

請用 2B 鉛筆作答於答案卡，並先詳閱答案卡上之「畫記說明」。

單選題 共 50 題 (A) (B) (C) (D) (E) 5 選 1 答錯不倒扣

第 1 至 25 題 每題 1.5 分 第 26 至 50 題 每題 2.5 分

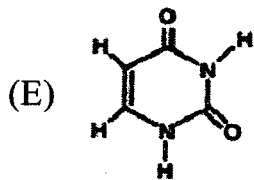
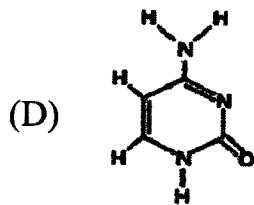
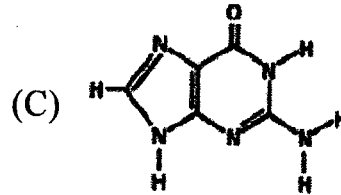
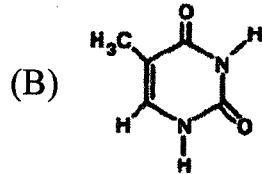
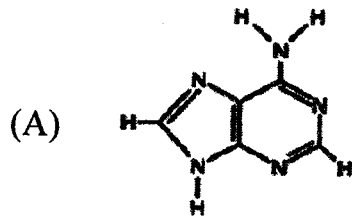
- Which description is **correct**?
 - α -Keratin is rich in connective tissue.
 - A protein should be dissolved in a buffer with pH higher than its pI in order to bind to a cation exchange column.
 - If protein A runs faster than protein B in SDS-PAGE, protein A must have lower molecular mass than protein B.
 - Carboxypeptidase could be used to cleave the "X-C" peptide bond (X is any residue).
 - The non-amino acid part of a conjugated protein is called its prosthetic group.
- Choose the **correct** answer to describe the configuration of cellulose.
 - Gal(β 1 \rightarrow 4)Glc. (B) GlcNAc(β 1 \rightarrow 4)GlcNAc. (C) Glc(β 1 \rightarrow 4)Glc.
 - (D) Glc(α 1 \rightarrow 4)Glc. (E) GlcNAc(α 1 \rightarrow 4)GlcNAc.
- In the binding of oxygen to hemoglobin, the relationship between the concentration of oxygen and the fraction of binding sites occupied can best be described as:
 - hyperbolic. (B) linear with a negative slope. (C) linear with a positive slope.
 - (D) random. (E) sigmoidal.
- The dehydrogenase enzymes facilitate the direct transfer of hydride anion. Which of the following coenzymes is required for this transfer?
 - NAD⁺. (B) Folic acid. (C) Lipoic acid. (D) TPP. (E) Biotin.
- In the biochemical reaction, ATP \rightarrow ADP + P_i is an example of a(n) _____ reaction.
 - group transfer. (B) internal rearrangement. (C) free radical.
 - (D) homolytic cleavage. (E) oxidation/reduction.
- A monoclonal antibody differs from a polyclonal antibody in that monoclonal antibodies:
 - are labeled with chemicals that can be visualized.
 - are produced by cells from the same organism that produced the antigen.
 - are synthesized by a population of identical, or "cloned," cells.
 - are synthesized only in living organisms.
 - have only a single polypeptide chain that can recognize an antigen.
- Consider the reaction below, which of the following statement is **false**?
 - Citric acid cycle is the central pathway of metabolism of the cell because its intermediates are commonly used by other metabolic reactions.
 - Citric acid cycle takes place in mitochondria matrix.
 - Citric acid cycle is amphibolic because it plays a role in both catabolism and anabolism.
 - Three NADH, 1 FADH₂ and 1 GTP are generated in each cycle.
 - None of above is false.

