

國立清華大學 命題紙

96 學年度_生命科學院、生命科學院醫學生物科技學程_系(所)_甲、乙_組碩士班入學考試

科目_生物化學_ 科目代碼_0201、0301、0501_共 6 頁第 1 頁 *請在【電腦答案卡】內作答

第一部份單選擇題，請填在電腦答案卡，每題 1.5 分，共 50 題，答錯倒扣 0.5 分

1. The major fuel source for the brain is (A) glucose (B) fatty acids (C) ketone bodies (D) amino acids (E) lipoproteins.
2. In glycolysis, fructose 1,6-bisphosphate is a substrate of the reaction of (A) dehydration (B) dephosphorylation (C) aldose-ketose isomerization (D) carbon-carbon bond cleavage (E) oxidation.
3. Considering the reaction pathway from glucose-1-phosphate to lactate in glycolysis, the net yield is (A) 2 ATP and 2 NADPH (B) 2 ATP and 1 NADPH (C) 2 ATP and no NADPH (D) 3 ATP and no NADPH (E) 3 ATP and 2 NADPH.
4. What will happen when an uncoupler is added to a mitochondrial suspension containing excess substrates and oxygen? (A) O_2 consumption decrease and ATP synthesis decrease (B) O_2 consumption decrease and ATP synthesis increase (C) O_2 consumption increase and ATP synthesis decrease (D) O_2 consumption increase and ATP synthesis increase (E) nothing changes.
5. Which of the following is true for glucokinase: it is (A) located in liver only and inhibited by glucose-6-phosphate (G6P) (B) located in muscle only and inhibited by G6P (C) located in all tissues and NOT inhibited by G6P (D) located in liver only and NOT inhibited by G6P (E) located in muscle and NOT inhibited by G6P.
6. Chemically, lecithin is (A) phosphatidylcholine (B) phosphatidylethanolamine (C) phosphatidylserine (D) phosphatidylglycerol (E) phosphatidylinositol.
7. In the electron transport system, Fe-S center normally carries (A) 1 electron and 1 proton (B) 2 electrons and 2 protons (C) 1 electron only (D) 1 proton only (E) 2 electrons and 1 proton.
8. The standard reduction potential for the half-reaction: $\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$ is around (A) -0.8 (B) -0.4 (C) 0 (D) +0.4 (E) +0.8 V.
9. Fluoroacetate is extremely poisonous in vivo. Its presence results in the inhibition of (A) pyruvate dehydrogenase (B) citrate synthase (C) aconitase (D) isocitrate dehydrogenase (E) fumarase.
10. After a long starvation (more than 3 weeks), which of the following will not be the major fuel source: (A) glucose from amino acids (B) ketone bodies from fatty acids (C) glucose from gluconeogenesis (D) fatty acids from lipolysis (E) glucose from glycogenolysis.
11. Biological molecules are functionally active only within a narrow range of environmental conditions with denaturation occurring in all EXCEPT: (A) dramatic increase in temperature (B) change in ionic strength (C) refrigeration (D) addition of strong acid or base (E) none, all will denature biological macromolecules.
12. Buffers have all of the following characteristics EXCEPT: (A) they have relatively flat titration curves at the pH(s) where they buffer (B) they resist changes in their pH as acid or base is added. (C) they are typically composed of a weak acid and its conjugate base (D) they buffer best for polyprotic acids half-way between the two pKa values (E) buffer where the amounts of conjugate base are nearly equivalent to the amounts of weak acid.
13. What is the overall net charge on the peptide Arg-Gly-Ser-Glu at pH 7.0? (A) +2 (B) +1 (C) 0 (D) -1 (E) -2

