※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

＊ 請務必在答案卷上作答，並清楚地註明題號

一、 選擇題（每小題 2%，共 40%）

1. Which one of the following analytical techniques does not help illuminating 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

2. Which of the following is least likely to result in protein denaturation?
   A). Altering net charge by changing pH.
   B). Changing the salt concentration
   C). Disruption of weak interactions by boiling.
   D). Exposure to detergents.
   E). Mixing with organic solvents such as acetone.

3. An integral membrane protein can be extracted with:
   A). a buffer of alkaline or acidic pH B). a solution containing detergent
   C). a solution of high ionic strength D). hot water
   E). a chelating agent that removes divalent cations.

4. For amino acids with neutral R group, at any pH below the pI of amino acid, the population of amino acids in solution will have:
   A). a net negative charge B). a net positive charge
   C). no charged group D). no net charge
   E). positive and negative charges in equal concentration

5. All of the following contribute to large, negative, free-energy change upon hydrolysis of high-energy compound except:
   A). electrostatic repulsion in the reactant.
   B). stabilization of products by solvation.
   C). stabilization of products by ionization.
   D). low activation energy of forward reaction.
   E). stabilization of product by extra resonance forms.

6. Which of the following compounds can not serve as the starting material for the synthesis of glucose via gluconeogenesis?
   A). Acetate B). glycerol C). lactate D). oxaloacetate E). α -ketoglutarate

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

7. Cellular isozymes of pyruvate kinase are allosterically inhibited by:
   A). high concentrations of AMP B). high concentrations of ATP
   C). low concentrations of acetyl-CoA D). high concentrations of citrate
   E). low concentrations of ATP

8. Order the steps leading to glycogen breakdown resulting from the stimulation of liver cells by glucagon.
   1). Activation of protein kinase A (PKA) 2). cAMP levels rise
   3). Phosphorylation of phosphorylase *b* 4).Stimulation of adenyl cyclase
   5). Phosphorylation of phosphorylase *b* kinase
   A). 5-2-1-4-3 B). 4-2-1-5-3 C). 4-1-2-3-5 D). 5-2-1-4-3

9. The conversion of 1 mole of pyruvate to 3 mole of CO_2 via pyruvate dehydrogenase and the citric acid cycle also yields ____ mole of NADH, ____ mole $FADH_2$, and ____ mole of ATP (or GTP)
   A). 2; 2; 2 B). 3; 1; 1 C). 3; 2; 0 D). 4; 1; 1 E). 4; 2; 1

10. What is the correct order of function of the following enzymes of β-oxidation?
   1. β-Hydroxyacyl-CoA dehydrogenase 2). Thiolase
   3). Enoyl-CoA hydrase 4). Acetyl-CoA dehydrogenase
   A). 1-2-3-4 B). 3-1-4-2 C). 4-3-1-2 D). 1-4-3-2 E). 4-2-3-1

11. Which of the following is not true of the reaction catalyzed by glutamate dehydrogenase?
   A). It is similar to transamination in that it involves the coenzyme pyridoxal phosphate.
   B). NH_4^+ is produced
   C). The enzyme can use either NAD^+ or $NADP^+$ as a cofactor.
   D). The enzyme is glutamate-specific, but the reaction is involved in oxidizing other amino acids.
   E). α-Ketoglutarate is produced from an amino acid.

12. Which of these directly donates a nitrogen atom for the formation of urea during the urea cycle?
   A). Adenine B). Aspartate C). Creatine D). Glutamate E). ornithine

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

13. Which of the following is correct concerning the mitochondrial ATP synthase?
A). It can synthesize ATP after it is extracted from broken mitochondria.
B). It catalyzes the formation of ATP even the reaction has a large positive $\Delta G'^{o}$.
C). It consists of F_0 and F_1 subunits, which are transmembrane polypeptides.
D). It is actually an ATPase and only catalyzes the hydrolysis of ATP.
E). When it catalyzes the ATP synthesis reaction, the $\Delta G'^{o}$ is actually close to zero.

14. Which of these enzymes is not part of the Calvin cycle?
A). Aldolase B). Glyceraldehyde 3-phosphate dehydrogenase
C). Phosphofrutokinase-1 C). Ribulose-5-phosphate kinase
E). Transketolase

15. All are true for phosphorespiration except:
A). It is driven by light B). It oxidizes substrates to CO_2
C). It produces O_2 D). It results in no fixation of carbon
E). It results from a lack of specificity of the enzyme rubisco.

