國 立 清 華 大 學 命 題 紙

九十一學年度 生命科學 系（所） 組碩士班研究生招生考試

科目 生物化學 科號 0801, 0901 共 5 頁第 1 頁 *請在試卷【答案卷】內作答

請將是非題和選擇題的答案畫在答案卡上. 問答題則請用答案卷作答.

I. 是非題 (A statement is regarded here as false if any part of it is false. If you believe a statement to be true, mark '**A**' in answer sheet; if false, mark '**B**'. A positive grade will be given for a correct answer, an equal negative grade for an incorrect answer, and a zero grade for no answer. 每題1分，共15分)

1. The urea cycle is linked to TCA cycle by fumarate.
2. The urea cycle involves processes in both mitochondria and cytosol.
3. Cori cycle involves lactate synthesis in the liver.
4. The effects of insulin, epinephrine and glucagon are mediated by NADPH.
5. Insulin increases the capacity of the liver to synthesize glycogen.
6. During the actin/myosin reaction cycle, binding of ATP causes dissociation of myosin from actin.
7. Avidin, a protein in egg white, tightly binds biotin.
8. Under competitive inhibition, V_{max} is unchanged compared to the uninhibited reaction.
9. Under non-competitive inhibition, V_{max} is unchanged compared to the uninhibited reaction.
10. β-tubulin is exposed at the minus end of a microtubule.
11. Hormones that induce production of cyclic-AMP enter cells and accumulate in the cytosol, where they activate adenylate cyclase.
12. Enzymes of proteosome are classified as serine proteases.
13. The formation of hydrogen bonds between amide carbonyls and amide hydrogens do not contribute much to the free energy change ($\Delta G^{o'}$) for the folding of a polypeptide.
14. For most globular proteins, the aliphatic and aromatic amino acids are found on the surface of a folded protein and the polar and ion forming amino acids are found in the core (inner regions).
15. The constant regions of all IgG moleucles in our serum are identical.

九十一學年度 生命科學 系（所） 組碩士班研究生招生考試

科目 生物化學 科號 0801, 0901 共 5 頁第 2 頁 *請在試卷【答案卷】內作答

II. 選擇題 （每題 1 分，共 30 分. 每題只有一個正確答案）

1. What solution is usually used to fill the reference electrode of a pH electrode? (a) HCl (b)NaCl (c)KCl (d)AgCl.
2. The pH of frequently used Tris buffer varies with temperature. What is its approximate temperature coefficient? (a) 0.001 (b) 0.01 (c) 0.03 (d) 0.1 pH/°C.
3. 640 nm light is a (a) blue light (b) yellow light (c) green light (d) red light.
4. What is the unit of absorbance? (a) cm^{-1} (b) mM (c) mg/ml (d) no unit.
5. The absorbance of a sample is NOT directly proportional to (a) light wavelength (b) sample concentration (c) optical path length (d) absorption coefficient.
6. The resolution of a gel filtration chromatography can be improved by using (a) a long column running at low flow rate (b) a short column running at low flow rate (c) a long column running at high flow rate (d) a short column running at high flow rate.
7. N,N'-methylene-bis-acrylamide is used in making polyacrylamide gel as a (a) catalyst (b) crosslinker (c) free radical generator (d)initiator.
8. K-factor of a rotor represents (a) rotor size (b) maximum speed (c) rotor material (d) pelleting efficiency.
9. Which of the following radioisotopes emits β^- particles with the lowest energy? (a) ^{3}H (b) ^{14}C (c) ^{32}P (d) ^{35}S
10. Nucleotides often are detected at the wavelength of (a) 280 nm (b) 260 nm (c) 240 nm (d) 220 nm.
11. An uncoupler can be used to inhibit (a) electron transport (b) ATP synthesis (c) H^+ transport (d) ATP transport.
12. What is the function of the β subunit of F_1F_0-ATP synthase? (a) H^+ channel (b) regulatory site (c) substrate binding (d) electron transport
13. (a) Ribulose (b) Fructose (c) Xylulose (d) Glucose is NOT a ketose.
14. The redox potential of (a) P680 (b) P700 (c) plastoquinone (d) cytochrome b is more positive than that of H_2O.
15. (a) Green (b) Red (c) Yellow (d) Orange light drives the photosynthetic reaction with a higher efficiency.
16. The average pK_a value of fatty acids is (a) 2.5 (b) 4.5 (c) 6.5 (d) 8.5.
17. In the equation $\Delta G = RT \ln (C_{in}/C_{out})$, R is the (a) Planck's constant (b) Gas constant (c) Faraday constant (d) Boltzmann constant.
18. NADPH generally can be obtained from (a) glycolysis (b) citric acid cycle (c) pentose phosphate pathway (d) tricarboxylic acid cycle.
19. How many carbon atoms are there in a molecule of citric acid? (a) 3 (b) 4 (c) 5 (d) 6.
20. Which of the following is NOT the products of anaerobic fermentation? (a) ethanol (b) lactate (c) acetyl-CoA (d) acetaldehyde.

