

※ 注意：全部題目均請作答於試卷內之「非選擇題作答區」，請標明題號依序作答。

I. True or False (2.0 points for each question, 40 points)

1. In a dihybrid cross $AAbb \times aaBB$, 3/4 proportion of the F2 offspring is expected to be homozygote for at least one gene.
2. If the parents of a family already have two boys, the probability that the next two offspring will be girls is 1/4.
3. If a gene is monomorphic in a population the most likely phenotypic ratio for the trait that would be obtained from a cross between two random individuals in the population would be 3:1.
4. The stage of mitosis when sister chromatids separate from each other and migrate to opposite poles of a cell is called anaphase.
5. Sister chromatids can be on non-homologous chromosomes.
6. Suppose a three-point testcross was conducted involving the genes X , Y , and Z . If the most abundant classes are Xyz and xyZ and the rarest classes are xYZ and Xyz , Y gene is in the middle.
7. Two genes are considered linked when F2 progeny more commonly show the recombinant genotypes.
8. Chiasmata are structures of crossover between sister chromatids of homologous chromosomes.
9. The total genetic relatedness of two siblings is 0.5.
10. In an experiment to distinguish genetic versus environmental effect on a phenotype, it is important to make sure that the test individuals are as genetically identical as possible.
11. A bacterial cell protects its own DNA from restriction enzymes by adding methyl groups to adenines and/or cytosines.
12. DNA methyl-binding domains are specialized proteins contain chromodomain that bind to methylated cytosine.
13. Doubling genome size without polyploidization is because of retrotransposon amplification.
14. Genome annotation, identifying the biological function of coding sequences, can be assisted by alignments of DNA sequences through BLAST or amino acid sequence through BLASTP.
15. Mismatch repair is template independent and requires polymerase activity.
16. Mutations induced by mobile elements, including transposable elements and retrotransposons, are not always recessive.
17. RNA polymerase II transcribes small rRNA, tRNA, and some snRNA.
18. TFIID binds to the TATA box and positions the active site of RNA polymerase I to initiate transcript properly.
19. The T-DNA is flanked by two imperfect 25bp repeat motifs at either end, called the left border (LB) and right border (RB) which are containing resistant genes and capable to carry exogenous genes.
20. Transcription factors are only positive rather negative regulator of transcription.

II. Choice (2.0 points for each question, 40 points)

1. According to Mendel's law of independent assortment, which statement is true? (A) Genes of different chromosomes randomly assort into different gametes. (B) Alleles for one gene randomly assort into different gametes. (C) Dominant alleles for one gene must assort into the same gamete as the dominant alleles for another gene. (D) Dominant alleles for one gene must assort into the same gamete as the recessive alleles for another gene.
2. The gene that controls ABO blood type phenotype includes which of following inheritance patterns? (A) partial dominance (B) additive effect (C) codominance (D) none of the choices is correct.
3. During which of following stages of the cell cycle would a chromosome consist of only a single chromatid? (A) G_1 (B) G_2 (C) mitotic prophase (D) mitotic metaphase.

