一、單選題：（選擇最合適的答案，50%）

1. Facilitated membrane transport:　(A) selectively internalizes ligands of cell surface receptors　(B) is responsible for transport of glucose across the plasma membrane　(C) transports RNA out of the nucleus through the nuclear pore complex　(D) is mediated by gap junctions　(E) is only see in bacteria

2. Polycistronic means:　(A) a virus that has more than one DNA fragment in its genome　(B) a gene having a single transcript that has more than one open reading frame　(C) a eukaryotic gene regulatory region with more than one binding site for transcription factors　(D) a type of cell cycle that lacks a G1 phase　(E) a chromosome with more than one centromere

3. A nucleosome is:　(A) the capsid of a virus that replicates in the nucleus　(B) a ribosome that is translating a protein while attached to the RER　(C) the crystalline core of a peroxisome　(D) a complex of histones and DNA　(E) a radioactive isotope used for DNA sequencing

4. During DNA synthesis, the lagging strand is synthesized:　(A) as RNA　(B) as Okazaki fragments　(C) as plasmids　(D) in a 3' to 5' direction　(E) outside the nucleus

5. Saying that the genetic code is degenerate means:　(A) that in less evolved organisms, codons only consist of two bases　(B) that during evolution the genetic code changed in most organisms　(C) that many amino acids are represented by more than one codon　(D) that U replaces T in mRNA　(E) that more than one ribosome can translate a single mRNA molecule at the same time

6. The enzyme that you would use for joining DNA fragments in a cloning experiment is called:　(A) a restriction enzyme　(B) DNA polymerase　(C) RNA polymerase　(D) DNA ligase　(E) reverse transcriptase

7. The function of the lysosome is:　(A) to protect the genomic DNA from outside chemical insults　(B) the location for synthesis of secreted proteins　(C) to produce a proton gradient for production of energy　(D) to store starch granules　(E) to degrade material internalized into the cell by endocytosis

8. The kinetochore is:　(A) the point where the mitotic spindle attaches to the chromosome　(B) the name of the lattice surrounding coated vesicles　(C) the basal structure of a eukaryotic flagellum　(D) the site where proteins are imported into mitochondria　(E) the chlorophyll molecule that starts the electron transport chain

9. A nonsense mutation is:　(A) a mutation that converts one amino acid to another　(B) a mutation that alters lipid biosynthesis　(C) a mutation that creates a stop codon from an amino acid codon　(D) a mutation that makes a cell more susceptible to viral infection　(E) a mutation makes no sense

10. The clonal selection theory is an explanation for　(A) how a single type of stem cell can produce both red blood cells and white blood cells　(B) how antibody proteins can be molded to fit antigens after the antigen interacts with an antibody-producing type of cell　(C) how an antigen can provoke development of very few cells to result in production of high levels of specific antibodies　(D) how HIV can disrupt the immune system　(E) how macrophages can recognize specific T cells and B cells

11. The shaping of an animal and its individual parts into a body form with specialized organs and tissues is called　(A) induction　(B) organogenesis　(C) differentiation　(D) determination　(E) pattern formation

12. All Protista are alike that they are:　(A) autotrophic　(B) heterotrophic　(C) unicellular　(D) eukaryotic　(E) flagellated

13. Which of the following is a FALSE statement about the ways that prokaryotic cells differ from eukaryotic cells?　(A) The prokaryotic genome has a unique organization　(B) Prokaryotes have a relatively simple organization of their cytoplasm　(C) Prokaryotes have a cell wall with unique components　(D) Prokaryotes lack specialized membranes　(E) Prokaryotes are usually smaller than eukaryotes

14. Cephalization is primarily　(A) an adaptation to the method of feeding　(B) due to the fate of the blastopore　(C) the result of the type of digestive system　(D) the result of segmentation　(E) an adaptation to movement

15. Reverse transcriptase is:　(A) an enzyme that makes a DNA strand using RNA as a template　(B) an enzyme that produces mirror image amino acids　(C) an enzyme that flips lipids between the outer and inner membrane leaflets　(D) an enzyme that unwinds the DNA double helix during DNA replication　(E) a regulatory protein that controls the cells entry into mitosis during the cell cycle

