

一、選擇題 (共25題單選，每題二分，答錯倒扣0.5分)

- Which of the following statements about cystine is CORRECT?
 - Cystine is formed through a peptide linkage between two cysteines.
 - Cystine forms when the $-\text{CH}_2\text{-SH}$ side chain is oxidized to form a $-\text{CH}_2\text{-S-S-CH}_2\text{-}$ disulfide bridge between two cysteines.
 - Cystine contains free $-\text{CH}_2\text{-SH}$.
 - Cystine contains free $-\text{CH}_2\text{-OH}$.
 - None of the above
- After heating in the presence of ninhydrin, the group on an amino acid found in the final purple product is the:
 - amino group nitrogens.
 - the α carbon and its bound hydrogen.
 - carboxylic acid oxygens.
 - carboxylic acid and amino group nitrogens.
 - carboxylic acid and the α carbon.
- By adding SDS (sodium dodecyl sulfate) during the electrophoresis of proteins, it is possible to
 - determine the amino acid composition of the protein.
 - preserve a protein's native structure and biological activity.
 - determine a protein's isoelectric point.
 - separate proteins exclusively on the basis of molecular weight.
 - determine an enzyme's specific activity.
- In a mixture of the five proteins listed below, which should elute second in size-exclusion (gel filtration) chromatography?
 - cytochrome c, $M_r = 13,000$
 - ribonuclease, $M_r = 13,700$
 - immunoglobulin G, $M_r = 145,000$
 - RNA polymerase, $M_r = 450,000$
 - serum albumin, $M_r = 68,500$
- A nonapeptide was determined to have the following amino acid composition: (Lys) $_2$, (Gly) $_2$, (Phe) $_2$, His, Leu, Met. The native peptide was incubated with 1-fluoro-2,4-dinitrobenzene (FDNB) and then hydrolyzed; 2,4-dinitrophenylhistidine was identified by HPLC. When the native peptide was exposed to cyanogen bromide (CNBr), an octapeptide and free glycine were recovered. Incubation of the native peptide with trypsin gave a pentapeptide, a tripeptide, and free Lys. 2,4-dinitrophenylhistidine was recovered from the pentapeptide, and 2,4-dinitrophenylalanine was recovered from tripeptide. Digestion with the enzyme pepsin produced a dipeptide, a tripeptide, and a tetrapeptide. The tetrapeptide was composed of (Lys) $_2$, Phe, and Gly. The native sequence was determined to be:
 - Gly-Phe-Lys-Lys-Gly-Leu-Met-Phe-His
 - Met-Leu-Phe-Lys-Phe-Gly-Gly-Lys-His
 - His-Phe-Leu-Gly-Lys-Lys-Phe-Met-Gly
 - His-Leu-Phe-Gly-Lys-Lys-Phe-Met-Gly
 - His-Phe-Leu-Gly-Lys-Phe-Lys-Met-Gly

6. The Thr residues tend to disrupt an α helix when they occur next to each other in a protein because
- of electrostatic repulsion between the Thr side chains.
 - Thr residue is highly hydrophobic.
 - the R group of both amino acids can form hydrogen bond.
 - of steric hindrance between the bulky Thr side chains.
 - of the possible covalent interactions between the Thr side chains.
7. V_{max} for an enzyme-catalyzed reaction:
- is twice the rate observed when the concentration of substrate is equal to the K_m .
 - generally increases when pH increases.
 - is four times the rate observed when the concentration of substrate is equal to the K_m .
 - generally decreases when pH decreases.
 - is unchanged in the presence of a noncompetitive inhibitor.
8. In a plot of $1/V$ against $1/[S]$ for an enzyme-catalyzed reaction, the presence of a competitive inhibitor will alter the:
- V_{max} .
 - intercept on the $1/V$ axis.
 - intercept on the $1/[S]$.
 - curvature of the plot.
 - pK of the plot.
9. An enzyme-catalyzed reaction was carried out with the substrate concentration initially 1,000 times greater than the K_m for that substrate. After 18 minutes, 1% of the substrate had been converted to product, and the amount of product formed in the reaction was 24 μ mole. If, in a separate experiment, one-fourth as much enzyme and one half substrate had been combined, how long it take for the same amount (24 μ mole) of product to be formed?
- 18 minutes
 - 36 minutes
 - 54 minutes
 - 72 minutes
 - 90 minutes
10. Studies with mutated forms of tyrosyl-tRNA synthetase showed that changing some active-site amino acids decreased the enzyme's turnover number but not the K_m of the reaction. The best interpretation of these results is that the
- reaction's K_m does not depend on which amino acid side chains are found in the active site.
 - two terms, K_m and turnover number, are inversely proportional.
 - transition state for this reaction is formed prior to the formation of the ES complex.
 - two substrates, tyrosine and ATP, must enter the active site in a specific order.
 - amino acids involved with the transition-state complex are different from the ones that affect enzyme-substrate association.