見背面

4. Which of the following statements applied to homologous chromosome? (A) They are attached to the same centromere (B) They contain the same genes in the same order but may have different alleles of some genes (C) They segregate each other at anaphase of mitosis (D) A chromosome is replicated using its homologous chromosome as template.
5. If you are a male, your X chromosome contains genes derived from (A) your paternal grandfather only (B) your maternal grandfather only (C) both your paternal grandfather and grandmother (D) both your maternal grandfather and grandmother.
6. Here is a list of meiotic events in no particular order: A. Segregation of homologous chromosomes to opposite poles; B. Segregation of sister chromatids to opposite poles; C. Alignment of homologous pairs on the midplate of the cell; D. Pairing and synapsis of homologous chromosome; E. Condensation of chromosomes in a diploid nucleus. What is the correct order of events? (A) CDEAB (B) DCEBA (C) DCABE (D) EDCAB.
7. Sturtevant's detailed mapping studies of the X chromosome of *Drosophila* established what genetic principle? (A) That genes are arranged in a linear order on the chromosomes (B) That genes are carried on chromosomes (C) That sex determination is controlled by the X and Y chromosomes (D) That different pairs of chromosomes assorted independently.
8. Which of the following is not one of the assumptions of the Hardy-Weinberg law? (A) The population is very large (B) Non-random mating occurs within the population (C) Mutation in the alleles do not occur (D) The ability of all genotypes for survival and reproduction is the same.
9. Why do the alleles that confer insecticide resistance in mosquitoes become less frequent in the population when insecticide application is discontinued? (A) The mosquitoes experienced a bottleneck effect (B) The allele were linked to a color variation that allowed for the mosquitoes that were resistant have a higher rate of predation (C) The population experienced genetic drift (D) The alleles for resistance had a negative fitness cost.
10. If the environmental variance (V_E) decreases and all other variance components remain the same, what will the effect be? (A) Both broad-sense heritability and narrow-sense heritability will increase (B) Both broad-sense heritability and narrow-sense heritability will decrease (C) Broad-sense heritability will increase, but narrow-sense heritability will decrease (D) Broad-sense heritability will decrease, but narrow-sense heritability will increase.
11. A geneticist introduces a transgene into yeast cells and isolates five independent cell lines in which the transgene has integrated into the yeast genome. In four of the lines, the transgene is expressed strongly, but in the fifth there is no expression at all. A likely explanation for the lack of transgene expression in the fifth cell line is that the (A) transgene integrated into a heterochromatic region of the genome. (B) transgene integrated into a euchromatic region of the genome. (C) transgene was mutated during the process of integration into the host cell genome. (D) host cell lacks the enzymes necessary to express the transgene. (E) transgene integrated into a region of the genome characterized by high histone acetylation.
12. DNA replication requires a free 3'-OH to initiate polymerase activity. This accomplished by synthesis (A) a temporary RNA primer, remove by Pol III. (B) a temporary RNA primer, removed by Pol I. (C) a permanent DNA primer, synthesized by pol III. (D) a permanent DNA primer, synthesized by pol I. (E) DNA replication does not require a free 3'-OH
13. DNA replication requires a free 3'-OH to initiate polymerase activity. In eukaryotes, a temporary RNA primer is (A) a removed by Pol III. (B) removed by Pol I. (C) removed by Fen1 endonuclease. (D) removed by APendonuclease. (E) DNA replication does not require a free 3'-OH
14. In general, mutation rates are higher in (A) promoter (B) 5'-UTR (C) exon (D) intron (E) 3'-UTR region.
15. In general, mutation rates are lower in (A) promoter (B) 5'-UTR (C) intergenic (D) intron (E) 3'-UTR region.
16. In general, nuclease hypersensitive sites are often found in which region of active genes? (A) upstream (B) 5'-UTR (C) exon (D) intron (E) downstream
17. PCR (Polymerase Chain Reaction) has been extensively utilized in researches of molecular biology and molecular breeding. Which setting or components are varied because of using different primers (A) DNA polymerase (B) DNA template concentration (C) denature temperature (D) annealing temperature (E) elongation temperature.
18. Rice is a model organism for crop research. Which one is NOT true for rice? (A) C3 plant (B) C4 plant (C) chromosome number, $N=12$ (D) genome size with approximate 430 Mb (E) predicted gene number with approximate 37,000

19. Which of the following is *true* for both prokaryotic and eukaryotic gene expression? (A) After transcription, a 3' poly(A) tail and a 5' cap are added to mRNA. (B) Translation of mRNA can begin before transcription is complete. (C) RNA polymerase may recognize a promoter region and begin transcription. (D) mRNA is synthesized in the 3' → 5' direction. (E) The mRNA transcript is the exact complement of the gene from which it was copied.
20. Which of the following is *true* for both prokaryotic and eukaryotic gene expression? (A) After transcription, a 3' poly(A) tail and a 5' cap are added to mRNA. (B) Translation of mRNA can begin before transcription is complete. (C) RNA polymerase may recognize a promoter region and begin transcription. (D) mRNA is synthesized in the 3' → 5' direction. (E) The mRNA transcript is the exact complement of the gene from which it was copied.

III. Assay (20 points)

- (5 points) In fruit flies, brown eyes can be caused by the recessive mutation *pn* (prune), *bw* (brown) or *ry* (rosy), which are on the X chromosome, second chromosome, and third chromosome, respectively. Wild-type alleles for all three genes must be present for eyes to be red. Supposed that two brown-eyed flies are crossed and their progeny consist of brown-eyed sons and red-eyed daughter. How many possible combinations for the crosses between two brown-eyed flies. What would be the genotypes of the two parents in each possible combination? Please explain your answer explicitly.
- (5 points) Supposed you made a cross between two specific diploid accessions of the same orchid species, one with strong fragrance and the other with no fragrance. Both of two orchid parental lines are native outcrossing and hence are heterozygous for most of chromosomal regions. Please design a QTL mapping experiment to describe how you can use the F1 population to achieve the goal to map QTLs controlling fragrance in orchid.
- (10 points) Next generation sequence technology (NGST) has been extensively utilized in current molecular genetic studies.
 - List two common used NGSTs (4 points)
 - How is NGST applied to genetic analysis? (3 points)
 - How is NGST applied to gene expression study? (3 points)

試題隨卷繳回