16. All of the following animal groups have evolved terrestrial life forms except　(A) Echinodermata　(B) Crustacea　(C) Mollusca　(D) Arthropoda　(E) Vertebrata

17. Which of the following traits is characteristic of all types of muscle tissue?　(A) intercalated discs that allow cells to communicate　(B) striated banding pattern seen under the microscope　(C) cells that lengthen when appropriately stimulated　(D) response that can be consciously controlled　(E) cells that contain actin and myosin

18. Humans can acquire trichinosis by:　(A) failing to practice safe sex　(B) eating undercooked pork　(C) inhaling the eggs of worms　(D) eating undercooked beef　(E) being bitten by tsetse flies

19. Malpighian tubules are excretory organs found in　(A) earthworms　(B) flatworms　(C) insects　(D) jellyfish　(E) vertebrates

20. Mitochondria and chloroplasts have double membranes because:　(A) they originated by endosymbiosis　(B) the double membrane is required to maintain a H^+ gradient　(C) they are derived from eukaryotic nuclei　(D) they need protection from lysosomes　(E) their DNA is light-sensitive

21. The Archaea are:　(A) fossils of cyanobacterial colonies　(B) a form of protobiont　(C) the same as eubacteria　(D) organelles that oxidize lipids　(E) living organisms similar to the most ancient life-forms

22. Retroviruses:　(A) only infect bacteria　(B) do not have a membrane envelope　(C) use reverse transcriptase to produce DNA from their RNA genome　(D) migrate through peripheral nerves to cell bodies in the central nervous system　(E) do not cause human disease

23. A lysogenic infection is:　(A) a viral infection that lyses the host cell　(B) infection by an intestinal parasite　(C) infection by bacteria that produce toxins and cause cell lysis　(D) a viral infection that integrates into the host genome and then does not produce more virus right away　(E) an intracellular parasitic protozoa infection that lyses the host cell

24. A Barr body consists of:　(A) protein being degraded in lysosomes　(B) viral capsids aggregated in the cytoplasm　(C) bacterial cell wall　(D) an X chromosome condensed as heterochromatin　(E) the point where the mitotic spindle binds to a chromosome

25. All the following descriptions are correct about PCR except:　(A) a process for producing large quantities of a single DNA fragment　(B) uses two oligonucleotide primers　(C) based on exponential amplification of a piece of DNA　(D) does not require the use of a vector　(E) a life saving process

26. Which level of ecology considers energy flow and chemical cycling?　(A) community　(B) ecosystem

(C) organismal　(D) population　(E) abiotic

27. In which of the following biomes is light most likely to be a limiting factor?　(A) desert　(B) estuary　(C) coral reef　(D) grassland　(E) ocean pelagic zone

28. A conformer is most likely to be successful in a(n)　(A) intertidal zone.　(B) coral reef.　(C) taiga.　(D) chaparral.　(E) estuary.

29. Phytoplankton is the basis of the food chain in　(A) streams.　(B) wetlands.　(C) the ocean photic zone.　(D) rocky intertidal zones.　(E) deep-sea thermal vents.

30. Upwellings in the ocean　(A) are locations of reef communities.　(B) occur over deep-sea hydrothermal vents.　(C) are responsible for ocean currents.　(D) bring nutrient-rich water to the surface.　(E) are most common in tropical waters, where they bring oxygen-rich water to the surface.

31. According to the principle of allocation, which type of organism would have the greatest amount of energy to devote to reproduction?　(A) an organism with behavioral or physiological responses to maintain homeostasis　(B) an endotherm　(C) a regulator　(D) a deregulator　(E) a conformer

32. In a range with a heterogeneous distribution of suitable habitats, the dispersion pattern of a population probably would be　(A) clumped.　(B) uniform.　(C) unpredictable.　(D) random.　(E) dense.

