※ 注意：請於答案卷上依序作答，並應註明作答之題號。

1-30 題為單選題，每題兩分，31-36 為問答題，每題分數標於該題後。

1. The conversion of 1 mol of pyruvate to 3 mol of CO_2 via pyruvate dehydrogenase and the citric acid cycle also yields _____ mol of NADH, _____ mol of $FADH_2$, and _____ mol of ATP (or GTP).
   A) 3; 2; 0
   B) 4; 2; 1
   C) 4; 1; 1
   D) 3; 1; 1
   E) 2; 2; 2

2. In skeletal muscle:
   A) large quantities of triacylglycerol are stored as fuel.
   B) phosphocreatine can substitute for ATP as the direct source of energy for muscle contraction.
   C) stored muscle glycogen can be converted to glucose and released to replenish blood glucose.
   D) at rest, fatty acids are the preferred fuel.

3. The hormones epinephrine and norepinephrine are derived biosynthetically from:
   A) tyrosine.
   B) histidine.
   C) tryptophan.
   D) arginine.
   E) isoleucine.

4. Glucose labeled with ^{14}C in C-1 and C-6 gives rise in glycolysis to pyruvate labeled in:
   A) its carboxyl carbon.
   B) its carbonyl carbon.
   C) its methyl carbon.
   D) both A and C.
   E) all three carbons.

5. Upon the addition of 2,4-dinitrophenol (DNP) to a suspension of mitochondria carrying out oxidative phosphorylation linked to the oxidation of malate, all of the following occur *except*:
   A) the P/O ratio drops from a value of approximately 2.5 to 0.
   B) oxygen consumption decreases.
   C) oxygen consumption increases.
   D) the proton gradient dissipates.

6. When comparing the β–oxidation pathway of fatty acid catabolism to the ω–oxidation pathway, which of the following statements is correct?
   A) β oxidation occurs mainly in the cytoplasm whereas w oxidation occurs mainly in the mitochondria.
   B) β oxidation occurs mainly in the mitochondria whereas w oxidation occurs mainly in the cytoplasm.
   C) β oxidation occurs at the carboxyl end of the fatty acid whereas w oxidation occurs at the methyl end.
   D) β oxidation occurs at the methyl end of the fatty acid whereas w oxidation occurs at the carboxyl end.
   E) None of the above is correct.

7. In *E. coli* the synthesis of phosphatidylethanolamine directly involves:
   A) acyl carrier protein.
   B) serine.
   C) CDP-choline.
   D) biotin.
   E) phosphatidylglycerol.

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8. Which of the following statements is true of muscle glycogen phosphorylase?
   A) It degrades glycogen to form glucose 6-phosphate.
   B) It exists in an active (a) form and an inactive (b) form that is allosterically regulated by AMP.
   C) It removes glucose residues from the reducing ends of the glycogen chains.
   D) It catalyzes phosphorolysis of the α(1- 6) bonds at the branch points of glycogen.

9. 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.

10. Which of the following is *not* true of the citric acid cycle?
   A) Oxaloacetate is used as a substrate but is not consumed in the cycle.
   B) In the presence of malonate, one would expect succinate to accumulate.
   C) Succinate dehydrogenase channels electrons directly into the electron transfer chain.
   D) The condensing enzyme is subject to allosteric regulation by ATP and NADH.
   E) All enzymes of the cycle are located in the cytoplasm, except succinate dehydrogenase, which is bound to the inner mitochondrial membrane.

11. Which of the following does *not* involve cyclic AMP?
   A) regulation of glycogen synthesis and breakdown
   B) regulation of glycolysis
   C) signaling by epinephrine
   D) signaling by acetylcholine
   E) signaling by glucagon

12. Which of the following enzymes catalyzes a reaction that does *not* produce CO_2?
   A) isocitrate dehydrogenase
   B) succinate dehydrogenase
   C) a-ketoglutarate dehydrogenase complex
   D) pyruvate dehydrogenase

13. Which of these cofactors participates directly in most of the oxidation-reduction reactions in the fermentation of glucose to lactate?
   A) $FAD/FADH_2$
   B) $NAD^+/NADH$
   C) glyceraldehyde 3-phosphate
   D) ATP
   E) ADP

14. The carbon assimilation ("dark") reactions of photosynthetic plants:
   A) cannot occur in the light.
   B) are driven ultimately by the energy of sunlight.
   C) are important to plants, but ultimately of little significance for bacteria and animals.
   D) yield (reduced) NADH.
   E) yield ATP, which is required for the light reactions.

15. Which of the following is *not* involved in signal transduction by the β–adrenergic receptor pathway?
   A) ATP
   B) GTP
   C) cyclic AMP
   D) cyclic GMP
   E) All of the above are involved.

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16. Conversion of ornithine to citrulline is a step in the synthesis of:
    A) tyrosine.
    B) aspartate.
    C) pyruvate.
    D) carnitine.
    E) urea.

17. The conversion of glutamate to an a-ketoacid and NH_4^+:
    A) is catalyzed by glutamate dehydrogenase.
    B) is a reductive deamination.
    C) is accompanied by ATP hydrolysis catalyzed by the same enzyme.
    D) requires ATP.
    E) does not require any cofactors.

18. Most transduction systems for hormones and sensory stimuli that involve trimeric G proteins have in common all of the following *except:*
    A) receptors with multiple transmembrane segments.
    B) receptors which interact with a G protein.
    C) self-inactivation.
    D) cyclic nucleotides.
    E) nuclear receptors.

