17th INTERNATIONAL BIOLOGY OLYMPIAD
JULY 9-16, 2006
Río Cuarto – República Argentina

第 17 屆 國際生物奧林匹亞

THEORETICAL TEST
理論題
PART B

學生代碼 Student code:	

GENERAL INSTRUCTIONS

- Please check that you have the appropriate examination and answer sheets, a calculator, a black pencil, and two pens: a green one and a red one.

  檢查你是否有試卷、答案紙、一台計算機、一支黑鉛筆、及綠色和紅色的兩支筆。

- Use the answer sheet provided to record your answers.

  使用答案紙記錄你的答案

- Remember to write down your personal code number on top of the answer sheet.

  記得在答案紙上寫下你的個人碼號

- **There are different kinds of questions**: in some of them you will have to choose one answer, in this case, you must fill in the corresponding box; in other questions you will have to complete diagrams or in blank spaces.

  本卷有不同種類的問題：有些必須選擇一個答案，有的答案要填在正確的格子中，有些則須完成圖示或填答在空白位置。

- In the examination sheets you will find the instructions to complete the answer sheet according to each question.

  根據在試卷上每個問題的指示，於答案紙中完成答案。

- Use the pencils provided to complete the answer sheet.

  使用所提供的鉛筆在答案紙作答

- You have **2 hrs 30 min (150 minutes)** to answer the questions.

  你有 2 小時 30 分(150 分鐘)回答問題

- The maximum score is approximately 79 points. The points assigned to each individual question depends on its complexity.

  滿分是大約 79 分，每題的配分取決於其複雜度

PLEASE, REMEMBER: THE ACADEMIC COMMITTEE WILL CONTROL ONLY THE ANSWER SHEET!

請記住：答案請勿寫在試卷上，學術委員會只看答案紙

GOOD LUCK IBO COMPETITORS!

祝好運！ IBO 選手

17º INTERNATIONAL BIOLOGY OLYMPIAD

THEORETICAL TEST

PART B

CELLULAR BIOLOGY (13 questions, 15 points) 細胞學(13 個問題，15 分)

1- In a laboratory of Molecular Biology, the amino acids sequence of an armadillo intestine protein has been partially determined. The tRNA molecules used in the synthesis have the following anticodons: 某一分生實驗室，已完成某種犰狳腸道蛋白胺基酸序列的部分定序， 其中用於合成蛋白質的 tRNA，具有以下補密碼序列：

3´ UAC 5´ 3´ CGA 5´ 3´ GGA 5´ 3´ GCU 5´ 3´ UUU 5´ 3´ GGA 5´

Mark the DNA nucleotide sequence of the complementary chain to the DNA chain that encodes for the armadillo intestine protein:

請選出 **DNA** 中對應那些補密碼的互補序列（非模板股的序列）

A) 5´-ATG-GCT-GGT-CGA - AAA-CCT-3´.

B) 5´-ATG-GCT-CCT-CGA - AAA-CCT-3´.

C) 5´-ATG-GCT-GCT-CGA - AAA-GCT-3´.

D) 5´-ATG-GGT-CCT-CGA - AAA-CGT-3´.

2- In the eukaryotic cell, the ribosomes that are located in the: cytosol, endoplasmic reticulum, mitochondria and chloroplast carry out the synthesis of specific proteins.

Using the answer code, mark the location of the ribosomes that carry out the synthesis of the detailed proteins: 真核細胞中，核糖體位於細胞質、內質網、粒線體或葉綠體中，負責合成特定蛋白質。利用答案代號，標示合成下列蛋白質之核糖體，在細胞中的位置。

Answer code: 答案代碼

01. Cytosol. 細胞質

02. Endoplasmic reticulum. 內質網

03. Mitochondria. 粒線體

04. Chloroplast. 葉綠體

PROTEINS 蛋白質	**CODE** 代碼
A) Fibronectin. 血清纖維黏接蛋白	
B) Lactate dehydrogenase. 乳酸脫氫酶	
C) Complex of the cytochrome b_6-f. 細胞色素 b_6-f	
D) Amylase. 澱粉酶	
~~E) Ribulose biphosphate carboxylase.~~	已刪除
~~F) Cytochrome C oxidase. 細胞色素 C 氧化酶~~	已刪除
G) Keratin. 角質素	
~~H) NADH dehydrogenase. NADH 去氫酶~~	已刪除

3- The nuclear protein DNA polymerase synthesized in the cytoplasmic ribosomes of the cell enters to the nucleus through the nuclear pores by:

由細胞質核糖體所合成的 DNA 聚合酶，藉由下列何種機制進入細胞核中？

A) passive diffusion through hydrophilic channels.
藉由親水性通道，以擴散方式進入

B) specific signal sequence of the protein using energy.
需要特定的訊息序列，並藉由主動運輸方式進入

C) receptor -mediated endocytosis.
由受體媒介的胞吞作用進入

D) specific signal sequence of the protein without energy.
需要特定的訊息序列，但不需耗能即可進入

4- Using the answer code, specify the characteristics of RNA synthesis, mRNA processing and protein synthesis corresponding.

依據 RNA 的合成、mRNA 的修飾及蛋白質的特徵，將正確答案代碼填入欄位中

Answer code: 答案代碼

01. prokaryote. 原核生物

02. eukaryote. 真核生物

03. both. 兩者均可

CHARACTERISTIC 特徵	CODE
A) A single RNA polymerase catalyzes the synthesis of the three types of RNA. 由單一種 RNA 聚合酶，合成三種 RNA	
B) The assembly of RNA polymerase at the promoter requires a set of proteins called general transcription factors which must be assembled at the promoter before transcription can begin. 於轉錄開始前，需先於啓動子處組合轉錄因子，以用於組合 RNA 聚合酶	
C) The structural genes are not contained in operons. 操縱組中不含結構基因	
D) In the mRNA processing, a metylguanine cap is added to the 5´-end and a poly-A tail to the 3´-end. RNA 的修飾過程中，會在 5´-end 加 Cap, 3´-end.加 poly-A tail	
E) Most of the structural genes contain introns that are spliced before the translation. 大部份構造基因中含有內插子，會在轉譯前被移除	
F) The protein synthesis starts even before the transcription has been completed. 轉錄作用結束前，蛋白質的合成便已開始	
G) The protein synthesis always starts in free ribosomes in the cytoplasm. 蛋白質的合成，常開始於細胞質中自由狀態的核糖體	
H) The degradation rate of the mRNA is regulated by extracellular signs. mRNA 的分解速率會受到細胞外的訊息所調控	
I) The Shine-Dalgarno sequence in the 5´-end of mRNA recognizes the ribosome and the translation starts. mRNA 5´-end 的 SD 序列可辨識核糖體，並啓動轉譯作用	

5- In order to investigate protein location either in the cytoplasm or in organelles such as endoplasmic reticula and Golgi bodies, analyses that combine proteinases and surfactants are frequently carried out. As a result of the target protein contacting the proteinase, the former is decomposed and can no longer be detected. Although the proteinase does not act across the biomembrane, this is destroyed by the surfactant.