33. The term $(K-N)/K$　(A) is the carrying capacity for a population.　(B) is greater when K is very large.　(C) is zero when population size equals carrying capacity.　(D) increases the value as N approaches K.　(E) accounts for the overshoot of carrying capacity.

34. A Type III survivorship curve would be more likely to be found in (A) a semelparous species that produces many offspring. (B) a K-selected population. (C) a species that undergoes periodic molting. (D) a species that is territorial. (E) a population that is regulated by density-dependent factors.

35. Density-independent factors (A) tend to maintain a population around the carrying capacity. (B) are involved in the population cycles seen in some mammals. (C) are important in the regulation of K-selected populations. (D) include climatic events and habitat disruptions. (E) affect a higher proportion of a small population.

36. Through resource partitioning,　(A) two species can compete for the same prey item.　(B) slight variations in niche allow closely related species to coexist in the same habitat.　(C) two species can share the same realized niche in a habitat.　(D) competitive exclusion results in the succession of the superior species.　(E) two species undergo character displacement that allows them to compete.

37. When one species was removed from a tide pool, the species richness became significantly reduced. The removed species was probably　(A) a strong competitor.　(B) a potent parasite.　(C) a resource partitioner. (D) a keystone species.　(E) the species with the highest relative abundance.

38. A highly successful parasite　(A) will not harm its host.　(B) may benefit its host.　(C) will be able to feed without killing its host.　(D) will kill its host fairly rapidly.　(E) will have coevolved into a commensalistic interaction with its host.

39. The most important factor(s) in determining community structure　(A) may change from one community to another.　(B) its predation.　(C) is competition.　(D) is mutualism.　(E) are structural diversity and environmental patchiness.

40. During succession, inhibition　(A) may prevent the achievement of a climax community.　(B) is evident for the equilibral theory of succession.　(C) is one of the factors that determines the most tolerant species in an area.　(D) may interfere with the successful colonization of other species.　(E) may involve

changes in soil pH or accelerated accumulation of humus.

41. A serious effect of the thinning of the ozone layer is (A) a reduction in species diversity. (B) global warming. (C) acid precipitation. (D) an increase in UV radiation reaching Earth. (E) cultural eutrophication.

42. Productivity in terrestrial ecosystems is affected by (A) temperature. (B) light intensity. (C) availability of nutrients. (D) availability of water. (E) all of the above.

43. Secondary productivity (A) is measured by the standing crop. (B) is the rate of biomass production in consumers. (C) is greater than primary productivity. (D) is 10% less than primary productivity. (E) is the gross primary productivity minus the energy used for respiration.

44. Chemosynthetic bacteria found around deep-sea vents are examples of (A) producers. (B) decomposers. (C) chemical cycling. (D) secondary productivity. (E) upwellings that make nutrients available.

45. Biogeochemical cycles are global for elements (A) that are found in the atmosphere. (B) that are found mainly in the soil. (C) such as carbon, nitrogen, and phosphorus. (D) that are dissolved in water. (E) in the nonavailable reservoirs.

46. carbon cycles relatively rapidly except when it is (A) dissolved in freshwater ecosystems. (B) released by respiration. (C) converted into sugars. (D) stored in petroleum, coal, or wood. (E) part of the bicarbonate reservoir in oceans.

47. A crow that aids its parents in raising siblings is increasing its (A) reproductive success. (B) altrusive behavior. (C) inclusive fitness. (D) coefficient of relatedness. (E) certainty of paternity.

48. Which of the following would not contribute to the migratory behavior of a bird that travels over long distances through all types of weather to return to its breeding grounds? (A) ability to sense Earth's magnetic field (B) navigation (C) orientation (D) piloting (E) kinesis and taxis.

