一、選擇題（每題兩分，答錯倒扣0.5分）

1. If the $\Delta G^{o'}$ of the reaction A → B is - 40 kJ/mol, the reaction:

   A. will proceed spontaneously from left to right.
   B. will never reach equilibrium.
   C. will proceed at a rapid rate.
   D. is at equilbrium.
   E. will not occur spontaneously.

2. The standard free-energy changes for the reactions below are given.
   Phosphocreatine → creatine + Pi = - 43.0 kJ/mol
   ATP → ADP + Pi = - 30.5 kJ/mol

   What is the overall $\Delta G^{o'}$ for the following reaction?
   Phosphocreatine + ADP → creatine + ATP

   A. - 12.5 kJ/mol
   B. + 12.5 kJ/mol
   C. - 74.0 kJ/mol
   D. + 74.0 kJ/mol
   E. $\Delta G^{o'}$ cannot be calculated without K'eq.

3. Biological oxidation-reduction reactions always involve:

   A. transfer of hydrogens.
   B. formation of water.
   C. mitochondria.
   D. transfer of electrons.
   E. direct participation of oxygen.

4. The standard reduction potentials (E_o') for the following half reactions are given.
   Fumarate + $2H^+$ + 2 e^- → succinate $E_o' = +0.031$ V
   FAD + $2H^+$ + 2 e^- → FADH2 $E_o' = -0.219$ V

   If you mixed succinate, fumarate, FAD, and $FADH_2$ together, all at 1 M concentrations and in the presence of succinate dehydrogenase, which of the following would happen initially?

   A. Succinate would become oxidized, FAD would become reduced.
   B. Succinate would become oxidized, $FADH_2$ would be unchanged because it is a cofactor, not a substrate.
   C. Both fumarate and succinate would become oxidized; both FAD and $FADH_2$ would become reduced.
   D. Fumarate would become reduced, $FADH_2$ would become oxidized.
   E. No reaction would occur, because all reactants and products are already at their standard concentrations.

5. Glucose labeled with ^{14}C in C-1 and C-6 gives rise in glycolysis to pyruvate labeled in:

   A. C-1 only.
   B. C-2 only.
   C. C-3 only.
   D. C-1 and C-3.
   E. C-4.

6. When a muscle is stimulated to contract aerobically, less lactic acid is formed than when it contracts anaerobically because:

   A. aerobic conditions prevent the activation of phosphorylase and make less sbstrate available for glycolysis.
   B. under aerobic conditions most of the pyruvate generated as a result of glycolysis is oxidized by the citric acid cycle rather than reduced to lactate.
   C. the lactic acid generated is rapidly incorporated into lipids under aerobic conditions.
   D. under aerobic conditions in muscle, the major energy-yielding pathway is the pentose phosphate pathway, which does not produce lactate.
   E. muscle is metabolically less active under aerobic than anaerobic conditions.

7. The rate-limiting reaction in glycolysis is:

   A. the breakdown of glycogen.
   B. the phosphorylation of glucose.
   C. the isomerization of glucose-6-phosphate to fructose-6-phosphate.
   D. the phosphorylation of fructose-6-phosphate.
   E. some step in the conversion of fructose-1,6-bisphosphate to pyruvate.

8. During strenuous exercise, the NADH formed in the glyceraldehyde-3-phosphate dehydrogenase reaction in skeletal muscle must be reoxidized to NAD^+ if glycolysis is to continue. The most important reaction involved in the reoxidation of NADH is:

   A. oxaloacetate → malate.
   B. pyruvate → lactate.
   C. dihydroxyacetone phosphate → glycerol-3-phosphate.
   D. isocitrate → α-ketoglutarate.
   E. glucose-6-phosphate → fructose-6-phosphate.

9. The conversion of one mole of glucose-6-phosphate to two moles of lactate in glycolysis is accompanied by a net gain of:

   A. three moles of ATP.
   B. two moles of ATP.
   C. one mole of ATP.
   D. one mole of NADH.
   E. none of the above.

10. The main function of the pentose phosphate pathway is to:

   A. supply energy.
   B. give the cell a back-up capability should glycolysis fail.
   C. provide energy and reducing power.
   D. provide a mechanism for the utilization of the carbon skeletons of excess amino acids.

11. All of the following are located in the mitochondria except the enzymes:

   A. of the citric acid cycle.
   B. of fatty acid oxidation.
   C. of glycolysis.
   D. and cofactors of electron transfer to oxygen.
   E. and cofactors of oxidative phosphorylation.