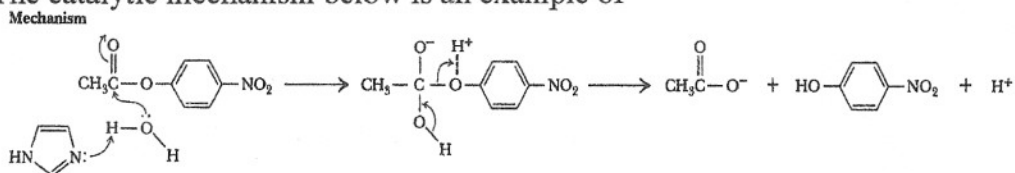
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14. Using an anion exchange resin, a mixture of four amino acids is separated using an elution gradient of increasing NaCl solution. What would be the correct elution sequence? (A) asp, arg, ser, lys (B) ser, asp, lys, arg (C) lys, arg, asp, ser (D) asp, ser, lys, arg (E) arg, lys, ser, asp
15. The amino acid with a side-chain pK_a near neutrality and which therefore plays an important role as proton donor and acceptor in many enzyme catalyzed reactions is: (A) histidine (B) cysteine (C) proline (D) serine (E) methionine.
16. What is the pH of a serine solution in which the $\alpha\text{-NH}_3^+$ group (pK_a 9.2) is one-third dissociated? ($\log 2 = 0.3$, $\log 3 = 0.477$) (A) 8.72 (B) 8.9 (C) 9.0 (D) 9.5 (E) 9.68
17. Glutamic acid has pK_a s at 2.2, 4.3 and 9.7. Calculate the isoelectric point for glutamic acid. (A) 8.6 (B) 4.3 (C) 5.4 (D) 7.0 (E) 3.25
18. Living systems are: (A) closed systems exchanging only energy with the surroundings (B) isolated systems that are totally contained (C) open systems exchanging only energy with the surroundings (D) open systems exchanging both energy and matter with their surroundings. (E) none of the above.
19. Which equation defines a system at equilibrium? (A) $\Delta G > 0$ (B) $\Delta G^\circ = \Delta G$ (C) $\Delta G = 0$ (D) $\Delta G^\circ = 0$ (E) $\Delta G = RT \ln ([\text{products}]/[\text{reactants}])$
20. All of the following functions of an enzyme are true EXCEPT: (A) Enzymes help to catalyze virtually every metabolic reaction (B) Enzymes mediate the rates of cellular reaction in proportion to cellular requirements (C) Enzymes are sensitive to temperature, pH, and concentration changes (D) An increased activity of an enzyme increases the amount of energy produced (E) Enzymes are used as a catalyst to increase reaction rates many orders of magnitude.
21. Which of the following statement about enzyme is true (A) Enzymes facilitate the chemical reactions by lowering the free energy of the end products (B) Enzymes facilitate the chemical reactions by lowering the free energy of the initial reactants. (C) Enzymes facilitate the chemical reactions by increasing the free energy of the transition states. (D) Enzymes are unable to change the reaction pathway of the chemical reaction it catalyzes. (E) One International Unit of enzyme is the amount of enzyme that catalyzes the formation of one micromole of product in one minute.
22. In the Michaelis-Menten equation, (A) k_{cat}/K_m is a measure of enzyme's turnover number. (B) K_m is directly proportional to the affinity of the enzyme for its substrate. (C) k_{cat}/K_m is an apparent first-order rate constant. (D) k_{cat} provides an index of the catalytic efficiency of an enzyme operating at substrate concentrations substantially below saturation amounts. (E) the apparent K_m increases in the presence of a competitive inhibitor.
23. In the serine proteases, which of the three residues form the "catalytic triad" in the active site of the enzyme? (A) Ser, Tyr, Asn (B) Trp, Glu, Thr (C) Ser, Arg, Lys (D) Ser, His, Asp (E) Ser, Gly, Pro
24. Sildenafil citrate (Viagra) was developed as an inhibitor of (A) acid phosphatases (B) cAMP phosphodiesterases (C) glycogen phosphorylase (D) cGMP phosphodiesterases (E) testosterone reductase.
25. The transition state in a chemical reaction has an estimated life-time about (A) microseconds (10^{-6} s) (B) nanoseconds (10^{-9} s) (C) 10^{-2} s (D) 10^{-14} to 10^{-13} s (E) milliseconds (10^{-3} s)