49. Which of the following is the most serious threat to biodiversity? (A) competition from exotic species (B) commercial harvesting (C) habitat destruction (D) overexploitation (E) pollution

50. Which of the following is typical of biodiversity hot spots? (A) a large land or aquatic area (B) a high rate of habitat degradation (C) little species diversity (D) a large proportion of endemic species (E) very large populations of migratory birds

二、問答題：（50%）

1. Briefly state the main components of Darwin's theory of evolution. (10 points)

2. Draw a diagram of a fern life cycle, and label the processes and structures. (15 points)

3. Describe the four levels of protein structure. (5 points)

4. Discuss the ecological impact of prokaryotes on the earth and all its inhabitants. (10 points)

5. Describe how positive and negative regulations of the *lac* operon are integrated to give an appropriate response to lactose and glucose levels in the growth medium. (10 points)

1. Alzheimer's disease is a progressive neurodegenerative disorder accounting for about 50 % of all dementias, yet its pathogenic mechanisms remain unclear. In order to provide a more complete picture of pathogenesis in Alzheimer's disease, proteomic analysis of the brain in Alzheimer's disease has been suggested. Describe how this can be done and what information can be obtained.(10 %)

2. Describe three major pathways of glucose metabolism in animals.(10 %)

3. Draw a graph for each of the following kinetic conditions: (10 %)
   (1) A plot of v_o versus [E].
   (2) A plot of v_o versus [S] for an enzyme that obeys the Michaelis-Menten equation.
   (3) A plot of v_o versus [S] for an allosteric enzyme.

4. Compare and contrast the characteristics of three types of enzyme regulation: (10 %)
   (1) Allosterism.
   (2) Covalent modification.
   (3) Proteolytic cleavage.

5. Give five key intermediate compounds generated by catabolism and used in anabolism.(10 %)

6. Term explanation:(20 %)
   (1) Ion-exchange chromatography.
   (2) Gluconeogenesis.
   (3) Competitive inhibition.
   (4) C4 plant.
   (5) β-pleated sheet.

7. Describe the Z scheme of photosynthesis.(10 %)

8. Describe how ATP synthase as a rotary engine driving the synthesis of ATP.(10 %)

9. Describe the factors determining secondary and tertiary structure in protein molecule.(10 %)

選擇題：（30 %）
1. Which statement is not true?
    (a) Heterochromatin is transcriptionally active.
    (b) Centromere and telomere are always inactive.
    (c) The promoter of an active gene is generally free of nucleosomes.
    (d) Transcriptionally active gene is sensitive to nuclease digestion.

2. Which of the following statements about TBP is not true?
    (a) TBP induces a bend in its DNA target.
    (b) TBP associates with different sets of proteins to recognize diverse promoters.
    (c) TBP is thought to interact with a polymerase subunit that is shared between polymerases I, II, III.
    (d) TBP binds the major groove of the DNA double helix.

3. The consensus sequence for poly $(A)_n$ addition is the site of poly A tail addition.
    (a) true   (b) false

4. Spliceosome contains the following components except
    (a) U1 snRNA, which interacts with the 5' splice site in pre-mRNA.
    (b) U2 snRNA, which interacts with the branch point in pre-mRNA.
    (c) A single snRNP containing several different snRNAs.
    (d) U6 snRNA, which interacts with U4 snRNA.

5. Which of the following factor is an assembly factor?
    (a) SP1   (b) TFIIIB   (c) TFIIH   (d) TBP

6. An RNA probe for a Northern blot will hybridize to
    (a) only the exact identical fragment.
    (b) any RNA fragment containing the same sequence.
    (c) any RNA fragment containing the complementary sequence.
    (d) only RNA fragments which are RNase-resistant.
    (e) All of the above.

7. Nucleic acids absorb UV light primarily due to the aromatic nature of the bases.
    Which of the following has the highest absorption per unit mass at 260 nm
    wavelength?
    (a) double-stranded DNA
    (b) RNA
    (c) Protein
    (d) Oligonucleotides
    (e) Mononucleotides

8. Shuttle vectors are designed for replication and selection in prokaryotic cells as
    well as in the desired host cells. Which of the following is necessary for bacterial
    plasmids to replicate in yeast cells?
    (a) ORC
    (b) ROS
    (c) CDK
    (d) ARS
    (e) CRP

9. There are two methods of DNA sequencing. Which one of the following
    statements about DNA sequencing is correct?
    (a) enzymatic method of sequencing uses a primer, which is extended by an
        RNA polymerase.
    (b) The Maxam-Gilbert method uses a DNA polymerase and chain terminating
        dideoxynucleotides.
    (c) The Sanger method uses chemicals for base-specific cleavages.
    (d) DNA sequencing methods were developed at 1980's.
    (e) For separation of labeled fragments during DNA sequencing, polyacrylamide
        gel electrophoresis (PAGE) is run.

