1. There is a solution containing amino acid A (pI 5.0), amino acid B (pI 11.0), protein C (M.M. 150 kDa, pI 5.0), protein D (M.M. 45 kDa, pI 5.5) and protein E (M.M. 50 kDa, pI 10.0), please design a experimental method to separate them. 15%

2. Explain the hydrophobic interaction of a long-chain fatty acids with alkyl chains mixed with water in terms of entropy or free energy changes. 10%

3. Outline the method of enzyme-linked immunosorbent assay (ELISA). 5%

4. Outline the Calvin cycle (CO_2 fixation). 10%

5. Describe the molecular mechanisms of signal transduction. 10%

6. (1) Glycogen, starch, and cellulose are polymers of glucose. Suggest reasons, based on structure, that the physical form of each is appropriate to its role in nature. (2) Suggest how a cell might selectively synthesize starch but not cellulose. 10%

7. An enzyme inhibitor can act in a reversible or an irreversible manner. How would you distinguish between an irreversible inhibitor and a reversible noncompetitive inhibitor? Assume you have an abundant supply of pure enzyme to work with. 10%

8. Describe the fate of glucose in mammalian muscles during intensive activity and its physiological significance. 10%

9. Explain why each of the following statements is false in terms of efficient metabolic regulation. 15%
   (1) Most enzymes operate *in vivo* near V_{max}.
   (2) Catabolic pathways tend to diverge from a single metabolite.
   (3) The enzymes regulated in a metabolic pathway usually exhibit simple Michaelis-Menten kinetics.
   (4) Energy charge is unimportant in regulation of anabolic pathways but is of primary important in the regulation of catabolic pathways.
   (5) Compartmentalization of metabolic pathways is seldom a regulatory strategy the cell uses.

10. Define the terms of glucogenic and ketogenic as applied to amino acids. 5%

（橫書式） 國立中山大學八十五學年度碩博士班招生考試試題

科 目：免疫學 生科所 甲組 選考

I. Match for the BEST answer: (15 points)

___ 1. Lyme disease	A. *Plasmodium* spp.
___ 2. Sleeping sickness	B. Nuts
___ 3. Autoimmune disease	C. *Mycobacterium*
___ 4. Immune complex nephritis	D. *Borrelia*
___ 5. Tuberculosis	E. *Trypanosoma brucei*
___ 6. Atopic urticaria	F. Nickle
___ 7. HIV receptor	G. Rhogam
___ 8. Contact-dermatitis	H. SLE
___ 9. Erythroblastosis fetalis	I. CD4
___ 10. Anaphylatoxin	J. C3a, C4a, C5a
___ 11. Major amplification	K. C3b
___ 12. Early component of classical pathway	L. C1, C4, C2, C3
___ 13. Has perforin-like activity	M. C9
___ 14. Mediates opsonization	N. C3a, C5a, C5b67
___ 15. Chemotatic factor	O. C3 ---> C3a + C3b

II. True (O) or false (X): (10%)

( ) 1. Mice infected with *Nippostrongylus brasiliensis* show decreased production of IgE.
( ) 2. Babies can acquire IgE-mediated allergies by passive transfer of maternal antibody.
( ) 3. Antihistamines are effective for the treatment of type III hypersensitivity.
( ) 4. Hydrophilic peptides are more likely to represent immunodominant B-cell epitopes than hydrophobic peptides.
( ) 5. Killed organism vaccines can evoke good antibody responses and last longer than live vaccines.
( ) 6. Attenuated vaccines are more likely to induce cell-mediated immunity than killed vaccines are.
( ) 7. Most pollen allergens contain a single allergenic component.
( ) 8. MHC genes play a major role in determining the degree of immune responsiveness to an antigen.
( ) 9. Each MHC molecule binds a unique peptide.
( )10. Most antigens induce polyclonal responses.

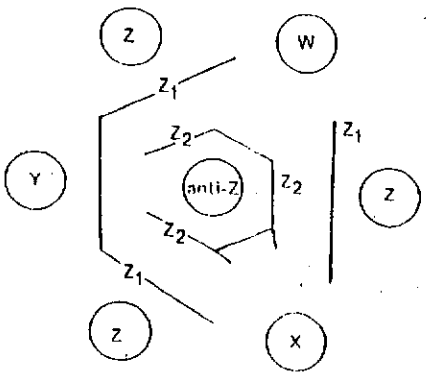
III. For the blanks below, number them in your answer sheet, use (+) for positive, (-) for negative, and (±) for slightly positive: (10%)

1. Ab property:	Whole Ig (example)	H chain	L chain	Fab	F(ab')2	Fc
Bind antigen	+	(1)	(2)			
Bivalent Ag binding				(3)	(4)	
Bind to Fc receptor		(5)	(6)			
Fix complement		(7)	(8)			(9)
Has variable domains		(10)				

2. Events happened during B-cell differentiation:

	Progenitor B cell	Pre B cell	Immature B cell	Mature B cell	Activated B cell	Plasma cell
Ig synthesis:						
Heavy chain		(11)	(12)			
Light chain	(13)	(14)	(15)			
RNA processin			(16)			
Isotype switching			(17)	(18)	(19)	(20)

V. Suppose that as a physician you carry out the following experiments. You isolate a substance, called Z, from the plasma of a patient with a particular disease. You prepare an antiserum to Z (anti-Z) by injecting the substance repeatedly into a rabbit. You isolate similar substances—call them W, X, and Y—from three other patients suspected of having a disease similar to that of the patient from whom Z was prepared. You prepare an Ouchterlony plate and place the anti-Z antibody in the center well. You arrange antigen preparations W, X, Y, and Z in the antigen wells, as shown in Figure



The precipitin pattern in an Ouchterlony test

(a) What is the minimum number of antigens present in Z? (4 %)
(b) How similar are these antigens? Compare preparations W, X, and Y to preparation Z in detail. (4 %)
(c) Would you conclude that your patients have similar diseases? (4 %)

VI. As a student in an immunology laboratory class, you have been given spleen cells from a mouse immunized with the LCM virus. You determine the antigen-specific functional activity of these cells with two different assays. In assay 1, the spleen cells are incubated with macrophages that have been briefly exposed to the LCM virus; the production of interleukin 2 (IL-2) is a positive response. In assay 2, the spleen cells are incubated with LCM-infected target cells; lysis of the target cells represents a positive response in this assay. The results of the assays using macrophages and target cells of different haplotypes are presented in the table below. Note that the experiment has been set up in a way to exclude alloreactive responses.

a. Which cell populations are detected in each of the two assays? (4 %)
b. From the results of this experiment, which MHC molecules are required, in addition to the LCM virus, for specific reactivity of the spleen cells in each of the two assays? (4 %)
c. Which additional experiments would you need to do to unambiguously confirm the MHC molecules required for antigen-specific reactivity of the spleen cells? (4 %)
d. Which of the mouse strains listed in the table could have been the source of the immunized spleen cells tested in the functional assays? Give your reasons. (4 %)

Mouse strain used as source of macrophages and target cells	MHC haplotype of macrophages and virus-infected target cells				Response of spleen cells	
	K	*A*	*E*	*D*	IL-2 production in response to LCM-pulsed macrophages (assay 1)	Lysis of LCM-infected cells (assay 2)
C3H	*k*	*k*	*k*	*k*	+	–
BALB/c	*d*	*d*	*d*	*d*	–	+
(BALB/c × B10.A)F_1	*d/k*	*d/k*	*d/k*	*d/d*	+	+
A.TL	*s*	*k*	*k*	*d*	+	+
B10.A (3R)	*b*	*k*	*k*	*d*		

VII. Three groups of mice were immunized according to the schedule shown in the table below. Spleen cells were isolated from the immunized mice, and the number of plaque-forming cells were determined; the direct and indirect PFC counts for each group are listed in the table.

