

國 立 清 華 大 學 命 題 紙

95 學年度^①生命科學院、^②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_0801、0901、1101_共 4 頁第 1 頁 *請在【答案卷卡】內作答

第一部份選擇題, 請填在電腦答案卡. 每題 1.5 分, 共 40 題. 答錯倒扣 1 分.

1. For each turn of the citrate acid cycle, there is no net production of (A) NADH, (B) FADH₂, (C) GTP or ATP, (D) citrate, (E) CO₂.
2. When the substrate concentration of an enzyme-catalyzed reaction is increased from 0.05 K_m to 0.2 K_m, the reaction rate increases 2.5-fold. However the rate increases only 14% as the substrate concentration is raised from 5K_m to 20K_m. This is because (A) the active sites of enzymes are mostly occupied at the substrate concentration of 5 K_m, (B) the enzyme is allosteric, (C) substrate at high concentration acts as competitive inhibitor, (D) the catalytic rate decreases as the enzyme becomes saturated, (E) substrate molecules diffuse slower at higher concentration. (Note: K_m is Michaelis Constant)
3. At equilibrium, the free energy change of a reaction is (A) equal to the standard free energy change, (B) a negative value, (C) equal to 0, (D) a positive value, (E) undefined.
4. Digestion and absorption of carbohydrates involves all of the following EXCEPT: (A) salivary amylase, (B) an acid stable amylase in the stomach, (C) pancreatic amylase, (D) disaccharidases in the intestine, (E) a sodium monosaccharide cotransport system.
5. During strenuous exercise, which allosteric effector activates glycolysis most effectively in skeletal muscles? (A) fructose-2,6-bisphosphate, (B) ATP, (C) ADP, (D) AMP, (E) CO₂.
6. If radioactive inorganic phosphate (³²P_i) is added to a cell extract undergoing glycolysis, the ³²P_i could be directly incorporated into a glycolytic intermediate by which step? (A) glucose→glucose-6-phosphate, (B) fructose-6-phosphate→fructose-1,6-bisphosphate, (C) glyceraldehydes-3-phosphate→1,3-bisphosphoglycerate, (D) 1,3-bisphosphoglycerate→3-phosphoglycerate, (E) phosphoenolpyruvate→pyruvate.
7. The slowest step in the electron transport system of higher plant photosynthesis is (A) H₂O→P680, (B) pheophytin→Q_A, (C) plastoquinol→cytochrome b₆f complex, (D) plastocyanin→P700, (E) ferredoxin→NADP⁺.
8. How many molecules of net O₂ are used to convert each glucosyl residue of glycogen to two molecules of lactate? (A) 0, (B) 1, (C) 2, (D) 3, (E) 4.
9. Two molecules, an amylose and a glycogen, both have 10,000 glucosyl residues. If they are digested by excess phosphorylase, what are the approximate relative initial rates of glucose 1-phosphate release? (A) 1:1, (B) 100:1 in favor of glycogen, (C) 100:1 in favor of amylose, (D) 1000:1 in favor of glycogen, (E) 1000:1 in favor of amylose.
10. Which of the following can move freely across the inner mitochondrial membrane without the help of transporters? (A) O₂, (B) NADH, (C) CO₂, (D) ADP, (E) citrate.

國 立 清 華 大 學 命 題 紙

95 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_0801、0901、1101_共 4 頁第 2 頁 *請在【答案卷卡】內作答

