

## I. 單選題. 每一題1分. (60 points)

1. Which organelle or structure is absent in plant cells? (A) mitochondria (B) Golgi vesicles (C) microtubules (D) centrosomes (E) peroxisomes
2. Which of the following produces and modifies polysaccharides that will be secreted? (A) lysosome (B) vacuole (C) mitochondrion (D) Golgi apparatus (E) peroxisome
3. Ions can travel directly from the cytoplasm of one animal cell to the cytoplasm of an adjacent cell through (A) plasmodesmata. (B) intermediate filaments. (C) tight junctions. (D) desmosomes. (E) gap junctions.
4. A protein that spans the phospholipid bilayer one or more times is (A) a transmembrane protein. (B) an integral protein. (C) a peripheral protein. (D) an integrin. (E) a glycoprotein.
5. Nitrous oxide gas molecules diffusing across a cell's plasma membrane is an example of (A) diffusion across the lipid bilayer. (B) facilitated diffusion. (C) active transport. (D) osmosis. (E) cotransport.
6. Which of the following is the smallest closed system? (A) a cell (B) an organism (C) an ecosystem (D) Earth (E) the universe
7. When a glucose molecule loses a hydrogen atom as the result of an oxidation-reduction reaction, the molecule becomes (A) hydrolyzed. (B) hydrogenated. (C) oxidized. (D) reduced. (E) an oxidizing agent.
8. Where does glycolysis take place in eukaryotic cells? (A) mitochondrial matrix (B) mitochondrial outer membrane (C) mitochondrial inner membrane (D) mitochondrial intermembrane space (E) cytosol
9. The light reactions of photosynthesis supply the Calvin cycle with (A) light energy. (B) CO<sub>2</sub> and ATP. (C) H<sub>2</sub>O and NADPH. (D) ATP and NADPH. (E) sugar and O<sub>2</sub>.
10. Starting with a fertilized egg (zygote), a series of five cell divisions would produce an early embryo with how many cells? (A) 4 (B) 8 (C) 16 (D) 32 (E) 64
11. If there are 20 chromatids in a cell, how many centromeres are there? (A) 10 (B) 20 (C) 30 (D) 40 (E) 80
12. Where do the microtubules of the spindle originate during mitosis in both plant and animal cells? (A) centromere (B) centrosome (C) centriole (D) chromatid (E) kinetochore
13. Which of the following triggers the cell's passage past the G<sub>2</sub> checkpoint into mitosis? (A) PDGF (B) MPF (C) protein kinase (D) cyclin (E) Cdk
14. At which stage of mitosis are chromosomes usually photographed in the preparation of a karyotype? (A) prophase (B) metaphase (C) anaphase (D) telophase (E) interphase
15. A human cell containing 22 autosomes and a Y chromosome is (A) a sperm. (B) an egg. (C) a zygote. (D) a somatic cell of a male. (E) a somatic cell of a female.
16. How many unique gametes could be produced through independent assortment by an individual with the genotype *AaBbCCDdEE*? (A) 4 (B) 8 (C) 16 (D) 32 (E) 64
17. Which of the following describes the ability of a single gene to have multiple phenotypic effects? (A) incomplete dominance (B) multiple alleles (C) pleiotropy (D) epistasis
18. Of the following human aneuploidies, which is the one that generally has the most severe impact on the health of the individual? (A) 47, +21 (B) 47, XXY (C) 47, XXX (D) 47, XYY (E) 45, X
19. Cytosine makes up 42% of the nucleotides in a sample of DNA from an organism. Approximately what percentage of the nucleotides in this sample will be thymine? (A) 8% (B) 16% (C) 31% (D) 42% (E) variable.
20. Which enzyme catalyzes the elongation of a DNA strand in the 5' → 3' direction? (A) primase (B) DNA ligase (C) DNA polymerase III (D) topoisomerase (E) helicase
21. In a nucleosome, the DNA is wrapped around (A) polymerase molecules. (B) ribosomes. (C) histones. (D) a thymine dimer. (E) satellite DNA.
22. A particular triplet of bases in the template strand of DNA is 5' AGT 3'. The corresponding codon for the mRNA

