

系所組別： 生物化學暨分子生物學研究所甲、乙組

考試科目： 生物化學

考試日期：0308，節次：1

※ 考生請注意：本試題 可 不可 使用計算機

一、選擇題：50 分，單選，每題二分，共廿五題，答錯倒扣 0.5 分

1. Glycoproteins contain oligosaccharides covalently linked through the amino acid residues:
 - (a) aspartate or glutamate.
 - (b) serine, threonine, or asparagine.
 - (c) glycine, alanine, or aspartate.
 - (d) tryptophan, asparagine, or cysteine.
 - (e) none of the above.

2. The basic proteoglycan unit consists of a "core protein" with covalently attached
 - (a) glycosaminoglycan.
 - (b) lectin.
 - (c) lipopolysaccharide.
 - (d) peptidoglycan.
 - (e) lipid A.

3. Humans cannot use cellulose as a nutrient because
 - (a) the human digestive enzyme α -amylase can split only $(\beta 1 \rightarrow 4)$ linkages.
 - (b) the human digestive enzyme α -amylase can split only $(\alpha 1 \rightarrow 6)$ linkages.
 - (c) humans do not produce an enzyme which splits the $(\beta 1 \rightarrow 4)$ linkages in cellulose.
 - (d) humans do not produce an enzyme which splits the $(\alpha 1 \rightarrow 4)$ linkages in cellulose.
 - (e) none of the above.

4. For the reaction $A + B \rightarrow C + D$, the K_{eq} ' is 10^4 . What is the ΔG° value for this reaction? ($R = 8.315$ J/mol·K, $T = 298$ K; $RT = 2477.9$ J/mol)
 - (a) 0 kJ/mol
 - (b) +22.8 kJ/mol
 - (c) -22.8 kJ/mol
 - (d) +9.9 kJ/mol
 - (e) -9.9 kJ/mol

5. Which of the following statements is true?
 - (a) ΔG and ΔG° mean the same thing.
 - (b) In a reaction under standard conditions, only the reactants are fixed at 1 M.

(背面仍有題目,請繼續作答)

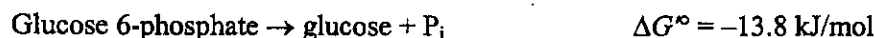
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※ 考生請注意：本試題 可 不可 使用計算機(c) When $\Delta G^\circ = 1.0$ kJ/mol, $K_{eq}' = 1$.(d) When $K_{eq}' > 1$, ΔG° is negative.

(e) None of the above.

6. Given ΔG° for each of the following reactions,Calculate the standard free-energy change (ΔG°) for the reaction:

(a) -16.7 kJ/mol

(b) +16.7 kJ/mol

(c) -44.3 kJ/mol

(d) +44.3 kJ/mol

(e) 0 kJ/mol

7. Which of the following compounds has the largest negative value for the standard free-energy change (ΔG°) upon hydrolysis?