8. A deficiency in which of the following within the mitochondrial matrix will **not** limit a cell's rate of oxidative phosphorylation?
(A) NAD^+ . (B) NADH . (C) O_2 . (D) FADH_2 .
(E) A deficiency in any of these will limit the rate of oxidative phosphorylation.
9. If the enthalpy change for a reaction is zero, ΔG° is equal to which of the following?
(A) $\ln K_{\text{eq}}$. (B) $-\ln K_{\text{eq}}$. (C) $-\Delta H^\circ$. (D) $T\Delta S^\circ$. (E) $-T\Delta S^\circ$.
10. Which lipid is **not** a signal messenger?
(A) Phosphatidylinositol. (B) Estradiol. (C) Sphingolipid.
(D) Vitamin K. (E) Eicosanoid.
11. Which lipid is widely used in apoptosis detection?
(A) Phosphatidylglycerol. (B) Phosphatidylethanolamine. (C) Sphingomyelin.
(D) Phosphatidylcholine. (E) Phosphatidylserine.
12. Which one is an ω -6 fatty acid?
(A) EPA ($20:5(\Delta^{5,8,11,14,17})$). (B) DHA ($22:6(\Delta^{4,7,10,13,16,19})$).
(C) Arachidonic acid ($20:4(\Delta^{5,8,11,14})$). (D) α -Linolenic acid ($18:3(\Delta^{9,12,15})$).
(E) Tetracosahexaenoic ($24:6(\Delta^{6,9,12,15,18,21})$).
13. Which fatty acid is **not** oxidized with β oxidation?
(A) Palmitic acid ($16:0$). (B) Linoleic acid ($18:2(\Delta^{9,12})$). (C) Phytanic acid.
(D) Eicosapentaenoic acid ($20:5(\Delta^{5,8,11,14,17})$). (E) Long chain odd number lipid.
14. Hexokinase and glucokinase belong to the kinase subclass of what class of enzymes?
(A) Oxidoreductase. (B) Isomerase. (C) Transferase.
(D) Hydrolase. (E) Lyase.
15. The metabolic function of the pentose phosphate pathway is to:
(A) act as a source of ADP biosynthesis.
(B) generate NADPH and pentoses for the biosynthesis of fatty acids and nucleic acids.
(C) participate in oxidation-reduction reactions during the formation of H_2O .
(D) provide intermediates for the citric acid cycle.
(E) synthesize phosphorus pentoxide.
16. The double helix of DNA in the B-form is stabilized **mostly** by:
(A) hydrogen bonds between the riboses of each strand.
(B) ribose interactions with the planar base pairs.
(C) nonspecific base-stacking interaction between two adjacent bases in the same strand.
(D) hydrogen bonding between the phosphate groups of two side-by-side strands.
(E) covalent bonds between the 3' end of one strand and the 5' end of the other.

17. Which of the following restriction sites would provide staggered 3' ends? The restriction site in each sequence is shown with an arrow.
- (A) 5'-T↓TCGAA-3'. (B) 5'-GTT↓AAC-3'. (C) 5'-CCC↓GGG-3'.
(D) 5'-CTGCA↓G-3'. (E) None of the above.
18. Cyclic electron flow in chloroplasts produces:
- (A) ATP and O₂, but not NADPH. (B) ATP, but not NADPH or O₂.
(C) NADPH and ATP, but not O₂. (D) NADPH, but not ATP or O₂.
(E) O₂, but not ATP or NADPH.
19. Which of the following metabolites is **not** involved in the amino acid catabolism:
- (A) Pyruvate. (B) α-Ketoglutarate. (C) Citrulline.
(D) Oxaloacetate. (E) glycerol.
20. Aminotransferases are enzymes that have all of the following characteristics **except**:
- (A) can make an α-ketoacid from an α-amino acid.
(B) use pyridoxal phosphate as a carrier of amino groups.
(C) catalyze highly reversible reactions.
(D) use ATP.
(E) serum levels are used as a clinical measure of tissue damage.
21. Which statement is **incorrect**?
- (A) The biosynthesis of dNTPs utilizes NTPs as source.
(B) Ribonucleotide reductase catalyzes ribose to deoxyribose in all biology.
(C) The biosynthesis of dTTP is first to convert dUDP to dUMP and subsequently to dTMP.
(D) The biosynthesis of dTDP from dTMP requires ATP as energy source.
(E) None of the above.
22. Of the following metabolic pathway, which one is **not** a source of acetyl-CoA?
- (A) Amino acid degradation. (B) β-oxidation of fatty acid.
(C) Pentose phosphate pathway. (D) Glycolysis. (E) None of the above.
23. Given the saturated fatty acid, $\text{CH}_3(\text{CH}_2)_{10}\overset{\text{O}}{\parallel}\text{C}-\text{OH}$. How many β-oxidation cycles would it be required to completely metabolize the given fatty acid?
- (A) 3. (B) 4. (C) 5. (D) 6. (E) 7.

