

單複選選擇題 答對一個答案得 1 分，答錯一個答案扣 0.5 分。

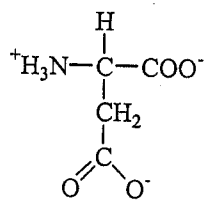
MULTIPLE-CHOICE QUESTIONS

Identify the correct statements. Note that more than one statement might be correct in each question. Gain one point for each correct choice and lose 0.5 point for each wrong choice.

- The amino acid glycine is often used as the main ingredient of a buffer in biochemical experiments. The amino group of glycine has a pKa of 9.6. Select correct statement(s).
 - Glycine has an effective buffer range centered about pH 9.6.
 - In a 0.1 M solution of glycine at pH 9.0, 4/5 of glycine has its amino group in the protonated form.
 - At pH 1.0, glycine exists entirely as the form $^+H_3N-CH_2-COOH$, with a net positive charge of 1.0.
 - The farther the pH from its isoelectric point, the greater the net electric charge of the population of glycine molecules.

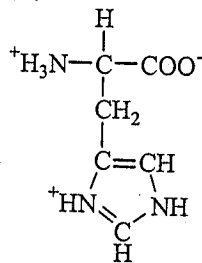
- Which of the following amino acids would be considered as basic?

(A)



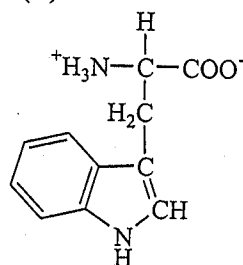
Aspartate (*Asp*)

(B)



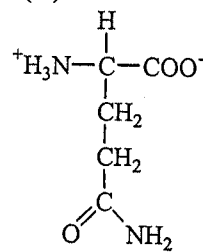
Histidine (*His*)

(C)



Tryptophan (*Trp*)

(D)



Glutamine (*Gln*)

- The formation of a disulfide bond is an example of which type of protein structure?
 - primary
 - secondary
 - tertiary
 - quarternary
- A protein can be denatured by which of the following?
 - acids
 - bases
 - heat
 - detergents
- An enzyme is known to move an amine group from one material to another. It would be referred to as a(n):
 - lyase.
 - oxioreductase.
 - transferase.
 - hydrolase.
- A catalytically inactive protein formed by removal of the cofactor from an active enzyme is called a(n):
 - activator.
 - apoenzyme.
 - proenzyme.
 - preenzyme.

(背面仍有題目,請繼續作答)

7. Which would you expect to have an effect on activity of an enzyme?
- (A) substrate concentration
 - (B) pH
 - (C) temperature
 - (D) enzyme concentration
8. Which chemical forms are preferred by human cells?
- (A) D-glucose
 - (B) L-glucose
 - (C) D-amino acids
 - (D) L-amino acids
9. Which carbohydrate is used in plant cell walls?
- (A) amylopectin
 - (B) amylose
 - (C) cellulose
 - (D) lignand
10. What material is used to help disperse fats in the digestive system?
- (A) prostaglandins
 - (B) steroids
 - (C) bile
 - (D) oxytocin
11. As the degree of unsaturation increases in a fatty acid, you would expect the melting point to:
- (A) increase.
 - (B) decrease.
 - (C) remain the same.
 - (D) impossible to predict.
12. Choose the true statement(s).
- (A) Starch including amylose and amylopectin is used by plants for energy storage.
 - (B) Glycogen is stored in the liver.
 - (C) Peptidoglycan gives rigidity, strength to bacterial cell envelope.
 - (D) Glycosaminoglycans and proteoglycans are components of the extracellular matrix.
13. What nucleotides can be formed in cells?
- (A) ribonucleoside 2',3'-cyclic phosphates
 - (B) ribonucleoside 3'-phosphates
 - (C) adenosine 3',5'-cyclic monophosphate
 - (D) guanosine 3',5'-cyclic monophosphate
14. What are the functions of nucleotides in cells?
- (A) as energy carriers
 - (B) as the subunits of nucleic acids
 - (C) components of enzyme cofactors
 - (D) chemical messengers
15. Choose the true statement(s) for solute transportation across membrane.
- (A) Simple diffusion produces concentration gradients.
 - (B) Passive transport is the same as facilitated diffusion.
 - (C) Active transport requires energy source such as ATP, light, substrate oxidation.
 - (D) Ions always move down their electrochemical gradient through ion channels.