(a) Fructose 6-phosphate

(b) AMP

(c) Phosphoenolpyruvate

(d) Sucrose

(e) Malate

8. Which of the following enzymes in glycolysis catalyze irreversible reactions under intracellular conditions?

(a) Hexokinase and phosphohexose isomerase

(b) Phosphofructokinase-1 and aldolase

(c) Phosphofructokinase-1 and glyceraldehydes 3-phosphate dehydrogenase

(d) Phosphofructokinase-1 and pyruvate kinase

(e) Pyruvate kinase and enolase

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9. Which of the following reactions in glycolysis catalyzes the formation of an energy-rich compound (i.e., a compound whose hydrolysis has a highly negative ΔG°)?
- (a) Glyceraldehyde 3-phosphate dehydrogenase.
 - (b) Hexokinase.
 - (c) Phosphofructokinase-1.
 - (d) Phosphoglycerate kinase.
 - (e) Aldolase.
10. An enzyme used in both glycolysis and gluconeogenesis is:
- (a) pyruvate kinase.
 - (b) 3-phosphoglycerate kinase.
 - (c) glucose 6-phosphatase.
 - (d) hexokinase.
 - (e) phosphofructokinase-1.
11. The oxidation of 6 mol of glucose by the pentose phosphate pathway may result in the production of:
- (a) 6 mol of pentose, 12 mol of NADPH, and 0 mol of CO_2 .
 - (b) 6 mol of pentose, 6 mol of NADPH, and 1 mol of CO_2 .
 - (c) 6 mol of pentose, 6 mol of NADPH, and 6 mol of CO_2 .
 - (d) 6 mol of pentose, 12 mol of NADPH, and 6 mol of CO_2 .
 - (e) None of the above.
12. The possible metabolic fates of pyruvate produced by glycolysis in humans are best described as following:
- (a) Under aerobic conditions, pyruvate is oxidized to acetyl-CoA and passes through the citric acid cycle.
 - (b) Under aerobic conditions, pyruvate is oxidized to lactate and passes through the citric acid cycle.
 - (c) Under anaerobic conditions, pyruvate is reduced to lactate to recycle NAD^+ to NADH, allowing the continuation of glycolysis.
 - (d) Under anaerobic conditions, pyruvate is oxidized to acetyl-CoA to recycle NADH to NAD^+ , allowing the continuation of glycolysis.
 - (e) None of the above.

(背面仍有題目,請繼續作答)

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13. Which of the following statements about fructose 2,6-bisphosphate is true?
- (a) Fructose 2,6-bisphosphate inhibits phosphofructokinase-1.
 - (b) Fructose 2,6-bisphosphate activates fructose-1,6-bisphosphatase.
 - (c) The phosphofructokinase-1 reaction is endergonic.
 - (d) A rise in the cellular level of fructose 2,6-bisphosphate stimulates the rate of glycolysis.
 - (e) None of the above
14. Muscle glycogen phosphorylase
- (a) catalyzes the degradation of glycogen by hydrolysis of glycosidic bonds.
 - (b) catalyzes phosphorolysis of the ($\alpha 1 \rightarrow 6$) bonds at the branch points of glycogen.
 - (c) removes glucose residues from the reducing ends of the glycogen chains.
 - (d) degrades glycogen to form glucose 6-phosphate.
 - (e) exists in an active (*a*) form and an inactive (*b*) form that is allosterically regulated by AMP.
15. Which of the following enzymes is affected in Type Ia (von Gierke's) glycogen storage disease?
- (a) Lysosomal glucosidase
 - (b) Glucose 6-phosphatase
 - (c) Muscle phosphorylase
 - (d) Branching enzyme
 - (e) Phosphorylase kinase
16. Glycogenin:
- (a) regulates the synthesis of glycogen.
 - (b) is the enzyme responsible for forming branches in glycogen.
 - (c) is the gene that encodes glycogen synthase.
 - (d) is the primer on which new glycogen chains are initiated.
 - (e) none of the above.
17. In which reaction of the citric acid cycle does substrate-level phosphorylation occur?
- (a) The conversion of citrate to isocitrate.
 - (b) The conversion of fumarate to malate.
 - (c) The conversion of malate to oxaloacetate.
 - (d) The conversion of succinate to fumarate.
 - (e) The conversion of succinyl-CoA to succinate.

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18. The cofactors that participate in the oxidation of α -ketoglutarate to succinyl-CoA are
- (a) biotin, thiamine pyrophosphate (TPP), FAD, NAD^+ , and CoA-SH.
 - (b) lipoate, TPP, FMN, NAD^+ , and CoA-SH.
 - (c) biotin, TPP, FMN, NAD^+ , and CoA-SH.
 - (d) lipoate, TPP, FAD, NAD^+ , and CoA-SH.
 - (e) none of the above.
19. Citrate synthase and the NAD^+ -specific isocitrate dehydrogenase are inhibited by:
- (a) acetyl-CoA and AMP.
 - (b) ATP and/or NADH.
 - (c) AMP and/or NADH.
 - (d) ATP and/or NAD^+ .
 - (e) None of the above.
20. Which of the following occurs during the citric acid cycle in mammals **EXCEPT**:
- (a) formation of α -ketoglutarate.
 - (b) generation of NADH and FADH_2 .
 - (c) net synthesis of oxaloacetate from acetyl-CoA.
 - (d) oxidation of acetyl-CoA.
 - (e) None of the above.
21. Cytochrome *c*
- (a) does not play a role in apoptotic cell death.
 - (b) does not release into the cytoplasm in apoptotic cell death.
 - (c) releases into the nucleus in apoptotic cell death.
 - (d) accepts electrons from Complex III and transfers them to Complex IV.
 - (e) none of the above.
22. Which of the following statements concerning respiratory control in mitochondria is correct?
- (a) Respiratory control is the regulation of electron flow and ATP synthesis by [ADP].
 - (b) When [ADP] is high, electron flow slows.
 - (c) When [ADP] is low, electron flow is stimulated.
 - (d) The overall effect of respiratory control is to prevent oxidation of fuels when the demand for ATP is high.
 - (e) None of the above.