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- transcribed is (A) 3' UCA 5'. (B) 3' UGA 5'. (C) 5' TCA 3'. (D) 3' ACU 5'. (E) either UCA or TCA, depending on wobble in the first base.
23. During splicing, which molecular component of the spliceosome catalyzes the excision reaction? (A) protein (B) DNA (C) RNA (D) lipid (E) sugar
24. If a protein is coded for by a single gene and this protein has six clearly defined domains, which number of exons below is the gene likely to have? (A) 1 (B) 5 (C) 8 (D) 12 (E) 14
25. Which of the following is a protein produced by a regulatory gene? (A) operon (B) inducer (C) promoter (D) repressor (E) corepressor
26. Mutations in which of the following genes lead to transformations in the identity of entire body parts? (A) morphogens (B) segmentation genes (C) egg-polarity genes (D) homeotic genes (E) inducers
27. Gap genes and pair-rule genes fall into which of the following categories? (A) homeotic genes (B) segmentation genes (C) egg-polarity genes (D) morphogens (E) inducers
28. Which viruses have single-stranded RNA that acts as a template for DNA synthesis? (A) lytic phages (B) proviruses (C) viroids (D) bacteriophages (E) retroviruses
29. Which of the following is used to make complementary DNA (cDNA) from RNA? (A) restriction enzymes (B) gene cloning (C) DNA ligase (D) gel electrophoresis (E) reverse transcriptase
30. Which of the following uses reverse transcriptase to make cDNA followed by amplification? (A) Southern blotting (B) Northern blotting (C) Western blotting (D) Eastern blotting (E) RT-PCR
31. Which of the following could be a density-independent factor limiting human population growth? (A) famines (B) social pressure for birth control (C) plagues (D) pollution (E) earthquakes
32. Positive feedback has occurred when (A) an increase in calcium concentration increases the secretion of a hormone that promotes the storage of calcium in bone. (B) an increase in blood sugar increases the secretion of a hormone that stimulates the movement of sugar out of the blood. (C) uterine contractions needed for the birthing process are expedited by the pressure of a moving baby in its mother's uterus. (D) a decrease in blood calcium increases the amount of the hormone that causes the release of calcium from bone. (E) a decrease in blood sugar increases the secretion of a hormone that increases the conversion of glycogen to glucose.
33. According to the punctuated equilibria model, (A) speciation is usually due to a single mutation. (B) natural selection is unimportant as a mechanism of evolution. (C) most evolution occurs in sympatric populations. (D) given enough time, most existing species will branch gradually into new species. (E) most new species accumulate their unique features relatively rapidly as they come into existence, then change little for the rest of their duration as a species.
34. The ability of some viruses to remain inactive (latent) for a period of time is exemplified by (A) Kaposi's sarcoma, which causes a skin cancer in people with AIDS, but rarely in those not infected by HIV. (B) herpes simplex viruses (oral or genital) whose reproduction is triggered by physiological or emotional stress in the host. (C) influenza, a particular strain of which returns every 10-20 years. (D) the virus that causes a form of the common cold, which recurs in patients many times in their lives. (E) myasthenia gravis, an autoimmune disease that blocks muscle contraction from time to time.
35. You are studying a large tropical reptile that has a high and relatively stable body temperature. How would you determine whether this animal is an endotherm or an ectotherm? (A) You know that it is an ectotherm because it is not a bird or mammal. (B) You subject this reptile to various temperatures in the lab and find that its body temperature and metabolic rate change with the ambient temperature. You conclude that it is an ectotherm. (C) You know from its high and stable body temperature that it must be an endotherm. (D) You measure the metabolic rate of the reptile, and because it is higher than that of a related species that lives in temperate forests, you conclude that this reptile is an endotherm and its relative is an ectotherm. (E) You note that its environment has a high and stable temperature. Because its body temperature matches the environmental temperature, you conclude that it is an ectotherm.