26. The catalytic mechanism below is an example of



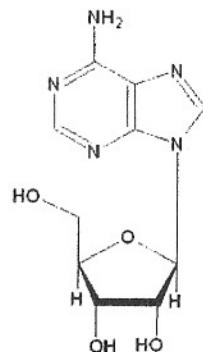
- (A) covalent nucleophilic catalysis (B) covalent electrophilic catalysis (C) specific base catalysis (D) general base catalysis (E) low barrier hydrogen bond catalysis
27. Proinsulin is converted into insulin by (A) proteolytic excision of a specific peptide (B) allosteric binding of glucose (C) phosphorylation to the active form (D) removal of phosphate by converter enzymes (E) none of the above
28. Usually the quickest method of influence an enzymatic activity is by (A) allosteric regulation (B) covalent modification (C) enzyme induction (D) activation of a zymogen (E) enzyme destruction
29. The function of glycogen phosphorylase is (A) the conversion of glucose-1-phosphate to glucose-6-phosphate (B) to break down ATP (C) to catalyze the phosphorolysis of glucose-1-phosphate from glycogen molecules (D) to inhibit the production of glucose-1-phosphate (E) to stimulate the build up of glycogen
30. The power stroke in muscle contraction is associated with (A) the binding of ATP to ATPase (B) the dissociation of ADP and P_i from the ATPase (C) binding of myosin to actin (D) addition of water for ATP hydrolysis (E) the hydrolysis of ATP
31. The bond length of a hydrogen bond (H-bond) between the donor and acceptor atoms is most likely (A) 0.1 (B) 0.2 (C) 0.3 (D) 0.4 (E) 0.5 nm.
32. The pK_a values for the amino groups of free amino acids are most likely (A) 2~3 (B) 3~4 (C) 4~5 (D) 8~9 (E) 9~10.
33. The pK_a values for the carboxylic groups of free amino acids are most likely (A) 2~3 (B) 3~4 (C) 4~5 (D) 8~9 (E) 9~10.
34. The melting temperatures for 16:1, 18:0, and 18:1 fatty acids are (A) 16:1 > 18:1 > 18:0 (B) 18:0 > 18:1 > 16:1 (C) 18:0 > 16:1 > 18:1 (D) 16:1 > 18:0 > 18:1 (E) 18:1 > 18:0 > 16:1
35. The committed step(s) of fatty acid oxidation involve (A) phosphorylation (B) dephosphorylation (C) carboxylation (D) decarboxylation (E) adenylation.
36. The committed steps of fatty acid synthesis involve the formation of (A) acetyl-CoA (B) malonyl-CoA (C) mevalonate (D) acetoacetate (E) isoprene.
37. The committed steps of cholesterol biosynthesis involve the formation of (A) acetyl-CoA (B) malonyl-CoA (C) mevalonate (D) acetoacetate (E) isoprene.
38. Glycogen biosynthesis is the conversion of glucose to glycogen via (A) G-1-P (B) G-6-P (C) G-1-P first and then G-6-P (D) G-6-P first and G-1-P (E) None of above.
39. Galactose utilization involves biotransformation of (A) G-1-P (B) G-6-P (C) G-1-P first and then G-6-P (D) G-6-P first and G-1-P (E) None of the above.

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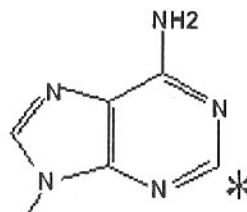
40. The central molecule responsible for phospholipid biosynthesis is (A) diacylglycerol (B) phosphatidic acid (C) glycerol-3-phosphate (D) acetyl-CoA (E) dihydroxyacetone phosphate.
41. The pitch length in A-DNA is about (A) 2.5 nm (B) 3.4 nm (C) 34 nm (D) 4.5 nm (E) 5.5 nm
42. This is the chemical structure of (A) Adenine. (B) Guanine.
(C) Cytosine. (D) Adenosine. (E) Guanosine.