16. Choose the true statement(s).
- (A) If cell membranes are punched or disrupted mechanically, they quickly and automatically reseal.
 - (B) The lipids and proteins of the cell membrane are inserted into the bilayer without specific sidedness.
 - (C) Annexins and fusion proteins mediate the fusion of two membranes, which accompanies processes such as endocytosis and exocytosis.
 - (D) In the absence of specific membrane proteins, the lipid bilayer is impermeable to polar substances.
17. Choose the true statement(s). allosteric enzymes:
- (A) can be inhibited or stimulated by their modulators.
 - (B) follow Michaelis-Menten behavior.
 - (C) V_{max} will not change, but $K_{0.5}$ is modulated by the modulator.
 - (D) V_{max} changes but $K_{0.5}$ is unaffected by the modulator.
18. Phosphoglucomutase catalyzes the reaction of glucose-1-phosphate to glucose-6-phosphate. If we start with 0.02 M glucose-6-phosphate and allow the reaction to go in the reverse direction, the final equilibrium mixture contains 0.001 M glucose-1-phosphate and 0.019 M glucose-6-phosphate. What is the equilibrium constant (K_{eq}) and standard free-energy change (ΔG^0)?
- (A) $K_{eq}=19$, $\Delta G^0=7.28$ kcal/mol
 - (B) $K_{eq}=19$, $\Delta G^0=-1.74$ kcal/mol
 - (C) $K_{eq}=0.053$, $\Delta G^0=7.28$ kcal/mol
 - (D) $K_{eq}=0.053$, $\Delta G^0=1.74$ kcal/mol
19. Choose a correct answer to fill in the following blanks. Glycolysis leads to the production of _____ and two molecules of ATP. In the absence of oxygen, fermentation leads to the production of _____. Glycolysis plus the citric acid cycle can convert the carbons of glucose to _____, storing the energy as ATP, _____ and _____.
- (A) lactic acid, pyruvate, CO_2 , NADH, $FADH_2$.
 - (B) pyruvate, lactic acid, CO_2 , NADH, $FADH_2$.
 - (C) CO_2 , NADH, $FADH_2$, lactic acid, pyruvate.
 - (D) glucose, lactic acid, CO_2 , NADH, $FADH_2$.
20. Which of the following statements are false?
- (A) Most enzymes operate *in vivo* near V_{max} .
 - (B) End-product inhibition usually occurs at the last or next-to-last enzyme in a metabolic pathway.
 - (C) Catabolic pathways tend to diverge from a single metabolite.
 - (D) Enzymes that catalyze a sequence of reactions are rarely grouped in a multienzyme complex.
21. If you isolate mitochondria and place them in buffer with a low pH they begin to manufacture ATP. Why?
- (A) Low pH increases the concentration of base causing mitochondria to pump out H^+ to the inter membrane space leading to ATP production.
 - (B) The high external acid concentration causes an increase in H^+ in the inter membrane space leading to increase ATP production by ATP synthetase.
 - (C) Low pH increases the acid concentration in the mitochondria matrix, a condition that normally causes ATP production.
 - (D) Low pH increases the concentration of OH^- in the matrix resulting in ATP production by ATP.
22. Explain why in anaerobic cells the ratio of pyruvate/ lactate is much less than 1 while under aerobic conditions the ratio of pyruvate/ lactate is much greater than 1.
- (A) Lactate is produced from pyruvate only under anaerobic conditions.
 - (B) Under anaerobic condition pyruvate is converted to carbon dioxide.
 - (C) In anaerobic conditions, pyruvate is converted to glucose using the energy of light.
 - (D) Pyruvate is transported into mitochondria under anaerobic conditions.

(背面仍有題目,請繼續作答)

23. Choose the false statement(s).
- (A) Hydrolysis of the thioester bond of acetyl-CoA yields insufficient energy to drive phosphorylation of ADP.
 - (B) The methyl group of each acetyl-CoA molecule entering the TCA cycle is derived from the methyl group of pyruvate.
 - (C) Malate cannot be converted to fumarate because the TCA cycle is unidirectional.
 - (D) Even if aconitase was unable to discriminate between the two ends of the citrate molecule, the CO_2 released would still come from the oxaloacetate rather than the acetyl-CoA substrate of the citrate synthase reaction.
24. What cellular compartment becomes acidic (high concentration of hydrogen ions) during mitochondrial electron transport?
- (A) mitochondrial stroma
 - (B) endoplasmic reticulum
 - (C) cytoplasm
 - (D) space between inner and outer mitochondrial membrane
25. In the absence of oxygen, the primary purpose of fermentation is to:
- (A) produce amino acids for protein synthesis.
 - (B) generate a proton gradient for ATP synthesis.
 - (C) regenerate NAD^+ from NADH allowing glycolysis to continue.
 - (D) oxidize glucose to generate reduced electron carriers.
26. During a heart attack, blood flowing to the heart muscle is interrupted by blockage of a coronary artery. How would you expect the metabolism in the heart to change?
- (A) Oxidative phosphorylation would slow down in the mitochondria.
 - (B) The rate of production of lactic acid would be stimulated.
 - (C) The use of glucose by the muscle tissue would decrease.
 - (D) The production of water by mitochondria would be inhibited.
27. ATP synthase can produce ATP using ____ as a direct energy source.
- (A) energy from the conversion of glucose to pyruvate
 - (B) energy from the oxidation of pyruvate producing CO_2 and H_2O
 - (C) energy from a proton gradient established in mitochondria
 - (D) energy derived from the breakdown of NADH and FADH_2
28. Insulin facilitates energy storage in the liver. Which enzymes of carbohydrate metabolism are coordinately regulated in the liver in response to insulin signaling?
- (A) glycogen phosphorylase
 - (B) phosphofructokinase-1
 - (C) phosphofructokinase-2
 - (D) pyruvate kinase
29. To which additional adrenergic receptor subtype does epinephrine bind in order to further activate *glycogen phosphorylase* in the liver?
- (A) α -1
 - (B) α -2
 - (C) β -1
 - (D) a novel β -3 subtype