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36. Exercise and emergency reactions include (A) increased activity in all parts of the peripheral nervous system. (B) increased activity in the sympathetic, and decreased activity in the parasympathetic branches. (C) increased activity in the enteric nervous system. (D) reduced heart rate and blood pressure. (E) decreased activity in the sympathetic, and increased activity in the parasympathetic branches.
37. Agricultural lands frequently require nutrient augmentation because (A) nitrogen-fixing bacteria are not as plentiful in agricultural soils because of the use of pesticides. (B) land that is available for agriculture tends to be nutrient-poor. (C) cultivation of agricultural land inhibits the decomposition of organic matter. (D) the nutrients that become the biomass of plants are not cycled back to the soil on lands where they are harvested. (E) grains raised for feeding livestock must be fortified, and thus require additional nutrients.
38. A significant contribution of intestinal bacteria to human nutrition is the benefit of bacterial (A) production of vitamin K. (B) generation of gases needed for elimination. (C) production of vitamins A and C. (D) recovery of water from fecal matter. (E) absorption of organic materials.
39. Trophic efficiency is (A) a measure of how nutrients are cycled from one trophic level to the next. (B) about 90% in most ecosystems. (C) usually greater than production efficiencies. (D) the percentage of production transferred from one trophic level to the next. (E) the ratio of net secondary production to assimilation of primary production.
40. The primary function of the corpus luteum is to (A) nourish and protect the egg cell. (B) stimulate the development of the mammary glands. (C) support pregnancy in the second and third trimesters. (D) maintain progesterone and estrogen synthesis after ovulation has occurred. (E) produce prolactin in the alveoli.
41. What is the single greatest threat to biodiversity? (A) disruption of trophic relationships as more and more prey species become extinct (B) introduced species that compete with native species (C) habitat alteration, fragmentation, and destruction (D) overharvesting of commercially important species (E) pollution of Earth's air, water, and soil
42. In a frog embryo, gastrulation (A) proceeds by involution as cells roll over the lip of the blastopore. (B) occurs within the inner cell mass that is embedded in the large amount of yolk. (C) produces a blastocoel displaced into the animal hemisphere. (D) occurs along the primitive streak in the animal hemisphere. (E) is impossible because of the large amount of yolk in the ovum.
43. The circulatory system of bony fishes, rays, and sharks is similar to (A) that of reptiles, with one pumping chamber driving blood flow to a gas-exchange organ, and a different pumping chamber driving blood to the rest of the circulation. (B) that of birds, with a four-chambered heart. (C) that of humans, where there are four pumping chambers to drive blood flow. (D) that of sponges, where gas exchange in all cells occurs directly with the external environment. (E) the portal systems of mammals, where two capillary beds occur sequentially, without passage of blood through a pumping chamber.
44. Which of the following could be considered the most recent common ancestor of living tetrapods? (A) a salamander that had legs supported by a bony skeleton but moved with the side-to-side bending typical of fishes (B) an early terrestrial caecilian whose legless condition had evolved secondarily (C) an armored, jawed placoderm with two pairs of appendages (D) an early ray-finned fish that developed bony skeletal supports in its paired fins (E) a sturdy-finned, shallow-water lobe-fin whose appendages had skeletal supports similar to those of terrestrial vertebrates
45. The primary difference between estrous and menstrual cycles is that (A) the endometrium shed by the uterus during the estrous cycle is reabsorbed, whereas the shed endometrium of menstrual cycles is excreted from the body. (B) most estrous cycles are of much longer duration compared to menstrual cycles. (C) season and climate have less pronounced effects on estrous cycles than they do on menstrual cycles. (D) behavioral changes during estrous cycles are much less apparent than those of menstrual cycles. (E) copulation normally occurs across the estrous cycle, whereas in menstrual cycles copulation only occurs during the period surrounding ovulation.

