

**I. Multiple-choice questions. (This section has 25 questions. All of them have just one correct answer.) Two points for each question. 請將答案寫在選擇題專用頁**

1. Which of the following is NOT related to cofactor? (a) coenzyme; (b) vitamin; (c) zinc; (d) iron; (e) competitive inhibitor
2. Steroids are NOT related to (a) cholesterol; (b) sex hormones; (c) glycocalyx; (d) wax; (e) lipid.
3. Which of the following animals has amniotic eggs? (a) Fish; (b) frog; (c) reptile; (d) agnathan; (e) lamprey.
4. Which of the following statements is INCORRECT for kelps? (a) They belong to the kingdom Protista; (b) They belong to the phylum Rhodophyta; (c) They have chloroplast; (d) Their gametophyte and sporophyte are isomorphic; (e) They display alternate generations
5. Which of following pairs is INCORRECTLY matched? (a) Polyps-medusa; (b) Nematocyst-cnidocil; (c) Ammonites-squid; (d) Osculum-sponge; (e) Radula-mollusks.
6. Active transport of solutes into plants is NOT related to (a) carrier proteins; (b) proton pump; (c) hydrogen ions; (d) cotransport; (e) chemiosmosis.
7. Which of the following is INCORRECTLY paired with its function? (a) Medulla oblongata-- controlling visceral functions; (b) Corpus callosum-- connecting the two brain hemispheres; (c) Cerebellum-- coordinating movement; (d) Thalamus--storing information related to speech; (e) Hypothalamus-- regulating homeostasis.
8. RNA splicing is related to (a) capping; (b) removing introns; (c) tailing; (d) removing exons; (e) adding exons.
9. A quantitative character is usually related to (a) polygenic inheritance; (b) pleiotropy; (c) codominance; (d) epistasis; (e) incomplete dominance.
10. When preparing a karyotype, drug was treated to arrest the cell cycle at metaphase during which (a) the centromere divides; (b) the chromosomes, each consisting of two joined sister chromatids, are very condensed; (c) the spindle apparatus begin pulling the chromatids toward the poles of the cell; (d) the cleavage furrow occurs; (e) the two centrosomes are close to each other.
11. Down syndrome in human is usually NOT the result of chromosomal alternations relating to (a) chromosome 21; (b) the sex chromosome; (c) aneuploidy; (d) trisomy; (e) the smallest human chromosome.
12. Which of the following is NOT an issue of microevolution? (a) Genetic

- drift; (b) Local population; (c) Founder effect; (d) Extinction; (e) Bottleneck effect.
13. The proper sequence of excitation of the heart should be (a) SA (sinoatrial) node, AV (atrioventricular) node, bundle branches, heart apex, Purkinje fibers; (b) AV node, SA node, bundle branches, heart apex, Purkinje fibers; (c) heart apex, SA node, AV node, bundle branches, Purkinje fibers; (d) heart apex, AV node, SA node, bundle branches, Purkinje fibers; (e) SA node, bundle branches, AV node, heart apex, Purkinje fibers.
  14. Clutch size is related to (a) the number of reproductive episodes per life time; (b) the size of the gonad; (c) the number of offsprings produced per life time; (d) the number of offsprings produced at each reproductive episode; (e) size of the home range.
  15. Which of the following chemical plays role in supplying energy during muscle contraction? (a) Tropomyosin; (b) Troponin complex; (c) erythropoietin; (d) Phosphagen; (e) Glucagon.
  16. Which of the following is an invertebrate hormone: (a) Calcitonin; (b) Ecdysone; (c) Prolactin; (d) Glucocorticoid; (e) Glucagon.
  17. The lens of an animal's eye is developed from (a) endoderm; (b) ectoderm; (c) mesoderm; (d) polar lobe; (e) optic cup.
  18. Which of the following is NOT related to learning? (a) Habituation; (b) Fixed action pattern; (c) Play; (d) Critical period; (e) imprinting.
  19. Ecological efficiency is (a) the multiplicative loss of energy from a food chain; (b) the rate at which a consumer converts the chemical energy of the food they eat into its own new biomass; (c) the ratio of net productivity at one trophic level to net productivity at the level below; (d) the rate at which light energy is converted to chemical energy by the autotrophs; (e) the ratio of the numbers of individual organisms present in two adjacent trophic levels.
  20. Morphogen is (a) a homeotic gene; (b) a neurotransmitter; (c) a chemical that interacts with DNA and causes a mutation; (d) a chemical signal that varies in concentration along a gradient, enabling cells to resolve their position along that gradient; (e) the development of body shape and organization during ontogeny.
  21. Which of the following is NOT the four basic parts of floral plants? (a) Sepal; (b) Stamen; (c) Tendril; (d) Petal; (e) Carpel.
  22. Which of the following tools or methods of recombinant DNA technology is INCORRECTLY paired with its use? (a) Radioactive isotope-- tracing the position of a probe; (b) restriction enzyme--cutting a particular section

