b. There are 5,000 megabases of DNA in a 2n leaf cell
    c. There are 5,000 megabases of DNA in a 1n pollen grain

17. A principal justification for sequencing the genomes of cacao and strawberry was
    a. Ownership of genes
    b. Determining the genome size
    c. Determining the number of linkage groups
    d. Making it more efficient to develop better varieties

18. The cacao and strawberry are similar in that they have approximately how many genes?
    a. 10,000
    b. 20,000
    c. 30,000
    d. 40,000

19. All changes in DNA sequence that lead to new alleles at a locus will cause changes in phenotype
    a. T
    b. F

20. The ancestral and basal condition of angiosperm flowers is
    a. Dioecious
    b. Sterile
    c. Hermaphroditic
    d. Self incompatible

21. In a monoecious plant, the male and female flowers form through
    a. The action of different genes
    b. The selective abortion of floral organs during development
    c. The separation of sister chromatids at mitosis

22. Advantages of cross-pollination as compared to self-pollination include avoiding inbreeding depression. Inbreeding depression refers to
    a. Recurring depression from remaining indoors
    b. Too much effort devoted to producing male plants
    c. Phenotypes due to interaction between dominant alleles at different loci
    d. Negative phenotypes due to homozygosity for deleterious recessive alleles

23. Male sterility and self-incompatibility are mechanisms that promote cross-pollination in
    a. Monoecious plants and plants with perfect flowers
    b. Dioecious plants with defined sex chromosomes

24. Self incompatibility is a mechanism maximizing the likelihood of cross-pollination by which of the following mechanisms?
    a. Causing pollen to be sterile
    b. Disrupting mitosis
    c. Preventing viable pollen from successfully fertilizing eggs on the same plant

25. Plants, like humans, can have defined X and Y chromosomes
    a. T
    b. F

26. The high level of recombination between X and Y chromosomes is one of the principal features of dioecious species
    a. T
    b. F

27. The required reading on "dark matter" argued that non-coding (formerly known as junk) DNA is
    a. Useless
    b. Actually coding for genes
    c. Involved in aging
    d. Involved in gene regulation

28. One chromosome at the G1 stage of mitosis consists of
    a. 2 DNA molecules joined at the centromere
    b. 1 DNA molecule plus histone proteins
    c. 1 protein molecule
    d. multiple centromeres

29. The shortening of centromeres at mitosis is hypothesized to be related to aging.
    a. T
    b. F

30. Telomeres are the points of attachment of spindle fibers.
    a. T
    b. F

31. Which of the following is most likely to **not** be heterochromatic?
    a. Centromere
    b. Telomere
    c. Highly compact region
    d. Relaxed DNA

32. An example of facultative heterochromatin is
    a. A centromere
    b. A telomere
    c. A Y chromosome
    d. An X chromosome

33. Pairing of homologous chromosomes occurs at
    a. Mitosis
    b. Meiosis
    c. Mitosis and meiosis
    d. None of the above

34. If a plant that is 2n = 2x = 20 undergoes mitosis, the result will be
    a. 2 daughter cells, each 2n = 20
    b. 4 daughter cells, each n = 10

35. If a plant that is 2n = 2x = 20 undergoes meiosis, the result will be
    a. 2 daughter cells, each 2n = 20
    b. 4 daughter cells, each n = 10

36. There is an S phase, where DNA is replicated, in both mitosis and meiosis
    a. T
    b. F

37. The required reading on testing for telomere length

a. Confirms that telomere shortening causes aging
b. Reports the development of diagnostic tests for telomere length
c. Proposes free and universal telomere length diagnosis
d. Reports that telomere shrinkage is not related to aging

38. If a plant is 2n = 2x = 30, how many chromatids will be present in one bivalent?
   a. 1
   b. 2
   c. 3
   d. 4

39. The random alignment of non-homologous chromosomes at which stage of meiosis accounts for independent assortment?
   a. Zygonema
   b. Pachynema
   c. Metaphase I
   d. Metaphase II

40. Independent assortment can be due to random alignment of non-homologous chromosomes and/or to
   a. Colchicine doubling of haploids
   b. Recombination between loci very close on the same chromosome
   c. Recombination between loci far apart on the same chromosome
   d. Separation of sister chromatids at Anaphase II