10. Mutations are heritable, permanent changes in the base of the DNA. One type of
    mutation will sometimes lead to production of a truncated protein. Which of the
    following would be most likely the cause of a nonsense mutation?
    (a) GGA to AGA
    (b) CGA to UGA
    (c) UAA to UGA
    (d) UAC to AAC
    (e) UAA to AAA

問答題:

1. Describe the ways in which eIF-4G participates in translation initiation. (8 %)

2. Define the genetic code. What do we mean that "The genetic code is degenerate" ? Why is it important that the genetic code is degenerate? (15 %)

3. Describe the posttranscriptional modification of eukaryotic gene and explain what are the effects of these modification on gene expression. (12 %)

4. (a) What are restriction endonucleases? (b) If a virus infects a bacterium, the restriction enzymes will attack the viral genome and cut it wherever they find their recognition sequence. What prevents the same restriction enzymes from cutting in the bacterial chromosome? (c) How can a restriction enzyme find its target sites on DNA and cut the specific target sequence?　　　　　　　　　　　　(15%)

5. (a) Explain the operation of the trp operon, and note why it is considered a repressible operon. (b) Discuss an extra level of control, attenuation, and its importance.　　　　　　　　　　　　(10%)

6. Suppose you have discovered a thermo-stable bacterium from a hot spring. White a brief essay on how you would clone the gene for its DNA polymerase.　　(5%)

7. It is reported that spontaneous mutation rate in *E. coli* is about one error per 10^{10} bases incorporated during replication. What are the mechanisms for *E. coli* to have the minimized error rate?　　　　　　　　　　　　(5%)

1.解釋下列名詞（3% each）：

(1). Adenylyl cyclase-cAMP-PKA second messenger system

(2). Refractory period (in nerve)

(3). GFR (Glomerular filtration rate)

(4). Ovulatory surge

(5). Oxygen debt

(6). Respiratory acidosis

(7). Muscle spindle

(8). Organ of Corti (in the ear)

(9). Motor unit

2. 2000 年諾貝爾生物醫學獎頒給了 Arvid Carlsson, Paul Greengard and Eric Kandel 三人以獎勵他們對中樞神經訊號傳遞的偉大貢獻。中樞神經是主宰動物體的一個重要組織，請問神經與神經之間如何傳遞訊息？請從訊號的產生到訊息的終止做一詳細的說明（10%）。

3. 請說明 Neutrophil 及 Macrophage 在發炎反應中的角色（10%）。

4. 聽過臍帶血銀行嗎？最近興起為新生兒保存臍帶血的熱潮，原因是裏面含有許多的 stem cell。請問何謂 Stem cell？保存 Stem cell 在生物醫療科技有何相關性？（10%）

5. 由心臟所打出去的血液主要會經由體循環及肺循環二種路徑送出心臟，請問何謂肺循環？請就其路徑與功能加以說明。（8%）

6. 使一人靜坐於極小空間之室內，不久即可見此人呼吸速率及呼吸深度皆增大. 試問, 何物刺激其呼吸? (3%) 請以流程圖顯示此物之作用機制, 圖中請分別註明週邊及中樞化學接受器之作用 (7%).

7. Amiloride 可作為強效利尿劑, 試述它影響水分運輸因而造成利尿效果之機制. (10%)

8. 試敘述一次心動週期中(a) 左心室內血壓之變化 (3%), (b) 動脈壓之變化 (3%), (c) EKG 圖形(3%), (d)各主要心臟瓣膜之開闔情形(請以相同的時間軸線描述上列各項變化)(6%).