30. The equilibrium constant for the conversion of the disaccharide sucrose to the simple sugars glucose and fructose is 140,000. What can you conclude about the reaction: sucrose + H₂O → glucose + fructose?
- (A) It is a closed system.
(B) It is spontaneous, starting with sucrose.
(C) The equilibrium constant increases when the starting concentration of sucrose is increased.
(D) At equilibrium, the concentration of sucrose is much higher than the concentrations of the glucose and fructose.
31. Energy-requiring reactions can occur in biological systems because enzymes allow their coupling to other reactions with:
- (A) an increase in entropy.
(B) a low activation energy.
(C) products of lower free energy than the reactants.
(D) oxidation-reduction.
32. During photosynthetic electron transport, the interior compartment of the thylakoid membranes becomes:
- (A) enriched in ATP.
(B) the site for glucose synthesis.
(C) more acidic than the stroma.
(D) basic compared to the reaction centers.
33. The overall source of energy for photosynthesis is:
- (A) energy released when water is oxidized and oxygen is produced.
(B) energy from the hydrolysis of ATP.
(C) light energy from the sun.
(D) energy from the reduced electron carriers NADH and FADH₂.
34. Which of the following do happen in cyclic photophosphorylation?
- (A) ATP is produced.
(B) Photosystem I reaction center is active.
(C) NADPH is formed.
(D) Electron transport occurs in the photosynthetic membranes.
35. The conversion of light energy to chemical energy during photosynthesis begins when an excited pigment molecule:
- (A) undergoes fluorescence.
(B) loses energy as heat.
(C) undergoes an oxidation reaction.
(D) is transported across a proton channel.
36. About the metabolism of steroid hormones, choose the true statement(s).
- (A) The initial reaction in steroid hormone biosynthesis is catalyzed by desmolase.
(B) The product, pregnenolone is subsequently transferred to the endoplasmic reticulum.
(C) The carbon atoms of the steroid ring can be used as a source of metabolic energy.
(D) Steroid hormones are stored for subsequent secretion.

37. Choose the true statement(s).
- (A) Binding to the promoter orients RNA polymerase so that it transcribes the adjacent gene; however the choice of template strand is directed by additional protein factors.
 - (B) In any one region of the DNA double helix, only one DNA strand is usually used as a template.
 - (C) Bacterial cells use one type of RNA polymerase to transcribe all classes of RNA, whereas eukaryotic cells use three different types of RNA polymerase.
 - (D) Wobble base-pairing occurs between the first position in the codon and the third position in the anticodon.
38. One strand of a section of DNA isolated from *E. coli* reads: 5'-GTACCTACCCAATAGG-3'
How many different peptides are encoded in this mRNA?
- (A) 1
 - (B) 2
 - (C) 3
 - (D) 6
39. Choose the false statement(s).
- (A) Many antibiotics used in modern medicine selectively inhibit bacterial protein synthesis by exploiting the structural and functional differences between prokaryotic and eukaryotic ribosomes.
 - (B) Each aminocyl-tRNA linkage is activated for addition of the next amino acid to the growing polypeptide chain rather than for its own addition.
 - (C) Because AUG serves as the start codon for protein synthesis, methionine is found only at the N-terminus.
 - (D) The primary function of the small subunit of the ribosome is to bind mRNA and tRNAs, whereas the large ribosomal subunit catalyzes peptide bond formation.
40. The unwinding of the DNA helix at the replication fork is catalyzed by a _____, which uses the energy from ATP hydrolysis to move unidirectionally along DNA.
- (A) DNA polymerase
 - (B) DNA ligase
 - (C) DNA helicase
 - (D) DNA topoisomerase
41. The enzyme that seals nicks in the DNA helix during DNA synthesis and repair is called _____.
- (A) DNA polymerase
 - (B) DNA ligase
 - (C) DNA helicase
 - (D) DNA topoisomerase
42. The enzyme responsible for DNA synthesis both in replication and repair is _____.
- (A) DNA polymerase
 - (B) DNA ligase
 - (C) DNA helicase
 - (D) DNA topoisomerase