- of DNA; (c) gel electrophoresis-- separating macromolecules; (d) plasmid--cloning a gene; (e) Sanger method--measuring nucleic acids' rate of migration.
23. The greatest mass extinction in the history of life occurred during the (a) Devonian period; (b) Precambrian period; (c) Permian period; (d) Jurassic period; (e) Paleocene period.
24. Placental mammals with chisel-like and continuously growing incisor teeth belong to the order (a) Sirenia; (b) Rodentia; (c) Insectivora; (d) Cetacea; (e) Proboscidea.
25. Cellular respiration is related to (a) the Calvin cycle; (b) the Krebs cycle; (c) the carbon cycle; (d) Nitrification; (e) the phosphorus cycle.

**II. Fill-in questions (questions 26-35). Three points for each question. Answers must be in English. 請將答案寫在答案欄，每行一題**

26. In a light microscope, light is focused on the specimen, while \_\_\_\_\_ is focused on the specimen in electron microscope.
27. \_\_\_\_\_ and \_\_\_\_\_ are organs or biological structures in which countercurrent exchange takes place.
28. An operon in a chromosome includes \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
29. \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ are three types of postzygotic reproductive barriers.
30. Given that the relative fitness of the most fertile variants (or genotypes) is set at 1, and that the other less fit variant has an average of only 70% as many offsprings, the selection coefficient is \_\_\_\_\_.
31. Proteins are constructed from a set of 20 different amino acids. If a codon were two-nucleotide (INSTEAD OF THREE-NUCLEOTIDE) sequence of DNA or mRNA that specifies a particular amino acid, then \_\_\_\_\_ different amino acids can be expected. (Give number of types of different amino acids).
32. A population is under Hardy-Weinberg equilibrium, 9% of the individuals show the recessive trait, the frequency of the dominant allele in the population is \_\_\_\_\_, and the percentage of the individuals showing the heterozygotic trait is \_\_\_\_\_%.
33. Alternation of the following environmental factors (such as \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_) may lead to denaturation of proteins.

34. Put the following groups of plant (ferns, bryophytes, angiosperms, gymnosperms) into a proper evolutionary sequence: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
35. \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ are the three domains of life.

**III. The following paragraphs are quoted from an article written by J.M. Siegel at the University of California at Los Angeles. This article appears in the November, 2003 issue of the Scientific American, pp. 72-77. Read these materials and**

- (a) Give a proper English title for these paragraphs as a whole. (4 points)  
(b) Give an overview or condensed summary in CHINESE. (16 points)

At a recent sleep conference, an attendee commented that the function of sleep remains a mystery. The chair of the session argued against that position—she did not, however, provide a concrete description of exactly why sleep's function was no longer mysterious. Clearly, no general agreement yet exists. But based on the currently available evidence, I can put forth what many of us feel are some reasonable hypotheses.

One approach to investigating the function of sleep is to see what physiological and behavioral changes result from a lack of it. More than a decade ago it was found that total sleep deprivation in rats leads to death. These animals show weight loss despite greatly increased food consumption, suggesting excessive heat loss. The animals die, for reasons yet to be explained, within 10 to 20 days, faster than if they were totally deprived of food but slept normally.

Researchers study the natural sleep habits of a variety of organisms. An important clue about the function of sleep is the huge variation in the amount that different species need. For example, the opossum sleeps for 13 hours a day, whereas as the elephant get by with only three or four. Closely related species that have genetic, physiological and behavioral similarities might also be expected to have similar sleep habits. Yet studies of laboratory, zoo and wild animals have revealed that sleep times are unrelated to the animals' taxonomic classification. If evolutionary relatedness does not determine sleep time, then what does?