Answer the following questions:

1. Recently, an additional means by which the complement cascade can be activated. (1) Please compare how do the three pathways differ in the substances that can initiate activation? (2) Which portion of the overall activation sequence differs in the three pathways? Which portion is similar? (3) How do the biological consequences of complement activation via these pathways differ? (15%)

2. Describe the functions of helper T lymphocytes in both humoral and cell-mediated immunity (10%)

3. Use arrows to indicate stimulatory and inhibitory effects to explain the regulation of $T_H 1$ and $T_H 2$ subsets by cytokines. (10%)

4. Define the following terms (15%)：
    (1) hyposensitization   (2) junctional flexibility   (3) affinity maturation
    (4) Self-MHC restriction   (5) Second-set graft rejection

5. Compare and contrast T-cell epitope and B-cell epitope. (15%)

6. How DNA vaccine works in stimulating immune protection against infectious agents? What are the advantages and disadvantages of DNA vaccine? (10%)

7. Define superantigens and describe the effects of superantigens on the immune system. (10%)

8. B-cell maturation depends on rearrangement of the immunoglobulin gene and protein expression in early progenitor cell. Describe the immunoglobulin gene and protein configurations in each progenitor cell during the processes of B-cell development. (15%)

1. A student has isolated a previously undiscovered species of bacteria from a hot spring. Many organisms that grow in these extreme environments are Archaea, so he wants to determine whether the one he found should be classified with the Archaea or with the Bacteria. Give two characteristics that would help him distinguish between the two. (8 pts)

2. It is generally true that Gram-negative cells are more resistant to antibiotics, disinfectants and other chemical agents than Gram-positive cells. However, this is not always the case. Which one of the following chemicals would most likely be more effective against Gram-negative cells than against Gram-positive cells, and why? (6 pts)
   a. Lysozyme
   b. A detergent that disrupts membranes
   c. Penicillin
   d. An antibiotic that selectively binds to and destroys teichoic acid

3. *Pseudomonas aeruginosa* is an obligate aerobe. Strangely enough, if you put some *P. aeruginosa* cells in saline buffer at low pH (high concentration of H^+), they will make a little ATP, even though there is no glucose or other energy source present. The same thing happens even if the cells are not living, as long as their proteins and membranes are intact! Considering what you know about metabolism, give an explanation for this result. (8 pts)

4. Widespread use of antibacterial soaps has raised some concerns about the possibility of developing and spreading resistance. However, overuse of these products could also cause problems in a different way. Other than selecting for and spreading resistance, what could be a negative consequence of using bacteria-killing products on our skin? (8 pts)

5. A student made a series of six dilutions of a phage stock. Tube #1 contained a 1:4 dilution of the original phage stock, and each subsequent tube contained a 1:4 dilution from the preceding tube. Plating 10 µl from Tube #4 resulted in 129 plaques on one plate and 137 plaques on a duplicate plate. What was the concentration of the original phage stock in phage particles/ml? (6 pts)

1	2	3	4	5	6
(1:4)	(1:16)	(1:64)	(1:256)	(1:1024)	(1:4096)
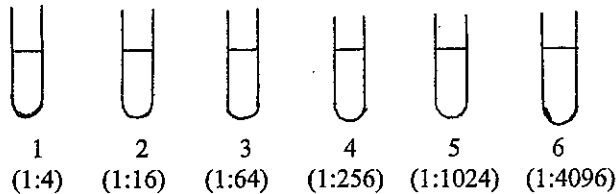
6. **Matching.** Below are several ways that horizontal transfer of antibiotic-resistance genes might occur among bacteria. Match each with the one statement that best describes it. (12 pts)

   (1)_____Conjugation

   (2)_____Transposition

   (3)_____Transduction

   (4)_____Transformation

   a. Could transfer genes between cells if a gene flanked by IS sequences moved into a self-transmissible plasmid.
   b. Can "capture" gene cassettes and assemble clusters of many antibiotic-resistance genes.
   c. Bacteria could acquire either plasmid or chromosomal genes from other cells that had lysed nearby.
   d. Requires a plasmid carrying resistance genes integrated into the bacterial chromosome.
   e. Can occur when a bacteriophage makes a mistake and packages host DNA.
   f. Involves an efflux pump for efficient export of plasmid DNA from the cell.
   g. Requires genes for pilus formation and for DNA transfer.

