一、選擇題 50% (1% each) ＊下列題目請在試卷內的「選擇題作答區」作答。

1. Which metabolic pathway is common to both fermentation and cellular respiration?
A. the Krebs cycle
B. the electron transport
C. glycolysis
D. synthesis of acetyl CoA from pyruvate
E. reduction of pyruvate to lactate

2. An eukaryotic cell lacking telomerase would
A. be unable to take up DNA from the surrounding solution.
B. be unable to identify and correct mismatched nucleotides in its daughter DNA strands.
C. experience a gradual reduction of chromosome length with each replication cycle.
D. have a greater potential to become cancerous.
E. incorporate one extraneous nucleotide for each Okazaki fragment added.

3. In a population with two alleles for a particular locus, *B* and *b*, the allele frequency of *B* is 0.6. What would be the frequency of heterozygotes if the population were in Hardy-Weinberg equilibrium?
A. 0.6
B. 0.36
C. 0.24
D. 0.48
E. 0.16

4. Plastids that are surrounded by more than two membranes are evidence of
A. evolution from mitochondria.
B. phagocytosis of algal cells by another autotrophic algae, after which their plastids fused.
C. origin of the plastids from archaea.
D. secondary endosymbiosis of an algal protist by a heterotrophic protist, which left the new endosymbiont wrapped in a vacuole menbrane.
E. budding of the plastids from the nuclear envelope.

5. After surgical removal of an infected gallbladder, a person must be especially careful to restrict his or her dietary intake of
A. starch.
B. protein.
C. sugar.
D. fat.
E. water.

6. If humans and pandas belong to the same class, then they must also belong to the same
A. order.

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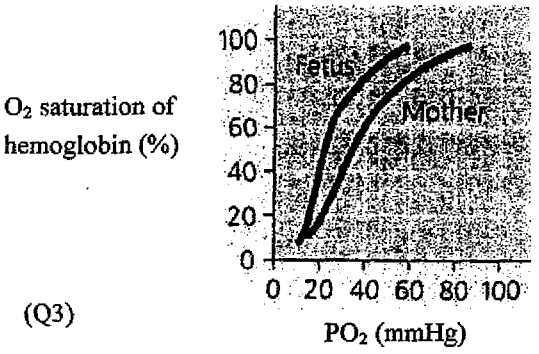
4. The hemoglobin of a human fetus differs from adult hemoglobin. Compare the dissociation curves of the two hemoglobin in the graph below. Propose a hypothesis for the function of this difference between these two versions of hemoglobin. (5%)



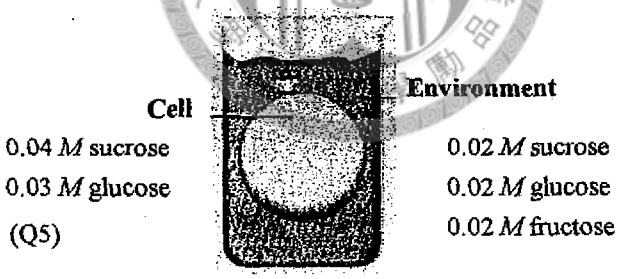
(Q3)

5. An artificial cell consisting of an aqueous solution enclosed in a selectively permeable membrane has just been immersed in a breaker containing a different solution. The membrane is permeable to water and to the simple sugars glucose and fructose but completely impermeable to the disaccharide sucrose. (6%)

a. Which solute(s) will exhibit a net diffusion into the cell?

b. Which solute(s) will exhibit a net diffusion out of the cell?

c. Which solution – the cell contents or the environment – is hypertonic to the other?



(Q5)

6. What is allelopathy? (5%)

7. What is the alternative generation? (5%)

8. What is eutrophication? the cause? (5%)

9. What has caused the climate change globally? (5%)

10. What forces have caused the water ascending in a land plant? (4%)

B. phylum.
C. family.
D. genus.
E. species.

7. Most of biological diversity has probably arisen by
A. anagenesis.
B. cladogenesis.
C. phyletic evolution.
D. hybridization.
E. sympatric speciation.

