

1. Please write down the definition of the following genetic terms: (10 points)
 - (1) Gene
 - (2) Allele
 - (3) Locus
 - (4) Character
 - (5) Trait
2. Please choose correct answers: (15 points)
 - (1) Which is the correct order of stages in the cell cycle ?
 - a. S, G1, anaphase, prophase, metaphase
 - b. G1, S, prophase, metaphase, anaphase
 - c. S, G1, prophase, metaphase, anaphase
 - d. Prophase, S, G1, metaphase, anaphase
 - (2) Which of the following events takes place in meiosis I but not in meiosis II ?
 - a. Synthesis of DNA
 - b. Contraction of chromosomes
 - c. Separation of homologous chromosomes
 - d. Separation of chromatids
 - (3) A chi-square test comparing observed and expected progeny is carried out, and the probability associated with the calculated chi-square value is 0.72. What does this probability represent?
 - a. Probability of obtaining the observed numbers.
 - b. Probability that the correct results were obtained.
 - c. Probability that the difference between observed and expected numbers could be due to chance.
 - d. Probability that the difference between observed and expected number is significant.
 - (4) What will be the sexual phenotype of a fruit fly with XXY sex chromosomes and two set of chromosomes?
 - a. Male.
 - b. Female
 - c. Intersex
 - d. Metamale
 - (5) If the probability of being blood-type A is $\frac{1}{8}$ and the probably of blood-type O is $\frac{1}{2}$, whatis the probability of being either blood-type A or blood-type O ?
 - a. $\frac{1}{8}$
 - b. $\frac{1}{16}$
 - c. $\frac{5}{8}$
 - d. $\frac{1}{2}$

3. Please briefly answer questions below: (12 points)
 - (1) How do complete dominance, incomplete dominance, and co-dominance differ?
 - (2) What is the difference between heterozygous and hemizygous ?
 - (3) What is the usage of a complementation test?
4. A cell in prophase II of meiosis contains 12 chromosomes. How many chromosomes would be present in a cell from the same organism if it were in prophase of mitosis? or if it were in prophase I of meiosis? (10 points)
5. Chicken, like all birds, have ZZ-ZW sex determination. The bar-feathered phenotype in chickens results from a Z-linked allele that is dominant over the allele for nonbar feathers. A barred female is crossed with a nonbarred male. The F1 from this cross are intercrossed to produce the F2. What will the phenotypes and their proportions be in the F1 and F2 progeny? (10 points)
6. Dwarfism is a recessive trait in Hereford cattle. A rancher in western Texas discovers that several of calves in his herd are dwarfs, and he wants to eliminate this undesirable trait from the herd as rapidly as possible. Supposed that the rancher hires you as a genetic consultant to advise him on how to breed the dwarfism trait out of the herd. What crosses would you advise the rancher to conduct to ensure that the allele causing dwarfism is eliminated from the herd? (10 points)
7. A farmer grew F1 hybrid seeds obtained from a cross of a pea plant setting inflated yellow pod and a plant setting inflated green pod. He obtained four classes of pod phenotypes from 182 F1 hybrids: 65 yellow inflated; 21 yellow restricted; 71 green inflated; 25 green restricted. Are these results consistent with the hypothesis that pod color and pod shape are controlled by independently assorting genes, each segregating two alleles? (Note: A_1A_1 , A_2A_2 , B_1B_1 , and B_2B_2 genotypes show phenotypes for yellow pod, green pod, inflated pod, and restricted pod, respectively. A and B are two loci controlling pod color and pod shape, respectively.)
 - a. Write down the genotypes of two parents and each class of progenies, and indicate which alleles are dominant. (6 points)
 - b. Verify the hypothesis using chi-square goodness-of-fit test and chi-square independence test, respectively. (12 points)

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8. Pink-eye and albino are two recessive traits found in the deer mouse *Peromyscus maniculatus*. In mice with pink-eye, the eye is devoid of color and appears pink from the blood vessels within it. Albino mice are completely lacking color both in their fur and eyes. F. H. Clark cross pink-eyed mice with albino mice; the resulting F_1 had normal coloration in their fur and eyes. He then crossed these F_1 mice with mice that were pink eyed and albino and obtained the following mice. It is very hard to distinguish between mice that are albino and mice that are both pink-eyed and albino, so he combined these two phenotypes together.

Phenotype	Number of progeny
wild-type fur, wild-type eye color	62
wild-type fur, pink eye	12
albino	78
albino, pink-eye	
Total	152

- Give the expected numbers of progeny with each phenotype if the genes for pink-eye and albino assort independently. (5 points)
 - Use a Chi-square test to determine if the observed numbers of progeny fit the number expected with independent assortment. (5 points)
9. A plant breeder investigated the inheritance of seed size between two inbred lines of flax. The plant breeder did reciprocal crosses between the large-seed flax and the small-seed flax. The mean of seed size of the F_1 progenies between the reciprocal crosses are statistically different, but the seed size of the F_1 progeny showed no difference from its mother. The plant breeder suspected that the seed size was controlled by either genetic maternal effect or cytoplasmic inheritance. Please design genetic crosses to distinguish these two possible inherited models. (5 points)

Critical values of the χ^2 distribution				
df	1	2	3	4
P=0.05	3.841	5.991	7.815	9.488