PBG430/530

Exam 1

2016

**In addition to turning in the scantron, we highly recommend that you also circle the correct answers on this hard copy and turn it in with your name written on the back of the last page.**

1. You read that the genome size of maize is 2,300 Mb and that this species 2n = 20. This means that there are 2,300 Mb of DNA in a cell that is
   1. n (e.g. gamete)
   2. 2n (e.g. embryo)
   3. 3n (e.g. endosperm)
2. If you had to estimate how many genes there are in an average diploid plant, which number would you pick?
   1. 5,000
   2. 10,000
   3. 30,000
   4. 100,000
3. A simple definition of a locus is:
   1. DNA sequence associated with a particular phenotype.
   2. Place on a chromosome where a gene is found and this place will (usually) be the same on two homologous chromosomes.
4. What is the most likely way in which genes can “flow”?
   1. Eggs
   2. Exploding centromeres
   3. Pollen
   4. Water
5. A homozygous Roundup resistant plant crosses with a homozygous Roundup susceptible plant of the same species. You harvest the F1 seed, plant it, and spray it with Roundup herbicide. What do you expect to happen?
   1. All F1 plants will die
   2. All F1 plants will live
   3. The F1 plants will segregate 3:1 for survival
   4. The F1 plants will segregate 1:1 for survival
6. The “Innate” potato and “Arctic” apple were developed using which one of the following techniques?
   1. RNAi
   2. CRISPR-CAS9
   3. Epigenetics
7. You make a cross between two homozygous diploid pepper plants. You then grow F1 plants. If you self an F1 plant, what % reduction in heterozygosity would you predict in h each subsequent generation of selfing?
   1. 5%
   2. 25%
   3. 50%
   4. 100%

Consider the following data from a diploid plant. One parent has purple flowers. The other parent has white flowers. You send the F1 seed to a company that makes doubled haploids. The company makes 100 doubled haploids from the F1 for you. Unfortunately, the company neglects to record the flower color of the F1 plants. Use this information to answer questions ***8 - 12.***

|  |  |
| --- | --- |
| Flower color | Number of doubled haploid plants |
| Purple | 46 |
| White | 54 |

1. Purple is dominant to white.
   1. T
   2. F
   3. No way to know since flower color was not noted in the F1
2. These data are suggestive of which type of inheritance?
   1. Quantitative
   2. Blending
   3. Cytoplasmic
   4. Qualitative
3. How many loci do you hypothesize are involved in determining flower color in this cross?
   1. 1
   2. 2
   3. 3
   4. 4
4. You calculate that the Chi-square for a predicted 1:1 ratio for purple: white is “0.64”. How many degrees of freedom will you use to test the hypothesis that the observed and expected ratios are equal?
   1. 1
   2. 2
   3. 3
5. After referring to a chi square table (see last page of exam) will you accept or reject the hypothesis that your observed and expected ratios are the same?
   1. Neither accept nor reject: chi square tests are not appropriate for these sorts of data.
   2. Accept
   3. Reject
6. A principal limitation of Chi Square tests is that they can only be applied to phenotypic data. That is, they are not useful for determining if alleles at a locus defined by a Single Nucleotide Polymorphism (SNP) are showing the expected segregation ratio.
   1. T
   2. F
7. A transcription factor gene (such as *Vrs1*) encodes a protein that
   1. causes the failure of spindle fibers
   2. causes shortening of telomeres
   3. causes expansion of “dark matter” with each mitosis
   4. regulates the expression of other genes
8. Considering the assigned reading by Komatsuda et al., the source of new *Vrs1* alleles is
   1. Mutation
   2. Colchicine
   3. Recombination
   4. Spontaneous generation
9. All changes in DNA sequence that lead to new alleles at a locus will cause changes in phenotype
   1. T
   2. F
10. The expected monohybrid genotypic ratio in the F2 is 1AA:2Aa:1aa. If you chose one of the F2 Aa individuals and selfed it, you would expect its F3 progeny to segregate in a genotypic ratio of 1AA:2Aa:1aa.
    1. T
    2. F
11. An allele conferring a recessive phenotype can be due to
    1. Complete deletion of a gene
    2. Deletions or insertions of multiple nucleotides at key regions of a gene
    3. Nucleotide substitutions at key regions of a gene
    4. All of the above

*You have 100 bean plants in your garden. You observe that the plants vary for two traits: the color of the seed 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*

1. Which of the following do you need to know before formulating a correct hypothesis regarding the inheritance of spike color and plant height?
   1. Degree of homozygosity of the parents
   2. Generation in which the data were recorded
   3. Genome size of bean
   4. A and B
   5. A,B, and C

*Assume there are 30,000 genes in the eggplant genome. You create an F1 hybrid by crossing two completely inbred parents that have contrasting (e.g. different) alleles at 10,000 of the 30,000 loci. Answer questions* ***20 and 21*** *based on this information.*