11. How many movements of the following is/are directly coupled with ATP hydrolysis (a) glucose across the animal cell plasma membrane. (b) Cl^- and HCO_3^- across the erythrocyte membrane. (c) Na^+ and K^+ across the plasma membrane (d) Ca^{+2} to the endoplasmic reticulum lumen.
- A. 0
B. 1
C. 2
D. 3
E. 4
12. How many of the following properties are correct for coated vesicles? (a) can be uncoated in an enzyme-catalyzed, ATP-requiring reaction. (b) are long-lived (c) can carry solutes such as horseradish peroxidase as well as ligands. (d) play a role in the internalization of all ligands.
- A. 0
B. 1
C. 2
D. 3
E. 4
13. An enzyme assay containing succinate (0.1 mM) and succinate dehydrogenase (1 μg) in a volume of 1 ml is found to have a specific activity of 10 μmoles of succinate utilized/min/mg of succinate dehydrogenase. Assume a K_m for succinate of 0.01 mM. Dilution of the assay solution 10-fold and re-assay results in a specific activity of
- A. 10 $\mu\text{mole}/\text{min}/\text{mg}$
B. 5 $\mu\text{mole}/\text{min}/\text{mg}$
C. 2 $\mu\text{mole}/\text{min}/\text{mg}$
D. 1 $\mu\text{mole}/\text{min}/\text{mg}$
E. 0.5 $\mu\text{mole}/\text{min}/\text{mg}$
14. How many of the following statements are INCORRECT?
- (a) Enzymes can accelerate chemical reactions by either stabilizing the transition state or destabilizing the ground state relative to each other.
- (b) Since the transition state is the least stable arrangement of atoms during the course of a chemical reaction, enzymes cannot bind the transition state very tightly. This contributes to a rate acceleration.
- (c) Enzymes which display negative cooperativity will show a change in velocity with increasing substrate concentration over a much larger range of substrate concentrations than non-cooperative enzyme.
- (d) A heterotropic activator which causes a decrease in the effective K_m for the substrate will bind to the high affinity form of the enzyme more tightly than to the low affinity form of the enzyme.
- A. 0
B. 1
C. 2
D. 3
E. 4

15. Which of the following statements is INCORRECT?
- A. Arachidonic acid can serve as the precursor to prostaglandin E₁.
 - B. Arachidonic acid can serve as the precursor to thromboxane A₂.
 - C. Arachidonic acid can serve as the precursor to leukotriene A.
 - D. In response to certain hormonal signals, phospholipase A₂ release arachidonic acid from membrane phospholipid.
 - E. Prostaglandin act in many tissues by regulation of protein kinase C activity.
16. Which of the following statements about lipid is INCORRECT?
- A. Phospholipase D can release inositol from phosphatidylinositol
 - B. Phospholipase A₂ can release unsaturated fatty acid from ceramide.
 - C. Phospholipase C can release diacylglycerol from phosphatidylinositol.
 - D. Phospholipase C can release inositol-1,4,5-trisphosphate from phosphatidylinositol.
 - E. Vitamin D is a derivative of cholesterol.
17. Which of the following statements about plasma membrane is INCORRECT?
- A. Some peripheral membrane proteins can be released from membrane by treatment of phospholipase C.
 - B. Some peripheral membrane proteins can be released from membrane by change of pH.
 - C. Release of integral membrane proteins is usually achieved by high ionic salt extraction.
 - D. The reorientation of membrane proteins by flip-flop diffusion occurs rarely.
 - E. Integral proteins usually have domains rich in hydrophobic amino acids.
18. Which of the following statements about membrane transport is CORRECT?
- A. Simple diffusion of N₂ through membrane requires protein carrier.
 - B. Passive transport of glucose through erythrocytes requires glucose permease.
 - C. Passive transport of glucose through erythrocytes cannot be saturated with substrates.
 - D. Passive diffusion of HCO₃⁻ through erythrocyte membrane requires cotransport of Na⁺
 - E. Active transport is usually energy-independent.
19. Which of the following statements about carbohydrate is INCORRECT?
- A. Cellulose is an unbranched homopolymer of D-glucose.
 - B. Glycogen is a branched homopolymer of D-glucose.
 - C. Carbohydrate can link to the ser, thr, or asn residues in proteins.
 - D. The sialic acid residue are usually found at the end of the oligosaccharide chain of many soluble glycoprotein.
 - E. Chitin is a linear homopolysaccharide composed of N-acetyl-D-glucose residues in α -linkages.
20. Which of the following statements about blood clotting is INCORRECT?
- A. Fibrinogen is soluble in circulation blood.
 - B. Fibrin monomer is released from fibrinogen by the action of thrombin.
 - C. The fibrin monomer associate into polymer in the presence of Mg⁺².
 - D. The activation of prothrombin to thrombin requires factor X_a.
 - E. The proteolytic cleavage of prothrombin to thrombin requires a post-transcriptional modification by vitamin K-dependent carboxylase.

