

一、單選題 (60%)：每題 2 分，請於試卷內之「選擇題作答區」依序作答。

1. Which of the following formulas would be a carbohydrate?
(A) $C_5H_{12}O_5$ (B) $C_4H_8O_6$ (C) $C_6H_{10}O_6$ (D) $C_3H_8O_3$ (E) $C_6H_{12}O_6$
2. Fatty acids are _____ meaning that they have both a hydrophobic and hydrophilic region of the molecule.
(A) aliphatic (B) amphipathic (C) saturated (D) unsaturated (E) phosphorylated
3. Which of the following polysaccharides contains exclusively glucose in $\beta(1\rightarrow4)$ glycosidic bonds?
(A) Amylose (B) Amylopectin (C) Glycogen (D) Cellulose (E) Chitin
4. An *N*-linked glycan would be attached to _____ while an *O*-linked glycan would be attached to _____.
(A) Asn; Ser (B) Lys; Tyr (C) Gln; Thr (D) Arg; Ser (E) Lys; Ser
5. Which of the following would most likely move across a membrane by simple diffusion?
(A) Potassium ions (B) Glucose (C) Carbon dioxide (D) Sodium ions (E) Water
6. A ceramide is derived from which combination of the following?
(A) A molecule of sphingosine and a monosaccharide
(B) A molecule of sphingosine and a molecule of phosphocholine
(C) A molecule of sphingosine and a fatty acid
(D) A molecule of sphingosine and two fatty acids
(E) A molecule of sphingosine, a fatty acid and a monosaccharide
7. DNA double helix structure is stabilized by all of the following EXCEPT:
(A) the sugar-phosphate backbones are oriented in opposite directions.
(B) the glycosidic bonds holding paired bases are directly across the helix from one another.
(C) cations such as Mg^{2+} bind to the anionic phosphates.
(D) bases stack together through hydrophobic interactions and van der Waals forces.
(E) appropriate base pairing builds a polymer whose external dimensions are uniform.
8. All are characteristics of pyrimidines EXCEPT:
(A) six membered ring.
(B) heterocyclic.
(C) conjugated.
(D) fused five membered rings.
(E) two nitrogens separated by a carbonyl.
9. Which enzyme catalyzes the primary regulation site of glycolysis?
(A) Hexokinase
(B) Phosphofructokinase-1
(C) Glyceraldehyde-3-phosphate dehydrogenase
(D) Phosphoglycerate kinase
(E) Pyruvate kinase

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10. In aerobic metabolism, _____ is the terminal electron acceptor during cellular oxidation of carbon containing fuels.
(A) NAD^+ (B) FAD (C) ATP (D) H_2O (E) O_2
11. Which of the following carbohydrates is the most common molecule exported by photosynthetic cells for use in other parts of the plant?
(A) Sucrose (B) Glucose (C) Fructose (D) Amylopectin (E) Amylose
12. Gluconeogenesis is the synthesis of:
(A) glucose from non-carbohydrate precursors.
(B) glycogen from glucose.
(C) pyruvate from glucose.
(D) fatty acids from glucose.
(E) glucose from fatty acids.
13. In its non-phosphorylated state, glycogen phosphorylase can be activated by which of the following molecules?
(A) ATP
(B) Glucose-6-phosphate
(C) Glucose
(D) AMP
(E) None of the above
14. The pentose phosphate pathway is an important source of _____ and _____, which is an essential precursor for DNA and RNA.
(A) ATP; NADH
(B) NADH; ATP
(C) NADPH; ATP
(D) NADH; ribose-5-phosphate
(E) NADPH; ribose-5-phosphate
15. The only reaction of the citric acid cycle (or TCA cycle) that provides substrate-level phosphorylation is catalyzed by:
(A) aconitase.
(B) isocitrate dehydrogenase.
(C) succinyl-CoA synthetase.
(D) fumarase.
(E) nucleotide triphosphate kinase.
16. Which of the following amino acid residues would most likely be buried in the interior of a water-soluble, globular protein?
(A) Asp (B) Lys (C) Ser (D) Arg (E) Phe
17. What term describes an inactive precursor of an enzyme such as the precursors to protease enzymes produced by the pancreas?
(A) Allosteric enzyme (B) Zymogen (C) Isozyme (D) Ribozyme (E) Hydrolase
18. Which of the following amino acid residue is the precursor of glutathione?
(A) Cys (B) Gly (C) Met (D) A&B (E) A&C

