

一. 單選題 (70分) ※注意：請於試卷「選擇題作答區」依題號作答。※

Questions 1-5

Nuclei from both the liver and brain cells of a mouse are isolated and incubated with radioactive RNA precursors, thus the RNA transcripts synthesized in these nuclei become radioactively labeled. These labeled RNAs are then incubated with a single-stranded DNA segment that is complementary to an mRNA found in brain-cell cytoplasm but not liver-cell cytoplasm. The RNA and DNA are allowed to form RNA/DNA hybrid with the specific DNA probe. An RNA-digesting enzyme is added to destroy single stranded RNA that is not in hybrid form. Radioactivity in the remaining hybrids is measured as counts per minute, and the results are presented in the table below.

<u>Incubation Components</u>	<u>Counts per Minute</u>
Brain cDNA probe + RNA transcripts from brain-cell nuclei	19,800
Brain cDNA probe + <u>RNA transcripts from liver-cell nuclei</u>	960

- Which of the following radioactive molecules cannot be used to label RNA transcript?
(A) ATP. (B) TTP. (C) GTP. (D) CTP. (E) UTP.
- To produce radiolabeled transcripts, the isolated nuclei from both liver and brain must have which of the following?
(A) Reverse transcriptase (B) Ribosomes (C) plasmid DNA
(D) RNA polymerase (E) DNA polymerase
- To make the single-stranded cDNA used as the probe in this experiment, which of the following is required?
(A) DNA polymerase (B) DNase (C) Protease
(D) RNA polymerase (E) tRNA
- Which of the following statements about the brain specific mRNA molecule is best supported by the data in the experiment?
(A) It is transcribed in liver-cell nuclei only
(B) It is transcribed in both brain- and liver-cell nuclei at approximately the same rate
(C) It is not transcribed in either liver- or brain-cell nuclei
(D) It is not transcribed in liver-cell nuclei but is transcribed in brain-cell nuclei
(E) It may be transcribed in both cell nuclei but cannot be detected in this experiment.
- The regulation of the expression of mRNA in the isolated nuclei from the two cell types as demonstrated in this experiment is an example of
(A) translational control (B) mRNA degradation control (C) transcriptional control
(D) protein degradation control (E) negative feedback control
- Charles Darwin discussed all of the following EXCEPT:
(A) Natural selection tends to remove those organisms that are poorly adapted to their environments.
(B) Gene mutations are the source of variation
(C) Individuals in a population compete with one another for limited resources.
(D) Individuals within species exhibit variability in form and function.
(E) Organisms tend to produce more offspring than can survive in each generation
- A population is correctly defined as having which of the following characteristics?
I. inhabiting the same general area
II. individuals belonging to the same species
III. possessing a constant and uniform density and dispersion
(A) I only (B) III only (C) I and II only (D) II and III only (E) I, II, and III
- Which of the following characterizes relatively K-selected populations?
(A) offspring with good chances of survival (B) many offspring per reproductive episode
(C) small offspring (D) a high intrinsic rate of increase (E) early parental reproduction

見背面

9. In a tide pool, 15 species of invertebrates were reduced to eight after one species was removed. The species removed was likely a(n)
(A) community facilitator. (B) keystone species. (C) herbivore.
(D) resource partitioner. (E) mutualistic organism.
10. Of the following pairs, which are the main decomposers in a terrestrial ecosystem?
(A) fungi and prokaryotes (B) plants and mosses (C) insects and mollusks
(D) mammals and birds (E) annelids and nematodes
11. Neurotransmitters are released from axon terminals via
(A) osmosis. (B) active transport. (C) diffusion. (D) transcytosis. (E) exocytosis.
12. In correct chronological order, the three phases of the uterine cycle in female reproduction system of human are:
(A) menstrual → ovulation → luteal (B) follicular → luteal → secretory
(C) menstrual → proliferative → secretory (D) follicular → ovulation → luteal
(E) proliferative → luteal → ovulation
13. Assume that successful reproduction in a rare salamander species, wherein all individuals are females, relies on those females having access to sperm from males of another species but that the resulting embryos show no signs of a genetic contribution from the sperm. In this case, the sperm appear to be used only for
(A) morphogenesis. (B) epigenesis. (C) egg activation.
(D) cell differentiation. (E) the creation of a diploid cell.
14. In the sequence of permeability changes for a complete action potential, the first of these events that occurs is
(A) the activation of the sodium-potassium "pump."
(B) the inhibition of the sodium-potassium "pump."
(C) the opening of voltage-gated sodium channels.
(D) the closing of voltage-gated potassium channels.
(E) the opening of voltage-gated potassium channels.
15. Which processes in animals are regulated by circadian rhythms?
(A) sleep cycles (B) hormone release (C) sex drive (D) A and B only (E) A, B, and C
16. What is a muscle spindle?
(A) an actin-myosin complex
(B) a troponin-tropomyosin complex
(C) axons wound around muscle fibers
(D) groups of dendrite-encircled muscle fibers
(E) muscle cells that make up muscle groups
17. A salmon returns to its home stream to spawn. What term best applies to this behavior?
(A) sign stimulus (B) habituation (C) imprinting
(D) classical conditioning (E) operant conditioning
18. All of the following are found in vertebrate smooth muscle EXCEPT
(A) sarcomeres (B) thin filaments (C) thick filaments
(D) tropomyosin (E) gap junction
19. During which of the following stages of the cell cycle will a diploid cell contain twice the amount of DNA found in a gamete?
(A) prophase (B) entire S phase (C) entire G1 phase (D) entire G2 phase (E) metaphase
20. The system of classification that is based on physical similarities among organisms and does not try to reflect evolutionary relationships is
(A) evolutionary school (B) phenetic school (C) phylogenetic school
(D) cladistic school (E) none of the above