12. Oxaloacetate uniformly labeled with ^{14}C is condensed with unlabeled aectyl-CoA. After a single pass through the citric acid cycle back to oxaloacetate, what fraction of the original radioactivity will be found in the oxaloacetate?

A. all
B. 3/4
C. 1/2
D. 1/3
E. 1/4.

13. Citrate:

A. regulates glycolysis by inhibiting phosphofructkinase-1.
B. activates acetyl-CoA carboxylase.
C. stimulates synthesis of fatty acids.
D. acts to transport acetyl-CoA to the cytosol from the mictochondrial matrix.
E. does all of the above.

14. The role of hormone-sensitive triacylglycerol lipase is to:

A. hydrolyze lipids stored in the liver.
B. hydrolyze triacylglycerols stored in adipose tissue.
C. hydrolyze membrane phospholipids in hormone-producing cells.
D. synthesize triacylglycerols in the liver.
E. synthesize lipids in adipose tissue.

15. Which of the following compounds is able to cross the inner mitochondrial membrane?

A. fatty acyl-CoA.
B. malonyl-CoA.
C. acetyl-CoA.
D. fatty acyl-carnitine.
E. none of the above can cross.

16. If the 16-carbon saturated fatty acid palmitate is oxidized completely to carbon dioxide and water, and all of the energy-conserving products are used to drive ATP synthesis in the mitochondrion, the net yield of ATP per molecule of palmitate is, in round numbers:

A. 3.
B. 10.
C. 25.
D. 130.
E. 1000.

17. The following fatty acid, in which the indicated carbon is labeled with ^{14}C, is fed to an animal:
$^{14}CH_3(CH_2)_9COOH$
after allowing 30 minutes for fatty acid β oxidation, the label would most likely be recovered in:

A. acetyl-CoA.
B. propionyl-CoA.
C. palmitoyl-CoA.
D. malonyl-CoA.
E. both acetyl-CoA and propionyl-CoA.

18. The major site of formation of acetoacetate from fatty acids is the:

A. intestinal mucosa.
B. adipose tissue.
C. liver.
D. muscle.
E. kidney.

19. Glutamate is metabolically converted to α-ketoglutarate and NH_4+ by a process described as:

A. hydrolysis.
B. deamination.
C. oxidative deamination.
D. reductive deamination.
E. transamination.

20. Which of these directly donates a nitrogen atom for the formation of urea during the urea cycle?

A. ornithine.
B. aspartate.
C. glutamate.
D. adenine.
E. creatine.

21. The human genetic disease phenylketonuria can result from:

A. inability to synthesize phenylalanine.
B. inability to catabolize ketone bodies.
C. inability to convert phenylalanine to tyrosine.
D. production of enzymes containing no phenylalanine.
E. deficiency of protein in the diet.

22. Uncoupling of mitochondrial oxidative phosphorylation:

A. halts all mitochondrial metabolism.
B. slows down the citric acid cycle.
C. allows continued mitochondrial ATP formation, but halts O_2 consumption.
D. halts mitochondrial ATP formation, but allows continued O_2 consumption.
E. none of the above would occur.

23. In humans, gluconeogenesis:

A. helps to reduce blood glucose after a carbohydrate-rich meal.
B. is essential in the conversion of fatty acids to glucose.
C. can result in the conversion of protein into blood glucose.
D. requires the enzyme hexokinase.
E. will increase glycogen synthesis.

24. If malonyl-CoA is synthesized from radioactive (^{14}C-labeled)carbon dioxide and unlabeled acetyl-CoA, and the labeled malonate is then used for fatty acid synthesis, the final product(fatty acid) will have radioactive carbon in:

A. every C.
B. every odd-numbered C (carboxyl end is C-1).
C. every even-numbered C.
D. only the farthest carbon from C-1.
E. no part of the molecule.

25. Which of these can be synthesized by plants but not by animals?

A. palmitate (18:0)
B. stearate (20:0)
C. linoleate [18:2 ($\Delta^{9,12}$)]
D. pyruvate
E. phosphatidylcholine.

26. The synthesis of both glycerophospholipids and triacylglycerols involves:

A. CDP-diacylglycerol.
B. phosphoethanolamine.
C. phosphatidate.
D. CDP-choline.
E. phosphatidate phosphatase.

27. Cholesterol is synthesized from:

A. acetyl-CoA.
B. malate.
C. oxalate.
D. lipoic acid.
E. choline.

28. Nonessential amino acids:

A. are not utilized in ammmalian proteins.
B. may be substituted with other amino acids in proteins.
C. can be synthesized in humans as well as in bacteria.
D. are synthesized by plants and bacteria, but not by humans.
E. are synthesized by bacteria only.

