

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

1. Which of the following pairs of bonds can rotate within a peptide backbone and the torsion angle of the latter is assigned as psi angle?

- (A) $C_{\alpha}-CO$ and $N-C_{\alpha}$ (B) $C_{\alpha}-N$ and $CO-C_{\alpha}$ (C) $CO-N$ and $N-C_{\alpha}$
 (D) $N-CO$ and $C_{\alpha}-CO$ (E) $N-C_{\alpha}$ and $CO-N$

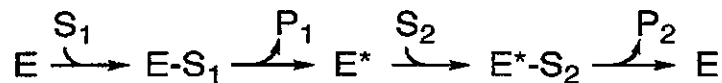
2. Which description is correct?

- (A) Every turn of α -helix is 3.6 Å in length.
 (B) Hydrogen bond in α -helix formed between residue i and $i+3$.
 (C) Heparin is glycosaminoglycan.
 (D) Collagen is full of α -helix structure and has Gly-X-Pro repeating sequence.
 (E) Orthologous genes are presumed to have been derived by gene duplication followed by gradual changes in the sequences of both copies.

3. Which description is correct?

- (A) Glycogen is a homopolysaccharide form of glucose.
 (B) The galactose unit of the compound $Gal(\beta 1 \rightarrow 4)Glc$ residue is at the reducing end.
 (C) Starch is the most abundant polysaccharide in nature.
 (D) Gly residues are particularly abundant in α -keratin.
 (E) All amino acids in proteins are L-amino acids.

4. In the following enzyme reaction scheme, what sort of multi-enzyme kinetics are shown?

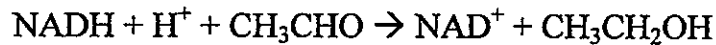


- (A) Ordered substrate binding with random product release.
 (B) Ordered substrate binding with ordered product release.
 (C) Random substrate binding with ordered product release.
 (D) Random substrate binding with random product release.
 (E) Ping-pong mechanism.

5. Adenylyl cyclase catalyzes the synthesis of cAMP, and cAMP hydrolysis is catalyzed by a 5'-phosphodiesterase. If caffeine inhibits 5'-phosphodiesterases, drinking a caffeinated beverage would ____ cAMP levels and ____ glycogen phosphorylase activity.

- (A) increase; decrease. (B) increase; increase. (C) decrease; decrease.
 (D) decrease; increase. (E) have no effect on; have no effect on.

6. Which one of the following statements concerning the reaction below is **not true**?



- (A) This reaction happens during vigorous muscle contraction.
(B) Oxidizing half reaction is $\text{CH}_3\text{CHO} + 2\text{H}^+ + 2e^- \rightarrow \text{CH}_3\text{CH}_2\text{OH}$.
(C) Reduction half reaction is $\text{NADH} \rightarrow \text{NAD}^+ + 2\text{H}^+ + 2e^-$.
(D) CH_3CHO can be produced from pyruvate.
(E) None of above.
7. Which of the below is **not** required for the oxidative decarboxylation of pyruvate to form acetyl-CoA?
(A) NAD^+ . (B) ATP. (C) Lipoic acid. (D) FAD. (E) CoA-SH.
8. 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. Which of the following is **not true** of both processes?
(A) Both contain cytochromes and flavins in their electron carrier chains.
(B) Both processes are associated with membranous elements of the cell.
(C) Both use oxygen as a terminal electron acceptor.
(D) Each represents the major route of ATP synthesis in those cells in which it is found.
(E) Protons are pumped from the inside to the outside of both mitochondria and chloroplast membranes.
9. 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) Alternate oxidation and reduction of the mitochondrion-bound coenzyme Z can be readily demonstrated.
(B) Removal of coenzyme Z from the mitochondria results in a decreased rate of oxygen consumption.
(C) 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.
(D) The reduction potential of Z is between that of two compounds known to participate in the electron transport chain.
(E) When added to a mitochondrial suspension, coenzyme Z is taken up very rapidly and specifically by the mitochondria.