21. Which following phylum is deuterostomes, which means the initial opening, blastopore, develops onto the anus?
(A) Nematoda (B) Mollusca (C) Annelida (D) Echinodermata (E) Arthropoda
22. The presence of cholesterol in the plasma membranes of some animals
(A) enables the membrane to stay fluid more easily when cell temperature drops.
(B) enables the animal to remove hydrogen atoms from saturated phospholipids.
(C) enables the animal to add hydrogen atoms to unsaturated phospholipids.
(D) makes the membrane less flexible, allowing it to sustain greater pressure from within the cell.
(E) enables the membrane to be more flexible when cell temperature raises.
23. Which of the following statements is (are) true about enzyme-catalyzed reactions?
(A) The free energy change of the reaction is opposite from the reaction in the absence of the enzyme.
(B) The reaction always goes in the direction toward chemical equilibrium.
(C) The reaction is faster than the same reaction in the absence of the enzyme.
(D) A and C only
(E) A, B, and C
24. Which process in eukaryotic cells will proceed normally whether oxygen (O_2) is present or absent?
(A) electron transport (B) the citric acid cycle (C) oxidative phosphorylation
(D) chemiosmosis (E) glycolysis
25. As a research scientist, you measure the amount of ATP and NADPH consumed by the Calvin cycle in 1 hour. You find 30,000 molecules of ATP consumed, but only 20,000 molecules of NADPH. Where did the extra ATP molecules come from?
(A) chlorophyll (B) cyclic electron flow (C) linear electron flow
(D) photosystem I (E) photosystem II
26. If a pharmaceutical company wished to design a drug to maintain low blood sugar levels, one approach might be to
(A) design a compound that blocks epinephrine receptor activation.
(B) design a compound that inhibits cAMP production in liver cells.
(C) design a compound to block G-protein activity in liver cells.
(D) design a compound that inhibits phosphorylase activity.
(E) All of the above are possible approaches.
27. In order for anaphase to begin, which of the following must occur?
(A) Chromatids must lose their kinetochores.
(B) Cohesin must attach spindle microtubules to kinetochores.
(C) Cohesin must be cleaved enzymatically.
(D) Kinetochores must attach to the metaphase plate.
(E) Spindle microtubules must begin to depolymerize.
28. The common ancestors of birds and mammals were very early (stem) reptiles, which almost certainly possessed 3-chambered hearts (2 atria, 1 ventricle). Birds and mammals, however, are alike in having 4-chambered hearts (2 atria, 2 ventricles). The 4-chambered hearts of birds and mammals are best described as
(A) structural homologies. (B) vestiges. (C) the result of shared ancestry.
(D) homoplasies. (E) molecular homologies.
29. The lining of the smallest tubules in the kidneys is composed of
(A) connective tissue. (B) epithelial tissue. (C) neural tissue.
(D) smooth muscle cells. (E) adipose tissue.
30. Increasing the surface area directly facilitates which of the following digestive processes?
(A) hydrolysis (B) absorption (C) elimination (D) A and B only (E) A, B, and C

31. If, during protein starvation, the osmotic pressure on the venous side of capillary beds drops below the hydrostatic pressure, then
(A) hemoglobin will not release oxygen.
(B) fluids will tend to accumulate in tissues.
(C) the pH of the interstitial fluids will increase.
(D) most carbon dioxide will be bound to hemoglobin and carried away from tissues.
(E) plasma proteins will escape through the endothelium of the capillaries.
32. In some insects, such as *Drosophila*, fungal cell wall elements can activate the protein *Toll*. What is *Toll*'s function?
(A) acts as a receptor that, when activated, signals synthesis of antimicrobial peptides
(B) functions directly to attack the fungi presented to it
(C) produces antimicrobial peptides by interaction with chitin
(D) secretes special recognition signal molecules that identifies specific pathogens
(E) causes some hemocytes to phagocytize the pathogens
33. Clonal selection is an explanation for how
(A) a single type of stem cell can produce both red blood cells and white blood cells.
(B) V, J, and C gene segments are rearranged.
(C) an antigen can provoke production of high levels of specific antibodies.
(D) HIV can disrupt the immune system.
(E) macrophages can recognize specific T cells and B cells.
34. What would account for increased urine production as a result of drinking alcoholic beverages?
(A) increased aldosterone production
(B) increased blood pressure
(C) the osmoregulator cells of the brain increasing their activity
(D) increased reabsorption of water in the proximal tubule
(E) inhibition of antidiuretic hormone secretion (ADH)
35. One reason a person might be severely overweight is due to
(A) an undersecretion of thyroxine.
(B) a lower than normal level of insulin-like growth factors.
(C) hyposecretion of oxytocin.
(D) a defect in hormone release from the posterior pituitary.
(E) a higher than normal level of melatonin.

※下列題目請標明題號，依序作答於試卷內「非選擇題作答區」。※

二、名詞解釋 (30%)

1. Anticodon
2. Acrosomal reaction
3. Telomere
4. Restriction enzyme
5. Hydration Shell
6. Okazaki fragment
7. miRNA
8. Proteomics
9. Repetitive DNA
10. Totipotent cell