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46. Antidiuretic hormone (ADH) functions at the cellular level by (A) causing an increase in the number of aquaporin molecules of collecting duct cells. (B) triggering the synthesis of an enzyme that makes the phospholipid bilayer more permeable to water. (C) decreasing the speed at which filtrate flows through the nephron, leading to increased reabsorption of water. (D) causing membranes to include more phospholipids that have unsaturated fatty acids. (E) stimulating the reabsorption of glucose through channel proteins.
47. The most important feature that permits a gene to act as a molecular clock is (A) having a large number of base pairs. (B) having a larger proportion of exonic DNA than of intronic DNA. (C) its recent origin by a gene-duplication event. (D) its being acted upon by natural selection. (E) having a reliable average rate of mutation.
48. A stalked, sessile marine organism has several feathery feeding structures surrounding an opening through which food enters. The organism could potentially be a cnidarian, a lophophorate, a tube-dwelling worm, a crustacean, or an echinoderm. Which of the following traits, if found in this organism, would allow the greatest certainty of identification? (A) a nervous system (B) a hard covering made partly of calcium carbonate (C) a digestive system with mouth and anus separate from each other (D) a water vascular system (E) the presence of what seems to be radial symmetry
49. The absorption of fats differs from that of carbohydrates in that the (A) most absorbed fat first enters the lymphatic system, whereas carbohydrates directly enter the blood. (B) fats, but not carbohydrates, are digested by bacteria before absorption. (C) carbohydrates need to be emulsified before they can be digested, whereas fats do not. (D) fat absorption occurs in the stomach, whereas carbohydrates are absorbed from the small intestine. (E) processing of fats does not require any digestive enzymes, whereas the processing of carbohydrates does.
50. A rod exposed to light will (A) undergo a graded depolarization that will increase its release of glutamate. (B) fire action potentials that will increase its release of glutamate. (C) undergo a graded hyperpolarization that will increase its release of glutamate. (D) undergo a graded depolarization that will decrease its release of glutamate. (E) undergo a graded hyperpolarization that will decrease its release of glutamate.
51. Which of the following statements best summarizes evolution as it is viewed today? (A) It is the descent of humans from the present-day great apes. (B) It is synonymous with the process of gene flow. (C) It represents the result of selection for acquired characteristics. (D) It is the differential survival and reproduction of the most-fit phenotypes.
52. What is the most probable explanation for the continued presence of pseudogenes in a genome such as our own? (A) They are duplicates or near duplicates of functional genes but cannot function because they would provide inappropriate dosage of protein products. (B) They are genes with significant inverted sequences. (C) They are genes that are not expressed, even though they have nearly identical sequences to expressed genes. (D) They are genes that had a function at one time, but that have lost their function because they have been translocated to a new location. (E) They are genes that have accumulated mutations to such a degree that they would code for different functional products if activated.
53. The role that humans play in artificial selection is to (A) determine who lives and who dies. (B) train organisms to breed more successfully. (C) create the genetic variants, which nature then selects. (D) perform artificial insemination. (E) choose which organisms breed, and which do not.
54. The following steps refer to various stages in transmission at a chemical synapse. 1. Neurotransmitter binds with receptors associated with the postsynaptic membrane. 2. Calcium ions rush into neuron's cytoplasm. 3. An action potential depolarizes the membrane of the axon terminal. 4. The ligand-gated ion channels open. 5. The synaptic vesicles release neurotransmitter into the synaptic cleft. Which sequence of events is correct? (A) 5 → 1 → 2 → 4 → 3 (B) 1 → 2 → 3 → 4 → 5 (C) 3 → 2 → 5 → 1 → 4 (D) 2 → 3 → 5 → 4 → 1 (E) 4 → 3 → 1 → 2 → 5
55. Imagine that you are designing an experiment aimed at determining whether the initiation of migratory behavior is largely under genetic control. Of the following options, the best way to proceed is to (A) perform within-population matings with birds from different populations that have different migratory habits. Do this in the laboratory and see if offspring display parental migratory behavior. (B) observe genetically distinct populations in the field and see if they