10. Which one is **not** a component of plasma membrane?
(A) Phospholipids. (B) Glycolipids. (C) Cholesterol. (D) Triacylglycerol.
(E) Phosphatidylcholine.
11. Which one is **not** a second messenger derived from membrane lipid?
(A) Diacylglycerol (DAG). (B) Phosphatidylinositol-3,4,5-trisphosphate (PtdIns(3,4,5)P₃).
(C) Arachidonic acid. (D) Lysophosphatidic acid (LPA). (E) Cardiolipin.
12. Which one is **not** required for fatty acid synthesis?
(A) NADPH. (B) NADH. (C) Acetyl Co-A. (D) Malonyl-CoA.
(E) Fatty acid synthase.
13. Which one does **not** utilize cytoplasmic fatty acid as a primary precursor?
(A) Cholesterol. (B) Triacylglycerides. (C) Phosphoglycerides. (D) Sphingolipid.
(E) Prostaglandin.
14. Which one does **not** contribute to cytoplasmic fatty acid pool?
(A) Palmitic acid. (B) LDL receptor. (C) FA transport proteins or FA translocase.
(D) FA binding proteins (FABPs). (E) Arachidonic acid.
15. Which one is **not correct** regarding β -oxidation?
(A) Activation of fatty acid by coupling to CoA, followed by transfer of the acyl group to carnitine palmitoyltransferase 1.
(B) Acylcarnitine is shuttled to the mitochondrial matrix by the carnitine-acylcarnitine translocase.
(C) The acyl chain is transferred back to CoA by carnitine palmitoyltransferase 2.
(D) Very long fatty acids require initial shortening in the cytoplasm.
(E) 16-carbon fatty acid palmitate yields approximately 130 molecules of ATP.
16. The immediate reducing power of ribonucleotide reductase is provided by:
(A) Thioredoxin. (B) Ferredoxin. (C) NADH. (D) Fe-S complex. (E) Cyt P-450.

17. Which of the following hormones affects the arcuate nucleus of the hypothalamus and ultimately results in an inhibition of nutrient intake?

- (A) Adiponectin. (B) Leptin. (C) Ghrelin. (D) Gucagon.
(E) None of the above.

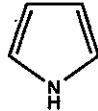
18. The reaction, $\text{glutamate} + \text{NAD(P)}^+ + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \alpha\text{-ketoglutarate} + \text{NAD(P)H} + \text{H}^+$, is catalyzed by:

- (A) Nitrogenase. (B) Carbamoyl-phosphate synthetase (CPS-I).
(C) Glutamate dehydrogenase (GDH). (D) Glutamine synthetase (GS). (E) None are true.

19. Nitroglycerine is a potent _____ because of the release of _____.

- (A) antioxidant; O_2 (B) vasoconstrictor; $\text{NO}\cdot$ (C) vasodilator; $\text{NO}\cdot$
(D) muscle tensor; O_2 (E) All are true

20. By definition of a Lewis acid, choose the **correct** answer.

1. Fe^{2+} 2. H^- 3. Mg^{2+} 4. NH_3 5. 

- (A) 1 and 3 are Lewis acids. (B) 2 and 4 are Lewis acids. (C) 5 is Lewis acid.
(D) 1 and 4 are Lewis acids. (E) 2 and 3 are Lewis acids.

21. What enzyme breaks apart the hydrogen bonds between two strands of DNA?

- (A) Polymerase I. (B) Polymerase III. (C) Ligase. (D) Helicase. (E) Okazaki.

22. Which statement about the elongation of the lagging strand during DNA replication is **correct**?

- (A) It is synthesized in a 3'→5' direction. (B) It progresses (grows) toward the replication fork.
(C) It requires a short RNA primer to proceed. (D) It is synthesized by DNA ligase.
(E) It is synthesized continuously.

23. Using RNA as a template for protein synthesis instead of translating proteins directly from the DNA is advantageous for the cell because

- (A) RNA is much more stable than DNA.
(B) RNA acts as an expendable copy of the genetic material.
(C) only one mRNA molecule can be transcribed from a single gene, lowering the potential rate of gene expression.
(D) tRNA, rRNA and others are not transcribed.
(E) mRNA molecules are subject to mutation but DNA is not.

24. Which of the following is **not true** of RNA processing?
- (A) Exons are cut out before mRNA leaves the nucleus.
 - (B) Nucleotides may be added at both ends of the RNA.
 - (C) Ribozymes may function in RNA splicing.
 - (D) RNA splicing can be catalyzed by spliceosomes.
 - (E) A primary transcript is often much longer than the final RNA molecule that leaves the nucleus.
25. Which of the following is most likely to have a small protein called ubiquitin attached to it?
- (A) A regulatory protein that requires sugar residues to be attached.
 - (B) A cell surface protein that requires transport from the ER.
 - (C) An mRNA that is leaving the nucleus to be translated.
 - (D) A cyclin that usually acts in G1, now that the cell is in G2.
 - (E) An mRNA produced by an egg cell that will be retained until after fertilization.