24. The function of a molecular chaperone is to:
- (A) act as an energy source during the polymerization of amino acids into a polypeptide.
 - (B) act as a carrier molecule and bring "activated" monomers to a polymer for incorporation.
 - (C) bind to specific structures on the polypeptide in order to assist the folding of a protein into its correct three dimensional shape.
 - (D) unfold proteins with the incorrect three-dimensional shape and refold them into the proper shape.
 - (E) transport rRNA from the nucleus to the cytoplasm.

25. In the transcription of DNA to RNA the nitrogenous base cytosine will pair with:



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28. Five students are discussing a peptide consisting of nine amino acid residues.

Student A: When this peptide is digested by chymotrypsin, you can get a tripeptide and a hexapeptide.

Student B: This peptide cannot be cut by cyanogen bromide.

Student C: This peptide does not contain any amino acids with two chiral centers

Student D: When this peptide is digested by trypsin, you can get a tripeptide and a hexapeptide.

Student E: When I dissolved the peptide in 100 mM phosphate buffer (pH 7), this peptide is positively charged.

What might be the peptide sequence?

(A) MSEFAHKVW.

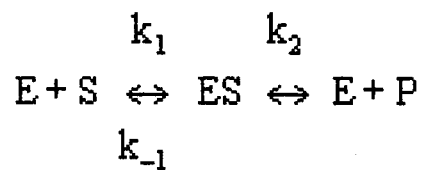
(B) SERLLWATK.

(C) QGEKCYIPC.

(D) FHRGPWSSM.

(E) CSKQAYNDR.

29. Which statement is **correct** about the Michaelis-Menten constant, K_m , for the kinetic mechanism below?



(A) Its numeric value has the units of moles^{-1} .

(B) Its defined as $K_m = k_1/(k_{-1} + k_2)$.

(C) It is approximately equal to the dissociation constant for the enzyme-substrate complex to E + P.

(D) The value of K_m is constant for an enzyme regardless of the specific substrate molecule used to determine it.

(E) It is numerically equal to the substrate concentration required to achieve one half the maximum velocity.

30. The following data were obtained in a study of an enzyme known to follow Michaelis-Menten kinetics.

V_0 (mol/min)	Substrate added (mmol/L)
217	0.8
325	2
433	4
488	6
647	1,000

The K_m for this enzyme is approximately:

(A) 1 mM.

(B) 1,000 mM.

(C) 2 mM.

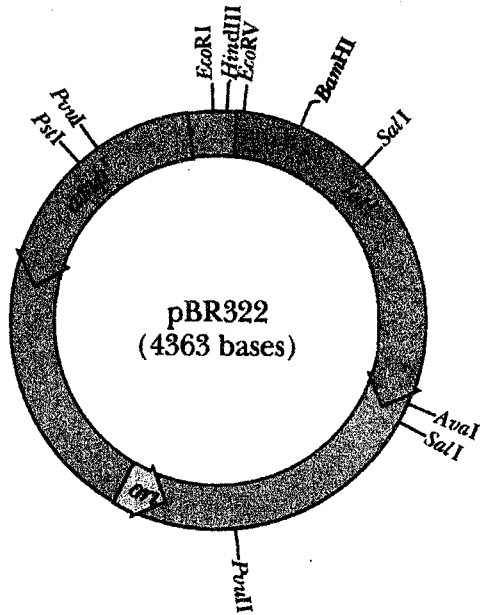
(D) 4 mM.

(E) 6 mM.