8. Selection acts directly on
A. phenotype.
B. genotype.
C. the entire genome.
D. each allele.
E. the entire gene pool.

9. *Meiosis II is similar to mitosis in that*
A. homologous chromosomes synapse.
B. DNA replicates before the division.
C. the daughter cells are diploid.
D. sister chromatids separate during anaphase.
E. the chromosome number is reduced.

10. Cell signaling is believed to have evolved early in the history of life because
A. it is seen in "primitive" organisms such as bacteria.
B. yeast cells of different mating types signal one another.
C. signal-transduction molecules found in distantly related organisms are similar.
D. signaling can operate over large distances, a function required before the development of multicellular life.
E. signal molecules typically interact with the outer surface of the plasma membrane.

11. Which of the following is a true distinction between fermentation and cellular respiration?
A. Only respiration oxidizes glucose.
B. NADH is oxidized by the electron transport chain only in respiration.
C. Fermentation, but not respiration, is an example of a catabolic pathway.
D. Substrate-level phosphorylation is unique to fermentation.
E. NAD^+ functions as an oxidizing agent only in respiration.

12. As humans diverged from other primates, which of the following most likely appeared first?
A. the development of technology.
B. language.

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C. an erect stance.
D. tool-making.
E. an enlarged brain.

13. Which of the following could be considered to be the first tetrapod?

A. sturdy-finned, shallow-water lung fishes whose appendages had skeletal supports similar to those of terrestrial vertebrates.
B. armored, jawed placoderms that had two sets of paired appendages.
C. early ray-finned fishes that developed bony skeletal supports in their paired fins.
D. salamanders of the order Urodela that had legs supported by a bony skeleton but moved with the same side-to-side bending typical of fishes.
E. an early terrestrial caecilian line whose legless condition had evolved secondarily.

14. A distinctive feature of the mechanism of action of thyroid hormones and steroid hormones is that

A. these hormones are regulated by feedback loops.
B. target cells react more rapidly to these hormones than to local regulations.
C. these hormones bind with specific receptor proteins on target cell plasma membranes.
D. these hormones bind to receptors inside cells
E. these hormones affect metabolism.

15. Which of the following factors would tend to increase membrane fluidity?

A. a greater proportion of unsaturated phospholipids.
B. a lower temperature.
C. a relatively high protein content in the membrane.
D. a greater proportion of relatively large glycolipids compared to lipids having smaller molecular weights.
E. a high membrane potential.

16. Signal-transduction pathways benefit cells for all of the following reasons *except*

A. they help cells respond to signal molecules that are too large or too polar to cross the plasma membrane.
B. they enable different cells to respond appropriately to the same signal.
C. they help cells use phosphate generated by ATP breakdown.
D. they can amplify a signal.
E. variations in the signal-transduction pathways can enhance response specificity.

17. Clams and lobsters both have exoskeletons, but lobsters have much greater mobility. Why?

A. Clams only have adductor muscles that hold the small closed, whereas lobsters have both abductor and adductor muscles.
B. The paramyosin of clam muscle holds them in a low-energy state of contraction, whereas lobster muscles are very similar to vertebrate striated muscles.
C. Clams can only grow by adding to the outer edge of the shell, whereas lobsters molt and repeatedly

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replace their exoskeleton with a larger, more flexible one.