43. What is the nucleotide sequence of the DNA strand that is complementary to 5'-ATCGCAACTGTCACTA-3'?
- (A) 5'-TAGCGTTGACAGTGAT-3' (B) 5'-UAGUGACAGUUGCGAU-3'
(C) 5'-TAGCGTTGACAGTGAT-3' (D) 5'-TAGTGACAGTTGCGAT-3'
(E) 5'-ATCACTGTCAACGCTA-3'
44. DNA double helix structure is stabilized by all of the following EXCEPT: (A) sugar-phosphate backbones run in opposite directions. (B) the two glycosidic bonds holding the bases are exactly across the helix. (C) both internal and external hydrogen bonds are present. (D) bases stack together through hydrophobic interactions and van der Waals forces. (E) appropriate base pairing builds a polymer whose external dimensions are uniform
45. The higher the _____ content of a DNA, the _____ the melting temperature, and the _____ the ionic strength, the _____ the melting temperature. (A) G:C; higher; higher; lower (B) G:C; lower; higher; lower (C) G:C; higher; lower; lower (D) A:T; higher; higher; lower (E) A:T; lower; lower; higher

46.

“*” denotes position (A) 2 (B) 3 (C) 4 (D) 5 (E) 6



47. All are true for DNA polymerase EXCEPT: (A) requires a primer with a free 5'-OH end, but the 3'-end may be phosphorylated. (B) copies the sequence of nucleotides of one strand to form a new second strand. (C) copies the sequence of nucleotides of one strand in a complementary fashion. (D) generates dsDNA from ssDNA. (E) synthesizes new strands by adding successive nucleotides in the 5' → 3' direction.
48. rRNA molecules make up about _____ of ribosome (A) 1/2 (B) 3/4 (C) 2/5 (D) 1/3 (E) 2/3

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49. Which kind of experiment procedure is used to probe RNA sequences? (A) Eastern Blotting (B) Southern Blotting (C) Western Blotting (D) Northern Blotting
50. A genomic DNA library is:(A)a collection of short fragments from nuclear DNA digestion. (B)arrays of synthetic oligonucleotides used to select for a specific DNA. (C) a set of cloned fragments that collectively represent the genes of a particular organism. (D) a short segment of DNA whose sequence is complementary to a portion of the DNA of interest. (E) a circular DNA molecule of 1 kb to 200 kb found in bacteria and yeast cells.

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第二部份問答題，請寫在答案券，每題 5 分，共 5 題

1. Draw the Fisher and Haworth projections of α -D-glucopyranose.
2. What are the four levels of organization described in the proteins structure?
3. Cholera toxin is an enzyme that covalently modifies the $G\alpha$ -subunit of G proteins. (Cholera toxin catalyzes the transfer of ADP-ribose from NAD⁺ to an arginine residue in $G\alpha$, an ADP-ribosylation reaction.) Covalent modification of $G\alpha$ inactivates GTPase activity. Predict the consequence of cholera toxin on cellular cAMP and glycogen levels. (explain in details)
4. The biological effects of cAMP, insulin, and epinephrine on glycolysis, glycogenolysis, lipolysis, and fatty acid synthesis are summarized below. Please indicate these effects in (1) to (10) by writing "I" if it is increased, "D" if it is decreased, and "N" if it has no effect. Answer I, D, or N in (1) to (10) sequentially on your answer sheet.

Substrate	Glycolysis	Glycogenolysis	Lipolysis	Fatty acid synthesis
cAMP	(1)	(4)	(7)	
Insulin	(2)	(5)	(8)	(10)
Epinephrine	(3)	(6)	(9)	

5. The result of sequence determination by the Sanger dideoxy chain termination method is shown below. (1) What is the sequence of the original oligonucleotide? (2). Chargaff's rules provided an important clue to solve the structure of double-stranded DNA. What are Chargaff's rules?

