

(I) Answer the following questions, 8 points each. (64%)

1. (a) Explain how eukaryote chromosome become shorter at each round of replication.
(b) Explain how the DNA shortening problem in replication is coped with.

2. (a) Describe, in broad term, the main ways in which the formation of mRNA in eukaryotes differs from that in prokaryotes.
(b) In what ways does eukaryote initiation of transcription differ from that in prokaryotes?

3. (a) By means of diagram, explain the mechanism of splicing. What possible biological significance does the existence of intron have?
(b) There are 64 codons available for 20 amino acids. Why do you think 61 codons are actually used to specify the 20 amino acids?

4. (a) Ribonucleic acid (RNA) almost certainly evolved before deoxyribonucleic acid. Why do you think that evolution has favoured DNA as the repository of genetic information?
(b) Why is TTP used in DNA synthesis-why not UTP as in RNA?

5. How do the following experimental systems relate to the variable gene activity hypothesis?
 - (1) Chromosome puffs
 - (2) isozyme distributions in different tissues
 - (3) *in situ* hybridization of growth hormone transcripts

6. Assume that in a Hardy-Weinberg population, 9% of the individuals are of the homozygous recessive phenotype. What percentage of the individuals would be expected to be heterozygous? What percentage homozygous dominant?

7. Genetic diversity can be assessed at a variety of levels: DNA sequences, proteins, and chromosomes. Briefly describe methods which are currently used to assess diversity at each of the "level" mentioned.

8. (a) Assume that a given plasmid vector to be used in a cloning experiment contains 4000 base pairs of DNA. Assume also that the restriction endonuclease EcoR I cuts this plasmid at following sites (starting from an arbitrary zero point): 1000, 1500, and 3000. Given complete digestion of the plasmid with the endonuclease so that only linear fragments are produced. What sizes of DNA are expected?
(b) Type II restriction enzymes cleave DNA in such a manner as to produce blunt ends. Most often ligation of blunt end fragments is enhanced by the use of the enzyme *terminal deoxynucleotidyl transferase*. Why?

(背面仍有題目,請繼續作答)

(II). Choose the most appropriate answer for the following questions.

3 points each. (36%)

- Two purebred plants producing white flowers were crossed, and all of the resulting progeny had red flowers. When the red flowering plants were allowed to self-fertilized, 450 red flowering plants and 350 white flowering plants were produced. These results indicate that for these plants, flower color is determined by
 - a single gene
 - two independently assorting genes
 - two linked genes
 - two genes on the same chromosome.
- Two individuals with the genotype CcRrBb are mated. What proportion of their offspring would be expected to have the genotype CCrrBb?
 - 1/2
 - 1/8
 - 1/16
 - 1/32
- People with phenylketonuria often have small heads and light-colored hair, in addition to being unable to metabolize the amino acid phenylalanine. This indicates that the gene responsible for phenylketonuria is
 - dominant
 - pleiotropic
 - incompletely penetrant
 - variably expressed
- If a diploid organism has seven alleles at one locus, how many of the genotypes for that locus would be heterozygous?
 - 7
 - 14
 - 21
 - 28
- Which of the following statements is true?
 - Qualitative traits are not subject to environmental influences.
 - Qualitative traits tend to be polygenic.
 - Qualitative traits show a precise genotype-phenotype relationship.
 - all of the above
- A scientist accidentally combines culture flasks containing human cells with culture flasks containing mouse cells. She performs karyotypes on both sets of cells. How can she determine which culture contained the human cells?
 - Human chromosomes are all metacentric.
 - Mouse chromosomes are all telocentric.
 - Human chromosomes are larger than mouse chromosomes.
 - Mouse chromosomes do not produce banding patterns when stained with a chemical dye.

7. A woman appears to be perfectly healthy, but she only has 45 chromosomes. This could be due to a(n)
- inversion
 - duplication
 - translocation
 - deletion
8. Hormones influence gene activity when they bind to
- receptor protein
 - hormone response elements
 - promoter sequences
 - TATA or CAAT regions
9. A mutation in the gene encoding phenylalanine tRNA synthetase cause phenylalanine to bind to a tRNA that normally carries methionine. This mutation would probably
- be undetectable at the phenotypic level
 - alter only one protein
 - slightly change the activity of some enzyme
 - be lethal to the cell
10. The *in vitro* assembly of 70S ribosomes requires the help of which enzyme?
- ribosome synthetase
 - RNA polymerase
 - aminoacyl tRNA synthetase
 - none of the above
11. DNA fingerprints were used to determine whether Tom could be the father of Sally's baby. Which of the following would show that Tom is not the father? If _____ genetic fingerprint showed some bands not in _____ genetic fingerprint.
- Tom's.....the baby's
 - Sally'sthe baby's
 - the baby's..... Tom's
 - the baby's..... Tom's or Sally's
12. Examination of testcross data in *Drosophila* revealed that two linked genes (gene *p* and gene *q*) showed a recombination rate of 0.05. A third gene (gene *d*) showed recombination rates of 0.24 and 0.19 with gene *p* and *q*, respectively. What is the order of these three genes on the chromosome?
- p-d-q*
 - p-q-d*
 - q-d-p*
 - d-p-q*