31. Which of the following statements regarding electron transfer is **true**?
1. A positive reduction potential means substance has higher affinity for electron.
 2. ATP synthase would be unable to produce ATP if a toxin inhibits the establishment of the proton gradient in the mitochondrial intermembrane space.
 3. Cells treated with the drug 2,4-dinitrophenol (2,4-DNP) which destroys the H^+ gradient that forms in the electron transport chain will be forced to perform fermentation.
 4. Cyanide is very toxic in high enough doses because it binds irreversibly to cytochrome C, resulting in the increase of several enzymes' activities of the citric acid cycle.
- (A) 1, 2, and 4 are correct. (B) 1, 3, and 4 are correct.
(C) 1, 2, and 3 are correct. (D) 2, 3, and 4 are correct. (E) All are correct.
32. Pyruvate carboxylase catalyzes the conversion of pyruvate to oxaloacetate. What coenzyme is found in pyruvate carboxylase that aids in many carboxylation reactions?
- (A) Thiamine pyrophosphate. (B) Biotin. (C) Folic acid.
(D) Lipoic acid. (E) None of the above.
33. Pyruvate carboxylase catalyzes the conversion of pyruvate to oxaloacetate. In this pyruvate carboxylase catalyzed reaction, bicarbonate is "activated" by attachment to the _____ of ATP to form _____.
- (A) β -phosphate; carbonyl ADP. (B) α -phosphate; carbonyl AMP.
(C) α -phosphate; carbonylphosphate. (D) γ -phosphate; carbonylphosphate.
(E) γ -phosphate; carbonyl AMP.
34. Which of the following statements about glyoxylate pathway is(are) **correct**?
- During seed germination, the glyoxylate pathway is important to plants because it enables them to:
1. carry out the synthesis of glucose from acetyl-CoA.
 2. accomplish the net synthesis of four-carbon dicarboxylic acids from acetyl-CoA.
 3. obtain acetyl-CoA from fatty acids.
 4. obtain glyoxylate from fatty acids.
 5. conversion of lipid to carbohydrate.
 6. accomplish the net synthesis of long-chain fatty acids from citric acid cycle intermediates.
- (A) 2 and 4 are correct. (B) 1, 2, and 5 are correct. (C) 3 and 6 are correct.
(D) 3 and 5 are correct. (E) Only 4 is correct.
35. Glucose, labeled with ^{14}C in different carbon atoms, is added to a crude extract of a tissue rich in the enzymes of the pentose phosphate pathway. The most rapid production of $^{14}CO_2$ will occur when the glucose is labeled in:
- (A) C-1. (B) C-3. (C) C-4. (D) C-5. (E) C-6.

36. When a muscle is stimulated to contract aerobically, less lactic acid is formed than when it contracts anaerobically because:
- (A) glycolysis does not occur to significant extent under aerobic conditions.
 - (B) muscle is metabolically less active under aerobic than anaerobic conditions.
 - (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) 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.
37. Which of the following substrates **cannot** contribute to net gluconeogenesis in mammalian liver?
- (A) Alanine. (B) Glutamate. (C) Palmitate.
 - (D) Pyruvate. (E) α -ketoglutarate.
38. Which of the following reactions is catalyzed by a transketolase in the pentose phosphate pathway?
- I. fructose-6-P + glyceraldehyde-3-P \rightarrow xylulose-5-P + erythrose-4-P
 - II. erythrose-4-P + fructose-6-P \rightarrow sedoheptulose-7-P + glyceraldehyde-3-P
 - III. sedoheptulose-7-P + glyceraldehyde-3-P \rightarrow ribose-5-P + xyulose-5-P
- (A) I only. (B) II and III. (C) II only. (D) I and III. (E) I and II.
39. Fructose in the diet or fructose from sucrose in the diet can be a source of calories for fat synthesis in the liver because:
- (A) ketoses are fattening.
 - (B) fructose enters glycolysis after the primary regulation point, phosphofrutokinase-1 (PFK-1).
 - (C) fructose provides a net of four ATP from glycolysis.
 - (D) fructose enters the branch of glycolysis that forms fat.
 - (E) glycerol (the "backbone" of triacylglycerols) comes specifically from fructose.
40. If yeast cells were given glucose that was labeled with ^{14}C at carbon 3, where would the ^{14}C be found after glycolysis under anaerobic conditions?
- (A) CO_2 . (B) Ethanol, C1. (C) Ethanol, C2.
 - (D) Lactic acid, C1. (E) Lactic acid, C3.