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- have different migratory habits. (C) bring animals into the laboratory and determine the conditions under which they become restless and attempt to migrate. (D) perform within- population matings with birds from different populations that have different migratory habits. Rear the offspring in the absence of their parents and observe the migratory behavior of offspring. (E) All of the options are equally productive ways to approach the question.
56. When a steroid hormone and a peptide hormone exert similar effects on a population of target cells, then (A) the steroid and peptide hormones must use the same biochemical mechanisms. (B) the steroid and peptide hormones must bind to the same receptor protein. (C) the steroid hormones affect the synthesis of effector proteins, whereas peptide hormones activate effector proteins already present in the cell. (D) the steroid hormones affect only the release of proteins from the target cell, whereas peptide hormones affect only the synthesis of proteins that remain in the target cell. (E) the steroid hormones affect the activity of certain proteins within the cell, whereas peptide hormones directly affect the processing of mRNA.
57. Why do tropical communities tend to have greater species diversity than temperate or polar communities? (A) They are less likely to be affected by human disturbance. (B) Tropical communities are low in altitude, whereas temperate and polar communities are high in altitude. (C) There are fewer parasites to negatively affect the health of tropical communities. (D) More competitive dominant species have evolved in temperate and polar communities. (E) Tropical communities are generally older than temperate and polar communities.
58. Generalized global air circulation and precipitation patterns are caused by (A) the revolution of Earth around the sun. (B) mountain ranges that deflect air masses containing variable amounts of moisture. (C) rising, warm, moist air masses that cool and release precipitation as they rise and then, at high altitude, cool and sink back to the surface as dry air masses after moving north or south of the tropics. (D) polar, cool, moist high-pressure air masses from the poles that move along the surface, releasing precipitation along the way to the equator where they are heated and dried. (E) air masses that are dried and heated over continental areas that rise, cool aloft, and descend over oceanic areas followed by a return flow of moist air from ocean to land, delivering high amounts of precipitation to coastal areas.
59. What distinguishes a coelomate animal from a pseudocoelomate animal is that coelomates (A) have a complete digestive system with mouth and anus, whereas pseudocoelomates have a digestive tract with only one opening. (B) have a body cavity completely lined by mesodermal tissue, whereas pseudocoelomates do not. (C) have a body cavity, whereas pseudocoelomates have a solid body (D) have a gut that lacks suspension within the body cavity, whereas pseudocoelomates have mesenteries that hold the digestive system in place. (E) contain tissues derived from mesoderm, whereas pseudocoelomates have no such tissue.
60. If a fossil is encased in a stratum of sedimentary rock without any strata of igneous rock (for example, lava, volcanic ash) nearby, then it should be (A) difficult to determine the absolute age of the fossil, because radiometric dating of sedimentary rock is less accurate than that of igneous rock. (B) easy to determine the absolute age of the fossil, because the radioisotopes in the sediments will not have been "reset" by the heat of the igneous rocks. (C) easy to determine the absolute age of the fossil, because the igneous rocks will not have physically obstructed the deposition of sediment of a single age next to the fossil. (D) easy to determine, as long as there is enough metamorphic rock nearby. (E) difficult to determine the absolute age of the fossil, because the "marker fossils" common to igneous rock will be absent.