A fraction containing vesicles enclosed in a biomembrane was obtained by homogenizing and fractionating liver cells. In order to investigate the respective locations of protein A (40 kDa), protein B (50kDa) and protein C (80kDa) contained in this fraction, the following proceedings were performed followed by Western analysis to respectively detect and investigate the molecular weights of proteins A, B and C. (Note: kDa indicates a unit to express the molecular weight of proteins).

為了探討特定蛋白質位於細胞質中或胞器內，常需合併使用介面活性劑及蛋白酶進行分析，因介面活性劑可破壞細胞膜，使得胞內的蛋白質易被蛋白酶分解。將肝細胞均質化，可得含有脂雙層液胞的粗萃取物，為探討其中所含 protein A (40 kDa), protein B (50kDa) 和 protein C (80kDa)在細胞內的位置，採用以下的處理，配合西方墨跡法進行偵測。

Procedure 1: Proteinase K was added followed by warming.

實驗處理 1:加入 proteinase K 並加溫

Procedure 2: Surfactant Triton X-100 was added followed by warming.

實驗處理 2:加入介面活性劑 Triton X-100 並加溫

Procedure 3: Both proteinase K and surfactant Triton X-100 were added followed by warming.

實驗處理 3:同時加入 proteinase K 及 TritonX-100 並加溫

Procedure 4: Only the vesicles were separated by precipitating with ultra-high-speed centrifugation followed by removal of cytoplasm components.

實驗處理 4: 利用超高速離心移除細胞質，只保留液胞的成份

The experiment results are as shown below. 實驗結果如下

	Procedure 1	Procedure 2	Procedure 3	Procedure 4
Protein A	40 kDa	40 kDa	Not detected 測量不到	40 kDa
Protein B	Not detected 測量不到	50 kDa	Not detected 測量不到	Not detected 測量不到
Protein C	40 kDa	80 kDa	Not detected 測量不到	80 kDa

Fill in the blanks using answer code corresponding to the location of each protein:

請將正確答案代碼填入對應的空格處

Answer code: 答案代碼

01. Suspended in the cytoplasm. 懸浮於細胞質

02. Attached to the outside of the vesicle. 接在液胞的外層

03. Entrapped inside the vesicle. 位於液胞內

04. Penetrating the vesicle membrane with one half being exposed on the outside and the other half entrapped inside. 穿過細胞膜，一半位於液胞外層，一半位於液胞內

05. Cannot be determined from this experiment only. 無法單憑本實驗作判斷

The protein is present: 各蛋白質分別位於下列何處？

	CODE
Protein A	
Protein B	
Protein C	

6- Which of the following combinations among elements of the cytoskeleton and their characteristics is correct: 有關細胞骨骼及其特徵的配對，下列何者正確？

ELEMENTS OF THE CYTOSKELETON 細胞骨骼

I. Microfilaments. 微絲

II. Microtubules. 微管

III. Intermediate Filaments. 中間絲

STRUCTURAL AND FUNCTIONAL CHARACTERISTICS 結構及功能特徵

01. Polymer of the protein actin.	由肌動蛋白形成的聚合物
02. Participate in animal cytokinesis.	參與動物細胞的胞質分裂
03. Participate in the formation of cilia and flagella.	參與了纖毛及鞭毛的形成
04. Polymer of the protein tubulin.	由微管蛋白形成的聚合物
05. Provide mechanical stability to the cell.	提供細胞機械性的穩定力
06. Participate in cellular locomotion.	參與了細胞的移動
07. non polar polymer.	不帶極性的聚合物
08. Form the nuclear lamina.	形成核內膜層
09. Form the mitotic spindle.	形成纺錘絲

	I	**II**	**III**
A)	01, 03, 05	02, 04, 08	02, 03, 07
B)	01, 02, 06	03, 04, 09	05, 07, 08
C)	01, 03, 08	03, 04, 05	02, 06, 09
D)	01, 06, 09	02, 04, 07	03, 05, 07

7- Using the answer code, answer which of the following statements about the transport through the plasmatic membrane of the animal cell is correct or incorrect.

利用答案代碼判斷下列有關動物細胞膜運輸的敘述是否正確。

Answer code: 答案代碼

01. Correct. 正確

02. Incorrect. 不正確

STATEMENT 敘述	**CODE**
A) Steroid hormones are incorporated into the cell by endocytosis. 固醇類激素藉由胞吞作用進入細胞	
B) Amino acids are incorporated into the cell by simple diffusion. 胺基酸利用簡單擴散作用進入細胞	
C) Bacteria are incorporated into the cell by phagocytosis. 細菌利用吞噬作用進入細胞	
D) Metabolic wastes are incorporated into the cell by endocytosis. 代謝廢物藉由胞吞作用進入細胞	
E) Ions pass through channel proteins by passive transport. 離子以被動運輸方式通過通道蛋白	
F) Cholesterol is incorporated into the cell as a low-density lipoprotein (LDL) by receptor-mediated endocytosis. 膽固醇以 LDL 形式藉由受體媒介胞吞作用進入細胞中	
G) In the epithelial cells of the intestine, the macromolecules transport from the apical side to the basolateral side is by transcytosis. 小腸上皮細胞中，巨分子由頂端以穿細胞的方式送至基底部	
H) The Na^+ / K^+ pump transports 3 Na^+ into the cell and 2 K^+ out of the cell. 鈉/鉀 pump 把 3 Na^+送入細胞，把 2 K^+送出細胞	

8- In the following table, some components, processes and structures of mitochondria are presented. Match both columns and identify the correct combination.

下表為粒線體中的特定組成、過程及構造。請根據下表選出正確的組合。

01. Porin. 普恩蛋白 02. Enzymes of mitochondrial RNA synthesis. 粒線體 RNA 合成之酵素 03. ATP synthase. ATP 合成酶 04. Monoamine oxidase. 單胺基氧化酶 05. Enzymes of fatty acid oxidation. 脂肪酸氧化酵素 06. Coenzyme Q. 輔酶 Q 07. Enzymes of citric acid cycle. 檸檬酸循環之酵素	I. Outer mitochondrial membrane. 粒線體外膜 II. Inner mitochondrial membrane. 粒線體內膜 III. Mitochondrial matrix. 粒線體基質

	I	**II**	**III**
A)	02, 06, 07	01, 04, 07	01, 05
B)	01, 05, 06	02, 03	02, 04, 07
C)	01, 04	03, 06	02, 05, 07
D)	02, 05	01, 03, 07	06, 07

9- Statements about prokaryotic and eukaryotic flagellae are:

以下為原核和真核鞭毛的敘述：

01. prokaryotic flagellae are covered with membrane. 原核鞭毛由膜所覆蓋

02. eucaryotic flagellae are rotating. 真核鞭毛是旋轉型的

03. both prokaryotic and eukaryotic flagellae use proton gradient as a direct source of the energy for the movement. 原核和真核鞭毛都使用質子梯度作為運動能量的直接來源

04. prokaryotic flagellae are formed from actin, eukaryotic ones from the tubulin.