D. The lobster skeleton can actively contract, while the clam skeleton lacks its own contractile mechanisms.

E. Lobsters have a jointed exoskeleton, allowing for the flexible movement of appendages and body parts by the joints.

18. Select the pair in which the nitrogenous waste is incorrectly matched with the benefit of its excretion.

A. urea – low toxicity relative to ammonia.

B. uric acid – can be stored as a precipitate.

C. ammonia – very soluble in water.

D. uric acid – minimal loss of water when excreted.

E. urea – very insoluble in water.

19. Which of the following vertebrate organs systems does *not* open directly to the external environment?

A. digestive system

B. circulatory system

C. excretory system

D. respiratory system

E. reproductive system

20. Which of the following hormones is *incorrectly* paired with its action?

A. oxytocin – stimulates uterine contractions during childbirth.

B. thyroxine – stimulates metabolic processes.

C. insulin – stimulates glycogen breakdown in the liver.

D. ACTH – stimulates the release of glucocorticoids by the adrenal cortex.

E. melatonin – affects biological rhythms, seasonal reproduction.

21. An example of antagonistic hormones controlling homeostasis is

A. thyroxine and parathyroid hormone in calcium balance.

B. insulin and glucagons in glucose metabolism.

C. progestins and estrogens in sexual differentiation.

D. epinephrine and norepinephrine in fight-or-flight responses.

E. oxytocin and prolactin in milk production.

22. Which of the following provides an example of habituation?

A. Humpback whales migrating from Hawaii to Alaska are observed singing songs first identified in humpbacks migrating between Alaska and Baja California.

B. Male sticklebacks attempt to attack any red-colored object near their tank.

C. Adult brown pelicans are more successful at capturing fish than are juveniles.

D. Female warblers incubate the eggs cowbirds deposit in their nests.

E. Aquarium fish are initially startled by tapping on the aquarium glass but eventually ignore it.

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23. Which of the following correctly describes a case of osmoregulation?

A. body fluids that are isoosmotic with the external environment.
B. discharge of excess water in a hypoosmotic environment.
C. expenditure of energy to convert ammonia to less toxic wastes.
D. excretion of salt in a hypoosmotic environment.
E. secretion of drugs and reabsorption of nutrients by the proximal tubule.

24. The symbiotic microbes that help nourish a ruminant live mainly in specialized regions of the

A. large intestine
B. liver
C. small intestine
D. pharynx
E. stomach

25. Which of the following is correctly paired with its description?

A. nertic zone – shallow area over continental shelf
B. benthic zone – surface water of shallow seas
C. pelagic zone – seafloor
D. aphotic zone – zone in which light penetrates
E. intertidal zone – open water at the edge of the continental shelf

26. Vertebrates and tunicates may seem as different as two animal groups can be, yet they share

A. jaws adapted for feeding.
B. a high degree of cephalization.
C. the formation of structures from the neural crest.
D. an endoskeleton that includes a cranium.
E. the presence of a notochord; a dorsal, hollow nerve cord; and pharyngeal slits.

27. Which of the following molecules is incorrectly paired with a source?

A. lysozyme – tears
B. interferous – virus-infected cells
C. interleukin-I – macrophages
D. perforins – cytotoxic T cells
E. immunoglobulins – helper T cells

28. The water vascular system of echinoderms

A. functions as a circulatory system that distributes nutrients to body cells.
B. functions in locomotion, feeding, and gas exchange.
C. is bilateral in organization, even though the adult animal has radial anatomy.
D. moves water through the animal's body for suspension feeding.
E. is analogous to the hydrostatic skeleton of annelids.

29. In protandrous hermaphroditism

A. some individuals may change from male to female.

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B. individuals fertilize themselves.
C. males rather than females release pheromones.
D. diploid ova are produced.
E. the adult gonads are undifferentiated.

30. Which of the following is not an adaptation for reducing the rate of heat exchange between an animal and its environment?
A. feathers or fur
B. vasoconstriction
C. nonshivering thermogenesis
D. countercurrent heat exchanger
E. blubber of fat layer

31. Which of the following statement would best support the hypothesis that mitochodria and chloroplast are evolved from certain endosymbiotic organisms in early cells?
A. Both organelles lack mRNA.
B. Both organelles can grow independently in artificial medium.
C. Both organelles produce energy to support cell function.
D. Both organelles contain DNA molecules.
E. Both organelles are surrounded by a double membrane.