Immunization schedule	Direct PFC/10^6 spleen cells	Indirect PFC/10^6 spleen cells
(A) 1° DNP-BSA	310	343
(B) 1° DNP-BSA; 2° DNP-BSA	62	4060
(C) 1° DNP-BSA; 2° DNP-BGG	366	386

a. Describe the assay used to measure a primary (1°) and secondary (2°) PFC response. (4%)
b. Calculate the number of IgM-secreting and IgG-secreting plasma cells/10^6 spleen cells for each group of mice. (4%)
c. Why is the indirect PFC so much higher than the direct PFC for group B but not for group A or C? (4%)

VIII. You produced a monoclonal antibody to HIV and suspect that it has been stolen by a colleague and is now being marketed by a biotechnology company. You want to prove that the company's product is the same as the monoclonal antibody that you isolated.

a. Describe quick and inexpensive immunologic tests that you could perform to determine if the two antibodies might be identical. (5%)
b. Assuming these initial tests suggest that the two antibodies are identical, what more expensive and time-consuming procedures could you use to demonstrate unequivocally whether or not the two antibodies are the same? (5%)

一. 解釋名詞 10%，每題 2.5 分，請敘述下列細胞生理現象
1. Receptor-mediated endocytosis
2. synaptic transmission
3. exocytosis
4. Fluid mosaic model of cellular membranes

二. 周圍神經系統分布於呼吸道的神經纖維，可分爲腎上腺素性纖維(adrenergic fiber)，膽鹼性纖維(cholinergic fiber)及非腎上腺素性非膽鹼性纖維(nonadrenergic noncholinergic fiber)，請問它們各有何功能？各釋放那些神經傳導物質(neurotransmitter)？ 10%

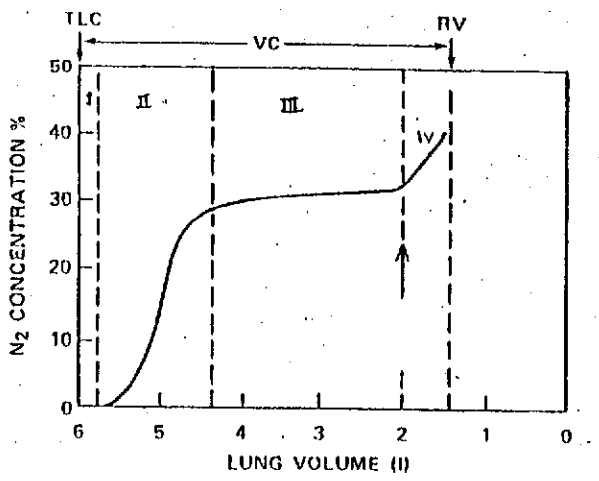
三. 正常成人在休息狀態時，心臟每 0.8 秒搏動一次[亦稱爲心動周期(cardiac cycle)]，因此一分鐘心跳 75 次，心電圖(electrocardiogram)計錄心臟的電波變化，請畫出心電圖波(waves of ECG)，並說明其和心臟不同部位的生理活動的關係。 10%

四. 試說明肺及腎如何調控血液酸鹼度之平恆？ 10%

五. 列舉並說明影響呼吸道阻力之因素. 10%

六. 某生接受單次呼吸法測定吸入氣體在肺中之分布狀態，受測學生先盡力呼出肺中存氣然後盡力吸入氧(20%)-氦(80%)混合氣體，接著緩緩呼完肺中存氣，並以氦分析儀連續偵測其呼氣中含氦濃度如圖一。(本題分數為 10%).
1. 若呼出氣之平均氦濃度爲 20%，試估算此生之 TLC(肺總量)
2. 請估算其 RV(肺餘氣容積)
3. 請說明爲何圖中 I, II, III,線段之形態各不相同？
4. 圖中 IV 區氦濃度上昇代表之意義爲何？

圖一



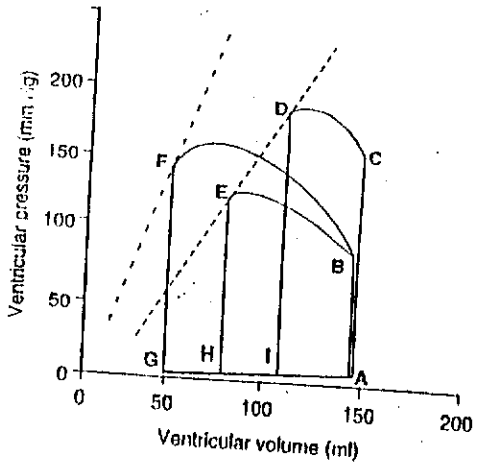
七. 指出下列 hormone 分別作用於腎臟之何部位？ 10%

1. aldosterone
2. ADH
3. renin
4. epinephrine

八. 圖 2 爲左心室之壓力-容積相關圖(pressure-volume loop), ABEH 爲正常之圖(normal P-V loop)

1. 在 ABEH loop 中指出代表心縮期(systole)及心舒張期(diastole)之線段. 2.5%
2. ABFG loop 顯示之心搏輸出量 stroke volume 大約爲多少?可從何線段估算之. 2.5%
3. ACDI, ABFG, 及 ABEH 三圖, 何者最能代表正腎上腺素作用後之結果？ 2.5%
4. 前述三圖何者最能代表因昇高 after load 造成之結果？試述造成心肌 after load 及 preload 昇高之因素. 2.5%

圖 2



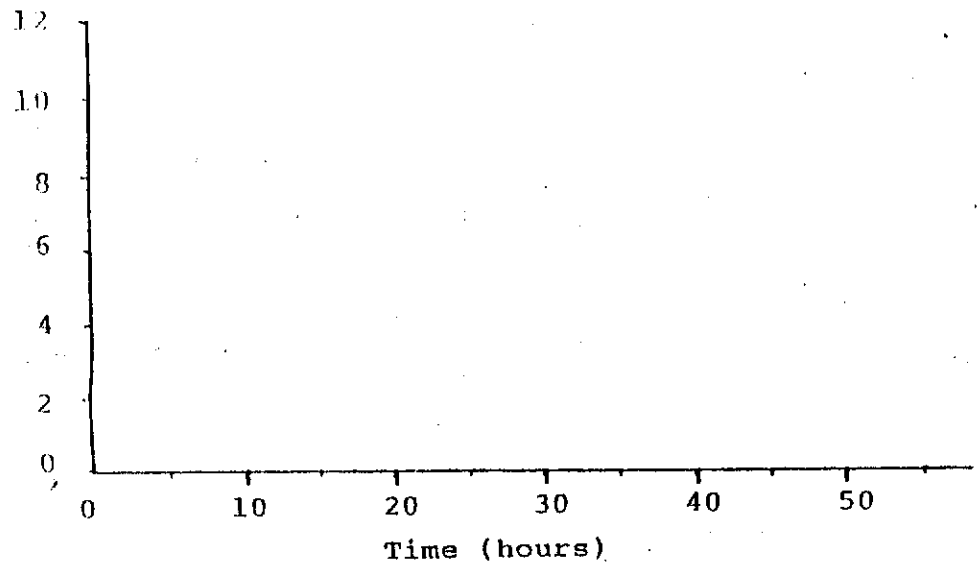
九. 試分別舉述最常用於人體及實驗動物之血壓量測方法並列舉決定動脈血壓之因素. 10%

十. 有一正常個體某日因腹瀉(diarrhea)失去 2 公升體液(isotonic solution), 但他同時也喝下 2 公升白開水以補充體液損失, 試問其體內下列介值是否產生變化? 解釋之. 10%

1. extracellular fluid volume
2. body-fluid osmolarity
3. renin secretion
4. ADH secretion

1. Draw a standard bacterial growth curve on the graph below from the following information: (6 pts)

100 viable bacterial cells were inoculated into 100 ml of fresh borth medium and incubated under optimal conditions for growth. After a six-hour lag phase, the cells began to increse in numbers so that at 12 hours, the population reached a density of 1,000 cells per ml of broth. The cell population continued to multiply at this rate until 24 hours, enterd the stationary phase for six hours, and started to decrease in viable numbers at 30 hours, arriving at a cell number of 100 cells per ml at 40 hours.