原核鞭毛由肌動蛋白(actin)所組成，真核鞭毛由微管蛋白所組成

05. procaryotic flagellae consist of three parts: the basal apparatus, the hook and the filament. 原核鞭毛由基粒、鉤、微絲等三個部分組成

06. all prokaryotic cells have at least one flagellum.

所有原核細胞至少有一根鞭毛

07. all eukaryotic flagellae are covered with plasma membrane.

所有真核鞭毛均由細胞膜所覆蓋

08. all functional eucaryotic flagellae contain motor-proteins (dyneins).

所有具有功能的真核鞭毛都有含動力蛋白(dyneins)

09. procaryotic flagellae can rotate only in one direction.

原核鞭毛只能朝一個方向旋轉

The correct statements are: 正確的敘述有哪些？

A) 01, 04, 07.

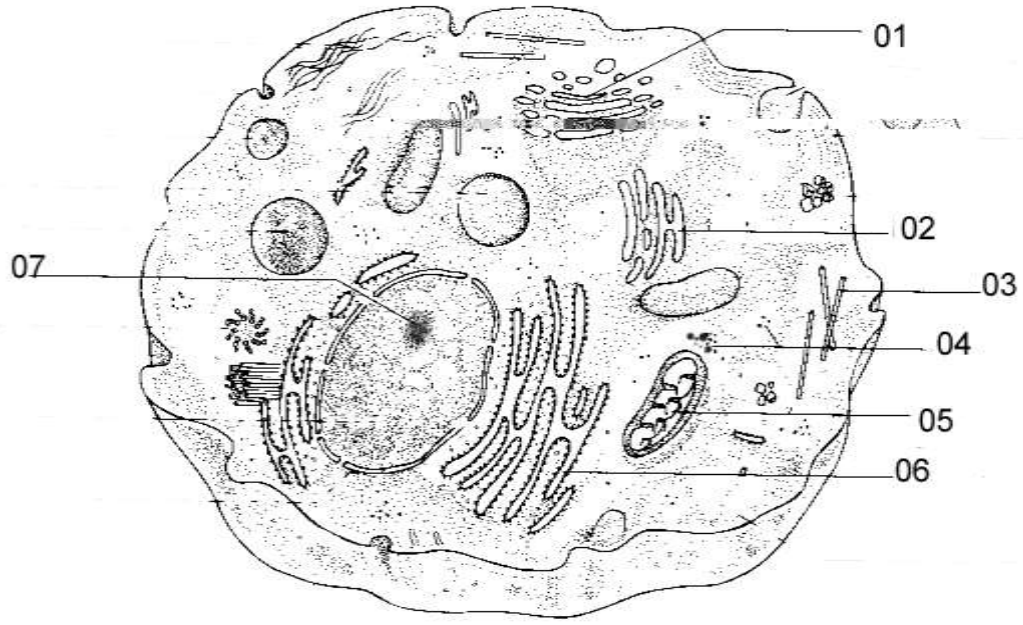
B) 03, 07, 08.

C) 02, 05, 09.

D) 05, 07, 08.

10- Look at the following picture and write down the correct answer code.

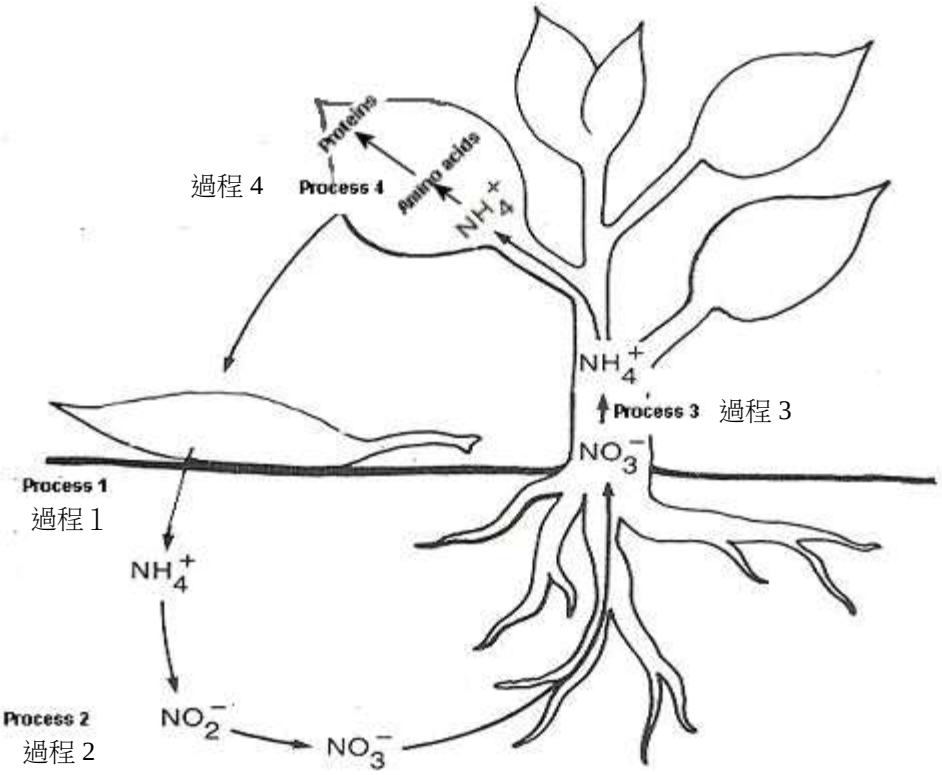
根據下圖寫出正確的答案代碼



Which of the structures: 何種構造・・・	**CODE** 代碼
A) is the place where the ribosomes' subunits are formed? 是核糖體次單元形成的地方？	
B) is the place where the glycosylation of proteins and lipids are carried out? 是進行蛋白質和脂質糖基化的地方？	
C) can form protein not encoded by the nuclear DNA? 能合成不屬於核 DNA 所記載的蛋白質？	
D) is the structure that maintains the structural integrity of an axon? 是保持樹突構造完整的構造？	
E) is the most abundant structure in the cytoplasm of the pancreatic acinar cells? 是胰腺細胞的細胞質中含量最多之構造？	
F) is the most abundant structure in an insect flight muscle? 是在昆蟲飛行肌肉中最豐富的構造？	
G) is the place of lipid synthesis? 是脂類合成的地方？	

11- The following figure corresponds to the nitrogen cycle. Match the processes numbered 1 to 4 in the figure with the following answer code.