41. New combinations of alleles at linked loci arise through
   a. Segregation
   b. Independent assortment
   c. Crossovers at Metaphase of mitosis
   d. Crossovers at Pachynema of meiosis

42. If a plant is 2n = 20, and lots of marker data from a doubled haploid population of 94 plants are available, how many linkage groups (maps) would you expect?
   a. 5
   b. 10
   c. 20
   d. 40

43. Crossing over is the basis of linkage mapping. Which type of crossover will be most informative for map construction?
    a. Crossovers between sister chromatids
    b. Crossovers between monomorphic loci
    c. Crossovers between polymorphic loci
    d. Crossovers involving all four chromatids in the bivalent, at the same time

44. If you have independent assortment of alleles at two loci on different chromosomes, what is the maximum percentage of non-parental types in a population of doubled haploids?
    a. 10
    b. 25
    c. 50
    d. 100

45. The maximum frequency of recombination between linked loci is which of the following (values are percentages)?
    a. 10
    b. 25
    c. 50
    d. 100

46. You are a plant breeder interested in developing a high yielding, disease resistant variety.  You observe that in the 100 doubled haploid progeny derived from the cross of a low yielding, disease resistant variety with a high yielding, disease susceptible variety, there is one plant that is high yielding and disease resistant and one plant that is low yielding and disease susceptible.  Which of the following best describes the genetic relationship between yield and disease reaction?
    a. DNA binding by transcription factors
    b. Linkage
    c. Pleiotropy
    d. Gene interaction

47. A cross is made between parents with the following genotypes at two linked loci: WWnn x wwNN. Which of the following terms best describes the linkage of these two loci?
    a. Tight
    b. Repulsion
    c. Coupling
    d. Loose

48. Crossing over is such a potent source of genetic variation because crossovers involve the loss and addition of chromatin, and these mutations give rise to new alleles at each meiosis.

a. T
b. **F**

49. All types of crossover (e.g. single crossovers, three-stand doubled crossovers, and four strand double crossovers) give rise to the same combinations of alleles at linked loci.
    a. T
    b. **F**

50. The high rates of recombination between X and Y account for the presence of functional male and female reproductive organs in perfect flowers.
    a. T
    b. **F**

51. Given the following data from a doubled haploid population derived from the cross of TTYY x ttyy parents, it is obvious that the two loci can only be on separate chromosomes.

| TTYY | TTyy | ttYY | ttyy |
|------|------|------|------|
| 22 | 27 | 24 | 26 |

    a. True
    b. **False**

52. Given the following data from a doubled haploid population derived from the cross of QQZZ x qqzz parents, the two loci are obviously on the same chromosome.

| QQZZ | QQzz | qqZZ | qqzz |
|------|------|------|------|
| 40 | 10 | 10 | 40 |

    a. **True**
    b. False

53. In question # 52, what would be the estimated % recombination between the Q and Z loci?
    a. 0
    b. 10
    c. **20**
    d. 40

54. If you converted the percent recombination value in question # 53 to centiMorgans (either Haldane or Kosambi), the centiMorgan value would be
    a. Lower than the % recombination value
    b. The same as the % recombination value
    c. Larger the % recombination value
    d. Only different from the % recombination value at the centromere

55. In comparing linkage maps of the same chromosome in the same species based on two different population, which of the following is the most likely
    a. Locus orders will the same but cM distances will vary
    b. Locus orders will be different but cM distances will be the same

56. To convert cM to Mbp you can
    a. Multiply by 3.84
    b. Divide by .789
    c. Use the Haldane formula
    d. Politely inform the Professor that this conversion is not possible

57. Two loci can be in the same linkage group but show independent assortment.
    a. T
    b. F

58. If a linkage map is 200 cM long, this means that two telomeric regions will show 200% recombination.
    a. T
    b. F

59. In linkage mapping, interference refers to
    a. The centromere preventing recombination
    b. The telomere shrinking at mitosis
    c. The phenomenon that double crossovers occur more often than expected
    d. The phenomenon that double crossovers occur less often than expected

60. Which of the following is the best example of synteny?
    a. The HvHin1 gene is found in barley but there is nothing like it in rice
    b. The ADH gene is found in both barley and rice, but the genes differ slightly in DNA sequence
    c. Sections of barley and rice chromosomes have similar genes in the same order
    d. Barley and rice have the same numbers of chromosomes