(1) Lable the Y-axis with the appropriate units for measuring bacterial growth. (2 pts)

(2) On your plot above lable the four characteristic phases of a typical bacterial growth curve. (2 pts)

(3) What is the number of viable cells attained by this culture during the stationary phase of the growth cycle? _____ viable cell / ml (2 pts)

(4) The generation time of this bacterial culture is: (select one answer) _____. (1 pt)
i) between 1 mimute and 10 minutes
ii) between 10 minutes and 2 hours
iii) between 2 hours and 10 hours
iv) greater than 10 hours

(5) Suppose the antibiotic ampicillin was added to the susceptible bacterial culture at 18 hours. What do you predict as the growth curve measured over the next six hours? (Indicate your answer on the graph above by drawing a dashed line ----- between 18 and 24 hours). (2 pts)

2. You want to know how many bacteria are present in a gram of garden soil. You decide to use the plate count method to enumerate them. You suspend one gram of soil in 1,000 ml of sterile buffer, and you spread 1.0 ml of this suspension onto each of three agar plates containing rich medium. Because you have no idea about how much bactera are present in that soil sample, you also spread 0.1 ml of the same suspension onto each of three plates. After 24-hour incubation period, the first three set of plates (1.0 ml) give rise to 673, 645, and 620 colonies; while the second three set of plates (0.1 ml) give rise to 75, 84, and 81 colonies, respectively. (1) What is the total number of bacteria that you estimate to be present in the gram of soil? (2) What limitations or qualifications, if any, do you place on this estimate? (5 pts)

3. Describe how you would make a lysine auxotroph mutant from a wild type *Escherichia coli* strain? List all of the steps you would take. (10 pts)

4. The bovine spongiform encephalopathy (BSE) or so called "mad cow disease" is suspected to have some connection to the human spongiform encephalopathy know as Creutzfeldt-Jakob disease (CJD). Both diseases was thought caused by a same type of infectious agent called "**prion**" which contains no DNA or RNA. (1) What is a prion? (2) In your opinion, is prion a living organism? Why or Why not? (3) How prion "multiplies" itself in the host cells? (4) How prion damages the host brain tissue? (5) Do you think the human CJD is an infectious disease among human population? Why or Why not? (10 pts)

5. Read the following essay about **tetanus** (破傷風) carefully, pick out at least 10 mistaken statements (assume there is no spelling or grammar error). (10 pts)

Tetanus is caused by *Bacillus tetani*, an aerobic gram-positive spore former. This bacterium is commonly found in hospital environments, in soil and in feces of many farm animals and humans. Under appropriate cultural conditions the organism produces a sopre centrically located and of considerably greater diameter than the vegetative cell, which gives the characteristic spindle appearance. Transmission to humans is associated with food and water. Any ingestion of contaminated food can allow tetani endospore to germinate inside the intestine and cause this disease. The spore conveys to the organism considerable resistance to the various disinfectants but not to heat. It is easily destroyed by boling for 20 minutes. When the bacteria die and lyse, the endotoxin **tetanospasmin** is released. This toxin acts on the central nervous systen to prevent the release of the glycin, and the results is that opposing sets of muscles often contract simultaneously and in uncontrollable fashion, giving rise to spasms . Death usually results from the liver and kidney damage. The mortality rate is very low at 1 to 3 percent. Immunization against tetanus is impossible due to its high mutation rate and the high toxicity of its toxin. The treatment of tetanus varies with the severity of the disease. In general, large dose of sulfa drugs should be given. Mild tetanospasm may be controlled with barbiturates and diazepam to release the stress of muscle. Tetanus is now relatively rare in well-developed countries. In developing

6. Conditional-lethal mutations are of research and medical interests, since they may be useful in vaccines, e.g., influenza vaccine. (a) What is a conditional-lethal mutation? (b) Give one example of conditional-lethal mutation. (c) Discuss reasons how they can be used for vaccines. (10 pts)

7. Fungi are eukaryotic organisms whereas bacteria are prokaryotic. Explain briefly (a) How do fungal and human cell membrane differ? (b) How do bacterial and fungal cell wall differ? (c) How can amphotericin B be used in the treatment of a variety of fungal diseases? (10 pts)

8 (a) What is a provirus? (b) Distinguish between a provirus and an oncogene. (c) Discuss the relationship between provirus and insertional mutagenesis. (10 pts)

9. You are assigned to study differences of growth curve between bacteria and virus. Growth media, an animal virus stock, cells for growing virus, other materials and equipments needed are all given to you. (a) How will you design the experiment for studying growth curve of virus ? (b) Draw a typical growth curve for virus and explain the significance of the curve. (10 pts)

10. Define the following terms that are essential in modern biotechnology: (10 pts)
(a) Restriction endonucleases
(b) Transformation
(c) Site-directed mutagenesis
(d) Hybridization
(e) Monoclonal antibodies

(橫書式) 國立中山大學八十五 學年度碩博士班招生考試試題

目： 植物生理學 生科所 乙組 適考

1. Describe the environmental conditions on stomates. (10%)

2. Figure a diagram of cotransport and countertransport of solutes across the plasma membrane driving by energy in ATP. (10%)

3. Describe the pathway of CO_2 fixation in C_4 species. (15%)

4. Term explanation. (15%)
   (1) Emerson enhancement effect: cooperating photosynthesis
   (2) Totipotent
   (3) Symplast and apoplast

5. Describe the model for the redistribution of calcium and auxin during gravitropism in roots. (10%)

6. Describe how the phytochrome regulates gene transcription. (10%)

7. Describe the polar auxin transport. (10%)

8. Term explanation: (20%)
(1). morphogenesis (2). statolith (3). gibberellin (GA)
(4). abscisic acid (ABA)

I. Multiple Choice

(select the one lettered answer that is best in each case, 2 % each, 20 % total)

1. Prion is believed to be the extraordinary agent associated with the "Mad Cow Disease". Which of the following statements is incorrect about prion ?
(A) the major component is a 28 kDa protein (B) it is a glycoprotein (C) it is coded by a cellular gene (D) it is expressed in normal brain (E) it is associated with a cryptic nucleic acid.

2. Which of the followings may interact with the Shine-Dalgano sequence during translation process ? (A) the 50S ribosome subunit (B) the 30S ribosome subunit (C) the 3' of 16S RNA (D) the 3' of 5S RNA (E) the charged tRNA.

3. Which of the followings is not necessary for the construction of a cloning vector ?
(A) a replication origin (B) a antibiotics resistance gene (C) multiple cloning sites (D) a strong promoter (E) small in size.

4. Which of the followings can help you most to identify a membrane protein ?
(A) hydropathy plot (B) palindromic structure search (C) restriction analysis (D) motif analysis (E) DNA sequence alignment.

5. Which of the following compounds is usually used as a chemical inducer for the *lac* promoter-driven transcription ?
(A) IAA (B) GA (C) IPTG (D) CAT (E) GABA.

6. Which of the followings can not describe the power of PCR technology ?
(A) gene cloning (B) site-directed mutagenesis (C) rapid dignosis (D) DNA methylation (E) DNA amplification.

7. Which of the following statements is not suitable for "enhancer" ?
(A) modular like protein (B) enhance enzyme activities (C) function in either direction (D) function in variable distance (E) may increase the concentration of transcription factors in the vicinity of the promoter.

8. Which of the following statements is inappropriate for the *trans*-splicing reaction ?
(A) it is a intramolecular reaction (B) it is relatively rare (C) it can occur if complementary sequences are introduced in the introns (D) it is the same thing as alternative splicing (E) some chloroplast genes are *trans*-spliced.

9. Which of the followings is the most conserved sequence among all living species ?
(A) introns (B) lactate dehydrogenase gene (C) 16S RNA genes (D) promoter sequences (E) amino acid biosynthetic genes.

10. Which of the following statements about genome is inappropriate ?
(A) mycoplasma have the smallest genome in self-replicating entities (B) the genome size of mammals is usually smaller than the amphibians (C) the flowering plants usually have a smaller genome than insects (D) genome size has nothing to do with evolutionary history

II. Answer the Following Questions

(10 % each, except 20 % for problem #3, 80 % total)

1. What is the appropriate temperature to keep the followings ?
   (A) genomic library using lambda EMBL3 vector
   (B) polyconal antiserum
   (C) DNA solution prepared from the alkaline method
   (D) restriction endonucleases
   (E) 0.8 % agarose

2. Please describe the major functions of the following proteins.
   (A) Hu protein (B) DNA polymerase (C) topoisomerase (D) *dam* methylase
   (E) nuclease.

3. Explain the following terms. (20 %)
   (A) codon degeneracy (B) Western analysis (C) restriction mapping (D) transduction
   (E) RNA editing (F) Alu sequence (G) CpG island (H) zinc finger
   (I) chromosomal jumping (J) DNA fingerprinting.