下圖表示氮循環的過程。用下列答案代碼配對圖中的過程 1 到過程 4。



Answer code: **答案代碼：**

01. Ammonifying bacteria. 氨化菌
02. Denitrifying bacteria. 去硝基菌
03. Nitrate reduction. 硝酸鹽還原
04. Nitrifying bacteria. 硝化菌
05. Protein synthesis. 蛋白質合成

	CODE 代碼
Process 1 過程 1	
Process 2 過程 2	
Process 3 過程 3	
Process 4 過程 4	

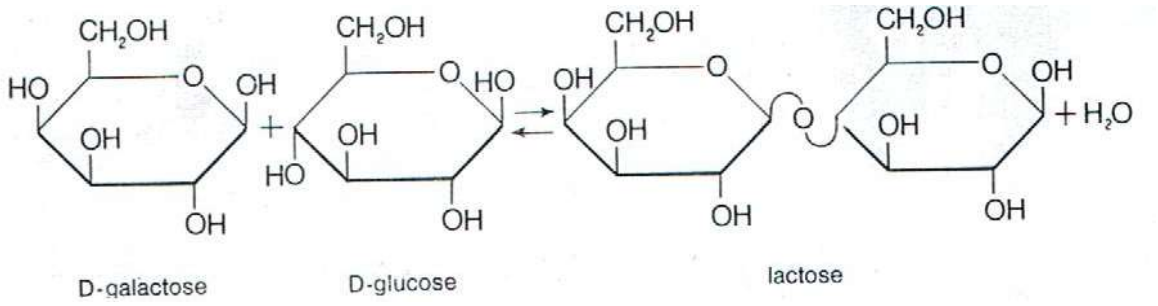
12- Using the answer code, select which of the following statements about carbohydrates and human body are correct or incorrect.

有關碳水化合物與人體之敘述，以答案代碼判斷下列敘述正確與否

Answer code: 答案代碼：

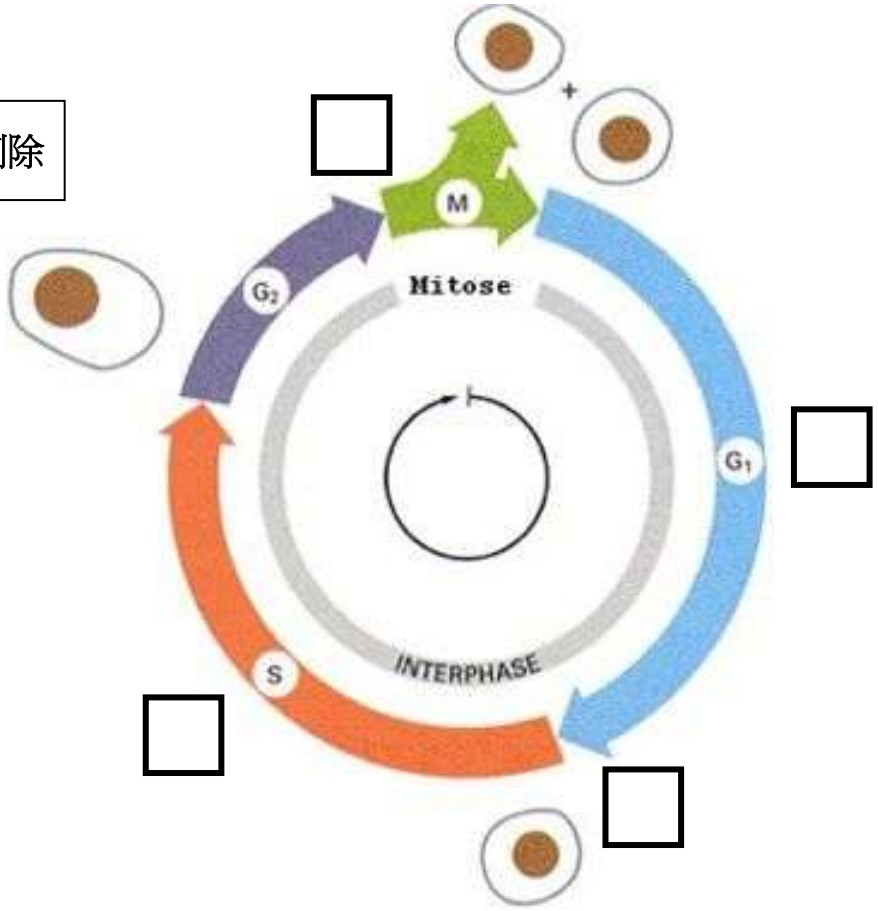
01. Correct. 正確

02. Incorrect. 錯誤



STATEMENT 陳述	**CODE** 代碼
A) D-Galactose and D-glucose are pentose sugars. D-半乳糖和 D-葡萄糖是五碳糖	
B) D-Galactose and D-glucose are stereoisomers. D-半乳糖和 D-葡萄糖是立體異構物	
C) D-Galactose and D-glucose are aldoses. D-半乳糖和 D-葡萄糖是醛糖	
D) In the human body the reaction from left to right takes place in the duodenum. 在人體裡來自左到右的反應在十二指腸裡進行	
E) In the human body the reaction from left to right takes place in the mammary glands. 在人體裡來自左到右的反應在乳腺裡進行	

本題已刪除



~~13. Complete the following diagram by using the answer code. Fill in the blank boxes with the number corresponding to the regulation of the cycle phases.~~

~~使用答案代碼來完成下圖。用符合調控該細胞循環期的羅馬數字填入空格中。~~

~~**Answer code:** 答案代碼：~~

~~**I**. Cyclin B-CdK1.~~

~~**II**. Cyclin A-Cdk2.~~

~~**III**. Cyclin E-CdK2.~~

~~IV**. Cyclin D- CdK4.**~~

PLANT ANATOMY AND PHYSIOLOGY (8 questions, 12 points)

The figure in the next page shows the life cycle of a plant.

下頁的圖表示植物的生活史

Examine this figure and its captions carefully. Answer questions 14 to 21.

仔細檢視該圖及其說明, 並回答 14-21 題

14- This life cycle corresponds to the following taxon:

此圖表示何種分類群的生活史?