32. Sublethal concentration colchicines in an actively dividing flagellated algal culture inhibits all of the following *except*
A. growth of flagella
B. polymerization of tubulin
C. mitotic apparatus formation
D. flagellate movement
E. microtubular cytoskeleton formation

33. In eukaryotes the rbcLs (large subunits of ribulose bisphosphate carboxylase/oxygenase) are coded for by the DNA and then synthesized (translated) in the
A. nuclei
B. mitochondria
C. chloroplast
D. Golgi bodies
E. vacuoles

34. Fe is considered an important algal nutrient primarily because it is associated with
A. nucleic acid
B. active site of chlorophyll molecule
C. osmotic adjustment
D. enzymes
E. cytoskeleton

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35. Which of the following is the best description of the function of carotenoids in photosynthetic organisms

A. illumination in the dark
B. give color for identification
C. light-protecting agents
D. Coenzymes
E. Photosynthetic pigments

36. Which of the following seaweed evolved cells comparable to sieve tubes in vascular plants?

A. *Porphyra*, 紫菜
B. *Acetabularia*, 笠藻
C. *Macrocystis*, 巨藻
D. *Ectocarpus*, 外子藻
E. *Gelidium*, 石花菜

37. Which of the following plant hormones involved in the ripening of banana

A. gibberellin
B. abscisic acid
C. cytokinin
D. ethylene
E. auxin

38. Which of the following pigments that supports the red algae being able to live at greater depths in the ocean than other algae

A. biliproteins
B. ferredoxins
C. xanthophylls
D. lutein
E. chlorophyll c

39. Which of the following groups of alga that does not have sexual reproduction.

A. Rhodophycophyta
B. Phaeophycophyta
C. Cyanophycophyta
D. Pyrrhophycophyta
E. Chrysophycophyta

40. What is the ploidy level of the endosperm which is formed as nutrient supporting organ from the central binucleate cell during the embryo sac development in flowering plants

A. haploid
B. diploid
C. triploid
D. tetraploid

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E. pentaploid

41. Under aerobic conditions, some blue-green algae (or cyanobacteria) reduce atmospheric nitrogen in

A. endospores
B. exospores
C. heterocysts
D. carpospores
E. akinetes

42. Which of the following tissue has the most numerous chloroplasts

A. Epidermis
B. Endodermis
C. Palisade mesophyll
D. Spongy mesophyll
E. Xylem *tracheid*

43. Which of the following would be considered to be a natural population in a stream

A. all the adults of any one species
B. all the individuals of the species *Oryzias latipes*
C. all the individuals of the genus *Oryzias*
D. all the interacted fish and algal species
E. all the fishes or the algae

44. At which of the following trophic levels is the greatest amount of free energy available?

A. decomposers
B. tertiary consumers
C. carnivores
D. herbivore
E. producers

45. Transfer of the sperm to the egg in ferns and mosses occurs via

A. a pollen tube
B. a haustorium
C. a male gametophyte
D. a free-water film
E. wind

46. All of the following are true of mycorrhizae, except:

A. they form nitrogen-fixing nodules on roots
B. they may transfer nutrients from one plant to another
C. their growth depends on carbohydrates from the plant
D. they increase the absorptive surface of plants
E. they permit plants to survive in phosphorus-poor environment

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47. Countercurrent flow provides an efficient means of exchange between

A. lumen of the small intestine and the capillaries within the villi
B. alveoli of human lungs and the adjacent capillaries
C. blood in the capillaries and the adjacent body cells
D. capillaries in the glomerulus and Bowman's capsule
E. filaments of a fish gill and the surrounding water

48. Blood fibrinogen is converted into fibrin during

A. clot formation
B. glucose regulation
C. CO_2 transport
D. oxygen exchange
E. an immune response

49. By which of the following organelles in root cells, sucrose is converted to starch after transporting out of the phloem?

A. mitochondria
B. plastids
C. peroxisomes
D. lysosomes
E. vacuoles

50. In mammals, which of the following are produced after rearrangement of DNA sequences in specific cells

A. cancer cell
B. antigens
C. antibodies
D. T_4 cells
E. embryos

二、問答題 50%

＊ 下列題目請在試卷內的「非選擇題作答區」作答。

1. What is the ultimate cause for altruistic behavior among kin? In terms of ultimate causation, why is "fighting to the death" an unusual form of agonistic behavior among animals? (5%)

2. Why are vitamins required in such small doses compared to other essential organic nutrients, such as essential amino acid?(5%)

3. If the DNA sequences called homeoboxes, which help homeotic genes direct development, are common in flies and mice, then, why aren't these animals are more alike?(5%)

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