7. Your friend has a bad cold...she's achy, her throat is sore, she's sneezing and coughing constantly and her nose is running. She feels so bad and goes to see a doctor, but the doctor says she just has to wait it out and refuses to give her any antibiotics. Your friend is mad! Can you help her understand the doctor's decision?
    a. Why won't the doctor give her antibiotics for this infection? (3 pts)
    b. What harm could there be in giving in and prescribing some antibiotics anyway? (5 pts)

8. **Matching.** Below are some important ecological roles of bacteria. For each one, choose one letter from the left list below for the type of bacteria that would perform this activity. Then, choose one number from the right list below to specify the type of metabolism these bacteria use. One letter and one number per blank, but you may re-use the letters and numbers. (24 pts)

    (1)_____   Return carbon from dead organisms to atmosphere as CO_2
    (2)_____   Produce CO_2 from methane.
    (3)_____   Provide sulfide used as an electron source by purple bacteria
    (4)_____   Use CO_2 for carbon but lack the Calvin cycle; produce methane
    (5)_____   Convert ammonia to nitrate or nitrite in the nitrogen cycle
    (6)_____   Convert H_2S to biologically useful sulfate in the sulfur cycle

    a. nitrogen fixers   1. chemoheterotrophs
    b. nitrifying bacteria   2. chemoautotrophs
    c. denitrifying bacteria   3. photoheterotrophs
    d. sulfide oxidizers   4. photoautotrophs
    e. sulfate reducers
    f. decay microbes
    g. sulfate assimilators
    h. methane oxidizers
    i. methanogens
    j. carbon fixers

9. *Treponema pallidum* is a spiral shaped, gram negative bacteria that is a spirochete. It is a human pathogen that causes syphilis. It attaches to the urogenital tract of humans and can undergo conjugation. Draw and label a picture of this organism drawing all structures you would expect to find inside and outside the cell. (8 pts)

10. *Nitrosomonas* is a chemolithoautotroph that oxidizes ammonia. It requires no growth factors. It's a mesophile and only grows at neutral pH. (12 pts)
    a. Explain (or diagram) how *Nitrosomonas* obtains its energy.
    b. Design a **defined** medium that would provide all the nutrients for *Nitrosomonas* to grow and indicate what each ingredient provides to the bacterium. It requires no growth factors.
        Ingredient   **Purpose**

1. How do mycorrhizae assist a plant in the uptake of nutrient elements. (10%)

2. While most plants take up nitrogen in the form of nitrate ion, there are some that seem to prefer ammonium. Can you suggest a possible biochemical basis for this difference? (10%)

3. How does the anatomy of a leaf lend itself to the efficient uptake of CO_2 for photosynthesis by leaf mesophyll cells? (10%)

4. Describe the difference between cyclic and non-cyclic electron transport. How can non-cyclic photosynthetic electron function if the PSII and PSI units are located in different regions of the thylakoid membrane? (10%)

5. In what ways does temperature influence physiological processes? Does temperature interact with other environmental factors? If so, which ones? (10%)

6. Describe how phytochrome regulates gene expression. (10%)

7. Describe the signal transduction of the stomatal response to blue light. (10%)

8. Describe the proposed model for the redistribution of auxin during gravitropism. (10%)

9. Describe the transcription factors regulating α-amylase gene expression. (10%)

10. Describe the model for ABA action stomatal guard cells. (10%)

1. Please give the most significant contribution by the following scientists (1 point each, total 10 points)

   (1) John Harper,   (2) R. H. Whittaker,   (3) C. H. Muller,   (4) E. P. Odum,
   (5) W. D. Billings,   (6) F. E. Clements,   (7) F. H. Bormann,   (8) H. A. Gleason,
   (9) E. D. Wilson,   (10) P. H. Raven