### 問答題

- II. Draw a diagram of a mammalian ear and explain these sensory organs for hearing. (10 points)
- III. Explain the evolutionary adaptations of mammalian digestive systems from dentition and digestive tracts of a carnivore (dog) and an herbivore (cattle). (10 points)
- IV. Describe (and/or illustrate) a life cycle of a typical fern plant. (10 points)
- V. Make a comparison of stem internal structures between a typical monocot plant and a typical dicot plant. (10 points)

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- All of the amino acids EXCEPT \_\_\_\_\_ have both free  $\alpha$ -amino and free  $\alpha$ -carboxyl groups.  
(A) aspartate (B) proline (C) lysine (D) valine
- \_\_\_\_\_ with a side-chain  $pK_a$  near neutrality and which therefore plays an important role as proton donor and acceptor in many enzyme catalyzed reactions.  
(A) Histidine (B) Cysteine (C) Serine (D) Methionine
- The peptide bond has partial \_\_\_\_\_ character.  
(A) triple bond (B) double bond (C) hydrogen bond (D) van der Waals bond
- The amino acid sequence is defined as \_\_\_\_\_ structure.  
(A) primary (B) secondary (C) tertiary (D) quaternary
- $\alpha$ -Helix and  $\beta$ -strand are components of \_\_\_\_\_ structure.  
(A) primary (B) secondary (C) tertiary (D) quaternary
- All of the information necessary for a protein to achieve its intricate architecture is contained within its \_\_\_\_\_ structure.  
(A) primary (B) secondary (C) tertiary (D) quaternary
- $\alpha$ -helices are stabilized primarily by \_\_\_\_\_.  
(A) hydrogen bonds between the main chain peptide bond component atoms  
(B) electrostatic interactions between the R groups  
(C) hydrophobic interactions between the  $\alpha$ -carbons of the main chain.  
(D) hydrogen bonding between the R groups.
- The unique composition of collagen is accommodated in a \_\_\_\_\_ structure.  
(A)  $\beta$ -pleated sheet (B) triple helix (C) helix-turn-helix motif (D) coiled coils
- All of the following disaccharides are reducing sugars EXCEPT \_\_\_\_\_.  
(A) lactose (B) maltose (C) sucrose (D) cellulose
- All are true for cellulose and  $\alpha$ -amylose EXCEPT:  
(A) Both are linear homopolymers of glucose.  
(B) Both have (1 $\rightarrow$ 4) linkages.  
(C) Both form extended ribbon most stable conformations.  
(D) Both have extensive intramolecular hydrogen bonding.
- Cholesterol is a component of all EXCEPT:  
(A) lipoproteins. (B) plant cell plasma membranes.  
(C) membranes of intracellular organelles. (D) animal cell membranes.
- Lipids that spontaneously form micelles, monolayers and bilayers have what property?  
(A) waxy (B) polar (C) amphipathic (D) bipolar

13. All of the following are examples of nucleotide functions EXCEPT \_\_\_\_\_.  
(A) UTP in complex carbohydrate synthesis (B) ATP in energy for the cell  
(C) GTP in protein synthesis (D) TTP in phosphoryl group transfers.
14. All are true for the DNA double helix EXCEPT:  
(A) the two strands are parallel.  
(B) the two strands are held together by interchain hydrogen bonds.  
(C) the two strands have complementary base pairing.  
(D) they are easily sheared into shorter fragments during isolation procedures.
15. In a double-stranded nucleic acid, guanine typically base-pairs with \_\_\_\_\_.  
(A) adenosine (B) uracil (C) thymine (D) cytosine
16. In a sample of double-stranded DNA containing 32% cytosine, the percentage of adenine would be \_\_\_\_\_.  
(A) 32% (B) 68% (C) 18% (D) 0%
17. What is the nucleotide sequence of the DNA strand that is complementary to 5'-ATCGCAACTGTCACTA-3'?  
(A) 5'-TAGCGTTGACAGTGAT-3' (B) 5'-UAGUGACAGUUGCGAU-3'  
(C) 5'-TAGCGTTGACAGTGAT-3' (D) 5'-TAGTGACAGTTGCGAT-3'
18. In eukaryotic cells, DNA is found principally in the nucleus, but it also occurs in \_\_\_\_\_ and in \_\_\_\_\_.  
(A) ribosomes; mitochondria (B) mitochondria; chloroplasts  
(C) chloroplasts; peroxisomes (D) peroxisomes; vacuoles
19. Sequencing nucleic acids is now easier than sequencing polypeptides owing to the development of which technology?  
(A) restriction endonucleases and polyacrylamide gel electrophoresis.  
(B) base specific chemical cleavage and autoradiography.  
(C) cytosine methylation and base specific chemical cleavage.  
(D) double helix denaturation and restriction endonucleases.
20. The hyperchromic shift that occurs when dsDNA is \_\_\_\_\_ is a(n) \_\_\_\_\_ in absorption at \_\_\_\_\_ nm.  
(A) methylated; increase; 220 (B) methylated; decrease; 260  
(C) denatured; decrease; 260 (D) denatured; increase; 260
21. Histones are rich in the amino acids \_\_\_\_\_, and interact with DNA via \_\_\_\_\_.  
(A) glutamic acid and aspartic acid; hydrogen bonds  
(B) glutamic acid and aspartic acid; ionic bonds  
(C) lysine and arginine; hydrogen bonds (D) lysine and arginine; ionic bonds