11. The dissociation of the second proton from H_3PO_4 ($\text{H}_2\text{PO}_4^- \rightarrow \text{HPO}_4^{2-}$) has a pK_a of 7.2. At pH 7.5, the relative concentrations of H_3PO_4 , H_2PO_4^- and HPO_4^{2-} are (A) $[\text{H}_3\text{PO}_4] > [\text{H}_2\text{PO}_4^-] > [\text{HPO}_4^{2-}]$; (B) $[\text{H}_3\text{PO}_4] < [\text{H}_2\text{PO}_4^-] = [\text{HPO}_4^{2-}]$, (C) $[\text{H}_3\text{PO}_4] < [\text{H}_2\text{PO}_4^-] > [\text{HPO}_4^{2-}]$, (D) $[\text{H}_3\text{PO}_4] < [\text{H}_2\text{PO}_4^-] < [\text{HPO}_4^{2-}]$, (E) $[\text{H}_3\text{PO}_4] = [\text{H}_2\text{PO}_4^-] = [\text{HPO}_4^{2-}]$.
12. Which of the following is not oxidation-reduction components in the respiratory electron chain of mitochondria? (A) FMN, (B) cytochromes, (C) Fe-S clusters, (D) copper ions, (E) ATP.
13. The reactions of pentose phosphate pathway operate exclusively in (A) mitochondria, (B) cytoplasm, (C) chloroplast, (D) ribosome, (E) endoplasmic reticulum.
14. Which of the following enzymes is not involved in glyoxylate cycle? (A) citrate synthase, (B) aconitase, (C) isocitrate lyase, (D) isocitrate dehydrogenase, (E) malate dehydrogenase.
15. The accumulation of citric acid will tend to (A) activate glycolysis, (B) inhibit glycolysis, (C) have no effect on glycolysis, (D) reverse glycolysis, (E) none of above.
16. The major store of metabolic energy available during long-term starvation is (A) smooth muscle glycogen, (B) liver glycogen, (C) skeletal muscle glycogen, (D) skeletal muscle protein, (E) adipose tissue triacylglycerol.
17. In glycogen biosynthesis the most important, direct addition unit is (A) Glucose, (B) Glucose-1-P, (C) Glucose-6-P, (D) Glucose-CDP, (E) Glucose-UDP. (P = phosphate)
18. In fatty acid biosynthesis the most important addition unit is (A) Acetyl-ACP, (B) Acetyl-CoA, (C) Coenzyme A, (D) Ketoacyl-ACP, (E) Malonyl-ACP.
19. In phospholipid biosynthesis the most important activated precursor is (A) Diacylglycerol-ATP, (B) Diacylglycerol-CDP, (C) Diacylglycerol-ATP, (D) Diacylglycerol-UDP, (E) Acetyl-CoA.
20. In phospholipid biosynthesis the pathway is (A) $\text{PC} \rightarrow \text{PE} \rightarrow \text{PS}$, (B) $\text{PE} \rightarrow \text{PC} \rightarrow \text{PS}$, (C) $\text{PC} \rightarrow \text{PS} \rightarrow \text{PE}$, (D) $\text{PE} \rightarrow \text{PS} \rightarrow \text{PC}$, (E) $\text{PS} \rightarrow \text{PE} \rightarrow \text{PC}$. (PC = phosphatidylcholine, PE = phosphatidylethanolamine, PS = phosphatidylserine)
21. In cholesterol biosynthesis the most frequently used 5-carbon unit is (A) Dimethylallyl pyrophosphate, (B) Farnesyl pyrophosphate, (C) Geranyl pyrophosphate, (D) Isopentenyl pyrophosphate, (E) Presqualene.
22. In steroid hormone biosynthesis the most important precursor is (A) Aldosterone, (B) Cortisol, (C) Pregnenolone, (D) Progesterone, (E) Testosterone.
23. In nucleotide biosynthesis the most important 5-carbon unit is (A) Ribose-1-P, (B) Ribose-5-P, (C) Ribulose-1-P, (D) Ribulose-5-P, (E) Xylulose-5-P. (P = phosphate)
24. In purine nucleotide biosynthesis the most important direct precursor is (A) Adenosine, (B) Inosine, (C) Guanine, (D) Uridine, (E) Xanthosine.
25. The reaction of deoxynucleotide synthesis is (A) oxidation, (B) phosphorylation, (C) reduction, (D) carboxylation, (E) adenylation.

國 立 清 華 大 學 命 題 紙

95 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_0801、0901、1101_共4頁第3頁 *請在【答案卷卡】內作答