16. The rate-limiting step in fatty acid synthesis is:
A). condensation of acetyl-CoA and malonyl-CoA
B). formation of acetyl-CoA from acetate
C). formation of malonyl-CoA from malonate and coenzyme A.
D). the reaction catalyzed by acetyl-CoA carboxylase
E). the reduction of the acetoacetyl group to a β-hydroxybutyryl group.

17. Which of the following statements is true?
A). the brain prefers glucose as an energy source, but can use ketone bodies.
B). Muscle cannot use fatty acids as an energy source.
C). In a well-fed human, about equal amounts of energy are stored as glycogen and as triacylglycerol.
D). In skeletal muscle, glucose is the preferred fuel at rest.
E). Amino acids are a preferable energy source over fatty acids.

18. 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. C). phosphodiester bond hydrolysis.
E). reversal of polymerization reaction.

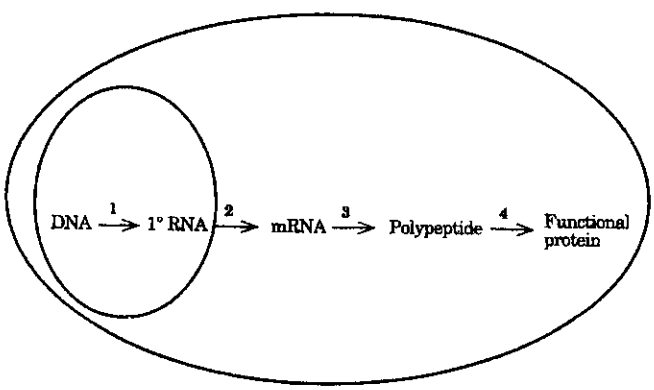
※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

19. "Footprinting" or DNase protection is a technique used to identify:
   A). a region of DNA that has been damaged by mutation.
   B). *E. coli* cells that contain a desired, cloned piece of DNA.
   C). the position of a particular gene of a chromosome.
   D). the position of internally double-stranded regions in a single-stranded DNA molecule.
   E). the specific binding site of a repressor, polymerase, or other protein on DNA.

20. Which one of the following is true about the genetic code?
   A). All codons recognized by a given tRNA encode different amino acids.
   B). It is absolutely identical in all living things.
   C). Several different codons may encode the same amino acid.
   D). The base in the middle position of tRNA anticodon sometimes permits wobble base pairing with 2 or 3 different codons.
   E). The first position of the tRNA anticodon is always adenosine.

二、 非選擇題

1. The figure shown below represents a typical eukaryotic cell. Identify each of the numbered steps involved in gene expression. (12%)



※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

2. In samples of DNA isolated from two unidentified species of bacteria, X and Y, adenine makes up 32% and 17%, respectively, of the total bases.
   (a). What relative proportions of adenine, guanine, thymine, and cytosine would you expect to find in the two DNA samples? (5%)
   (b). What assumptions have you made? (3%)
   (c). One of these species was isolated from hot spring (64 °C). Which species is most likely the thermophilic bacterium, and why? (5%)

3. A biochemist obtains the following set of data for an enzyme that is known to follow Michaelis-Menten kinetics.

Substrate concentration (μM)	Initial velocity (μmol/min)
1	49
2	96
8	349
50	621
100	676
1,000	698
5,000	699

   (a). What is the V_{max} for this enzyme? And explain how you determined $V_{max.}$ (6%)
   (b). What is the K_m for this enzyme? And explain how you determined K_m. (6%)

4. (a). What is the pH of a mixture of 0.42 M NaH_2PO_4 and 0.058 M Na_2HPO_4? The Ka_2 of H_3PO_4 is 6.2×10^{-8}. (5%)
   (b). If 1.0 mL of 10.0 N NaOH is added to a liter of the buffer prepared in a), how much will the pH change? (6%)

5. (a). Under what circumstances does the bifunctional protein phosphofrutokinase-2/ fructose 2,6-bisphosphatase (PFK-2/FBPase-2) become phosphorylated. (6%)
   (b). What are the consequences of the phosphorylation to the glycolytic and gluconeogenic pathway? (6%)