43. Choose the false statement(s).
- (A) Hybridization reactions using DNA probes are so sensitive and selective that it is possible to determine how many copies of a particular DNA sequence are present in a cell's genome.
 - (B) Because the members of a gene family are close relatives, they can usually be detected by high-stringency hybridization using one member as a probe.
 - (C) Hybridization of DNA probes to RNA molecules is useful for determining whether a cell is expressing a given gene, but it is not useful for determining transcription start and stop sites or the possible introns.
 - (D) If a variation in the DNA sequence is a rare one in population, it is called a mutation; if it is a common one, it is called a polymorphism.
44. For a PCR amplified fragment, in which cycle can you first obtain the amplified products?
- (A) 1st
 - (B) 2nd
 - (C) 3rd
 - (D) 4th
45. Choose the true statement(s).
- (A) Each chromosome contains a single long DNA molecule.
 - (B) A telomere allows a chromosome to be replicated precisely so that no nucleotides are lost from the end of the chromosome, thereby solving the end-replication problem.
 - (C) In genes from higher eukaryotes, introns are usually larger and more numerous than exons.
 - (D) Histones are relatively small proteins with a very high proportion of positively charged amino acids; the positive charge helps the histones bind tightly to DNA, regardless of its nucleotide sequence.
46. Choose the false statement(s).
- (A) Chromosomal regions are replicated in large units, and different regions of each chromosome are replicated in a reproducible order.
 - (B) Replication forks in bacteria and eukaryotic cells travel at the same rate, indicating that the packaging of DNA into chromatin does not hinder the replication process.
 - (C) The two X chromosomes in a female mammalian cell, only one of which is active, are replicated at the same time during the S phase.
 - (D) Telomerase synthesizes a new copy of the telomere repeat using an RNA template that is a component of the enzyme itself.
47. Choose the true statement(s).
- (A) RNA polymerase I, II and III are each composed of multiple subunits, but none of the subunits are shared by all three polymerases.
 - (B) Only about 5% of the RNA synthesized by RNA polymerase II ever reaches the cytoplasm; the rest is degraded in the nucleus.
 - (C) Since introns are largely genetic "junk", they do not have to be removed precisely from the primary transcript during RNA splicing.
 - (D) There is no nucleolus in a metaphase cell.
48. Choose the true statement(s).
- (A) The major difference between the group I and group II self-splicing introns is that the attacking nucleotide is free in group I introns but a part of the introns sequence in-group II introns.
 - (B) In most vertebrate cells, the cluster of genes encoding 28S rRNA are transcribed independently of the clusters of genes that encode 18S rRNA and 5.8S rRNA.
 - (C) The proteins that constitute the nuclear matrix can be shown to bind specific DNA sequences.
 - (D) Unlike cytoplasmic organelles, the nucleolus is not bounded by a membrane.

49. Choose the true statement(s).

- (A) Helix-turn-helix proteins bind as symmetric dimers to DNA sequences that are composed of two very similar half-sites, which are also arranged symmetrically.
- (B) A particular advantage of the zinc finger motif is that the strength and specificity of the DNA-protein interaction could be adjusted during evolution by changes in the number of zinc finger repeats.
- (C) Only α -helices are involved in DNA-protein interactions.
- (D) Particular amino acid side chains are always used to recognize specific base pairs, forming a relatively simple amino acid-base pair recognition.

50. Choose the true statement(s).

- (A) The DNA between the enhancer and the promoter loops out to allow the proteins bound to the enhancer to interact directly either with one of the general transcription factors or with RNA polymerase itself.
- (B) General transcription factors and gene regulatory proteins are abundant proteins in the cells.
- (C) Inactive gene regulatory proteins in mammalian cells are almost always activated by ligand binding, as they are in bacterial cells.
- (D) As much as 5% of the coding capacity of a mammalian genome may be devoted to the synthesis of proteins that serve as regulators of gene transcription.

51. Which of the following mutational changes would be predicted to harm an organism?

- (A) Insertion of a single nucleotide near the end of the coding sequence.
- (B) Removal of a single nucleotide near the beginning of the coding sequence.
- (C) Deletion of three consecutive nucleotides in the middle of the coding sequence.
- (D) Substitution of one nucleotide for another in the middle of the coding sequence.

52. Choose the true statement(s).

- (A) Restriction endonucleases cut DNA at specific sites that are always located between genes.
- (B) DNA migrates toward the positive electrode during electrophoresis.
- (C) Clones isolated from cDNA libraries contain promoter sequences.
- (D) PCR utilizes a heat-stable DNA polymerase because for each amplification step, double-stranded DNA must be heat denatured.