第 26 至 50 題 每題 2.5 分

26. Sam is trying to separate a protein mixture containing three proteins A, B, C.

Protein A: homotetramer, $M_r = 120,000$, $pI = 6$;

Protein B: monomer, $M_r = 80,000$, $pI = 7$;

Protein C: monomer, $M_r = 13,000$, $pI = 9$.

Please choose the **correct** one from the following descriptions:

- (A) If Sam dissolves the mixture in 0.1 M Tris-HCl (pH 7) and uses SDS-PAGE to separate the mixture, the protein bands in the gel from top to bottom should be B-A-C.
 - (B) If Sam dissolves the protein mixture in 20 mM phosphate buffer (pH 8) and loads it to an anion exchange column equilibrated with the same buffer, only protein C can bind to the column.
 - (C) If Sam dissolves the mixture in 0.1 M Tris-HCl (pH 7) and uses size exclusion column to separate the mixture, protein C will be first eluted.
 - (D) If Sam dissolves the mixture in 0.1 M Tris-HCl (pH 7) and uses size exclusion column to separate the mixture, the elution sequence is B-A-C.
 - (E) If Sam dissolves the protein mixture in 20 mM phosphate buffer (pH 7) and loads it to a cation exchange column equilibrated with the same buffer, only protein A can bind to the column.
27. Which description is **correct**?
- (A) All the residues in the peptide with sequence "AKLFPIEARQA" have only one chiral center.
 - (B) The peptide with sequence "AKQHPMLWNR" does not contain the residue which can be O-glycosylated.
 - (C) The pI value of peptide with sequence "DSQWMKLGIV" should be near 9.
 - (D) When the peptide with sequence "CYTTLNKTG" was completely digested by trypsin, we can get one tripeptide and one hexapeptide.
 - (E) The peptide with sequence "AKLFPIEARGQA" does not contain any aromatic ring.

28. 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 decrease.
 - (C) V_{\max} decreases, K_m appears to increase.
 - (D) V_{\max} does not change, K_m appears to increase.
 - (E) V_{\max} decreases, K_m does not change.
29. Which of the following explains why enzymes are extremely effective catalysts?
- (A) An enzyme stabilizes the transition state.
 - (B) Enzymes bind very tightly to substrates.
 - (C) Enzymes release products very rapidly.
 - (D) An enzyme can convert a normally endergonic reaction into an exergonic reaction.
 - (E) An enzyme lowers the energy of activation only for the forward reaction.
30. Recent studies have shown that the H-bond between the distal histidine and oxygen molecule in myoglobin has a strength of ~ 15 kJ/mol, but in hemoglobin, the strength of the bond is only ~ 8 kJ/mol. What does this suggest about the differences between myoglobin and hemoglobin?
- (A) Myoglobin binds oxygen more strongly than hemoglobin.
 - (B) Hemoglobin binds oxygen more strongly than myoglobin.
 - (C) The iron in myoglobin is more easily oxidized than in hemoglobin.
 - (D) The iron in hemoglobin is more easily oxidized than in myoglobin.
 - (E) None of the above.
31. Which of the following is **true** regarding effectors of oxygen-hemoglobin binding?
- (A) Actively metabolizing tissues produce acid which increases hemoglobin's affinity for oxygen.
 - (B) The presence of CO_2 enhances the release of oxygen from hemoglobin.
 - (C) 2,3-Bisphosphoglycerate must dissociate from hemoglobin before oxygen can be released.
 - (D) The presence of protons will counter the effect of CO_2 on the release of oxygen by hemoglobin.
 - (E) None of the above.
32. Which of the following statements regarding enzyme regulation is **true**?
- (A) Addition of an inhibitor to a V system results in kinetics similar to addition of a competitive inhibitor to a typical hyperbolic system.
 - (B) Allosteric effectors are always more powerful than covalent modification.
 - (C) Addition of an allosteric activator to a K system changes the plot of V vs. [S] from a sigmoidal curve to a more hyperbolic curve.
 - (D) The T state of an enzyme generally has more activity than the R state.
 - (E) None of the above are true.

