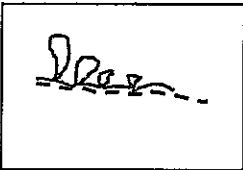


※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一、單選題 (Single choice questions) :每題2分，共50分

1. The goal of performing *in situ* hybridization in biological sample is to detect the expression of:
(a) DNA (b) RNA (c) Protein (d) both choices a and b (e) both choices b and c
2. What does R mean according to the nomenclature of restriction enzyme EcoRI?
(a) Genius (b) Species (c) Strain (d) Discovered sequence
3. During the separation of digested DNA by agarose gel electrophoresis, which of the following direction is correct for migration?
(a) positive to negative charge (b) negative to positive charge (c) not related to the charge
4. The best wave length to detect the concentration of RNA by the optical density meter is:
(a) 260 (b) 280 (c) 600 (d) 650 (e) 700 nanometer
5. In the research field of genetic engineering in plants, the transformation of gene into plant is a commonly used. Which of the following genetic material will carry the interested gene in the *Agrobacterium tumefaciens* during transformation?
(a) rRNA (b) cDNA (c) T-DNA (d) tRNA (e) mRNA
6. Which of the following material can be used as an insecticide in the transgenic plant?
(a) *Bacillus thuringiensis* (Bt) toxin (b) pepper ferredoxin-like protein (pflp) (c) granule-bound starch synthase (d) polyphenol oxidase (PPO) (e) Vacuolar anti-porter
7. Which of the following method can not detect the expression of mRNA?
(a) DNA microarray (b) RNA sequence (c) Southern blot analysis (d) Northern blot analysis (e) Quantitative RT-PCR
8. Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/Cas9 system is the common technique used to create mutant. By using this technique, what mechanism will happen after creating gene specific DNA double strand break in order to create insertion or deletion?
(a) Homologous recombination (b) Non-homologous end joining (c) DNA replication (d) DNA transcription (e) RNA splicing
9. In order to ligate a gene DNA fragment into the expression vector, T4 ligase is commonly used for ligation. What kind of bond does T4 ligase use to ligate the DNA fragments?
(a) Di-sulfide bond (b) peptide bond (c) phosphodiester bond (d) Nitrogen bond (e) phosphoanhydride bond
10. Electrophoretic Mobility Shift Assay (EMSA) is used for detect which kind of interaction in the following molecules?
(a) protein-protein (b) DNA-DNA (c) RNA-RNA (d) protein-DNA (e) DNA-RNA
11. At physiological pH, which amino acid will be negatively charged?
(a) Glutamate (b) Cysteine (c) Asparagine (d) Lysine

12. Trypsin is often used to identify protein sequences. What is its major function?
 (a) hydrolysis of peptide bonds on the carboxyl side of aromatic residues
 (b) cleavage of peptide bonds on the carboxyl side of methionines
 (c) cleavage of peptide bond on the carboxyl side of tryptophans
 (d) hydrolysis of peptide bonds on the carboxyl side of lysine and arginine residues
13. Shown right is the observed structure of a purified eukaryotic messenger RNA with DNA containing the full-length gene corresponding to the mRNA. Then, which statement is correct?
 (a) The right-and side of the mRNA sequences contains a polyadenylic acid sequence
 (b) There are four introns and five exons in this gene structure
 (c) The dash line is the DNA
 (d) Both structures require a primer for sequence amplification
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14. Which of the following is correct regarding cooperative binding of a ligand to a protein?
 (a) It did not require an allosteric protein (b) It rarely occurs in enzymes
 (c) The slope of the Hill Plot is usually larger than 1 (d) It results in a hyperbolic binding curve
15. Which of the following statement regarding the Michaelis-Menton equation is correct?
 (a) It relates the rate of enzyme-catalysed reaction with product concentration
 (b) It cannot describe the binding reaction of hemoglobin to oxygen
 (c) The K_m value is the substrate concentration at which the reaction rate reach its maximal value
 (d) Most enzymes did not follow the relationship
16. Regarding to enzymatic activity regulation, which statement is correct?
 (a) It usually requires conformation changes
 (b) It is always reversibly converted between active and inactive form
 (c) the reversible covalent bond can be formed during the reaction
 (d) Adding an activator can also increase the maximum reaction velocity
17. Which of the following is true about the sorting pathway for proteins destined for incorporation into lysosomes or the plasma membrane of eukaryotic cells?
 (a) Binding of signal recognition particle to the signal peptide and the ribosome temporarily accelerates protein synthesis
 (b) The newly synthesized polypeptides include a signal peptide at their carboxyl termini
 (c) The signal peptide is cleaved off inside the mitochondria by signal peptidase
 (d) The signal recognition particle binds to the signal peptide soon after it appears outside the ribosome
18. Which statement about the cell cycle in eukaryotes is true?
 (a) In G1 phase, the cells contain one copy of each chromosome
 (b) During S phase, cyclin amounts are increased along with chromatin formation.
 (c) During G2 phase, the spindle forms and each chromosome aligns independently for seperation
 (d) Sequences of the key regulator cdc2 proteins are very diverse between eukaryotic organisms
19. Uncoupling of mitochondrial oxidative phosphorylation
 (a) allows continued mitochondrial ATP formation, but halts O_2 consumption
 (b) halts mitochondrial ATP formation, but allows continued O_2 consumption
 (c) slows down the citric acid cycle
 (d) slows the conversion of glucose to pyruvate by glycolysis