4. Please give a few examples to distingush the functions of "oncogenes" and "tumor suppressor genes" in cancer cells.

5. Describe and discuss the expression of human hemoglobin genes during development.

6. Compare the arrangement of *cis*-acting sites in the control regions of genes from prokaryotes and eukaryotes.

7. In both Drosophila and humans, the gene for glucose-6-phosphate dehydrogenase (G6PD) is X-linked. Different alleles of G6PD gene are known to confer different electrophoretic mobilities of the enzyme.

   (A) If you had a female fly heterozygous for the two electrophoretically different G6PD alleles, would you expect that the alleles would be expressed in the same cell ? Why or why not ?
   (B) If you had a female human heterozygous for the two electrophoretically different G6PD alleles, would you expect that the alleles would be expressed in the same cell ? Why or why not ?

單選題: 60 pts, 2 pts each

1. Animals in the phylum _____ have a cranium.
a. Cephalochordata b. Urochordata c. hemichordata d. none of the above.

2. Which of the following statements is true?
a. the body of the lancelet is compressed.
b. Sea squirts are gonochoristic.
c. Hemichordates are fresh-water dwellers.
d. No pharynx slits exist in the larval tunicates.

3. The study of the kinds and diversity of organisms and of any relationships among them is
a. zoological classification
b. taxonomy
c. systematics
d. zoological nomenclature

4. The specific name
a. must be a latin noun b. same can be used in different genera c. a Greek verb d. none of the above

5. Which school of taxonomy is a theory-free approach?
a. numerical phenetics b. cladistics c. evolutionary classification d. all of the above.

6. The keys of a taxonomic publication must be
a. non-dichotomous b. not diagnostic c. of internal characters d. of characters relative constant.

7. In a taxonomic publication, the _____ distinguish the species (taxon) from other known similar ones.
a. diagnosis b. descriptions c. discussion d. measurement

8. Which of the following groups of chordates evolved prior to the appearance of cartilaginous fishes?
a. tunicates, and agnathans
b. bony fishes and sea squirts
c. agnathans and bony fishes
d. tunicates, lancelets, and mammals

9. Which is true about the order Cypriniformes 鯉形目?
a. no adipose fin
b. salt water dwelling
c. little bone connecting the swim bladder and the outer ear
d. no barbels

10. Which statement is true?
a. Cichlids 慈鯛科魚 are originally occur in Asia.
b. Gobies 鰕虎 usually do not have swim bladder.
c. Basses 鱸魚 have an adipose fin.
d. Basses do not have true spines.

11. All but one of the following are valid characteristics of the Bufonidae. Select the exception.
a. teeth on premaxillae and maxillae
b. head broad
c. skin covered with wards
d. fingers not webbed.

12. Which of the following does not occur in Taiwan?
a. narrow-mouthed frogs
b. Asiatic salamanders
c. caecilians
d. tree-frogs.

13. Which of the following correctly describe the Amphibians?
a. lateral-line system exist for aquatic individuals
b. eyes without eyelids
c. most oviparous
d. no internal fertilization.

14. Which of the following is most closely related to dinosaurs?
a. amphibians
b. snakes
c. birds
d. mammals

15. Modern reptiles include all of the following groups except
a. caimans
b. tortoises
c. tuatara
d. none of the above

16. Which has a three-chambered heart?
a. *Pycnontus sinensis* 白頭翁
b. *Ilyla chinensis* 中國樹蟾
c. *Eplphe carinata* 臭青公
d. *Oncorhynchus mason* 櫻花鉤吻鮭

17. The eggs of reptiles and birds have many similarities. Which of the following is not a common feature of both?
a. developing embryo in and air-filled chamber
b. exterior shell
c. complex system of internal membranes
d. yolk

18. Which of the following are viviparous?
a. *Ocadia sinensis* 斑龜
b. *Mabuya longicaudata* 長尾南蜥
c. *Gekko japonica* 守宮
d. *Hydrophis nardwickii* 刺海蛇

19. Which birds practice polyandry?
a. eagles b. geese c. jacanas d. albatrosses

20. Which statement is true?

a. A single testis exists in male birds
b. Two ovaries are found in the family of Emus
c. All birds lack external genitalia
d. Some birds copulate in the air

21. Which group of birds is most tropical, beak strongly hooked with a hinged upper mandible, and extremely vocal?
a. Charadriiformes 鴴形目 b. Psittaciformes 鸚形目 c. Cuculiformes 鵑形目 d. Falconiformes

22. Silent flight is a characteristic of
a. owls 貓頭鷹 b. cuckoos 杜鵑 c. woodpeckers 啄木鳥 d. quails 鵪鶉

23. Order Passeriformes 雀形目 includes all of the following except
a. swifts 雨燕 b. pittas 八色鳥 c. bulbuls 鵯 d. crows 烏鴉.

24. Which birds dwell mostly in high altitudes?
a. cuckoo-shrikes 山椒鳥 b. accentors 岩鷚 c. orioles 黃鸝 d. tits 山雀

25. Which of the following is an example of placental mammal?
a. cow
b. duck-billed platypus
c. spiny anteater
d. kangaroo

26. Which group is not odd-toed?
a. deer
b. horses
c. tapirs
d. rhinoceroses

27. All of the following mammals have binocular vision except
a. primates
b. rodents
c. herbivores
d. carnivores

28. Which is true about the animals in the order Cetacea 鯨目?
a. hair on the body
b. vertically set tail fluke
c. no visible hind limbs
d. marine only

29. Rays
a. are bottom living.
b. are fast moving.
c. are flattened laterally.
d. have dorsal gills .

30. Which of the following is not a function of the air bladder?
a. hydrostatic organ
b. making sound
c. water current information
d. assist in hearing

問答題: 40 pts

1. 解釋下列名詞 10 pts
notochord

lobbed feet

Amphisbaenians

vocal sacs

phylogeny

2. Distinguish among Ostrich, rheas, and kiwis, and give the distribution of these birds. What are the major shared characteristics of these birds? 10 pts

3. Compare and distinguish the fishes in class Chondrichthyes and Osteichthyes. 10 pts

4. Describe the distinguishing characteristics of the insectivores and rodents. 10 pts

(橫書式) 國立中山大學 85 學年度碩博士班招生考試試題

科 目：生態學 生科所丙組

I. 解釋名詞 (5 points each)

1. mutualism
2. polygyny threshold model
3. competitive and energy flow hypothesis for succession
4. life table
5. phytosociology
6. Wallace's line

II. 申論題

1. (10 points)

試述生態學與遺傳科學之間的關係、以及現階段生態學的主要發展方向及目標。

2. (10 points)

影響生物族群大小及密度變動的因素為何？

3. (10 points)

試述學習與本能的行為，在物種適應生態環境的生存上，孰優孰劣？理由為何 ？

4. (10 points)

試以生態學的觀點來解釋趨同演化及趨異演化。

5. (15 points)

現今地球上生物多樣性 (Biodiversity) 大的地方有那些？ 理由為何？目前所面臨的生物多樣性喪失， 其發生原因及其影響為何？

6. (15 points)

試擬一研究物種競爭的實驗計畫書， 其中包括主題、背景、目的、重要性、方法、預期結果、以及研究期間及經費的需求。

1. The following table shows the outcome of 500 interviews completed during a survey to study the opinions of residents of Kaohsiung city about the construction of the Cross-Harbor bridge (跨海大橋). 16 pts

	Outcome			
Area of City	For (F)	Against (Q)	Undecided (R)	Total
A	100	20	5	125
B	115	5	5	125
D	50	60	15	125
E	35	50	40	125
Total	300	135	65	500

If a questionnaire is selected at random from the 500, what is the probability that:
a. The respondent was for the construction of the Cross-Harbor bridge ?
b. The respondent lived in area A?
c. The respondent was for the construction of the Cross-Harbor bridge, given that he of she resided in area B?
d. The respondent was undecided or resided in area D?
e. $P(A \cap R)$
f. $P(Q \cup D)$
g. $P(\bar{D})$
h. $P(Q \mid D)$

2. Ages of eight oak trees determined as 25, 28, 17, 26, 27, 22, 25, and 30. We wish to know if we may conclude that the mean age of the population from which the sample may be presumed to have been drawn is greater than 20 years. Let $\alpha = 0.01$. 14 pts

3. Researchers wish to know if two fishes of a stream differ with respect to maturation. A field survey revealed the following information: 15 pts

Group	Number in the sample	Number matured
fish a	300	24
fish b	500	15

Do these data provide sufficient evidence to indicate a difference in the prevalence of mature fish in the two populations? Let $\alpha = 0.05$. Determine the p value.