A) Bryophyta. 蘚苔植物門

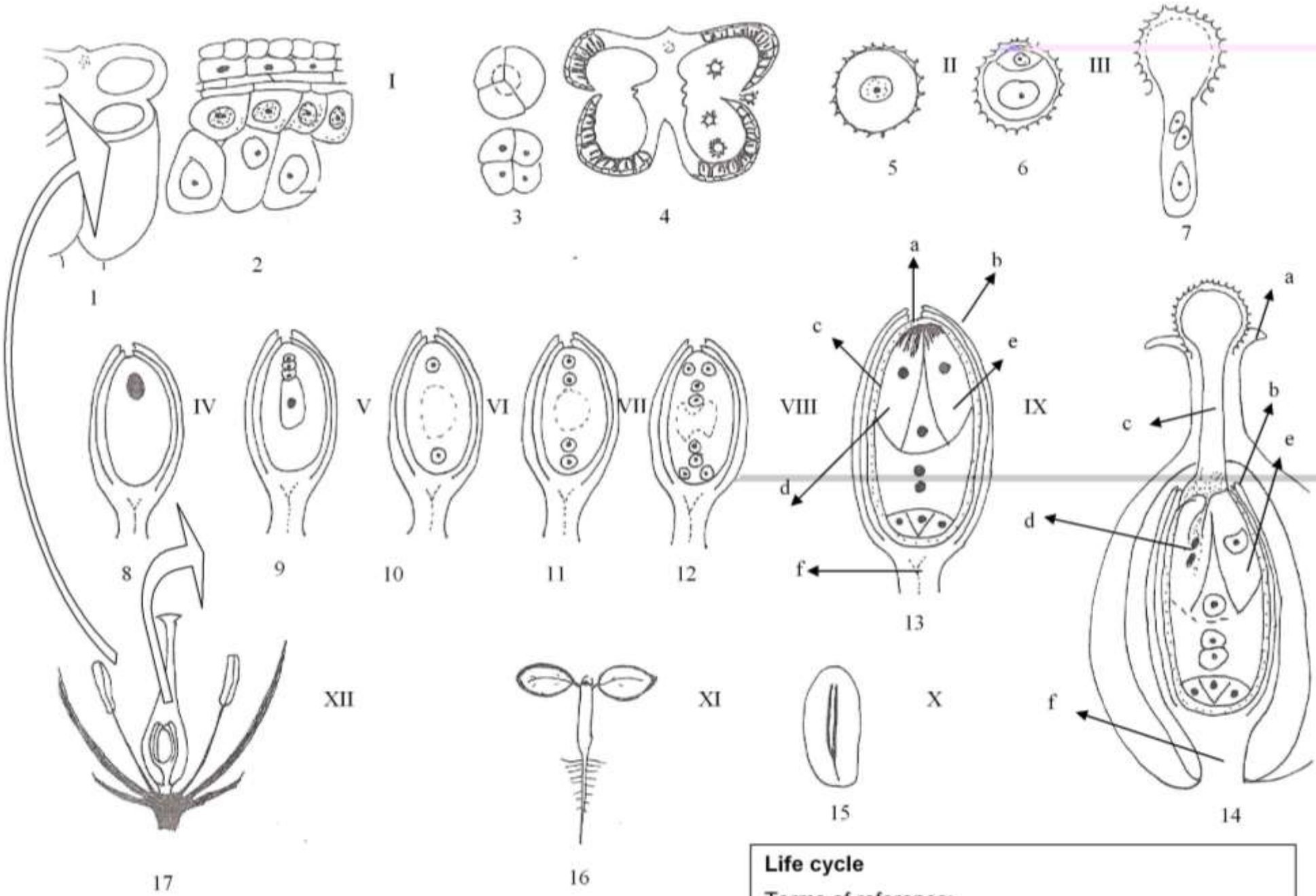
B) Pinophyta. 松柏植物門

C) Magnoliopsida. 雙子葉植物門

D) Liliopsida. 單子葉植物門

15- Choose and write down the number of the schematic drawing that represents fertilization. 選出圖中代表受精作用的代碼(數字), 並將答案寫於下方空格中

Answer: _____



Life cycle

Terms of reference:

Roman numbers: Processes
Arabic numbers: structure
Letters: Structural Components

16- The following table shows some of the components in diagram 14 of the plant life cycle figure. Choose the correct option.

下表為第 14 題植物生活史中各構造與其名稱之配對, 請選出正確的配對。

	a	b	c	d	d	f
A)	Stigma 柱頭	Outer integument 外層珠被	Pollen tube 花粉管	Zygote 合子	Synergid 助細胞	Funiculus 珠柄
B)	Pollen tube 花粉管	Pollen chamber 花粉腔室	Ovary 子房	Archegonium 藏卵器	Ovocell 卵細胞	Nucellus 細胞核
C)	Stigma 柱頭	Outer integument 外層珠被	Pollen tube 花粉管	Male Gametes 雄配子	Synergid 助細胞	Funiculus 珠柄
D)	Pollen chamber 花粉腔室	Synergid 助細胞	Stigma 柱頭	Funiculus 珠柄	Archegonium 藏卵器	Outer integument 外層珠被
E)	Style 花柱	Synergid 助細胞	Stigma 柱頭	Zygote 合子	Outer integument 外層珠被	Antipodal cells 反足細胞

17- Which of the following statements associated with this life cycle is incorrect?

有關於此生活史的敘述, 下列哪一個**錯誤**?

A) The anther endothecium develops into the fibrous layer.

花藥內層發育成纖維層

B) The megaspores are arranged in one row and, generally, three of them degenerate.

大孢子通常排列成一行, 其中三個退化

C) The mature male gametophyte consists of three cells resulting from two meiotic divisions. 成熟的雄配子體包括的三個細胞是由兩次減數分裂而來的

D) The seed develops from the ovule. 種子是由胚珠發育而來

E) The embryo constitutes a partially developed young sporophyte.

胚是一個幼小的孢子體

18- The species that shows the life cycle represented in this figure have the following pool of characteristics: 圖中生活史包括以下特性

Answer code:

01. Naked seed. 種子裸露

02. Protected seed. 種子受保護

03. Winged seed. 種子有翅

04. Exalbuminous seed. 無胚乳種子

05. Perfect flower. 完全花

06. Imperfect flower. 不完全花

07. Free pollen grains. 分離的花粉粒

08. Pollinium. 花粉團塊

~~**09**. Anatropous ovule. 側面著生的胚珠~~

~~**10**. Orthotropous ovule. 直立著生的胚珠~~

11. Gametophyte generation only. 僅有配子體世代

12. Sporophyte generation only. 僅有孢子體世代

13. Two alternating generations. 兩個交替的世代

14. Hypogeal germination. 地下型萌發

15. Epigeal germination. 地上型萌發

Write down the correct combination of characteristics.

寫下正確組合的特性號碼

Answer: _____

19- Observe the parts of the life cycle that correspond to processes occurring in the ovule before fertilization and mark with an “X” the corresponding boxes in which mitosis occurs. 胚珠內, 在受精作用之前的過程中, 將發生有絲分裂的步驟圈選”X”出來

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII

20- Suppose that the plant corresponding to this cycle, besides producing seeds, can reproduce asexually through stem pieces or slips. Which of the following plant hormones would you choose to improve rooting?

若具此生活史的植物, 除了可產生種子外, 也可用莖段進行無性生殖. 下列何種植物激素可促進生根?

A) Giberellins. 吉貝素

B) Cytokinins. 細胞分裂素

C) Ethylene. 乙烯

D) Auxins. 植物生長素

E) Abscisic acid. 離層素

21- In the following table nine mineral elements essential to the plant whose life cycle is represented in the figure are listed. Match both columns and identify the correct combination. 下表為具此生活史的植物所必須礦物元素, 下列對應何者正確?