26. What motor protein generates the sliding of microtubules that leads to bending of cilia? (A) actin, (B) myosin, (C) dynein, (D) kinesin, (E) tubulin.
27. N-acetylglutamate functions in ammonium incorporation into metabolic intermediates as: (A) a coenzyme for glutamine synthetase (GS), (B) a competitive inhibitor for glutamine synthetase (GS), (C) an allosteric activator for carbamoyl-phosphate synthetase I (CPS-I), (D) the energy source needed for the reductive amination of α -ketoglutarate (α -KG) to yield glutamate, (E) the substrate for the amination of the γ -glutamylphosphate.
28. The term ketogenic amino acids refers to amino acids: (A) that are precursors for glucose synthesis, (B) degraded to yield acetyl CoA or acetoacetate, (C) that can not be converted to fatty acids or ketone bodies, (D) degraded to yield succinyl-CoA, pyruvate, α -ketoglutarate, fumarate and oxaloacetate, (E) none of the above.
29. On a Lineweaver-Burk plot, which of the following statement is true? (A) The value of the X-intercept is equal to $-1/K_M$, (B) The value of the Y-intercept is equal to $-1/K_M$, (C) The slope is equal to V_{max}/K_M , (D) The value of the X intercept is equal to V_{max} , (E) The value of the Y-intercept is equal to V_{max} .
30. Which of the following statements concerning the reaction catalyzed by ATCase is true? (A) One ATP molecule is used in the ATCase reaction, (B) CTP is a feedback activator of ATCase, (C) Aspartate is a positive homotropic effector of ATCase, (D) Adding CTP to the reaction decreases the V_{max} of the ATCase reaction, (E) All of the above are true.
31. The cross-linking which occurs in collagen: (A) is carried out by lysyl oxidase, (B) involves the ϵ -amino group on lysine, (C) is a non-enzymatic aldol condensation, (D) is intermolecular between the tropocollagen molecules in the fibril, (E) all of above.
32. The enzyme which catalyzes the reaction ($\text{alcohol} + \text{NAD}^+ \rightarrow \text{aldehyde} + \text{NADH} + \text{H}^+$) is classified as a (A) lyase, (B) oxidoreductase, (C) isomerase, (D) hydrolase, (E) transferase.
33. For an enzyme which obeys Michaelis-Menten kinetics, what is the V_{max} value in $\mu\text{mole}/\text{min}$ if $v=35$ $\mu\text{mole}/\text{min}$ when $[S]=K_M$? (A) 35, (B) 50, (C) 70, (D) 45, (E) 95.
34. What is the unit of the turnover number? (A) M/sec , (B) M , (C) sec^{-1} , (D) sec/M , (E) M^{-1} .
35. Thymidylate synthase synthesizes dTMP from _____ by _____ utilizing the coenzyme _____ (A) dCTP; carboxylation; biotin, (B) dUMP; methylation; THF, (C) dCMP; methylation; THF, (D) dGMP; phosphorylation; ATP, (E) dUMP; phosphorylation; ATP.
36. During fasting or starvation, the brain: (A) converts endogenous fatty acids into β -hydroxybutyrate, (B) utilizes β -hydroxybutyrate from the blood stream., (C) utilizes amino acids for fuel from degradation of brain protein, (D) utilizes its glycogen stores as a first responding source of fuel, (E) all of the above.
37. Denitrifying bacteria are capable of all EXCEPT: (A) reducing NO_3^- to N_2 , (B) using NO_3^- as an electron acceptor in their energy-producing pathways. (C) oxidizing NH_4^+ to NO_3^- , (D) reducing the combined-nitrogen levels, (E) being utilized in water treatment plants to reduce nitrogen entering lakes and streams.

國 立 清 華 大 學 命 題 紙

95 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__0801、0901、1101__共4頁第4頁 *請在【答案卷卡】內作答

38. Amino acids biosynthesized from aspartate include all EXCEPT: (A) asparagine, (B) threonine, (C) methionine, (D) lysine, (E) glutamate.
39. What is the common product of purine catabolism? (A) xanthine, (B) uric acid, (C) inosine, (D) hypoxanthine, (E) xanthosine.
40. Kinesins are proteins which exhibit ATPase activity and are involved with: (A) intracellular movement of organelles, (B) movement of flagella, (C) movement of cilia, (D) subfiber A and B within an axoneme, (E) all of the above.

第二部份問答題 請寫在答案卷. 共 40 分.

1. What is the molar ratio of water to glucose for a 100 mL solution containing 1 mM glucose? (5%)
2. A chlorophyll molecule can be regarded as being composed of two different parts: a tetrapyrrole ring and a phytol tail. What are their functions? (5%)
3. General biochemistry. (20%)
 - (A) Oxaloacetic acid $\text{HOOC-CO-CH}_2\text{-COOH}$ forms divalent anion in solution (oxaloacetate). It undergoes decarboxylation in one of the two carboxylate groups. Indicate the decarboxylation site by drawing the reaction mechanism. (5%)
 - (B) Ethyl alcohol is transformed to acetaldehyde by alcohol dehydrogenase (ADH). Write (1) the biochemical reaction, including the non-enzymatic cofactor, and (2) indicate the atom(s) where the electron transfer involved. Also calculate how many electrons are involved and indicate the electron donor and electron acceptor. (5%)
 - (C) A Schiff base is an important metabolic intermediate. It is formed by condensation of two organic functional groups. Please use glutamine and acetone as an example to show the mechanism of Schiff base formation. (5%)
 - (D) The formation of oxidized LDL (low density lipoprotein) is suspected to be an important factor leading to atherosclerosis. Previous study indicated that the oxidation of lysine residue was the major cause of LDL oxidation. How can lysine be oxidized? (5%)
4. Phosphoglycerate kinase (1 μg) was incubated with 3-phosphoglycerate (5 mM) and MgATP (5 mM) at 30°C in 1 ml of a buffered solution at pH 8.2. The initial velocity of formation of MgADP was observed to be 350 nmol/min. If the molecular weight of the enzyme is 45,000, calculate (10%)
 - (A) The amount of enzyme activity in Katals in 1 μg of enzyme,
 - (B) The specific activity in Katal/kg,
 - (C) The turnover number (k_{cat}) under these conditions.