Part考生請注意：本試題 □可 ☑不可 使用計算機 請勿在本試題紙上作答，否則不予計分

A. Multiple Choice Questions: (2 points each)

1. Of the 20 standard amino acids, only _____is not optically active. The reason is that its side chain _____.
A) alanine; is a simple methyl group B) glycine; is a hydrogen atom
C) glycine; is unbranched D) lysine; contains only nitrogen

2. Which of the following statements about *cystine* is correct?
A) Cystine forms when the CH_2-SH R group is oxidized to form a -CH_2-S-S-CH_2- disulfide bridge between two cysteines.
B) Cystine is an example of a nonstandard amino acid, derived by linking two standard amino acids.
C) Cystine is formed by the oxidation of the carboxylic acid group on cysteine.
D) Cystine is formed through a peptide linkage between two cysteines.

3. The average molecular weight of the 20 standard amino acids is 138, but biochemists use 110 when estimating the number of amino acids in a protein of known molecular weight. Why?
A) The number 110 is based on the fact that the average molecular weight of a protein is 110,000 with an average of 1,000 amino acids.
B) The number 110 reflects the higher proportion of small amino acids in proteins, as well as the loss of water when the peptide bond forms.
C) The number 110 reflects the number of amino acids found in the typical small protein, and only small proteins have their molecular weight estimated this way.
D) The number 110 takes into account the relatively small size of nonstandard amino acids.

4. In the α helix the hydrogen bonds:
A) are roughly parallel to the axis of the helix.
B) are roughly perpendicular to the axis of the helix.
C) occur mainly between electronegative atoms of the R groups.
D) occur only between some of the amino acids of the helix.

5. Analysis of x-ray diffraction data yields a(n) ____; analysis of 2D NMR data yields a(n) _____.
A) electron density map; count of hydrogen atoms in the molecule
B) shadow of protein's outline; estimate of protein's molecular volume
C) table of interatomic distances; electron density map
D) electronic density map; table of interatomic distances

6. When oxygen binds to a heme-containing protein, the two open coordination bonds of Fe^{2+} are occupied by:
A) one O atom and one amino acid atom. B) one O_2 molecule and one amino acid atom.
C) one O_2 molecule and one heme atom. D) two O atoms.

7. The amino acid substitution of Val for Glu in Hemoglobin S results in aggregation of the protein because of ____ interactions between molecules.
A) covalent B) disulfide C) hydrogen bonding D) hydrophobic

8. Which of these statements about enzyme-catalyzed reactions is *false*?
A) At saturating levels of substrate, the rate of an enzyme-catalyzed reaction is proportional to the enzyme concentration.
B) If enough substrate is added, the normal V_{max} of a reaction can be attained even in the presence of a competitive inhibitor.
C) The rate of a reaction decreases steadily with time as substrate is depleted.
D) The activation energy for the catalyzed reaction is the same as for the uncatalyzed reaction, but the equilibrium constant is more favorable in the enzyme-catalyzed reaction.

(背面仍有題目,請繼續作答)

※ 考生請注意：本試題 □可 ☑不可 使用計算機

B. Short Answer Questions:

1. Describe two major differences between chemical synthesis of polypeptides and synthesis of polypeptides in the living cell. (4 points)
2. Describe briefly the basic structure and the function of an IgG protein molecule. (5 points)
3. What is a zymogen (proenzyme)? Explain briefly with at least one example. (5 points)

Part II

A. Multiple Choice Questions: (2 points each)

1. In comparison with DNA-DNA double helices, the stability of DNA-RNA and RNA-RNA helices is:
A) DNA-DNA > RNA-RNA > DNA-RNA. B) RNA-DNA > RNA-RNA > DNA-DNA.
C) RNA-RNA > DNA-DNA > DNA-RNA. D) RNA-RNA > DNA-RNA > DNA-DNA.

2. The proofreading function of DNA polymerase involves all of the following *except*:
A) a 3′ → 5′ exonuclease. B) base pairing. C) detection of mismatched base pairs. D) reversal of the polymerization reaction.

3. The function of the eukaryotic DNA replication factor PCNA (*p*roliferating *c*ell *n*uclear *a*ntigen) is similar to that of the b-subunit of bacterial DNA polymerase III in that it:
A) forms a circular sliding clamp to increase the processivity of replication. B) has a 3′ → 5′ proofreading activity.
C) increases the speed but not the processivity of the replication complex. D) participates in DNA repair.

4. Which one of the following statements about mRNA stability is true?
A) Degradation always proceeds in the 5′ to 3′ direction.
B) Degradation of mRNA by polynucleotide phosphorylase yields 5′-nucleoside monophosphates.
C) In general, bacterial mRNAs have longer half-lives than do eukaryotic mRNAs.
D) Secondary structure in mRNA (hairpins, for example) slows the rate of degradation.

5. Which of the following are features of the "wobble" hypothesis?
A) A naturally occurring tRNA exists in yeast that can read both arginine and lysine codons.
B) A tRNA can recognize only one codon.
C) Some tRNAs can recognize codons that specify two different amino acids, if both are nonpolar.
D) The "wobble" occurs only in the first base of the anticodon.

6. Which of the following is *not* true of tRNA molecules?
A) The 3′-terminal sequence is —CCA.
B) Their anticodons are complementary to the triplet codon in the mRNA.
C) They contain more than four different bases.
D) With the right enzyme, any given tRNA molecule will accept any of the 20 amino acids.

7. The pathway for polypeptides exported from *E. coli* includes the following steps, which occur in what order for correct export?
1. A chaperone, SecA, binds to the polypeptide.
2. A chaperone, SecB, binds to the polypeptide.
3. ATP is hydrolyzed by SecA.
4. SecA pushes 20 amino acids of the polypeptide into the translocation complex.