2. Please define the following term (2 points each, total 20 points)

   (1) Gross productivity,   (2) Alle's effect,   (3) Gause's rule,
   (4) Allelopathy   (5) Limiting factor,   (6) Demography
   (7) Compensation point,   (8) Sigmoid curve,   (9) Ecological niche,
   (10) Ecotype,

3. Please discuss the mechanisms of succession and climax of plant community (15 points)

4. Please discuss and compare the significance of r selection and **K selection** for the evolutionary process of a species (15 points)

5. Please discuss the significance of biodiversity and sustainable development (10 points)

6. What are the evolutionary and functional values of social hierachy and territoriality of animals? (10 points)

7. Explain how herbivory can directly and indirectly have an impact on community dynamics. (10 points)

8. What are the major approaches to control pest? Discuss the ecological advantages and disadvantages of the methods (10 points)

一、名詞解釋 （30分）

1. taxa
2. homoplasy
3. parsimony
4. character state
5. out-group
6. palynology
7. gene tree
8. apomorphy
9. allopolyploidy
10. polymorphism

二、問答題 （70分）

1. 請任舉五種台灣產之單子葉植物的中文名稱、拉丁文學名（作者名可略去）及科名。（14分）
2. 請任舉三種種的概念（species concept），並討論其在植物物種應用上之優缺點。（14分）
3. 何謂檢索表（keys）？並討論其可能之形式。（14分）
4. 請任舉國際植物命名法規（International Code of Botanical Nomenclature）上有列出的四種命名模式（nomenclatural type）及其區別。（14分）
5. 請討論 systematics, taxonomy, classification, identification 及 nomenclature 之間的關係。（14分）

1. The following table gives the education categories and gender of nurses in a large hospital.

	High School	5-year Professional School	University	Graduate School	Total
Male	0	3	15	2	20
Female	65	42	25	18	150
Total	65	45	40	20	170

Calculate the following probabilities:

a. P(University)   b. P(Female)   c. P(Female and University)

d. P(Female or University)   e. P(Female|University) (25 %)

2. A person's oxygen consumption during rest may be looked upon as a random variable having the normal distribution with $\mu = 30$ cc/min and $\sigma = 6$ cc/min. Find the probabilities that a person's oxygen consumption will be

a. greater than 33 cc/min;   b. less than 25 cc/min.(15 %)

3. The annual growth of a tree showed that 25 of them, selected at random, grew on the average 50 mm with a standard deviation of 5 mm. Construct a 99 percent confidence interval for the true average annual growth of the tree. (10 %)

4. The following are the cholesterol contents (in mg/package) which three laboratories obtained for 2-kg packages of two similar diet foods:

	Laboratory		
	1	2	3
Diet food A	4	5	7
Diet food B	4.1	4.9	7.2

Perform a two-way analysis of variance, using the 0.05 level of significance for both tests. (25%)

5. The following are education and incomes of five executives in the biotechnology industry.

Education (Years after high school)	Income (N.T. dollars)
4	1,200,000
4	2,000,000
6	3,500,000
8	4,000,000
10	4,500,000

a. Find the least-squares lines to predict Income with Education.

b. Test the significance of the regression. (25 %)

TABLE II　Critical Values of t

d.f.	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
inf.	1.282	1.645	1.960	2.326	2.576

TABLE I　Normal-Curve Areas

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Also, for $z = 4.0$, 5.0, and 6.0, the areas are 0.49997, 0.4999997, and 0.499999999.

TABLE IV Critical Values of F

Values of $F_{0.05}$

Denominator df	\ Numerator df → 1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161	200	216	225	230	234	237	239	241	242	244	246	248	249	250	251	252	253	254
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.5	19.5	19.5	19.5
3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.37
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

Degrees of freedom for numerator

Degrees of freedom for denominator