33. Which of the following is **correct** concerning the mitochondrial ATP synthase?
- (A) It can synthesize ATP after it is extracted from broken mitochondria.
 - (B) It catalyzes the formation of ATP even though the reaction has a large positive ΔG° .
 - (C) It consists of F_0 and F_1 subunits, which are transmembrane (integral) polypeptides.
 - (D) When it catalyzes the ATP synthesis reaction, the ΔG° is actually close to zero.
 - (E) It is actually an ATPase and only catalyzes the hydrolysis of ATP.
34. There is reciprocal regulation of glycolytic and gluconeogenic reactions interconverting fructose-6-phosphate and fructose-1,6-bisphosphate. Which one of the following statements about this regulation is **not correct**?
- (A) Fructose-2,6-bisphosphate activates phosphofructokinase-1.
 - (B) Fructose-2,6-bisphosphate inhibits fructose-1,6-bisphosphatase.
 - (C) The fructose-1,6-bisphosphatase reaction is exergonic.
 - (D) The phosphofructokinase-1 reaction is endergonic.
 - (E) This regulation allows control of the direction of net metabolite flow through the pathway.
35. Gluconeogenesis must use "bypass reactions" to circumvent (規避、繞行) three reactions in the glycolytic pathway that are highly exergonic and essentially irreversible. Reactions carried out by which three of the enzymes listed must be bypassed in the gluconeogenic pathway?
1. Hexokinase 2. Phosphoglycerate kinase 3. Phosphofructokinase-1
4. Pyruvate kinase 5. Triosephosphate isomerase
- (A) 1, 2, and 4. (B) 1, 2, and 3. (C) 1, 3, and 4. (D) 1, 4, and 5. (E) 2, 3, and 4.
36. 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) fumarate to malate. (C) malate to oxaloacetate.
(D) succinyl-CoA to succinate. (E) α -ketoglutarate to succinyl-CoA.
37. Which of these statements about the membrane proteins is **true**?
- (A) An integral membrane protein can be extracted with a chelating agent that removes divalent cations.
 - (B) Peripheral membrane proteins are generally noncovalently bound to membrane lipids.
 - (C) Carbohydrate moieties of membrane glycoproteins are linked to the intracellular domain of the proteins.
 - (D) Peripheral membrane proteins may have functional units on both sides of the membrane.
 - (E) Glycosylphosphatidylinositols, abbreviated GPI, are complex glycolipids that attach some proteins to the cytosolic surface of the plasma membrane.

38. In amino acid catabolism, the first reaction for many amino acids is a(n):
- (A) oxidative deamination requiring NAD^+ .
 - (B) hydroxylation requiring NADPH and O_2 .
 - (C) transamination requiring pyridoxal phosphate (PLP).
 - (D) reduction requiring pyridoxal phosphate (PLP).
 - (E) decarboxylation requiring thiamine pyrophosphate (TPP).
39. Which of the following is **not true** about cyclic electron flow of photophosphorylation?
- (A) Cyclic electron flow produces more NADPH per photon than noncyclic electron flow.
 - (B) Cyclic electron flow involves only photosystem I.
 - (C) Plastocyanin is required for cyclic electron flow.
 - (D) Cyclic electron flow leads to the build-up of a proton gradient.
 - (E) Cyclic electron flow does not produce O_2 .
40. Which of the following statements about mitochondrial transport systems is **correct**?
- (A) Malate-aspartate shuttle: converts cytosolic NADH to mitochondrial FADH_2 .
 - (B) ATP-ADP translocase: transfers ATP and a proton from matrix to cytosol while transferring ADP from cytosol to matrix.
 - (C) Glycerophosphate shuttle: converts cytosolic FADH_2 to mitochondrial NADH .
 - (D) The malate-aspartate shuttle is irreversible while the glycerophosphate shuttle is reversible.
 - (E) None of the above are correct.
41. A characteristic of the glycerophosphate shuttle is:
- (A) It shuttles NADH across the mitochondrial membrane to yield 2.5 ATP/ADH.
 - (B) It shuttles "NADH electron equivalents" across the mitochondrial membrane to yield 1.5 ATP/NADH.
 - (C) It only operates efficiently when the $[\text{NADH}]$ in the cytoplasm is higher than in the matrix.
 - (D) Malate is a key component in the shuttle process.
 - (E) Aspartate is a key component in the shuttle process.
42. Which of the following correctly and completely describes electron movement in electron transport?
- (A) $\text{NADH} \rightarrow \text{complex I} \rightarrow \text{complex III} \rightarrow \text{coenzyme Q} \rightarrow \text{Complex IV} \rightarrow \text{O}_2$
 - (B) $[\text{FADH}_2] \rightarrow \text{complex II} \rightarrow \text{cytochrome c} \rightarrow \text{complex III} \rightarrow \text{coenzyme Q} \rightarrow \text{Complex IV} \rightarrow \text{O}_2$
 - (C) $\text{NADH} \rightarrow \text{complex I} \rightarrow \text{coenzyme Q} \rightarrow \text{complex III} \rightarrow \text{cytochrome c} \rightarrow \text{Complex IV} \rightarrow \text{O}_2$
 - (D) $[\text{FADH}_2] \rightarrow \text{complex I} \rightarrow \text{coenzyme Q} \rightarrow \text{complex III} \rightarrow \text{Complex IV} \rightarrow \text{O}_2$
 - (E) None of the above

43. Glutamine synthetase plays an important role in the incorporation of ammonia (or ammonium ions) into glutamine. Which of the following mechanisms of covalent modification controls the activity of glutamine synthetase?