20. In what order do the following five steps occur in the photochemical reaction centers of chloroplasts?
(1)Excitation of the chlorophyll *a* molecule at the reaction center (2)Replacement of the electron in the reaction center chlorophyll (3)Light excitation of antenna chlorophyll molecule (4)Passage of excited electron to electron-transfer chain (5) Exit on transfer to neighboring chlorophyll
(a) 1-2-3-4-5 (b)3-2-5-4-1 (c)3-5-1-4-2 (d)4-2-3-5-1
21. The known mechanisms of activation of rubisco or of other enzymes of the Calvin cycle during illumination include all of the following *except*:
(a)increased stromal pH
(b)light-driven entry of Mg^{2+} into the stroma
(c)phosphorylation by cAMP-dependent protein kinase
(d)reduction of a disulfide bridge by thioredoxin.
22. During mRNA processing in a eukaryotic cell, which step does not occurred?
(a)attachment of a long poly(A) sequence at the 3' end
(b)binding of ribosomes
(c)excision of intervening sequences (introns)
(d)A phosphate is hydrolyzed at the 5' end
23. Which statement regarding DNA replication is correct?
(a) DNA polymerase binds to a fixed origin template and catalyzes replication starting from the 3' hydroxyl of a DNA deoxyribonucleotide reside on a primer strand
(b)The Okazaki fragment of the lagging strand is synthesized 3'-->5' toward replication fork and initiated by a short DNA primer
(c) The helicase-catalyzed unwinding of parental DNA strands is ATP-independent
(d) DNA polymerase I only contains polymerase activity and is mainly assigned for nucleotide incorporation during replication
24. Which is the correct feature of Eukaryotic genome?
(a) There is a correlation between the quantity of DNA and the complexity of the organism
(b) Most DNA in mammalian or plant is single-copy with little duplicate sequences
(c) One reason for the large size of eukaryotic genome is that most genes contain introns, which may serve as loci for alternative splicing
(d) In many cases, a gene family exists to code for different variants of the same type of proteins that may be evolved from mutation of different genes
25. Biosynthesis of cytosolic protein in Eukaryotes is a complex event. During elongation of protein synthesis, the growing polypeptide chain is covalently attached to the ___ in the P-site in the ribosomal – RNA complex. The new amino acid will be brought to the ___ site with the matched anticodon for further peptide bond formation. These processes require energy from ___ hydrolysis.
(a)tRNA, A, ATP (b)tRNA, A, GTP (c)rRNA, A, GTP (d)rRNA, E, ATP

二、問答題 (essay)：共 50 分

1. Please describe one gene editing method and its application. (6 分)
2. Please describe a method and its principle to observe gene expression at protein level. (6 分)

3. What is the purpose and the principle of Yeast Two-Hybrid System? (6 分)
4. Please describe the purpose and the principle of microarray technology? (6 分)
5. By using subtractive hybridization to clone the gene for the α chain of the T-cell receptor, T-cell cDNAs were hybridized with B-cell mRNAs. (1)What was the purpose of this hybridization step? (4 分) Can the principle be applied generally? (2 分)
6. Please describe three differences between DNA polymerase I and RNA polymerase. (6 分)
7. Please explain the following transport mechanism and provide an example: (1) voltage-gated ion channels (4 分) (2) antiporters (4 分)
8. Please explain how calcium functions as an important signal molecule? (6 分)