4. An experiment was designed to study the effects of three different drugs and three types of stressful situation in producing anxiety in rats. The table shows the difference between the Pre- and post treatment scores of 18 rats used in the experiment. 20 pts

Stressful Situation	Drug A	Drug B	Drug C
I	4	1	1
	5	3	0
II	6	6	6
	6	6	3
III	5	7	4
	4	4	5

Perform an analysis of variance of these data and test the three possible hypotheses. Let $\alpha = 0.05$ for all tests. Determine the p values.

5. The following are the ages (X) and systolic blood pressures (Y) of 20 healthy adults.

Age	B.P.	Age	B.P.
20	120	46	128
43	128	53	136
63	141	70	146
26	126	20	124
53	134	63	143
31	128	43	130
58	136	29	124
46	132	19	121
58	140	31	126
70	144	23	123

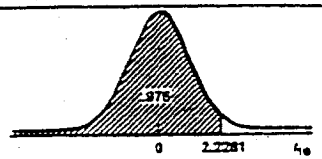
Find the simple linear regression equation and test $H_0: \beta = 0$ using both ANOVA and the t test. Test $H_0: \rho = 0$, and construct a 95 percent confidence interval for ρ. Find the 95 percent prediction interval for the systolic blood pressure of a person who is 25 years old. Let $\alpha = 0.05$ for all tests. How much variation in the blood pressure can be explained by age? 20 pts

6. The following table shows 200 birds classified according to species and preferences of perching stratification (棲枝分層) on a tree or on the ground. 15 pts

	species			
Perching stratification	A	B	C	Total
Top	6	30	22	58
Middle	11	35	17	63
Bottom	4	19	14	37
Ground	5	25	12	42
Total	26	109	65	200

Do these data provide sufficient evidence to indicate that these birds differ in the their preferences of perching? Let $\alpha = 0.05$.

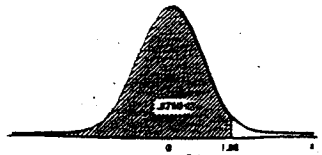
TABLE E Percentiles of the t Distribution



$p(t_{10} \le 2.2281) = .975$

d.f.	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$
1	3.078	6.3138	12.706	31.821	63.657
2	1.886	2.9200	4.3027	6.965	9.9248
3	1.638	2.3534	3.1825	4.541	5.8409
4	1.533	2.1318	2.7764	3.747	4.6041
5	1.476	2.0150	2.5706	3.365	4.0321
6	1.440	1.9432	2.4469	3.143	3.7074
7	1.415	1.8946	2.3646	2.998	3.4995
8	1.397	1.8595	2.3060	2.896	3.3554
9	1.383	1.8331	2.2622	2.821	3.2498
10	1.372	1.8125	2.2281	2.764	3.1693
11	1.363	1.7959	2.2010	2.718	3.1058
12	1.356	1.7823	2.1788	2.681	3.0545
13	1.350	1.7709	2.1604	2.650	3.0123
14	1.345	1.7613	2.1448	2.624	2.9768
15	1.341	1.7530	2.1315	2.602	2.9467
16	1.337	1.7459	2.1199	2.583	2.9208
17	1.333	1.7396	2.1098	2.567	2.8982
18	1.330	1.7341	2.1009	2.552	2.8784
19	1.328	1.7291	2.0930	2.539	2.8609
20	1.325	1.7247	2.0860	2.528	2.8453
21	1.323	1.7207	2.0796	2.518	2.8314
22	1.321	1.7171	2.0739	2.508	2.8188
23	1.319	1.7139	2.0687	2.500	2.8073
24	1.318	1.7109	2.0639	2.492	2.7969
25	1.316	1.7081	2.0595	2.485	2.7874
26	1.315	1.7056	2.0555	2.479	2.7787
27	1.314	1.7033	2.0518	2.473	2.7707
28	1.313	1.7011	2.0484	2.467	2.7633
29	1.311	1.6991	2.0452	2.462	2.7564
30	1.310	1.6973	2.0423	2.457	2.7500
35	1.3062	1.6896	2.0301	2.438	2.7239
40	1.3031	1.6839	2.0211	2.423	2.7045
45	1.3007	1.6794	2.0141	2.412	2.6896
50	1.2987	1.6759	2.0086	2.403	2.6778
60	1.2959	1.6707	2.0003	2.390	2.6603
70	1.2938	1.6669	1.9945	2.381	2.6480
80	1.2922	1.6641	1.9901	2.374	2.6388
90	1.2910	1.6620	1.9867	2.368	2.6316
100	1.2901	1.6602	1.9840	2.364	2.6260
120	1.2887	1.6577	1.9799	2.358	2.6175
140	1.2876	1.6558	1.9771	2.353	2.6114
160	1.2869	1.6545	1.9749	2.350	2.6070
180	1.2863	1.6534	1.9733	2.347	2.6035
200	1.2858	1.6525	1.9719	2.345	2.6006
∞	1.282	1.645	1.96	2.326	2.576

TABLE D Normal Curve Areas $P(z \le z_0)$ Entries in the Body of the Table are Areas between $-\infty$ and z



z	−0.09	−0.08	−0.07	−0.06	−0.05	−0.04	−0.03	−0.02	−0.01	0.00	z
−3.80	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	−3.80
−3.70	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	−3.70
−3.60	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0002	.0002	−3.60
−3.50	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	−3.50
−3.40	.0002	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	−3.40
−3.30	.0003	.0004	.0004	.0004	.0004	.0004	.0004	.0005	.0005	.0005	−3.30
−3.20	.0005	.0005	.0005	.0006	.0006	.0006	.0006	.0006	.0007	.0007	−3.20
−3.10	.0007	.0007	.0008	.0008	.0008	.0008	.0009	.0009	.0009	.0010	−3.10
−3.00	.0010	.0010	.0011	.0011	.0011	.0012	.0012	.0013	.0013	.0013	−3.00
−2.90	.0014	.0014	.0015	.0015	.0016	.0016	.0017	.0018	.0018	.0019	−2.90
−2.80	.0019	.0020	.0021	.0021	.0022	.0023	.0023	.0024	.0025	.0026	−2.80
−2.70	.0026	.0027	.0028	.0029	.0030	.0031	.0032	.0033	.0034	.0035	−2.70
−2.60	.0036	.0037	.0038	.0039	.0040	.0041	.0043	.0044	.0045	.0047	−2.60
−2.50	.0048	.0049	.0051	.0052	.0054	.0055	.0057	.0059	.0060	.0062	−2.50
−2.40	.0064	.0066	.0068	.0069	.0071	.0073	.0075	.0078	.0080	.0082	−2.40
−2.30	.0084	.0087	.0089	.0091	.0094	.0096	.0099	.0102	.0104	.0107	−2.30
−2.20	.0110	.0113	.0116	.0119	.0122	.0125	.0129	.0132	.0136	.0139	−2.20
−2.10	.0143	.0146	.0150	.0154	.0158	.0162	.0166	.0170	.0174	.0179	−2.10
−2.00	.0183	.0188	.0192	.0197	.0202	.0207	.0212	.0217	.0222	.0228	−2.00
−1.90	.0233	.0239	.0244	.0250	.0256	.0262	.0268	.0274	.0281	.0287	−1.90
−1.80	.0294	.0301	.0307	.0314	.0322	.0329	.0336	.0344	.0351	.0359	−1.80
−1.70	.0367	.0375	.0384	.0392	.0401	.0409	.0418	.0427	.0436	.0446	−1.70
−1.60	.0455	.0465	.0475	.0485	.0495	.0505	.0516	.0526	.0537	.0548	−1.60
−1.50	.0559	.0571	.0582	.0594	.0606	.0618	.0630	.0643	.0655	.0668	−1.50
−1.40	.0681	.0694	.0708	.0721	.0735	.0749	.0764	.0778	.0793	.0808	−1.40
−1.30	.0823	.0838	.0853	.0869	.0885	.0901	.0918	.0934	.0951	.0968	−1.30
−1.20	.0985	.1003	.1020	.1038	.1056	.1075	.1093	.1112	.1131	.1151	−1.20
−1.10	.1170	.1190	.1210	.1230	.1251	.1271	.1292	.1314	.1335	.1357	−1.10
−1.00	.1379	.1401	.1423	.1446	.1469	.1492	.1515	.1539	.1562	.1587	−1.00
−0.90	.1611	.1635	.1660	.1685	.1711	.1736	.1762	.1788	.1814	.1841	−0.90
−0.80	.1867	.1894	.1922	.1949	.1977	.2005	.2033	.2061	.2090	.2119	−0.80
−0.70	.2148	.2177	.2206	.2236	.2266	.2296	.2327	.2358	.2389	.2420	−0.70
−0.60	.2451	.2483	.2514	.2546	.2578	.2611	.2643	.2676	.2709	.2743	−0.60
−0.50	.2776	.2810	.2843	.2877	.2912	.2946	.2981	.3015	.3050	.3085	−0.50
−0.40	.3121	.3156	.3192	.3228	.3264	.3300	.3336	.3372	.3409	.3446	−0.40
−0.30	.3483	.3520	.3557	.3594	.3632	.3669	.3707	.3745	.3783	.3821	−0.30
−0.20	.3859	.3897	.3936	.3974	.4013	.4052	.4090	.4129	.4168	.4207	−0.20
−0.10	.4247	.4286	.4325	.4364	.4404	.4443	.4483	.4522	.4562	.4602	−0.10
0.00	.4641	.4681	.4721	.4761	.4801	.4840	.4880	.4920	.4960	.5000	0.00