19. All of the following contribute to the large, negative, free-energy change upon hydrolysis of "high-energy" compounds *except*:
    A) electrostatic repulsion in the reactant.
    B) stabilization of products by ionization.
    C) low activation energy of forward reaction.
    D) stabilization of products by solvation.
    E) stabilization of products by extra resonance forms.

20. The reaction of the citric acid cycle that is most similar to the pyruvate dehydrogenase complex-catalyzed conversion of pyruvate to acetyl-CoA is the conversion of:
    A) citrate to isocitrate.
    B) α–ketoglutarate to succinyl-CoA.
    C) succinyl-CoA to succinate.
    D) fumarate to malate.
    E) malate to oxaloacetate.

21. The main function of the pentose phosphate pathway is to:
    A) supply energy.
    B) give the cell an alternative pathway should glycolysis fail.
    C) supply NADH.
    D) provide a mechanism for the utilization of the carbon skeletons of excess amino acids.
    E) supply pentoses and NADPH.

22. A new compound isolated from mitochondria is claimed to represent a previously unrecognized carrier in the electron transfer chain. It is given the name coenzyme Z. Which line of evidence do you feel is the *least* conclusive in assigning this compound a position in the electron transfer chain?
    A) When added to a mitochondrial suspension, coenzyme Z is taken up very rapidly and specifically by the mitochondria.
    B) Removal of coenzyme Z from the mitochondria results in a decreased rate of oxygen consumption.
    C) Alternate oxidation and reduction of the mitochondrion-bound coenzyme Z can be readily demonstrated.
    D) The rate of oxidation and reduction of mitochondrion-bound coenzyme is of the same order of magnitude as the overall rate of electron transfer in mitochondria as measured by oxygen consumption.

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23. Which of the following enzymes is *not* involved in the assimilation of inorganic nitrogen into an organic molecule?
A) glutamine synthetase
B) nitrogenase
C) arginase
D) glutamate dehydrogenase
E) glutamate synthase

24. The radioimmunossay (RIA) is based on:
A) competition of unlabelled and radiolabelled antibodies for binding to a hormone.
B) competition of unlabelled and radiolabelled hormone for binding to a receptor.
C) competition of unlabelled and radiolabelled antibodies for binding to a receptor.
D) competition of unlabelled and radiolabelled hormone for binding to an antibody.
E) none of the above.

25. When transketolase acts on fructose 6-phosphate and glyceraldehyde 3-phosphate, the products are:
A) xylulose 5-phosphate and ribose 5-phosphate.
B) xylulose 5-phosphate and erythrose 4-phosphate.
C) 3-phosphoglycerate and glyceraldehyde 3-phosphate.
D) dihydroxyacetone phosphate and glucose 6-phosphate.

26. An example of a steroid hormone is:
A) testosterone.
B) epinephrine.
C) thyroxine.
D) thromboxane.
E) retinoic acid.

27. Photosynthetic phosphorylation and oxidative phosphorylation appear to be generally similar processes, both consisting of ATP synthesis coupled to the transfer of electrons along an electron carrier chain. Both processes:
A) use oxygen (O_2) as a terminal electron acceptor.
B) use cytochromes and flavoproteins in their electron carrier chains.
C) involve ferredoxin.
D) are associated with mitochondrial membranes.

28. Which of the following compounds that are found in the cell does *not* have a large negative free energy of hydrolysis?
A) thioesters such as acetyl-CoA
B) phosphoenolpyruvate
C) 1,3-bis phosphoglycerate
D) 3-phosphoglycerate
E) ADP

29. Transport of fatty acids from the cytoplasm to the mitochondrial matrix requires:
A) ATP, coenzyme A, and hexokinase.
B) ATP, carnitine, and coenzyme A.
C) carnitine, coenzyme A, and hexokinase.
D) ATP, carnitine, and pyruvate dehydrogenase.
E) ATP, coenzyme A, and pyruvate dehydrogenase.

30. Which of the following is *not* true of the fatty acid elongation system of vertebrate cells?
A) It is located in the smooth endoplasmic reticulum.
B) It uses malonyl-CoA as a substrate.
C) It produces stearoyl-CoA by the extension of palmitoyl-CoA.
D) The immediate precursor of the added carbons is acetyl-CoA.
E) It involves the same four-step sequence seen in the fatty acid synthase complex.

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31. Please discuss detail mechanism for pyruvate dehydrogenase. And explain its significance for metabolism. (5 %)

32. Describe five possible fates of amino acids arriving in the liver after intestinal uptake. (5 %)

33. Describe five possible fates for fatty acids in the liver. (5 %)

34. Signals carried by hormones must eventually be terminated; the response continues for a limited time. Discuss three different mechanisms for signal termination, using specific systems as examples. (5 %)

35. Please describe the major experiments that lead to the current accepted model for oxidative phosphorylation in mitochondria and chloroplast. (10%)

36. The following paragraph is the abstract from a review paper [Sheen, J., et al. (1999). "Sugars as signaling molecules." Curr Opin Plant Biol 2(5): 410-8.]. Please discuss the significance of this paper based on your knowledge in cell metabolism. (10%)

"Recent studies indicate that, in a manner similar to classical plant hormones, sugars can act as signaling molecules that control gene expression and developmental processes in plants. Crucial evidence includes uncoupling glucose signaling from its metabolism, identification of glucose sensors, and isolation and characterization of mutants and other regulatory components in plant sugar signal transduction pathways. The emerging scenario points to the existence of a complex signaling network that interconnects transduction pathways from sugars and other hormone and nutrient signals."