A) 1, 2, 3, 4 B) 1, 2, 4, 3 C) 2, 1, 4, 3 D) 2, 3, 1, 4

8. "Housekeeping genes" in bacteria are commonly expressed constitutively, but not all of these genes are expressed at the same level (the same number of molecules per cell). The primary mechanism responsible for

※ 考生請注意：本試題 □可 ☑不可 使用計算機

variations in the level of constitutive enzymes from different genes is that:
A) all constitutive enzymes are synthesized at the same rate, but are not degraded equally.
B) their promoters have different affinities for RNA polymerase holoenzyme.
C) some constitutively expressed genes are more inducible than others.
D) some constitutively expressed genes are more repressible than others.

B. Short Answer Questions:

1. Match the type of bond with the role below: (1 point each)

Bond type	Role
(a) phosphodiester	___ links base to pentose in nucleotide
(b) *N*-glycosidic	___ joins adjacent nucleotides in one strand
(c) hydrogen	___ joins complementary nucleotides in two strands
	___ difference between a nucleoside and a nucleotide

2. Match the damage type or repair step at the left with a related enzyme at right. Only one answer will be the most direct for each. (1 point each)

___ base loss	(a) hypoxanthine-*N*-glycosylase	(b) AP endonuclease
___ seals nicks	(c) mutH protein	(d) DNA polymerase I
___ binds to mismatch in DNA	(e) uracil *N*-glycosylase	(f) mutS-mutL complex
___ DNA synthesis in gaps	(g) DNA ligase	(h) RecA protein

3. For each of the following statements, indicate with a P if the statement applies only to prokaryotes, an E if the statement applies only to eukaryotes, and an E and a P if the statement applies to both eukaryotes and prokaryotes. (1 point each)
___ RNA synthesis is blocked by actinomycin D.
___ Transcription of mRNA is blocked by *a*-amanitin.
___ Termination of transcription requires the protein r factor.
4. Describe the sequence of events in the initiation of transcription by *E. coli* RNA polymerase. (4 points)
5. *E. coli* cells are placed in a growth medium containing lactose. Indicate how the following circumstances would affect the expression of the lactose operon (increase/decrease/no change). (4 points)
(a) Addition of high levels of glucose
(b) A *lac* repressor mutation that prevents dissociation of a *lac* repressor from the operator
(c) A mutation that inactivates b-galactosidase
(d) A mutation that inactivates galactoside permease

Part III.

A. Multiple Choice Questions: (2 points each)

1. Cells can terminate signal transduction by cell surface receptors by:
A) reducing agonist availability in the vicinity of the target cells.
B) internalizing and degrading the receptor-agonist complex.
C) modifying the receptor so that it is inactive or desensitized.
D) All of the above.

2. In the Cori cycle:
A) only tissues with aerobic metabolism are involved.
B) a three-carbon compound arising from glycolysis is converted to glucose at the expense of energy from fatty acid oxidation.
C) glucose is converted to pyruvate in anaerobic tissues, and this pyruvate returns to the livers, where it is converted to glucose.

(背面仍有題目,請繼續作答)

※ 考生請注意：本試題 □可 ☑不可 使用計算機

D) the same amount of ATP is used in the liver to synthesize glucose as is released during glycolysis, leading to no net effect on whole body energy balance.

3. If a cell requires more NADPH than ribose 5-phosphate:
A) only the first phase of the pentose phosphate pathway would occur.
B) glycolytic intermediates would flow into the reversible phase of the pentose phosphate pathway.
C) there would be sugar interconversions but no net release of carbons from glucose 6-phosphate.
D) the equivalent of the carbon atoms of glucose 6-phosphate would be released as $6CO_2$.

4. β-oxidation of fatty acids:
A) generates ATP only if acetyl CoA is subsequently oxidized.
B) is usually suppressed during starvation.
C) uses only even-chain, saturated fatty acids as substrates.
D) occurs by a repeated sequence of four reactions.

5. In biosynthesis of cholesterol
A) HMG-CoA is synthesized by mitochondrial HMG-CoA synthase.
B) HMG-CoA reductase catalyzes the rate-limiting step.
C) the conversion of mevalonic acid to farnesyl pyrophosphate proceeds via condensation of 3 molecules of mevalonic acid.
D) condensation of 2 farnesyl pryrophosphate to form squalene is freely reversible.

6. In Niemann-Pick disease, the deficient enzyme is sphingomyelinase. Sphingomyelins differ from other sphingolipids in that they are:
A) not based on a ceraminde core.
B) acidic rather than neutral at physiological pH.
C) only types containing *N*-actylneuraminic acid.
D) only types that are phospholipids.

7. The biosynthesis of heme requires all of the following *except*:
A) propionic acid B) succinyl CoA C) glycine D) ferrous ion

8 In the formation of urea from ammonia, all of the following are correct *except*:
A) aspartate supplies one of the nitrogens found in urea.
B) this is an energy-expensive process, utilizing several ATPs.
C) the rate of cycle fluctuates with the diet.
D) ornithine transcarbamoylase catalyzes the rate-limiting step.

9 Uric acid is
A) formed from xanthine in the presence of O_2.
B) a degradation product of cytidine.
C) deficient in the condition known as gout.
D) a competitive inhibitor of xanthine oxidoreductase.

10 Muscle metabolism during exercise.
A) is the same in both aerobic and anaerobic exercise.
B) shifts from primarily glucose to primarily fatty acids as fuel during aerobic exercise.
C) uses largely glycogen and phosphocreatine in the aerobic state.
D) causes a sharp rise in blood ketone body concentration.

B. Essays:
1. Describe how the hormone glucagon affects glycogen metabolism in the liver (10 points).
2. Briefly describe how the citric acid cycle is regulated (5 points).