TABLE D (*continued*)

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	z
0.00	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359	0.00
0.10	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753	0.10
0.20	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141	0.20
0.30	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517	0.30
0.40	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879	0.40
0.50	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224	0.50
0.60	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549	0.60
0.70	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852	0.70
0.80	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133	0.80
0.90	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389	0.90
1.00	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621	1.00
1.10	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830	1.10
1.20	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015	1.20
1.30	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177	1.30
1.40	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319	1.40
1.50	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441	1.50
1.60	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545	1.60
1.70	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633	1.70
1.80	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706	1.80
1.90	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767	1.90
2.00	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817	2.00
2.10	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857	2.10
2.20	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890	2.20
2.30	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916	2.30
2.40	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936	2.40
2.50	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952	2.50
2.60	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964	2.60
2.70	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974	2.70
2.80	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981	2.80
2.90	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986	2.90
3.00	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990	3.00
3.10	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993	3.10
3.20	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995	3.20
3.30	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997	3.30
3.40	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998	3.40
3.50	.9998	.9998	.9998	.9998	.9998	.9998	.9998	.9998	.9998	.9998	3.50
3.60	.9998	.9998	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	3.60
3.70	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	3.70
3.80	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	3.80

ed)

$F_{.05}$

Denominator Degrees of Freedom	Numerator Degrees of Freedom 1	2	3	4	5	6	7	8	9
	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
	10.13	9155	9.28	9.12	9.01	8.94	8.89	8.85	8.8
	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.0
	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.7
	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.1
	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.6
	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.3
	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.1
	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.0
	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.9
	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.8
	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.6
	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.5
	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.5
	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.4
	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96
	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88

TABLE G (*continued*)

Denominator Degrees of Freedom	Numerator Degrees of Freedom 10	12	15	20	24	30	40	60	120	∞
1	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

TABLE F Percentiles of the Chi-square Distribution

$p(\chi^2_{.95} \leq 31.410) = .95$

d.f.	$\chi^2_{.005}$	$\chi^2_{.025}$	$\chi^2_{.05}$	$\chi^2_{.90}$	$\chi^2_{.95}$	$\chi^2_{.975}$	$\chi^2_{.99}$	$\chi^2_{.995}$
1	.0000393	.000982	.00393	2.706	3.841	5.024	6.635	7.879
2	.0100	.0506	.103	4.605	5.991	7.378	9.210	10.597
3	.0717	.216	.352	6.251	7.815	9.348	11.345	12.838
4	.207	.484	.711	7.779	9.488	11.143	13.277	14.860
5	.412	.831	1.145	9.236	11.070	12.832	15.086	16.750
6	.676	1.237	1.635	10.645	12.592	14.449	16.812	18.548
7	.989	1.690	2.167	12.017	14.067	16.013	18.475	20.278
8	1.344	2.180	2.733	13.362	15.507	17.535	20.090	21.955
9	1.735	2.700	3.325	14.684	16.919	19.023	21.666	23.589
10	2.156	3.247	3.940	15.987	18.307	20.483	23.209	25.188
11	2.603	3.816	4.575	17.275	19.675	21.920	24.725	26.757
12	3.074	4.404	5.226	18.549	21.026	23.336	26.217	28.300
13	3.565	5.009	5.892	19.812	22.362	24.736	27.688	29.819
14	4.075	5.629	6.571	21.064	23.685	26.119	29.141	31.319
15	4.601	6.262	7.261	22.307	24.996	27.488	30.578	32.801
16	5.142	6.908	7.962	23.542	26.296	28.845	32.000	34.267
17	5.697	7.564	8.672	24.769	27.587	30.191	33.409	35.718
18	6.265	8.231	9.390	25.989	28.869	31.526	34.805	37.156
19	6.844	8.907	10.117	27.204	30.144	32.852	36.191	38.582
20	7.434	9.591	10.851	28.412	31.410	34.170	37.566	39.997
21	8.034	10.283	11.591	29.615	32.671	35.479	38.932	41.401
22	8.643	10.982	12.338	30.813	33.924	36.781	40.289	42.796
23	9.260	11.688	13.091	32.007	35.172	38.076	41.638	44.181
24	9.886	12.401	13.848	33.196	36.415	39.364	42.980	45.558
25	10.520	13.120	14.611	34.382	37.652	40.646	44.314	46.928
26	11.160	13.844	15.379	35.563	38.885	41.923	45.642	48.290
27	11.808	14.573	16.151	36.741	40.113	43.194	46.963	49.645
28	12.461	15.308	16.928	37.916	41.337	44.461	48.278	50.993
29	13.121	16.047	17.708	39.087	42.557	45.722	49.588	52.336
30	13.787	16.791	18.493	40.256	43.773	46.979	50.892	53.672
35	17.192	20.569	22.465	46.059	49.802	53.203	57.342	60.275
40	20.707	24.433	26.509	51.805	55.758	59.342	63.691	66.766
45	24.311	28.366	30.612	57.505	61.656	65.410	69.957	73.166
50	27.991	32.357	34.764	63.167	67.505	71.420	76.154	79.490
60	35.535	40.482	43.188	74.397	79.082	83.298	88.379	91.952
70	43.275	48.758	51.739	85.527	90.531	95.023	100.425	104.215
80	51.172	57.153	60.391	96.578	101.879	106.629	112.329	116.321
90	59.196	65.647	69.126	107.565	113.145	118.136	124.116	128.299
100	67.328	74.222	77.929	118.498	124.342	129.561	135.807	140.169

一、解釋下列各名詞　30%

1. Biological species
2. Catkin
3. Habit
4. Revision(of a gemus)
5. Allopatric distribution
6. Good character
7. Type method
8. Endemic species
9. Corolla
10. Polyphyletic

二、寫出下列各種植物所屬之英文科名　20%

1. 黃野百合
2. 龍葵
3. 芒草(菅草)
4. 馬櫻丹
5. 茉莉花
6. 蓮霧
7. 芒果
8. 月橘
9. 荷(蓮)
10. 福木
11. 山黃麻
12. 朱槿
13. 細葉饅頭果
14. 蘋果
15. 布袋蓮(鳳眼蓮)
16. 台灣海棗
17. 芹菜
18. 紅豆杉

三、以一個形態特徵區別下列各植物群　10%

1. Convolvulaceae　VS.　Cucurbitaceae
2. Mimosaceae　VS.　Papilionaceae
3. Malvaceae　VS.　Ericaceae
4. Lycopodiaceae　VS.　Selaginellaceae
5. Gramineae　VS.　Cyperaceae

四、製作一檢索表區分 Bryophytes，Pteridophytes，Gymnosperms，Monocotyledons，和 Dicotyledons　10%

五、以拉丁文寫出二種裸子植物、四種雙子葉植物和四種單子葉植物之種名　10%〔註：命名人不用寫〕

六、爲何植物分類學是一門綜合性的科學？　10%

七、有人說：標本館典藏的標本，每一種只需一份即可，當各種類的標本都有了之後，不必再採集標本。這句話你是否同意？請說明理由　10%

1. Multiple choice: (60%)

1. Which of the following is a true statement about Charles Darwin? (A) He was the first to discover that living things can change, or evolve. (B) He based his theory on the inheritance of acquired characteristics. (C) He worked out the principles of population genetics. (D) He proposed natural selection as the mechanism of evolution. (E) He was the first to realize that the Earth is billions of years old.