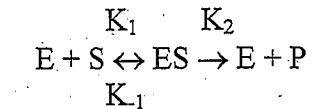
22. All are distinctive features of enzymes EXCEPT:

- (A) regulation. (B) catalytic activity.  
(C) ability to change  $\Delta G$ . (D) specificity.

23. How do catalysts work to accelerate a chemical reaction?

- (A) They raise the average energy of the reactants.  
(B) They provide a means of acceleration by being completely consumed in the reaction.  
(C) They lower the energy of activation.  
(D) They lower the overall free energy change of the reaction.

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



- (A) It is numerically equal to the  $[S]$  required to achieve one half the maximum velocity.  
(B) Its defined as  $K_m = K_1/(K_1 + K_2)$ .  
(C) It is approximately equal to the dissociation constant for the ES 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.

25. Malonate inhibition of succinate dehydrogenase is an example of \_\_\_\_\_.

- (A) noncompetitive inhibition (B) competitive inhibition  
(C) irreversible inhibition (D) uncompetitive inhibition.

26. Enzymes have active sites which have the greatest complementarity to the \_\_\_\_\_.

- (A) substrate (B) transition state  
(C) product (D) both substrate and product

27. Proinsulin is converted into insulin by \_\_\_\_\_.

- (A) proteolytic cleavage (B) allosteric binding of glucose  
(C) phosphorylation (D) dephosphorylation

28. All are characteristic of allosteric enzymes EXCEPT:

- (A) Effectors may show stimulatory or inhibitory activity.  
(B) They have multiple subunits.  
(C) They obey Michaelis-Menten kinetics.  
(D) The regulatory effect is by altering conformation and interaction of subunits.

29. Which statement below about contrasting hemoglobin (Hb) and myoglobin (Mb) is FALSE?

- (A) Hb shows sigmoidal, whereas Mb shows hyperbolic oxygen saturation curves.  
(B) Hb shows cooperativity, whereas Mb does not.  
(C) Hb binds  $O_2$  more tightly than Mb.  
(D) Hb-oxygen binding is dependent on physiological changes in pH, whereas Mb-oxygen binding is not.