29. If a cell were unable to synthesize or obtain tetrahydrofolic acid (H_4 folate), it would probably be deficient in the biosynthesis of:

A. serine.
B. cholesterol.
C. glycine.
D. asparate.
E. phosphatidylcholine.

30. The hormones epinephrine and norepinephrine are derived biosynthetically from:

A. tyrosine.
B. histidine.
C. tryptophan.
D. arginine.
E. isoleucine.

31. The largest energy store in a well-nourished human is:

A. muscle glycogen.
B. liver glycogen.
C. blood glucose.
D. triacylglycerols in adipose tissue.
E. ATP in all tissues.

32. 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. Fatty acids cannot be used as an energy source in humans, because humans lack the enzymes of the glyoxylate cycle.
E. None of the above.

33. The Cori cycle is:

A. the interconversion between glycogen and glucose-1-phosphate.
B. the synthesis of alanine from pyruvate in skeletal muscle and the synthesis of pyruvate from alanine in liver.
C. the synthesis of urea in liver and degradation of urea to carbon dioxide and ammonia by bacteria in the gut.
D. the production of lactate from glucose in peripheral tissues with the resynthesis of glucose from lactate in liver.
E. none of the above.

34. When blood glucose is abnormally low, the pancreas releases:

A. insulin.
B. glucagon.
C. epinephrine.
D. trypsin.
E. glucose.

35. The sequence of events in the response of hepatocytes to elevated epinephrine is:
    1. GTP replaces GDP on Gs
    2. adenylate cyclase is activated
    3. epinephrine binds to its receptor on the cell surface.
    4. Gs associates with adenylate cyclase.
    5. cAMP-dependent protein kinase is activated.

    A. 2,4,1,3,5
    B. 3,1,4,2,5
    C. 3,2,1,4,5
    D. 3,5,4,2,1
    E. 5,2,3,1,4

36. The sequence of events in the response of hepatocytes to elevated insulin is:
    1. the tyrosine kinase domain of insulin receptor is autophosphorylated
    2. insulin binds to the a subunit of the receptor.
    3. the tyrosine kinase domain phosphorylates (a) tyrosine residue (s) on the target protein (s).

    A. 1,2,3
    B. 2,1,3
    C. 2,3,1
    D. 3,1,2
    E. 3,2,1

37. When inositol-1,4,5-trisphosphate (IP_3) binds to its specific intracellular receptor:

    A. a phospholipase in the plasma membrane is activated.
    B. Ca^{+2} is released from the endoplasmic reticulum into the cytosol.
    C. GTP replaces GDP on a Gs protein.
    D. the intracellular concentration of cAMP rises.
    E. there is no intracellular receptor for IP_3.

38. Tumor promoters of the phorbol ester class act by:

    A. chemically altering DNA, causing mutations.
    B. stimulating protein kinase C.
    C. binding to G proteins and preventing GTP-GDP exchange.
    D. degrading intracellular cAMP.
    E. ADP-ribosylating G proteins.

簡答題（每題四分）

1. If a 0.1 M solution of glucose-1-phosphate is incubated with a catalytic amount of phosphoglucomutase, the glucose-1-phosphate is transformed to glucose-6-phosphate until equilibrium is reached. At equilibrium, the concentration of glucose-1-phosphate is 4.5×10^{-3} K'eq and $\Delta G^{o'}$ for this reaction (in the direction of glucose-6-phosphate formation). (R = 8.315 J/mol K; T = 298 K).

2. The citric acid cycle is frequently described as the major pathway of aerobic catabolism, which means that it is an oxygen-dependent degradative process. However, none of the reactions of the cycle directly involves oxggen as a reactant. Why is the pathway oxygen-dependent?

3. For each two-carbon increase in the length of a saturated fatty acid chain, how many additional moles of ATP can be formed upon complete oxidation of one mole of the fatty acid to CO_2 and H_2O?

4. During starvation, urea production is increased. Explain this observation.

5. What is respiratory control in mitochondria? What is accomplished by this control mechanism?

6. In his studies of alcoholic fermentation by yeast, Louis Pasteur noted that the sudden addition of oxygen to a previously anaerobic culture of fermenting grape juice resulted in a dramatic decrease in the rate of glucose consumption. This " Pasteur effect" can be counteracted by the addition of 2,4-dinitrophenol (DNP), an uncoupler of oxidative phosphorylation. (a) Why would the yeast cells consume less glucose in the presence of oxygen? (b) Why would DNP counteract or prevent the Pasteur effect?