

注意事項：共10題，不必抄題，請依序作答於答案卷上，並標明題號。

Answer the following questions.

1. In tomatoes, red fruit is dominant to yellow fruit and normal leaf is dominant to broad leaf. The progeny from one mating consisted of 305 red fruit, normal leaf plants; and 328 red fruit, broad leaf plants; 110 yellow fruit, normal leaf plants; and 97 yellow fruit, broad leaf plants, What was the genotype of the parents in this cross? (Designate the allele: R = red, r = yellow; B = normal, b = broad.) (6%)

2. A couple without an ancestral history of Cystic fibrosis disease (an autosomal recessive) have two normal children and an infant affected with Cystic fibrosis. The sister of the husband wants to marry the brother of the wife; in such a mating, what would be the probability of their first child having Cystic fibrosis disease? (6%)

3. (9%)

A true-breeding red snapdragon was crossed to a true-breeding white snapdragon. The F_1 progeny were red. When $F_1 \times F_1$ matings were made, the following F_2 progeny were observed:

1850	red
670	pink
<u>831</u>	<u>white</u>

Total: 3351

(1) Using your own clearly defined genetic symbols, give the appropriate parental, F_1 and F_2 genotypes in order to explain the above results.

(2) What phenotypic ratio would be expected from a testcross of an F_1 snapdragon?

(3) Suppose the white phenotype is now lethal. What phenotypic ratio would be expected from a cross between F_1 individuals?

4. (8%)

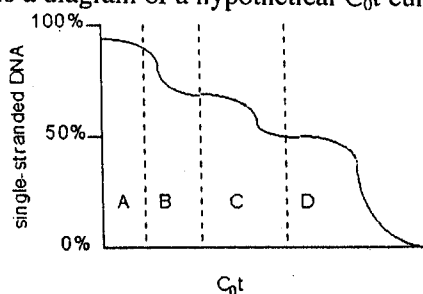
(1) A new virus has recently been discovered that infects human lymphocytes. The virus can be grown in the laboratory using cultured lymphocytes as host cells. Design an experiment using a radioactive label that would tell you if the virus contains DNA or RNA.

(2) Explain the function of a Locus Control Region(LCR).

(背面仍有題目,請繼續作答)

5. (9%)

The following is a diagram of a hypothetical C_0t curve:



In which region of the C_0t curve would you expect to find

- (a) DNA that is heterogeneous and coding for histone proteins, tRNA, and rRNA?
- (b) Inverted repeat DNA?
- (c) Structural genes coding for the most proteins?

6. (9%)

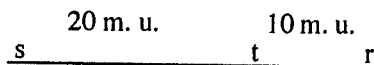
Three mouse-hybrid lines (A, B and C) were isolated with the following collection of human chromosomes.

	9	10	11	12	13	14	15
A	+	+	+	+	-	-	-
B	+	+	-	-	+	+	-
C	+	-	+	-	+	-	+

- (1) ABO blood group antigens were found in all three cell lines. To which human chromosome should this gene be assigned?
- (2) Hemoglobin beta chain genes was found by hybridization in lines A and C, not B. To which chromosome should this gene be assigned?
- (3) The enzyme LDH-B was found in line A only. To which chromosome should this gene be assigned?

7. (8%)

In *Drosophila*, three autosomal genes have the following maps:



provide the data, in terms of the expected number of flies in the following phenotypic classes, when $s+t+r+ / s t r$ females are crossed to $s t r / s t r$ males. Assume 1000 flies were counted.

- (1) $s^+ t^+ r^+$
- (2) $s t r$
- (3) $s^+ t r$
- (4) $s t^+ r^+$
- (5) $s^+ t r$
- (6) $s t r^+$
- (7) $s^+ t r^+$
- (8) $s t^+ r$

8. (15%)

(1) When the *his⁻* *Salmonella* strain used in the Ames test is exposed to substrate X, no *his⁺* revertants are seen. If, however, rat liver supernatant is added to the cells along substrate X, revertants do occur. Is substrate X a potential carcinogen for human cells? Explain.

(2) A DNA fragment that comes from the promoter region of a light-inducible plant gene is spliced to the 5' end of the promoter of another plant gene. The artificially constructed hybrid gene exhibits light inducibility. When the fragment from the original light-inducible promoter is "flipped-over" in its new place, this artificially constructed hybrid gene is also light inducible. What elements do the above fragment contain?

(3) In each of the motifs listed below associated with DNA binding, transcription activation, or dimer formation?

- a. helix-loop-helix
- b. Zinc finger
- c. leucine zipper
- d. acidic region
- e. helix-turn-helix

9. (15%)

(1) You have isolated a gene for an enzyme that is expressed in *E. coli*. Describe how you would alter the catalytic activity of the enzyme. Assume that you know the DNA sequence of the gene but do not know anything about which regions of the enzyme are important for catalytic activity.

(2) From Northern and Western hybridization, the mRNA and protein from a tissue specific gene are present in brain, liver, and fat cells but you are detecting only protein activity in fat cells. Give explanations for this phenomenon.

10. (15%)

(1) What will determine the rate of molecular clock for a gene that codes for a functional protein?

(2) In a population of mice, there are two alleles of the *Y* locus (*Y1* and *Y2*). Tests showed that in this population there are 384 mice of genotype *Y1/Y1*, 210 of *Y1/Y2*, and 260 of *Y2/Y2*. What are the frequencies of the two alleles in the population?