30. \_\_\_\_\_ are the final products of aerobic catabolism.  
(A) pyruvate and  $H_2O$  (B) acetyl-CoA and  $CO_2$   
(C)  $CO_2$  and  $H_2O$  (D) pyruvate and acetyl-CoA
31. The step that commits glucose to glycolysis is catalyzed by \_\_\_\_\_.  
(A) hexokinase (B) phosphoglucoisomerase  
(C) phosphofructokinase-1 (PFK-1) (D) fructose-1,6-bisphosphate aldolase
32. Under anaerobic conditions, skeletal muscle generates lactate from pyruvate to:  
(A) promote release of oxygen from hemoglobin.  
(B) generate additional ATP. (C) be warning of muscle fatigue.  
(D) regenerate  $NAD^+$  for further glycolysis.
33. In the TCA cycle, carbon enters the cycle as \_\_\_\_\_ and exits as \_\_\_\_\_ with metabolic energy captured as \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.  
(A) acetyl-CoA;  $CO_2$ ; NADH; ATP; NADPH  
(B) succinyl-CoA;  $CO_2$ ; ATP; NADH; NADPH  
(C) acetyl-CoA;  $CO_2$ ; ATP; NADH;  $FADH_2$   
(D) malonyl-CoA; water; NADH;  $FADH_2$ ; ATP
34. In eukaryotic cells, glycolysis occurs in the \_\_\_\_\_, and the TCA cycle reactions take place in \_\_\_\_\_.  
(A) mitochondria; mitochondria (B) cytoplasm; mitochondria  
(C) cytoplasm; cytoplasm (D) cytoplasm; ribosomes
35. ATP made in glycolysis and the TCA cycle is the result of \_\_\_\_\_ phosphorylation, and NADH-dependent ATP synthesis is the result of \_\_\_\_\_ phosphorylation.  
(A) oxidative; substrate-level (B) oxidative; electron  
(C) substrate-level; electron (D) substrate-level; oxidative
36. Where does the energy that drives ATP synthesis come from?  
(A) The proton gradient. (B)  $NAD^+$  and FAD.  
(C) The electron gradient. (D) The oxidation states of the complexes.
37. Gluconeogenesis is the synthesis of \_\_\_\_\_.  
(A) glucose from noncarbohydrate precursors (B) glycogen from glucose  
(C) pyruvate from glucose. (D) glucose from fatty acids.
38. The primary storage form of lipid is \_\_\_\_\_ and it is normally stored in the \_\_\_\_\_.  
(A) phospholipid; liver (B) cholesterol; muscles  
(C) triacylglycerols; adipocytes (D) triacylglycerols; liver
39. For the complete oxidation of a saturated fatty acid with 16 carbons, how many times must the  $\beta$ -oxidation cycle be repeated?  
(A) 4 (B) 7 (C) 8 (D) 16

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40. Ketone bodies are synthesized in the \_\_\_\_\_.  
(A) cytosol of muscle (B) mitochondria of liver  
(C) endoplasmic reticulum of heart (D) plasma membrane of brain
41. The brain normally uses \_\_\_\_\_ as its source of metabolic energy, but during starvation \_\_\_\_\_ may be the major source of energy.  
(A) glucose; ketone bodies (B) ketone bodies; fatty acids  
(C) fatty acids; amino acids (D) amino acids; glucose
42. The committed step in cholesterol biosynthesis is catalyzed by \_\_\_\_\_.  
(A) HMG-CoA synthase (B) HMG-CoA reductase  
(C) squalene monooxygenase (D) HMG-CoA lyase
43. All of the following are characteristics of phenylketonuria EXCEPT:  
(A) air oxidation causes urine to turn dark on standing.  
(B) treated by putting patient on a diet low in phenylalanine.  
(C) untreated patients suffer severe mental retardation.  
(D) deficiency or defect in phenylalanine hydroxylase.
44. \_\_\_\_\_ is the common product of purine catabolism.  
(A) xanthine (B) uric acid (C) inosine (D) hypoxanthine

## 問答題 (34 分)

- For the following protein isolation procedures, describe the theory of each procedure. (15分)
  - Gel filtration or molecular sieve chromatography
  - Ion exchange chromatography
  - Affinity chromatography
- Describe how epinephrine promotes the utilization of stored glycogen for glycolysis and ATP production in muscles. (12分)
- Discuss the roles of ATP in metabolism. (7分)