21. Which of the following statements about signal transduction is INCORRECT?
- A. Protein kinase C is activated by diacylglycerol.
 - B. Protein kinase C is activated by Ca^{+2} .
 - C. cGMP is an important second messenger in eucaryotic cell.
 - D. Nitric oxide (NO) is an important second messenger in eucaryotic cell.
 - E. Progesterone receptor is located on plasma cell membrane.
22. Which of the following statements about oncogenes is CORRECT?
- A. The product of ras gene is located in the nucleus.
 - B. The p53 protein is located in the nucleus.
 - C. The product of ras gene binds to adenine nucleotide.
 - D. The p53 protein binds to guanine nucleotide.
 - E. Mutations in ras and p53 genes are rarely observed in human cancer.
23. Which of the following statements about apoptosis is INCORRECT?
- A. Apoptosis is a programmed form of cell death.
 - B. DNA fragmentation is frequently observed in apoptosis.
 - C. Chromatin condensation is frequently observed in apoptosis.
 - D. Apoptosis is not found in the development of multicellular organism.
 - E. Apoptosis is different from necrosis.
24. Which of the following statements is INCORRECT?
- A. Many adjacent lys residues tends to destabilize α -helix.
 - B. The occurrence of proline residue tends to destabilize α -helix.
 - C. The keratin is composed of right-handed α -helix.
 - D. The collagen is composed of mixture of α -helix and β -sheet.
 - E. Fibroin of silk is mainly composed of β -sheet structure.
25. Which of the following statements about De Novo synthesis of purine and pyrimidine is INCORRECT?
- A. One origin of the ring atoms of purine is from alanine.
 - B. One origin of the ring atoms of purine is from glycine.
 - C. One origin of the ring atoms of purine is from aspartate.
 - D. One origin of the ring atoms of purine is from glutamine.
 - E. Pyrimidine nucleotides are made from aspartate and ribose-5-phosphate.

二、簡答題 (fifty points in 9 questions.)

1. The total length of all the DNA in a single human cell is about 2 meter. Describe how such large amounts of DNA can be packed into the nucleus. (4%)

2. A new unidentified unicellular organism was isolated in National Cheng Kung University Medical College. The DNA molecule is about 2×10^6 bp long in double-stranded form. You are assigned to study the replication mechanism of this cell. What kind of experiments can be used to study the following molecular mechanisms?
- A. Whether DNA replication is unidirectional or bidirectional? (2%)
 - B. Whether DNA replication is semiconservative? (2%)
 - C. Four kinds of DNA polymerases are purified and cloned from this organism, can you determine which one is actually responsible for DNA replication? (2%)
3. Describe the function of the following proteins in DNA replication in *E. coli*. (4%)
- A. DNA polymerase I
 - B. DnaA protein
 - C. topoisomerase
 - D. single-stranded DNA binding protein
- 4.
- (A) Describe the function of MutS gene product in *E. coli*.
 - (B) A human homologue of MutS gene was cloned, and found associating with hereditary colon cancer. A (T to C) transition mutation in this gene has been detected in the splice-acceptor site in affected individuals of two hereditary colon cancer families. Can you explain the biological meaning of this finding in cancer research. (6%)
- 5.
- (A) Give one example on how transcriptional repressor regulate gene expression in prokaryotic cell. (3%)
 - (B) Give one example on how transcriptional activator regulate gene expression in eucaryotic cell. (3%)
 - (C) Give some possible explanations on why eucaryotic cell more frequently use multiple cooperative activators to regulate gene expression, and less frequently use a single repressor to regulate gene expression. (2%)
6. Describe the common structural motif found in transcriptional activator in eucaryotic cell. (4%)
7. Explain the following terms in the usage of recombinant DNA:(8%)
- A. cosmid
 - B. restriction fragment length polymorphism
 - C. Ti plasmid in *Agrobacterium*
 - D. gene therapy
8. Describe common pathways of protein degradation in eucaryotic cell. (4%)

9. Suppose that on Mars, life evolved independently with its own genetic code. DNA and RNA have the same four bases and base pairs, but proteins are constructed from only 15 amino acids and codons have only two bases instead of three. The code is NOT degenerate. The following experiments were done to elucidate the Martian genetic code, using synthetic RNA molecules in a cell-free extract for protein synthesis: (6%)

RNA with repeating sequence	peptide generated
(A)n	polyalanine
(C)n	polyleucine
(U)n	polyhistidine
(AG)n	(glu)n or (gly)n
(AC)n	(trp)n or (pro)n
(AU)n	(ile)n or (tyr)n
(GC)n	(arg)n
(GU)n	(phe)n or (val)n
(CU)n	(asn)n or (ser)n
(GAU)n	(gly-val-ile)n
(ACU)n	(trp-tyr-asn)n
(UCG)n	(ser-phe-arg)n
(CAG)n	glu-pro, dipeptide only
(AGGU)n	(glu-phe)n or (lys-tyr)n

Solve the Martian genetic code:

		second base in codon			
		A	G	C	U
first	A				
base	G				
in	C				
codon	U				