單選題 (40%) (每題 2 分，答錯倒扣 0.5 分)

1. The enzyme fumarase catalyzes the reversible hydration of fumaric acid to l-malate, but it will not catalyze the hydration of maleic acid, the cis isomer of fumaric acid. This is an example of:
   A) biological activity. B) chiral activity. C) racemization. D) stereoisomerization.
   E) stereospecificity.

2. What is the approximate charge difference between glutamic acid and α-ketoglutarate at pH 9.5?
   A) 0 B) ½ C) 1 D) 1½ E) 2

3. Which of the following is not known to be involved in the process of *assisted* folding of proteins?
   A) Chaperonins B) Disulfide interchange C) Heat shock proteins
   D) Peptide bond hydrolysis. E) Peptide bond isomerization.

4. Which of the following is not a reducing sugar?
   A) Fructose B) Glucose C) Glyceraldehyde D) Ribose E) Sucrose

5. An individual molecular structure within an antigen to which an individual antibody binds is as a(n):
   A) antigen. B) epitope. C) Fab region. D) Fc region E) MHC site.

6. Which one of the following analytical techniques does not help illuminate a gene's cellular function?
   A) DNA microarray analysis B) Protein chip analysis C) Southern blotting
   D) Two-dimensional gel electrophoresis E) Two-hybrid analysis

7. Which of the following has not been shown to play a role in determining the specificity of protein kinases?
   A) Disulfide bonds near the phosphorylation site B) Primary sequence at phosphorylation site
   C) Protein quaternary structure D) Protein tertiary structure E) Residues near the phosphorylation site

8. Which of the following is a heteropolysaccharide?
   A) Cellulose B) Chitin C) Glycogen D) Hyaluronate E) Starch

9. In base-excision repair, the first enzyme to act is:
   A) AP endonuclease. B) DNA ligase. C) DNA glycosylase.
   D) DNA polymerase. E) Dam methylase.

10. At replication forks in *E. coli*:
    A) DNA helicases make endonucleolytic cuts in DNA.
    B) RNA primers are synthesized by primase. C) RNA primers are removed by primase.
    D) DNA topoisomerases make endonucleolytic cuts in DNA.

11. The 5' →3' exonuclease activity of *E. coli* DNA polymerase I is involved in:
    A) proofreading. B) removal of RNA primers. C) sealing of nicks.
    D) formation of Okazaki fragments. E) formation of a nick at the origin of DNA replication.

12. A branched ("lariat") structure is formed during:
    A) splicing of group II introns. B) splicing of all classes of introns.
    C) attachment of poly(A) tails to mRNA. D) attachment of a 5' cap to mRNA.
    E) processing of preribosomal RNA.

13. Processing of a primary mRNA transcript in a eukaryotic cell does not normally involve:
    A) attachment of a long poly(A) sequence at the 3' end.
    B) methylation of one or more guanine nucleotides at the 5' end.
    C) excision of intervening sequences (introns).
    D) conversion of normal bases to modified bases such as inosine and pseudouridine.
    E) joining of exons.

14. The amino acids serine, alanine, and cysteine can be catabolized to yield:
A) fumarate. B) pyruvate. C) succinate. D) α-ketoglutarate. E) none of the above.

15. The reverse transcriptase of an animal RNA virus catalyzes:
A) RNA formation in the 3' →5' direction.
B) RNA synthesis, but not DNA synthesis.
C) degradation of the RNA strand in a DNA-RNA hybrid.
D) insertion of the viral genome into a chromosome of the host (animal) cell.
E) both B and C.

16. Which of the following statements about the light reactions in photosynthetic plants is false?
A) A membrane-bound ATPase couples ATP synthesis to electron transfer.
B) No CO_2 is fixed in the light reactions.
C) The ultimate electron acceptor is O_2.
D) The ultimate source of electrons for the process is H_2O.
E) There are two distinct photosystems, linked together by an electron transfer chain.

17. Which of the following intermediates of the citric acid cycle is prochiral ?
A) Citrate B) Isocitrate C) Malate D) Oxaloacetate E) Succinate

18. The proofreading function of DNA polymerase involves all of the following except:
A) reversal of the polymerization reaction. B) a 3'→5' exonuclease. C) base pairing.
D) phosphodiester bond hydrolysis. E) detection of mismatched base pairs.

19. Histones are _____ that are usually associated with _____.
A) acidic proteins; DNA B) acidic proteins; RNA C) basic proteins; DNA
D) basic proteins; RNA E) coenzymes derived from histidine; enzymes

20. The two moles of CO_2 produced in the first turn of the citric acid cycle have their origin in the:
A) carboxyl and methylene carbons of oxaloacetate.
B) carboxyl group of acetate and a carboxyl group of oxaloacetate.
C) carboxyl group of acetate and the keto group of oxaloacetate.
D) two carbon atoms of acetate.
E) two carboxyl groups derived from oxaloacetate.

問答（40 %）:

1. Draw the structures of (1) histidine, (2) proline, (3) cyclic AMP, (4) malonyl CoA, (5) aspartic acid.(15%)
2. Diagram and describe the pathway of RNAi (RNA interference). (10%).
3. Describe the principle of next generation sequencing (NGS) and its application in agricultural, biotechnological research.(15%)

解釋名詞 (20%)

1. Yeast three hybrid analysis
2. codon optimization
3. zinc finger proteins
4. Southern blotting and northern blotting
5. two dimensional gel electrophoresis
6. gel mobility shift assay
7. yeast artificial chromosome
8. Shine-Dalgarno sequence
9. ribozyme
10. Actinomycin D