19. Tyrosine is the precursor of many biological molecules. Which of the following molecules is derived from tyrosine?
(A) Serotonin (B) Heme (C) Dopa (D) Spermidine (E) None of the above
20. Which of the following amino acid residue is required for heme biosynthesis?
(A) Ser (B) Cys (C) Gly (D) Trp (E) Glu
21. Which of the following fatty acid is the essential fatty acid?
(A) Palmitic acid
(B) Stearic acid
(C) Linolenic acid
(D) Arachidonic acid
(E) None of the above
22. The primary activation of triacylglycerol mobilization in adipocytes is through phosphorylation of the enzyme _____.
(A) perilipin
(B) hormone sensitive lipase
(C) adipose triglyceride lipase
(D) monoacylglycerol lipase
(E) none of the above
23. Which of the following represents the correct sequence of events in a cycle of β -oxidation beginning with a saturated fatty acyl-CoA?
(A) Hydration, FAD-coupled oxidation, NAD^+ -coupled oxidation, thiolytic cleavage
(B) FAD-coupled oxidation, hydration, NAD^+ -coupled oxidation, thiolytic cleavage
(C) FAD-coupled oxidation, NAD^+ -coupled oxidation, hydration, thiolytic cleavage
(D) NAD^+ -coupled oxidation, FAD-coupled oxidation, hydration, thiolytic cleavage
(E) NAD^+ -coupled oxidation, hydration, FAD-coupled oxidation, thiolytic cleavage
24. Which of the following types of tissues can use glucose and ketone bodies as sources of fuel?
(A) Skeletal muscle (B) Cardiac muscle (C) Liver (D) Brain (E) Adipose
25. Which of the following is used to activate phosphatidic acid for conversion to various phospholipids?
(A) ATP (B) UTP (C) GTP (D) CTP (E) TTP
26. The hormone _____ induces lipolysis, whereas the hormone _____ inhibits the process.
(A) epinephrine; adrenocorticotrophic hormone
(B) glucagon; insulin
(C) insulin; norepinephrine
(D) glucagon; epinephrine
(E) epinephrine; glucagon
27. How many rounds of β -oxidation would be required for a 18-C fatty acyl chain to be degraded to acetyl-CoA?
(A) 16 (B) 8 (C) 7 (D) 15 (E) None of the above

28. What is the committed step in fatty acid synthesis?
- (A) Binding of the fatty acyl group to the acyl carrier protein
 - (B) Synthesis of malonyl CoA
 - (C) Transacylase reaction
 - (D) The formation of acetoacetyl-ACP
 - (E) None of the above
29. Which of the following is an irreversible form of inhibition?
- (A) Competitive inhibitor
 - (B) Suicide inhibitor
 - (C) Noncompetitive inhibitor
 - (D) Uncompetitive inhibitor
 - (E) None of the above
30. What are the expected changes in kinetics in the presence of a competitive inhibitor?
- (A) V_{max} decreases, K_M appears to decrease
 - (B) V_{max} does not change, K_M appears to increase
 - (C) V_{max} decreases, K_M appears to increase
 - (D) V_{max} does not change, K_M appears to decrease
 - (E) V_{max} decreases, K_M does not change

二、問答題 (40%)：分數標示於各題，請於試卷內之「非選擇題作答區」標明題號依序作答。

1. The antibody consists of two light chains and two heavy chains, linked by the disulfide bond.
 - (1) (2%) Which amino acid residue forms the disulfide bond?
 - (2) (2%) What kind of the reagent can break the disulfide bond?
 - (3) (6%) In addition, antibodies have various applications. Please list and describe two techniques using antibodies.
2. (4%) What is the "specific activity" of the enzyme? Please describe it.
3. (1) (2%) Which amino acid residue is often found in the active sites of enzymes?
 - (2) (4%) In addition, please draw the amino acid and describe the characteristics of the amino acid residue.
4. (4%) The Nobel Prize in Physiology or Medicine 2019 was awarded jointly to William G. Kaelin Jr, Sir Peter J. Ratcliffe and Gregg L. Semenza "for their discoveries of how cells sense and adapt to oxygen availability." When oxygen is limited, hypoxic stress triggers the expression of hypoxia inducible factor (HIF) protein in mammalian tissues. Briefly describe the function of HIF-1 and how it affects the rate of glycolysis under hypoxia.

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5. (16%) The transformation of glucose to CO₂ and H₂O is a major energy production process. Please fill the blanks in the summary table of cell respiration below.

Energy production process	Where it takes place	Product produced	What goes on
<u>(1)</u>	Cytoplasm	ATP, <u>(2)</u> , pyruvate, H ₂ O	Glucose is converted to pyruvate.
Pyruvate processing	<u>(3)</u>	CO ₂ , <u>(4)</u> , <u>(5)</u>	Under aerobic conditions, pyruvate further is oxidized by an enzyme named <u>(6)</u> . On the other hand, in the absence of oxygen, pyruvate can be reduced to <u>(7)</u> in animals.
Citric acid cycle (TCA cycle)		ATP, NADH, <u>(8)</u> , <u>(9)</u>	The entry of a new carbon unit into this cycle can be formed either from pyruvate or from oxidation of <u>(10)</u> . This new carbon unit can combine with a 4-carbon molecule <u>(11)</u> to yield a 6-carbon product <u>(12)</u> , which is the first reaction to initiate this cycle.
<u>(13)</u>		ATP, H ₂ O	This process channels the free energy obtained from oxidation of food materials into the creation of a <u>(14)</u> gradient across the inner membrane. As a result, ATP is formed by an enzyme named <u>(15)</u> . In each 360-degree rotation of this enzyme, <u>(16)</u> (<i>number</i>) molecule(s) of ATP are generated.

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