2. Species of horseshoe crabs and cockroaches have existed virtually unchanged for millions of years. Which of the following models of speciation best explains these living "fossils"? (A) gradualism. (B) polyploidy. (C) punctuated equilibrium. (D) sympatric speciation. (E) adaptive radiation.

3. Ancient cyanobacteria, found in fossil stromatolites, were very important in the history of life because they (A) were probably the first living things to exist on Earth. (B) produced the oxygen in the atmosphere. (C) are the oldest known archaebacteria. (D) were the first multicellular organisms. (E) extracted heat from the atmosphere, cooling Earth.

4. The eggs of nonflowering seed plants are fertilized within ovules, and the ovules then develop into (A) seeds. (B) spores. (C) gametophytes. (D) fruit. (E) sporophytes.

5. Reptiles are much more extensively adapted to life on land than amphibians because reptiles (A) have a complete digestive tract. (B) lay shelled eggs. (C) are endothermic. (D) have legs. (E) go through a larval stage.

6. Which of the following most clearly demonstrates the evolutionary relationship between annelids and arthropods? (A) a complete digestive tract. (B) an exoskeleton. (C) body segmentation. (D) jointed appendages. (E) radial symmetry.

7. Every cell in the human body is in contact with an internal environment consisting of (A) blood. (B) connective tissue. (C) interstitial fluid. (D) matrix. (E) mucous membranes.

8. A human requires hundreds of grams of carbohydrates every day. The daily requirement for most vitamins is in the milligram range. Why are vitamins needed in such small quantities? (A) Vitamins are not very important in metabolism. (B) The energy content of vitamins is so great that you don't need much. (C) The body can store large quantities of most vitamins. (D) vitamins are reusable in metabolism. (E) Every cell needs carbohydrates, but only a few need vitamins.

9. Countercurrent exchange in the gills of a fish (A) speeds up the flow of water through the gills. (B) maintains a concentration gradient that enhances diffusion. (C) enables the fish to obtain oxygen while swimming backward. (D) means that blood and water flow in the same direction. (E) interferes with the efficient absorption of oxygen.

10. Blood pressure is highest in _____, and blood moves most slowly in _____. (A) veins.....capillaries. (B) arteries.....capillaries. (C) veins.....arteries. (D) capillaries.....arteries. (E) arteries .....veins.

11. Which of the following is not part of the body's nonspecific defense system? (A) natural killer cells. (B) antibodies. (C) interferons. (D) complement. (E) inflammation.

12. Which of the following best describes the difference in the way B cells and cytotoxic T cells deal with invaders? (A) B cells confer active immunity; T cells confer passive immunity. (B) B cells send out antibodies to attack; T cells themselves do the attacking. (C) T cells handle the primary immune response; B cells handle the secondary response. (D) B cells are responsible for cell-mediated immunity; T cells are responsible for humoral immunity. (E) B cells attack the first time the invader is present; T cells attack subsequent times.

13. In each nephron of the kidney, the glomerulus and Bowman's capsule (A) filter the blood and capture the filtrate. (B) reabsorb water into the blood. (C) break down harmful toxins and poisons. (D) reabsorb salts and nutrients. (E) refine and concentrate the urine for excretion.

14. Which of the following traces the path of sperm out of the body of a human male? (A) epididymis, seminiferous tubule, vas deferens, urethra. (B) seminiferous tubule, vas deferens, epididymis, urethra. (C) epididymis, seminiferous tubule, urethra, vas deferens. (D) seminiferous tubule, epididymis, vas deferens, urethra. (E) seminiferous tubule, epididymis, urethra, vas deferens.

15. Suppose a researcher carefully removes the myelin sheath from the axon of a neuron. The most likely result would be that the altered neuron would (A) no longer be able to produce neurotransmitters. (B) be much more sensitive to stimuli. (C) be much less sensitive to stimuli. (D) transmit nerve signals more rapidly. (E) transmit nerve signals more slowly.

16. Which of the following controls the activity of all the others? (A) thyroid gland. (B) pituitary gland. (C) adrenal cortex. (D) hypothalamus. (E) ovaries.
17. Which of the following hormones have antagonistic effects? (A) parathyroid hormone and calcitonin. (B) insulin and thyroxine. (C) growth hormone and epinephrine. (D) ACTH and cortisone. (E) epinephrine and norepinephrine.
18. Which of the following receptors are not present in human skin? (A) thermoreceptors. (B) chemoreceptors. (C) touch receptors. (D) pressure receptors. (E) pain receptors.
19. Which of the following bones in the human arm would correspond to the femur in the leg? (A) radius. (B) tibia. (C) humerus. (D) metacarpal. (E) ulna.
20. What is the role of acetylcholine in muscel contraction? (A) It makes up part of the thin filaments inside a muscle fiber. (B) It provides energy for contraction. (C) It blocks contraction when the muscle relaxes. (D) It signals a muscle fiber to contract. (E) It forms the heads of the myosin molecules in the thick filaments inside a muscle fiber.
21. The basic body types exhibited by cnidarians are (A) the polyp and the medusa. (B) the larva and the planula. (C) radial and bilateral. (D) unicellular and multicellular. (E) amoeboid and falgellated.
22. An action potential is said to occur when _____ the cell. (A) sodium ions rush into (B) sodium ions rush out of (C) potassium ions rush into (D) potassium ions rush out off (E) water molecules rush out off
23. The heartbeat is initiated by the (A) atrioventricular node. (B) sinoatrial node. (C) cardiovascular regulation center. (D) bundle of His. (E) sympathetic nervous system.
24. Nematocysts are characteristic of (A) Annelids. (B) Arachnids. (C) Nematodes. (D) Cnidarians. (E) Nemerteans.
25. The terms anterior and posterior only apply to animals that (A) have a true coelom. (B) form planula larvae. (C) undergo schizocoelous development. (D) develop a digestive system. (E) have bilateral symmetry.
26. Tetanus is (A) the result of puncture wounds. (B) the all-or-none contraction of a single muscle fiber. (C) the result of stimulation of additional motor neurons, called multiple motor unit summation. (D) the result of waveform summation, which produces increased and sustained contraction of a muscle. (E) a parasitic disease.
27. The archenteron develops into the (A) anus in deuterostomes. (B) blastocoel. (C) neural tube. (D) digestive tract. (E) mouth.
28. Two worms in the same class must also be grouped in the same (A) order. (B) phylum. (C) genus. (D) family. (E) species.
29. Which of the following sequences results in the secretion of estrogens in mammals? (A) GNRH→FSH →estrogen (B) LH→FSH→estrogen (C) CRH→ACTH→FSH→estrogen (D) Gonadotropin→LH→ estrogen (E) FSH→LH →estrogen
30. Which of the following would NOT function as a neurotransmitter? (A) acetylcholine. (B) neuropeptides. (C) biogenic amines. (D) steroids (E) all of above could serve as neurotransmitters
31. A seed is a mature (A) pollen grain. (B) fruit. (C) ovary. (D) ovule. (E) embryo.
32. The "halves" of an individual peanut, which represent its cotyledons, are composed of (A) triploid endosperm cells. (B) haploid endosperm cells. (C) diploid embryo sporophyte cells. (D) diploid maternal sporophyte cells. (E) diploid gametophyte cells..
33. An aggregate fruit develops from (A) a single ovary. (B) several ovaries from separate flowers. (C) several ovaries from a single flower. (D) several different plants. (E) several ovules from the same ovary.
34. Bark consists of (A) functioning xylem, secondary phloem, cork cambium, and cork. (B) vascular cambium, secondary phloem, cork cambium, and cork. (C) secondary phloem, cork cambium, and cork. (D) cork cambium and cork. (E) cork only.
35. How many chromosomes are there in a corn egg cell nucleus as compared to a corn pollen cell nucleus? (A) half as many. (B) twice as many. (C) the same number. (D) half as many or the same number, depending on whether the pollen cell has divided to produce sperm or not. (E) twice as many or the same number.