1. The F1 is expected to be heterozygous at 10,000 loci and homozygous at 20,000 loci
   1. T
   2. F
2. Which two sources of variation are most likely in an obligate apomict?
   1. Segregation and independent assortment
   2. Monoecy and dioecy
   3. Mutation and epigenetics
3. Sexual reproduction is generally considered to be more advantageous than asexual reproduction. However, only dioecious plants have this advantage. Monoecious plants and plants with perfect flowers do not have this advantage.
   1. T
   2. F
4. A pollen mother cell (PMC) has the genotype VvQQ. The tetrad of microspores resulting from meiosis of the PMC will have which genotypes?
   1. VQ,VQ,VQ,VQ
   2. vq,vq,vq,vq
   3. VQ,VQ,vQ,vQ
5. The synergids in the embryo sac of a diploid plant
   1. Are each “3n”
   2. Give rise to 3n endosperm
   3. Have no known function
   4. Attract the sperm
6. The ancestral condition of angiosperm flowers is thought to be
   1. Monoecious
   2. Dioecious
   3. Self-incompatible
   4. Male sterile
   5. None of the above
7. If a plant has maternal inheritance of organelles, genes in the mitochondrial genome are expected to
   1. Not segregate
   2. Segregate 3:1
   3. Segregate 1:2:1
   4. Segregate 9:3:3:1
8. Which of the following is the most important determinant of the degree of heterozygosity in a plant species?
   1. Genome size – e.g. species with genomes larger than 1000 Mb are most likely to be cross-pollinated
   2. Numbers of chromosomes – e.g. species with 2n = 20 and higher are most likely to be highly homozygous
   3. Mating biology – e.g. is the species dioecious, monoecious, or hermaphroditic
   4. The number of mammalian pollinators present
9. In a perfect flower, the site of pollen reception/ recognition/ and germination is the
   1. Stigma
   2. Style
   3. Ovary
   4. Anther
10. Which of the following nuclei will be fertilized by 1 sperm to give rise to the 3n endosperm?
    1. Antipodals
    2. Polar nuclei
    3. Synergids
    4. Egg
11. Apomixis is a system is which a heterozygous genotype can produce genetically identical offspring via seed.
    1. T
    2. F
12. The genetic basis of apomixis is well-understood and most corn, tomato, and pepper F1 hybrids sold in 2016 will be apomicts
    1. T
    2. F
13. Pleiotropy is the situation where one gene
    1. Determines only one phenotype
    2. Determines more than one phenotype
    3. Is regulated by a transcription factor and a neighboring gene is not regulated by that transcription factor.
14. In terms of the genetics of parents and progeny, asexual reproduction from somatic tissue and propagation from apomictic seeds are equivalent.
    1. T
    2. F
15. Male sterility is best described as the situation where alleles at a Self Incompatibility locus in the pollen and the stigma determine if the pollen will germinate, grow, and fertilize.
    1. T
    2. F
16. The high level of recombination between X and Y chromosomes is one of the principal features of dioecious species
    1. T
    2. F
17. There is an S phase, where DNA is replicated, in both mitosis and meiosis
    1. T
    2. F
18. In asparagus, supermale (YY) plants are produced by
    1. Self-pollinating male plants
    2. Self-pollinating hermaphroditic plants
    3. Deriving doubled haploids from female plants
    4. Deriving doubled haploids from male plants
19. Which of the following is most likely to **not** be heterochromatic?
    1. Centromere
    2. Telomere
    3. Highly compact region
    4. Relaxed DNA
20. Homologous chromosomes pair in both mitosis and meiosis
    1. T
    2. F
21. Centromeres play a very important function in plants. This is:
    1. Point of attachment of spindle fibers
    2. Capping ends of chromosomes
    3. Marking the point at which the two DNA molecules forming each chromosome (e.g. the two arms of each chromosome) are joined.
22. Chromosome doubling of haploid plants is essential in the production of doubled haploids because
    1. It doubles the 2n the chromosome number each generation, making diploids into polyploids and therefore more productive
    2. Haploid plants are fertile but only half as productive as doubled haploids
    3. It fixes heterozygosity at each locus
    4. Haploid plants are sterile whereas doubled haploid plants are fertile
23. A plant is 2n = 2x = 28. How many bivalents do you expect at Metaphase I of meiosis?
    1. 7
    2. 14
    3. 28
    4. 56
24. Nucleosomes are most related to
    1. Male sterility
    2. Gene regulation
    3. Mutation
    4. “Packaging” of DNA so that chromosomes will fit into nuclei
25. Which of the following is the most likely example of facultative heterochromatin?
    1. A centromere
    2. A telomere
    3. A Y chromosome
    4. One of the two X chromosomes in a female plant
26. Both meiosis and mitosis occur in all cells in all tissues and at all developmental stages during the plant life cycle.
    1. T
    2. F
27. A haploid plant will have intact floral structures but it will be sterile. This is most likely due to which of the following:
    1. mitosis does not function properly in haploids.
    2. haploid plants do not have an S phase.
    3. spindle fibers do not work in haploids.
    4. meiosis does not function properly because there is only one chromosome per homologous pair.
28. According to the assigned reading, a key line of evidence that “dark matter DNA” is not “junk DNA” is that on average which percentage of a genome is most likely transcribed?
    1. 5
    2. 20
    3. 80

1. Epigenetics is a term meaning
   1. Changes in phenotype due to heritable changes in the genotype
   2. Heritable changes in phenotype without change in the DNA
   3. The study of telomere shortening in the epidermal layers of skin
2. Which of the following is most correct?
   1. Methylation leads to reduced gene expression and acetylation leads to increased gene expression
   2. Methylation leads to increased gene expression and acetylation leads to reduced gene expression
3. Telomere shortening, if it occurs, is most likely during which one of the following events?
   1. Metaphase of mitosis
   2. Anaphase II of meiosis
   3. S phase of mitosis
   4. G2 of meiosis