41. If the pBR322 plasmid were treated with *Pst*I in order to insert a gene into the plasmid, which of the following would be **correct** regarding cells that were transformed with the resulting vector?

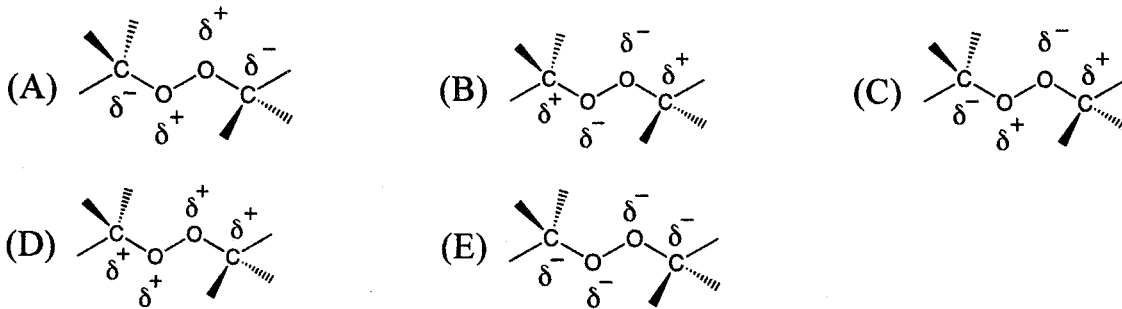


- (A) cells that contained the desired vector would be resistant to ampicillin but sensitive to tetracycline.
- (B) cells that contained the desired vector would be resistant to tetracycline but sensitive to ampicillin.
- (C) cells that contained the desired vector would be resistant to both ampicillin and tetracycline.
- (D) cells that contained the desired vector would be sensitive to both ampicillin and tetracycline.
- (E) none of the above.
42. A molecule such as 2,4-dinitrophenol (2,4-DNP) works to uncouple the proton gradient of the electron-transport chain. Which of the following is **true** about 2,4-DNP?
- (A) 2,4-DNP is protonated in the mitochondria matrix and deprotonated in the intermembrane space
- (B) The presence of an uncoupler results in an increase in the activity of the TCA cycle and electron transport.
- (C) 2,4-DNP is a very ineffective uncoupler because its hydrophobic structure prevents it from effectively crossing lipid bilayer membranes.
- (D) 2,4-DNP has been used as a very effective diet aid for the past 70 years.
- (E) None of the above are correct.
43. Under anaerobic conditions, skeletal muscle generates lactate from pyruvate to:
- (A) lower the pH. (B) promote release of oxygen from hemoglobin.
- (C) generate additional ATP. (D) be warning of muscle fatigue.
- (E) regenerate NAD⁺ for further glycolysis.

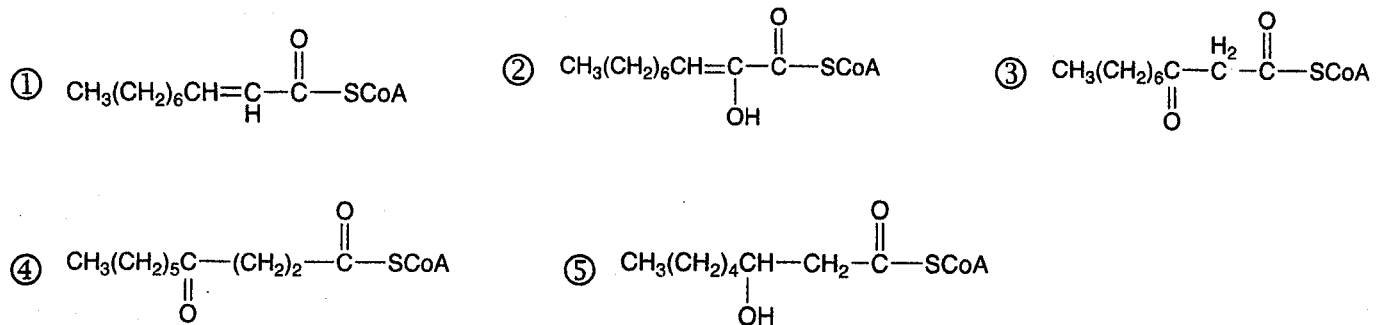
44. In a number of species calorie restriction without malnutrition may slow the biological aging process, resulting in longer maintenance of youthful health and an increase in both median and maximum lifespan. Which of the followings is involved in the underlying mechanism?