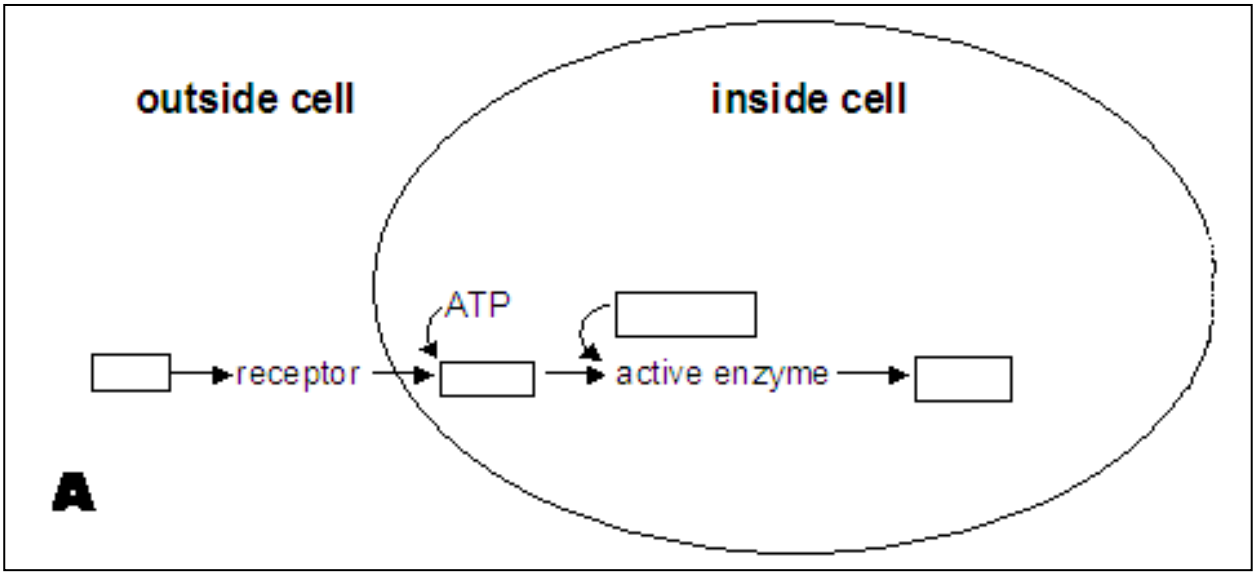
01. Calcium. 鈣 02. Potassium. 鉀 03. Iron. 鐵 04. Nitrogen. 氮 05. Magnesium. 鎂 06. Molybdenum. 鉬 07. Phosphorus. 磷 08. Zinc. 鋅 09. Sulfur. 硫	I. Macronutrients 巨量養分 II. Micronutrients 微量養分

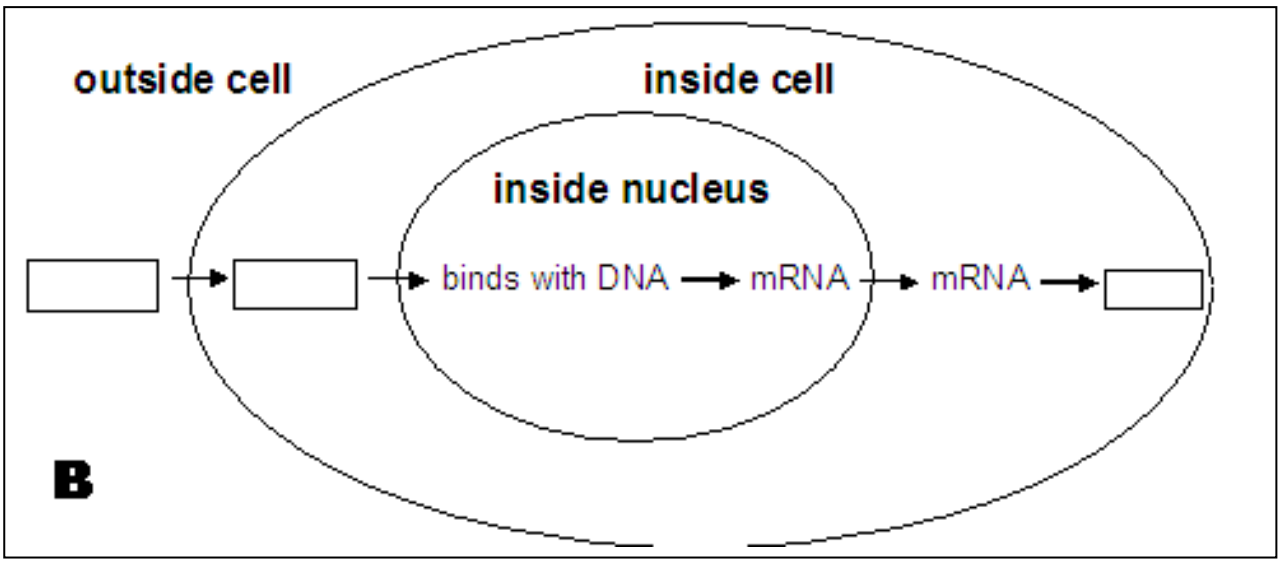
	I	**II**
A)	02, 04, 05, 07, 09	01, 03, 06, 08
B)	02, 04, 07, 09	01, 03, 05, 06, 08
C)	01, 02, 04, 05, 09	03, 06, 07, 08
D)	01, 02, 04, 05, 07, 09	03, 06, 08
E)	01, 02, 03, 04, 07	05, 06, 08, 09

ANIMAL ANATOMY AND PHYSIOLOGY (9 questions, 16 points)

動物解剖學及生理學(9 題，共 16 分)

22- Diagrams A and B correspond to the mechanisms of hormonal action. By using each corresponding code once, fill in the boxes. REMEMBER TO WRITE DOWN YOUR ANSWERS IN THE ANSWER SHEET. 圖 A 及圖 B 描述激素的作用機制，請將正確選項的代碼填入答案格中(**各代碼只使用一次**)。<u>注意：必須把答案填入答案卷中</u>





Answer code: 答案代碼

01. chemical reaction. 化學反應

02. steroid hormone. 固醇類激素

03. inactive enzyme. 非活化態的酵素

04. protein. 蛋白質

05. receptor. 受體

06. peptide hormone. 肽類激素

07. cyclical AMP. 單磷酸環狀腺苷

23- Complete the following table about the chemical nature of the hormones by using the codes below: 請於下表中填入該種激素的化學性質

Answer code: 答案代碼

01. Peptides or proteins. 肽類或蛋白質

02. Derivatives of amino acids. 胺基酸的衍生物

03. Fatty acid derivatives. 脂肪酸的衍生物

04. Steroid. 固醇類

05. Glycoprotein 醣蛋白

HORMONE 激素	**CODE 代碼**
A) Progesterone 助孕素	
B) Insulin 胰島素	
C) FSH (Follicle-stimulating hormone) 濾泡刺激素	
D) LH (Luteinizing hormone) 黃體素	
E) Prolactin 泌乳激素	
F) Oxytocin 催產素	
G) Estrogen 動情素	
H) Testosterone 睪固酮	
I) ACTH (Adrenocorticotropic hormone)腎上腺皮質素	
J) ADH (Antidiuretic hormone or vasopressin)抗利尿激素	

24- The following figure shows the interactions between the hypothalamus, the anterior hypophysis and the male gonades. The full arrows (→) indicate excitatory effects and the dotted arrows (⇢) indicate inhibiting effects.