- (A) Phosphorylation/dephosphorylation. (B) Adenylation/deadenylation.
 (C) Acetylation/deacetylation. (D) Methylation/demethylation. (E) None of the above.

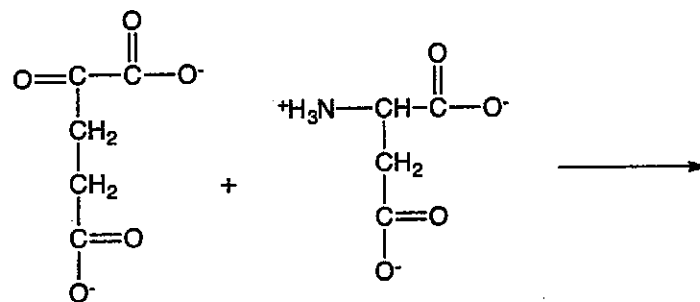
44. Most cancers depend on a high rate of aerobic glycolysis for their continued growth and survival. Paradoxically, some cancer cell lines also display addiction to glutamine. Which of the following is **not true** for the possible mechanism behind this glutamine addiction:

- (A) Glutamine is an essential amino acid.
 (B) Glutamine provides nitrogen for nucleotide synthesis.
 (C) Glutamine provides substrate for mitochondrial citric acid cycle.
 (D) Glutamine provides nitrogen for protein synthesis.
 (E) Glutamine activates mTORC1 signaling.

45. Insulin resistance causes an increase in gluconeogenic activity in the liver due to the lack of glucose. What serves as the primary carbon source for gluconeogenesis under these conditions?

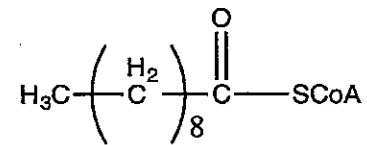
- (A) Amino acids. (B) Glycerol. (C) Fructose. (D) Acetyl-CoA.
 (E) Ketone bodies

46. Considered the following transamination reaction in amino acid biosynthesis, what amino acid would be produced?



- (A) Glu. (B) Asp. (C) Gln. (D) Asn. (E) Arg.

47. Given the saturated fatty acid shown below, how many ATPs can be produced when it is completely metabolized by β -oxidation?



Some useful info:

- i. In the TCA cycle, one Acetyl-CoA gives 3 NADHs, 1 FADH₂, and 1 GTP.
- ii. One NADH produces 2.5 ATPs.
- iii. One FADH₂ produces 1.5 ATPs.

- (A) 50. (B) 52. (C) 60. (D) 62. (E) 64.
48. One of the hopes for use of recent knowledge gained about non-coding RNAs lies with the possibilities for their use in medicine. Of the following scenarios for future research, which would you expect to gain most from RNAs?
- (A) Exploring a way to turn on the expression of pseudogenes.
 - (B) Targeting siRNAs to disable the expression of an allele associated with autosomal recessive disease.
 - (C) Targeting siRNAs to disable the expression of an allele associated with autosomal dominant disease.
 - (D) Creating knock-out organisms that can be useful for pharmaceutical drug design.
 - (E) Looking for a way to prevent viral DNA from causing infection in humans.
49. The role of a metabolite that controls a repressible operon is to
- (A) bind to the promoter region and decrease the affinity of RNA polymerase for the promoter.
 - (B) bind to the operator region and block the attachment of RNA polymerase to the promoter.
 - (C) increase the production of inactive repressor proteins.
 - (D) bind to the repressor protein and inactivate it.
 - (E) bind to the repressor protein and activate it.
50. A geneticist introduces a transgene into yeast cells and isolates five independent cell lines in which the transgene has integrated into the yeast genome. In four of the lines, the transgene is expressed strongly, but in the fifth there is no expression at all. Which is a likely explanation for the lack of transgene expression in the fifth cell line?
- (A) A transgene integrated into a heterochromatic region of the genome.
 - (B) A transgene integrated into a euchromatic region of the genome.
 - (C) The transgene was mutated during the process of integration into the host cell genome.
 - (D) The host cell lacks the enzymes necessary to express the transgene.
 - (E) Transgene integrated into a region of the genome characterized by high histone acetylation.