- (A) Decrease in body weight. (B) Inhibition of AMPK. (C) Activation of sirtuin.
 (D) Activation of mTOR. (E) Inhibition of autophagy.

45. Of the following, which polarity pattern is **correct**?

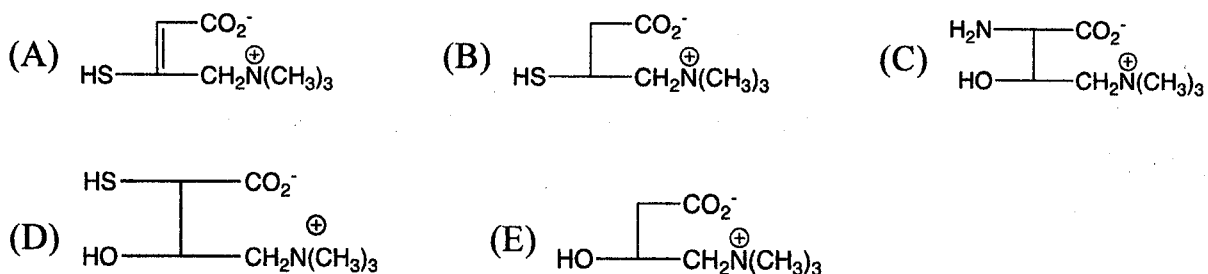


46. During the β -oxidation of the given fatty acid, $\text{CH}_3(\text{CH}_2)_{10}\overset{\text{O}}{\parallel}\text{C}-\text{OH}$, which metabolite could be **correct**?



- (A) ①③⑤ (B) ①④⑤ (C) ②③⑤ (D) ②④⑤ (E) ①②③⑤

47. Which biological molecule plays key role to transport long chain fatty acids into mitochondrial matrix?



48. You extract RNA from liver cells and then carry out an agarose gel electrophoresis of the liver RNA. The RNA fragments are then transferred to an RNA-binding membrane (nitrocellulose or nylon) using capillary action. Next, you hybridize a probe for gene X to the RNA on the membrane. Which of the following statements regarding your experiment is **true**?
- (A) You are trying to determine how many copies of Gene X are in liver cells.
 - (B) You are trying to determine if Gene X is expressed in liver cells.
 - (C) You are trying to determine if the Gene X protein is present in liver cells.
 - (D) You are trying to determine the chromosomal location of Gene X.
 - (E) You are trying to determine whether Gene X has a mutant sequence.
49. Suppose the *lac* repressor of *E. coli* is mutated so that it never binds to the operator. Which of the following is **true**?
- (A) Glucose digesting enzymes are never produced.
 - (B) Lactose digesting enzymes are never produced.
 - (C) Lactose digesting enzymes are always produced.
 - (D) The result depends on the concentration of glucose.
 - (E) None of the above.
50. The Nobel Prize in Physiology or Medicine 2009 was awarded jointly to Blackburn, Greider and Szostak for the discovery that chromosomes are protected by telomeres and the enzyme telomerase is highly correlated with aging and cancer in animals. Which of the following statements regarding telomere and telomerase is **correct**?
- (A) Telomerase is a DNA exonuclease.
 - (B) Telomerase is an RNA polymerase.
 - (C) Embryonic cells possess long telomeres and high telomerase activity.
 - (D) Telomeres are longer and telomerase is inactive in cancer cells.
 - (E) Telomeres are longer and telomerase is highly active in somatic cells.

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