21. CF_1CF_0-ATP synthase of chloroplast is located on the (a) inner membrane facing cytosol (b) inner membrane facing intermembrane space (c) thylakoid membrane facing lumen (d) thylakoid membrane facing stroma.
22. During a short-term, high-intensity exercise (e.g., a 100-m dash), most of the acquired energy is supplied by (a) aerobic respiration (b) anaerobic glycolysis (c) existing stores of ATP and creatine phosphate (d) glycogen.
23. The reaction of deoxynucleotide synthesis is (a) oxidation (b) phosphorylation (c) reduction (d) adenylylation.
24. Metabolic channeling is (a) when the product of one reaction is the substrate for the next (b) when metabolites are transferred from one cellular compartment to another (c) when metabolites are committed to a specific pathway in the reaction catalyzed by a highly regulated enzyme (d) a cellular system that channels metabolites from one metabolic pathway to another.
25. Which of the following is a list of amino acids that are abundant in proteins with a relatively short half-life?
    (a) HECT (b) RING (c) MAVG (d) PEST
26. During the purification of an enzyme, the purity of the enzyme recovered in the various fractions is determined from (a) the specific activity in that fraction (b) the total activity in that fraction (c) the activity in that fraction (d) the protein concentration in that fraction.
27. The enzyme which catalyzes the reaction below is classified as a
    alcohol + NAD^+ → aldehyde + NADH + H^+
    (a) lyase (b) oxidoreductase (c) isomerase (d) hydrolase
28. The Michaelis-Menten combined rate constant, K_m, is defined for the following kinetic mechanism as

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} E + P$$

    (a) $(k_1+k_2)/k_{-1}$ (b) $(k_{-1}+k_2)/k_1$ (c) $(k_1+k_{-1})/k_2$ (d) k_{-1}/k_1
29. Which of the following amino acids, whose amino group eventually ends up as part of urea, reacts with citrulline in the Urea cycle? (a) ornithine (b) alanine (c) lysine (d) aspartate
30. Which of the following statements is not a characteristic of k_{cat}/K_m? (a) It corresponds to a second order rate constant. (b) It provides an excellent parameter for comparison of the catalytic efficiency of enzymes. (c) It reflects the property of the enzyme when substrate concentration is at saturation. (d) The upper limit for the kcat/Km value is fixed by the diffusion-controlled limit for the reaction, which is 109 $M^{-1}s^{-1}$.

III. 問答題（共55分）

1. What would be the consequences of Mg^{2+} deficiency for glycolysis? (6%)

2. Why is the Q-cycle electron transport in the complex III of mitochondria electrogenic (generating membrane electric potential)? (6%)

3. The hydrolysis of ATP releases −31 kJ/mol of energy, while that of AMP releases −14 kJ/mol.
   (1) What is the full name of ATP? (2%)
   (2) What is kJ/mol? What is its relation to kcal/mol? (2%)
   (3) Why does ATP release more energy than AMP does under the same hydrolytic condition? (4%)

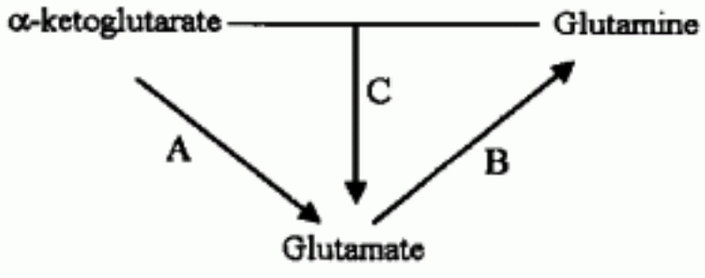
4. Please explain how your blood glucose level is controlled. Your explanation must include after meals and during fasting stage. Please include all the hormones and enzymes involved in each major key step. You may use drawings to help your explanation. Describe as detail as possible. (8%)

5. Please describe all what you know about current treatment of AIDS in terms of biochemistry, molecular biology and/or cell biology. You may use drawings to help your explanation. Specify the involved drugs, enzymes, and targets, if there is any. Avoid using or citing reports from newspapers. Only use scientific terminology. (8%)

6. A fluorescence decay is observed and follows the equation:
   $I(t) = I_0 \exp(-at)$
   (1) What is I(t)? What is the unit of "a" in the equation? (4%)
   (2) Draw a rough hypothetical curve of I(t) from zero time to infinite time. (4%)

7. Which government organization firstly initiated the US human genome project? (1%)

8. Indicate enzymes (A,B,C) that catalyze the following reactions (5%)



9. A simple pathway has two steps: A ↔ B ↔ C

$\Delta G^{0'}$ for A ↔ B = +11.4 kJ/mol and K_{eq} is 10^{-2}

$\Delta G^{0'}$ for B ↔ C = −22.8 kJ/mol and K_{eq} is 10^{4}

What is the standard free energy change for the conversion of A to C?

At equilibrium, what is the concentration ratio of C/A? (5%)