下圖呈現下視丘、腦垂腺前葉及男性性腺(睪丸)的交互作用，其中(→)代表活化效果，(⇢)代表抑制效果。

Complete the boxes in the figure by using the corresponding code.

請將正確答案代碼填入答案格中

Answer code: 答案代碼

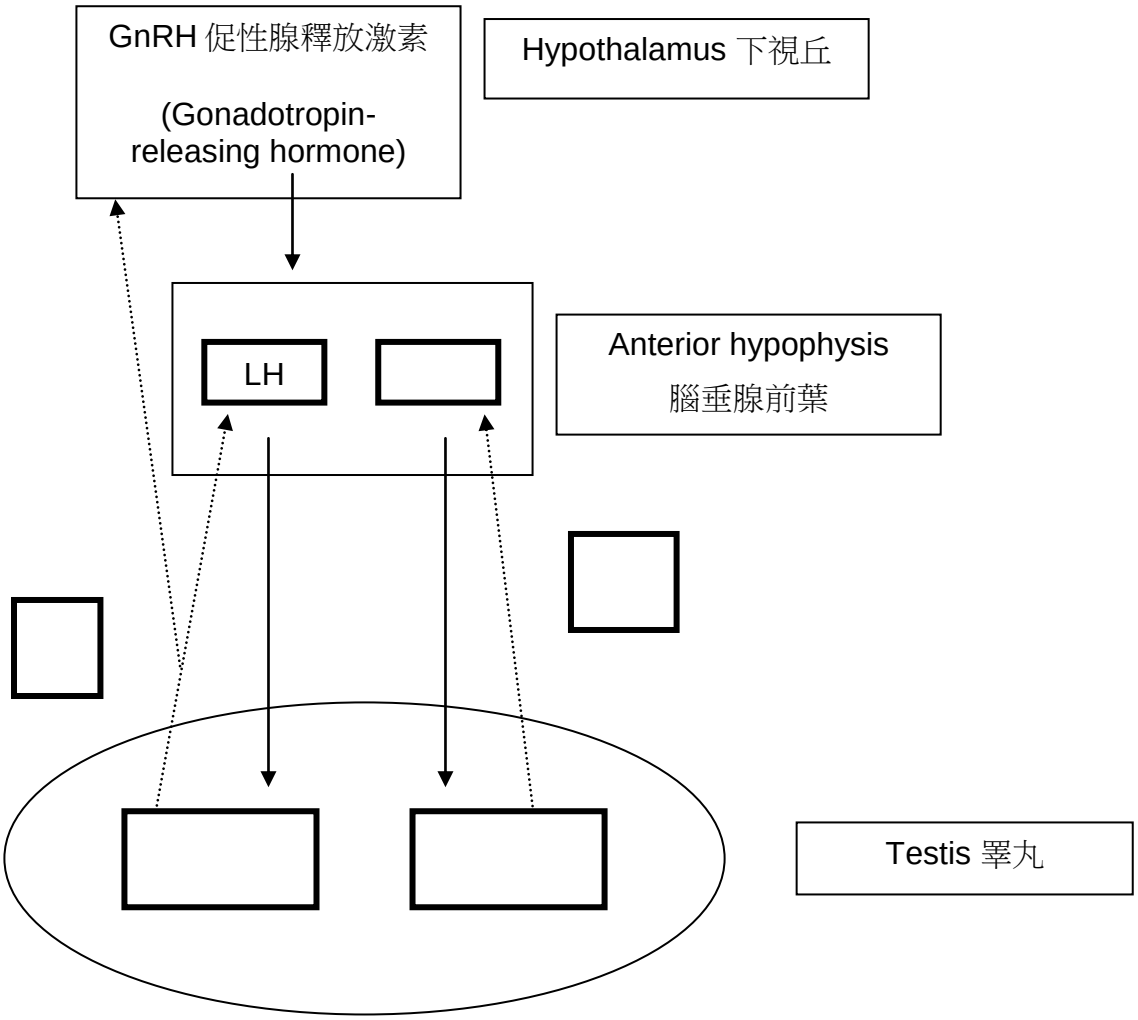
01. Sertoli cell. 賽氏細胞 (足細胞)

02. Testosterone. 睪固酮

03. FSH - Follicle-stimulating hormone. 濾泡刺激素

04. Leydig Cells. 萊氏細胞 (間質細胞)

05. Inhibin. 抑制素



25- 48 hours after beginning a hyposodic diet (low sodium), the renal and hormonal conditions of a person are controlled. Which combination of the following conditions does the patient display? Select the correct answer.

使用低鈉飲食 48 小時後，病人的腎功能及激素功能受到控制，其身體會呈現下列哪些變化？請選出正確的答案組合。

Reference signs: 表中符號代表的意義

+: increase. 增加

-: decrease. 減少

=: no changes. 無變化

	Aldosterone in plasma 血中留鈉激素(醛固酮)的濃度	ADH in plasma 血中抗利尿激素的濃度	Na^+ reabsorption 鈉的再吸收量	Water reabsorption 水的再吸收量
A)	+	+	+	+
B)	-	-	-	-
C)	+	-	+	=
D)	+	=	=	=
E)	+	-	+	-

26- Next of each kind of receptor, write down the answer code of the corresponding structure. 請將下列各受器的代碼，填入正確的分類欄位中

	CODE 代碼
Mechanoreceptor 機械性受器	
Chemoreceptor 化學性受器	
Photoreceptor 光受器	

Answer code: 答案代碼

01. Gustatory papillae. 味蕾

02. Crustacean statocysts. 甲殼類的平衡囊

03. Gustatory hairs in flies. 蠅類的味覺毛細胞

04. Vertebrate retina. 脊椎動物的視網膜

05. Muscle spindle. 肌梭

06. Arthropod omatidium. 節肢動物的複眼

07. Diptera halteres. 雙翅目的平衡器

08. Labyrinth of vertebrate ear. 脊椎動物的內耳迷路

27- Determine to what kind of muscular tissue corresponds each one of the following sets of characteristics. Write the correct answer codes in the corresponding box.