(背面仍有題目,請繼續作答)

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23. Which of the following statements concerning chemiosmotic theory in mitochondria is correct?
- (a) Electron flow through asymmetrically arranged membrane-bound carriers causes transmembrane flow of H^+ , creating a proton gradient (a proton motive force).
 - (b) Proton motive force only consists of membrane potential.
 - (c) The energy released by downhill movement of protons is captured when ATP is hydrolyzed to ADP and P_i .
 - (d) Anything that makes the membrane leaky to protons will promote the formation of a proton gradient.
 - (e) None of the above.
24. 2,4-dinitrophenol, an uncoupling agent, will:
- (a) allow oxidative phosphorylation in the presence of oligomycin.
 - (b) block electron transfer in the presence of oligomycin.
 - (c) diminish O_2 consumption in the presence of oligomycin.
 - (d) allow electron transfer in the presence of oligomycin.
 - (e) none of the above.
25. If intact mitochondria were incubated with antimycin A, excess NADH, and an adequate supply of O_2 , which of the following would be found in the oxidized state?
- (a) NAD^+
 - (b) Cytochrome a_3
 - (c) Cytochrome b
 - (d) Coenzyme Q
 - (e) None of the above

二、簡答題：共十一題，分數如題目標示

26. Some hormones trigger very rapid responses, whereas for others the response takes much longer to develop. What generalization about the mechanisms of action of these two types of hormones can explain the differences in response times? (4%)
27. Distinguish between homologs, paralogs, and orthologs as classes of related proteins. (4%)

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28. How does one determine the three-dimensional structure of a protein? Your answer should be more than the names of the techniques. (4%)
29. Please answer the following questions about the DNA-Based Information Technologies.
- (1) What is the essential difference between a genomic library and a cDNA library? (2%)
 - (2) What is a DNA microarray? How does it resemble and how does it differ from a DNA library? (2%)
30. Please answer the following questions about leptin.
- (1) What is leptin? (1%)
 - (2) Describe the signaling cascade initiated by leptin binding to its receptor. (2%)
 - (3) How does it function in the long-term maintenance of body mass? (2%)
31. Two vitamins, biotin and vitamin B₁₂, play crucial roles in the metabolism of propionic acid (propionate). Explain this by showing the steps in which each is essential in propionate metabolism. (4%)
32. A chemist working in a pharmaceutical lab synthesized a new drug as a racemic mixture. Why is it important that she separates the two enantiomers and tests each for its biological activity? (6%)
33. Explain why the structure of myoglobin makes it function well as an oxygen-storage protein whereas the structure of hemoglobin makes it function well as an oxygen-transport protein. (6%)
34. What is the role of ATP and ATP hydrolysis in the cycle of actin-myosin association and disassociation that leads to muscle contraction? (6%)
35. Glycosphingolipids and cholesterol cluster together in membrane regions known as “_____”. These regions are rich in proteins that are anchored to the membrane by covalently attached _____ and _____ groups and also those anchored by GPI linkage. Proteins aggregated in this fashion are often functionally related. (3%)
36. Sometimes, mutations in proteins might result in either loss of responsiveness to a given hormone or production of a continuous signal even in the absence of the hormone. In this regard, how does a defect in a G protein that renders the GTPase activity inactive do? (4%)