The extraordinary answer is that size is the major determinant: bigger animals simply need less sleep. Elephants, giraffes and large primates (such as humans) require relatively little sleep; rats, cats and other small animals spend most of their time sleeping. The reason is apparently related to the fact that small animals have

higher metabolic rates and higher brain and body temperature than large animals do. And metabolism is a messy business that generates free radicals—extremely reactive chemicals that damage and even kill cells. High metabolic rates thus lead to increased injury to cells and the nucleic acids, protein and fats within them.

Free-radical damage in many body tissues can be dealt with by replacing compromised cells with new ones, produced by cell division; however, most brain regions do not produce significant numbers of new brain cells after birth. The lower metabolic rate and brain temperature occurring during non-REM (REM stands for rapid eye movement) sleep seem to provide an opportunity to deal with the damage done during waking. For example, enzymes may more efficiently repair cells during periods of inactivity. Or old enzymes, themselves altered by free radicals, may be replaced by newly synthesized ones that are structurally sound.

Last year we observed what we believe to be the first evidence for brain cell damage, in rats, occurring as a direct result of sleep deprivation. This finding supports the idea that non-REM sleep wards off metabolic harm.

REM sleep, however, is the proverbial riddle wrapped in mystery inside an enigma. The cell-repair hypothesis could explain non-REM sleep, but it fails to account for REM sleep. After all, downtime repair cannot be taking place in most brain cells during REM sleep, when these cells are at least as active as during waking. But a specific group of brain cells that goes against this trend is of special interest in the research for a purpose of REM sleep.

Recall that the release of some neurotransmitters ceases during REM sleep, thereby disabling body movement and reducing awareness of the environment. The key neurotransmitters affected—norepinephrine, serotonin and histamine—are termed monoamines. Brain cells that make these monoamines are maximally and continuously active in waking. But researchers discovered in 1973 that these cells stop discharging completely during REM sleep.

In 1988, we hypothesized that the cessation of neurotransmitter release is vital for the proper function of these neurons and their receptors. Various studies indicate that a constant release of monoamines can desensitize the neurotransmitters' receptors. The interruption of monoamine release during REM sleep thus may allow the receptor systems to "rest" and regain full sensitivity. And this restored sensitivity may be crucial during waking for mood regulation, which depends on the efficient collaboration of neurotransmitters and their receptors.

The monoamines also play a role in rewiring the brain in response to new experience. Turning them off during REM sleep then may be a way to prevent changes in brain connections that might otherwise be inadvertently created as a result of other brain cells' intense activity during REM.

1. What is the physiological basis of seasickness? 15%
2. Describe the sequence of events thought to occur when a muscle fiber contracts, beginning with the release of acetylcholine. 15%
3. How do antibodies work against pathogens? 15%
4. Describe the fate of (1) glucose (2) absorbed amino acids and (3) absorbed fat in animal body. 15%
5. How do the adrenal glands help the body respond to stress? 15%
6. How does the countercurrent exchange system increase the efficiency of gas exchange between a fish's gill and blood? 10%
7. Describe initiation, elongation and termination of protein synthesis. 15%

問答題：

1. 說明植物細胞吸收水分的機轉 (15%)
2. 植物構造及其功能
  - a. 畫出植物細胞構造並說明各構造之功能 (10%)
  - b. 畫出高等植物全株之根、莖、葉型態並說明其功能 (10%)
  - c. 說明植物如何以型態及構造的改變適應缺水及低光的逆境 (10%)
3. 光合作用
  - a. 解釋並圖示光合作用電子傳遞鏈 (15%)
  - b. 解釋並圖示 C3 cycle (15%)
4. 說明植物群聚組成受環境變遷之影響及其演變過程 (15%)
5. 說明植物基因轉殖方法 (10%)

## I. Choose only one correct answer in each of the following questions. (10%)

1. The green coloration of many grasshoppers and caterpillars match their background is a kind of A) mimicry B) aposematism C) crypsis D) cheating E) none of the above.
2. Which of the following statements is incorrect? The nitrogen-fixing bacteria of the genus *Rhizobium* forms symbiosis with legumes A) in root part B) fixing nitrogen by an aerobic process C) forming nodules D) which has free-living capability.
3. In general, species richness decreases with increasing A) altitude B) temperature C) depth in the ocean D) spatial heterogeneity E) none of the above.
4. The place with the highest primary productivity in the ocean is A) open ocean B) continental shelf C) deep sea D) estuaries E) upwelling zone.
5. A species has a significant and disproportionate effect on the community called A) model species B) r-selected species C) k-selected species D) edge species E) keystone species.