36. A woody plant goes through five years of drought followed by five years of good growing conditions. The xylem cells formed during the five good years (A) will be larger in diameter than those formed during the drought years. (B) will be living, whereas those formed during the drought years will be dead. (C) will form smaller growth rings than were formed during the drought years. (D) will conduct a higher ratio of sugar to water than those formed during the drought years. (E) will form heartwood.
37. How many layers of vascular cambium will there be in the trunk of a ten-year old tree? (A) one. (B) two. (C) five. (D) nine. (E) ten.
38. The cells that store starch in dicot roots are located between (A) the xylem rays within the vascular cylinder. (B) the xylem and the phloem. (C) the epidermis and the root hairs. (D) the epidermis and the endodermis. (E) the epidermis and the cortex.
39. The sugar "sink" in roots is created by (A) the active transport of mineral ions into xylem cells. (B) the osmosis of water into xylem cells. (C) the absorption of water from the soil through epidermal cells. (D) active transport of sugars from phloem to other root cells. (E) the pull of gravity on sugar molecules.
40. The "sleep movements" of a bean plant's leaves are controlled by a biological clock. If you put a potted bean plant in a dark tool shed in June, which of the following would you expect to observe after 4 or 5 days? (A) The plant would continue to raise its leaves at around sunrise and fold them at around sunset. (B) The plant would exhibit a balanced 24 hour cycle, raising its leaves at around 6:00 a.m. and folding them at around 6:00 p.m. (C) The plant would change to an endigenous cycle and thus would drift out of synchrony with the sun. (D) The plant would cease its sleep movements. (E) The plant would exhibit random movements.
41. What is the function that phytochrome is known to perform in the photoperiod-related control of flowering? (A) determining whether night length exceeds a critical minimum. (B) determining whether night length is shorter than a critical maximum. (C) sensing sunrise and sunset. (D) inducing flowers to form. (E) either a or b.
42. Fruit that forms on an unpollinated plant in response to a hormone application will lack (A) ovules. (B) seeds. (C) carpels. (D) ovaries. (E) the capacity to produce ethylene gas.
43. Which of the following processes underlies the thigmotropic behavior of a green-bean tendril? (A) rotation of the tendril in response to photoperiod. (B) rotation of the tendril in response to a biological clock. (C) extra proliferation of cells on the shaded side of the tendril. (D) extra elongation of cells on the lower side of the tendril. (E) extra elongation of cells on the side opposite to an object that is contacting the tendril.
44. Shoot branching is controlled mainly by the relative levels of (A) auxins and gibberellins. (B) auxins and cytokinins. (C) gibberellins and cytokinins. (D) gibberellins and abscisic acid. (E) cytokinins and abscisic acid.
45. Which of the following is a correct sequence of events leading to leaf fall in deciduous trees? (A) formation of abscission layer; increase in ethylene levels; decrease in auxin levels. (B) cooler temperatures; decrease in auxin levels; formation of abscission layer. (C) shortening days; formation of abscission layer; decrease in ethylene levels. (D) shortening days; decrease in ethylene levels; increase in auxin levels. (E) decrease in ethylene levels; increase in auxin levels; formation of abscission layer
46. Which of the following ocean zones is both biologically the most productive and physically the most demanding? (A) intertidal. (B) pelagic. (C) abyssal. (D) upwelling. (E) bathypelagic.
47. Which of the following biomes is dominated by gymnosperm trees adapted to surviving desiccating conditions? (A) taiga. (B) tundra. (C) deciduous forest. (D) savanna. (E) chaparral.
48. Which of the following biomes would have the highest number of different species per square mile? (A) tropical deciduous forest. (B) tropical thorn forest. (C) tropical rain forest. (D) tropical savanna. (E) temperate deciduous forest.
49. The vertical structure of the tropical forest is due to the intense competition for (A) moisture. (B) nitrogen. (C) carbon dioxide. (D) minerals. (E) light.
50. In an ecosystem, you would most expect to find interspecific competition between (A) males and females of a species in which both sexes occupy the same niche. (B) populations of two species that occupy the same niche. (C) males of a species during the breeding season. (D) a prey species and its predator. (E) two wasp species that mimic each other's appearance.

51. The maximum number of individuals a habitat can support is called the (A) reproductive potential. (B) carrying capacity. (C) community size. (D) density dependent factor. (E) population growth.
52. Which of the following is most clearly a case of density-dependent population regulation? (A) the summer drying of savanna grass for an insect that feeds on grass sap. (B) a dangerous new flu strain that is transmitted among humans by sneezing. (C) the first hard frost of fall for a population of annual morning glory vines. (D) the growth of shade trees for a population of sun-loving shrubs in an abandoned field. (E) the occurrence of rainstorms for an opportunistic desert annual.
53. Which of the following is an example of Batesian mimicry? (A) the resemblance of a harmless fly to a bee. (B) the resemblance of the walking-stick insect (a kind of mantis) to the twigs it lurks among. (C) the resemblance of an African sunbird to a Central American hummingbird that occupies a similar niche. (D) the resemblance of the western meadowlark to the eastern meadowlark. (E) the similar appearance and black-and-gold coloration of many wasps.
54. A community is made up of (A) different kinds of living organisms. (B) one species of organism. (C) living organisms and their nonliving environment. (D) ecosystems. (E) the factors that constitute an organism's niche.
55. Eutrophication of a lake could occur if (A) phosphate-rich detergents are dumped into the lake. (B) fertilizers from farms are washed into the lake. (C) raw sewage is dumped into the lake. (D) runoff from over-fertilized lawns reaches the lake. (E) all of the above.
56. Domestic chickens are thought to be descended from Asian jungle fowl. Different species of jungle fowl display different types of social hierarchy, ranging from none to a linear pecking order. This finding is best interpreted as evidence for which of the following hypotheses? (A) Jungle fowls are more genetically variable than chickens. (B) Chickens are evolutionarily more advanced than most jungle fowl. (C) The social structure of chicken and fowl flocks is passed from generation to generation by imitative learning. (D) The social structure of chicken and fowl flocks is genetically determined. (E) Chicken and fowl flocks adopt the social structure that best suits their habitat.
57. When a nipple is placed in a newborn baby's mouth, the infant will immediately begin to suckle. This is an example of (A) habituation. (B) imprinted behavior. (C) classical. conditioning. (D) innate behavior. (E) imitation.
58. When you study with the stereo on in the background, you are demonstrating (A) habituation. (B) imprinting. (C) association. (D) conditioning. (E) imitation
59. Which of the following global changes is not likely to be directly and significantly worsened by widespread eradication of tropical rainforests? (A) increase in atmospheric CO_2. (B) destruction of the ozone layer. (C) loss of biodiversity. (D) shifts in global precipitation patterns. (E) elimination of potential crop species.
60. Which, if any, of the following was not a major factor in the desertification of the Fertile Crescent in what is now Iraq? (A) deforestation by early sedentary peoples. (B) overgrazing by early herders. (C) destruction of sod by early plows. (D) farming practices that removed nutrients from the soil faster than they were returned. (E) all of the above were contributing factors

II. Fill in the blanks: (10%)

1. The proteins _____ and _____ are the chief components of myofibrils.
2. Animals that eat mainly meat are _____, and those that eat only plants are_____.
3. _____ is a hormone secreted by stomach mucosa that can stimulate gastric glands to secrete pepsinogen.
4. The two major systems of internal communication that have evolved are the _____ and _____ systems.
5. Single cell eukaryotic organisms are classified in Kingdom _____ and prokaryotic organisms are classified in Kingdom _____.
6. _____ is development of egg without fertilization.

III. Briefly explain the clonal selection theory. Design an experiment to prove that spleen is one of the organs producing antibodies. (10%)

IV. Briefly describe the kinds and the functions of cytoskeletons. (10%)

V. Briefly discuss the biological evolution of the hominids. (10%)