## II. Explain the following terms. (30%)

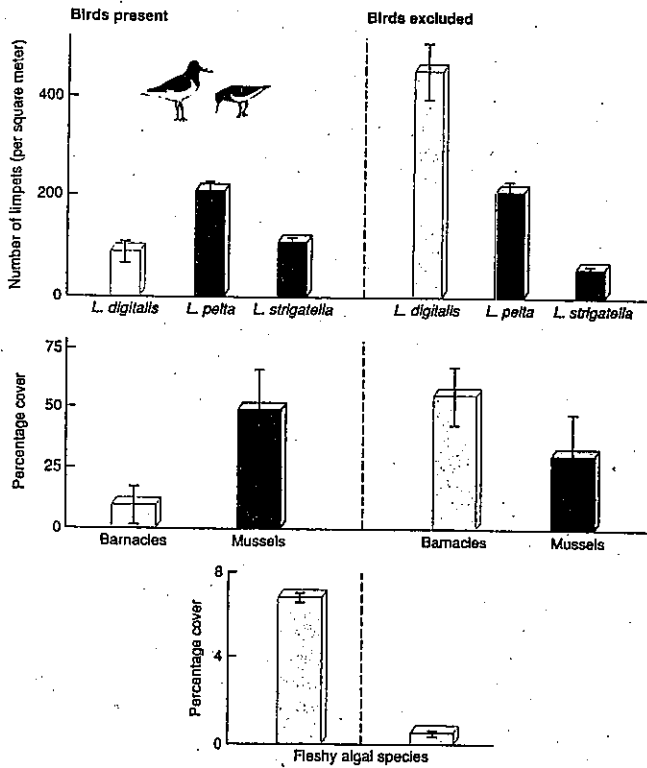
1. Life table
2. Iteroparity
3. Maximum sustainable yields
4. Greenhouse effect
5. Restoration ecology
6. Phenotypic plasticity
7. Upwelling
8. Temperature coefficient (Q<sub>10</sub>)
9. The CAM (crassulacean acid metabolism) plants
10. Founder effect

## III. Assay questions. (60%)

1. Describe the effects of Continental drift on the ecology of evolution. (10%)
2. Discuss three reasons why community composition changes as one moves down the continental shelf into the abyssal depths of the ocean. (10%)
3. Explain the contrasting trade-offs expected to be exhibited by r-selected and K-selected species. (10%)
4. What are meant by bottom-up and top-down control? How is the importance of each likely to vary with the number of trophic levels in a community? (10%)



5. Energy cannot be cycled and reused – matter can. Discuss this assertion and its significance for ecosystem functioning. (10%)
6. Explain the following figure. (10%)



水產生物學 (2005)

甲. 解釋名詞 (30%)

- a. 責任制漁業(responsible fishery)
- b. 單位努力漁獲量(catch per unit of effort)
- c. 魚梯 (fish ladder)
- d. Biological overfishing
- e. Turtle Excluding Device (TED)
- f. Beam trawl

乙. 問答計算題

1. 請以條列方式說明軟骨魚類與硬骨魚類在分類學和形態等方面的主要差異。(10%)
2. 請寫出某特定魚種的體長(L)與體重(W)關係的方程式, 及本式在水產及漁業生物學研究上的用途。(10%)
3. 就你所知略述翻車魚的生態習性和捕撈方法。(10%)
4. 請略述台灣沿近海域的圍網漁業作業方式, 作業對象, 和漁場範圍等。(10%)
5. 目前大家均普遍接受利用海水養殖來舒緩過度捕撈海洋資源對於資源環境的衝擊, 不過也有學者指出海水養殖本身也可能導致若干生態衝擊的問題, 請列舉之。(10%)
6. 假設多年來隨著研究人員的努力, 已經陸續記錄了一共 222 尾花蓮海域中出沒之飛旋海豚的身體特徵並且建立圖鑑檔案。在某一短暫且密集的賞鯨季節活動期中, 花蓮海域所有賞鯨船隊以目視的方式一共看到了 428 尾飛旋海豚, 其中有 52 尾經現場人員鑑定出是屬於圖鑑中已知的個體。
  - (a) 根據上面的資料, 請推算花蓮海域中飛旋海豚的大概數目。(10%)
  - (b) 上述推算方法的精確度有賴於若干假設條件是否成立, 請列舉之。(10%)