根據不同的特徵，將正確的肌肉種類代號填入答案欄中。

Muscular kind 肌肉種類 / 特徵 Characteristics			
Fibre shape **肌細胞的形狀**	Elongated, cylindrical, blunt ends 長形、圓筒狀、鈍端	Elongated, spindle-like, pointed ends 長形、紡綞狀、圓端	Elongated, cylindrical, branched, fibres fuse to each other 長形、圓筒狀 分支、纖維互相融合
Number of nuclei per fibre **肌纖維中的核數**	Many 多個	One 一個	One or two 一或二個
Nucleus location **核的位置**	Peripheral 週邊	Central 中央	Central 中央
Contraction speed **收縮的速度**	Very fast 非常快	Very slow 非常慢	Intermediate 中等速度

Answer code:

01. cardiac muscle. 心肌

02. skeletal muscle. 骨骼肌

03. smooth muscle. 平滑肌

28- The volume of blood pumped by each ventricle during a beat is known as systolic volume. If it is multiplied by the number of beats per minute, the product is the cardiac cost. 心輸出量為心搏輸出量(每次心搏時心室輸出血量)，乘上心跳頻率所得的數值

Cardiac cost = systolic volume X cardiac frequency

心輸出量 = 心博輸出量 X 心跳頻率 (次/分)

Which is the cardiac cost (volume of blood pumped by each ventricle in a minute) of an adult person in rest whose heart beats 72 times per minute and pumps 70 millilitres of blood in each contraction?

故心輸量等於每分鐘心室輸出的血量，正常成人於靜止狀態下，每分鐘心跳次數為 72 下，每次心博輸出量為 70ml，則其心輸出量為何？

Answer code: 答案代碼

A) 3 l/min.

B) 5 l/min.

C) 10 l/min.

D) 7 l/min.

29- The cardiac frequency can increase or diminish under the influence of several factors. Complete the column on the right by writing a (+) sign if the factor increases the cardiac frequency and a (-) sign if the factor diminishes it.

心跳速率受到多項因素的調控，請判別下列因素對心跳速率的影響。

(+)代表增加，(-)代表減少，請將正確的代號填入對應的欄位中。

FACTOR 因子	**SIGN 現象**
A) Hypoxia 缺氧	
B) Exhalation 吐氣時	
C) Fever 發燒	
D) Excitation 興奮	
E) Inspiration 吸氣時	
F) Exercise 運動時	

30- The following diagram shows some of the factors that influence the cardiac cost. Complete the blank boxes by using the answer code. 下圖中呈現不同因素對心輸出量的影響，請將正確答案的代號填入空格中。

Answer code: 答案代號

01. Cardiac frequency. 心跳速率

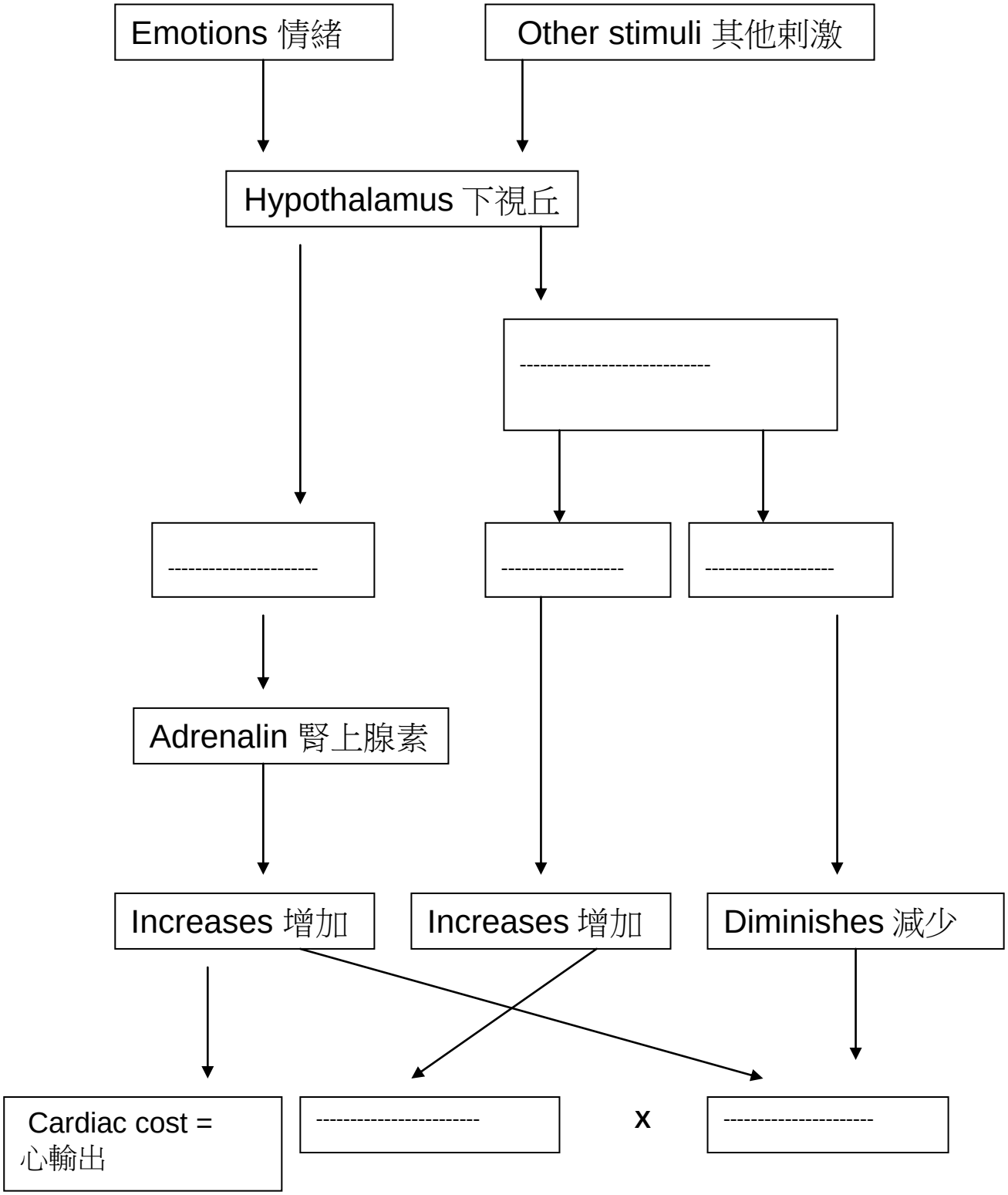
02. Adrenal glands. 腎上腺

03. Sympathetic nerves. 交感神經

04. Systolic volume. 心博輸出量

05. Parasympathetic nerves. 副交感神經

06. Cardiac centre in the medulla oblongata. 延腦中的血壓中樞


Emotions 情緒
Other stimuli 其他刺激
Hypothalamus 下視丘

Adrenalin 腎上腺素
Increases 增加
Increases 增加
Diminishes 減少
Cardiac cost = 心輸出
----
x

GENETICS (12 questions, 14 points)

**** In a butterfly species, the wing colour is determined by a locus with three alleles: *C* (black wings) > c^g (grey wings) > *c* (white wings). In a survey of a large population living in Río Cuarto, the following frequencies were obtained: *C*= 0.5; c^g = 0.4, and *c* = 0.1.**

某種蝴蝶翅的顏色，由位在同一基因座上的三種對偶基因所決定，其中 *C* (黑翅) > c^g (灰翅) > *c* (白翅). 於 Río Cuarto 進行了一次大規模的族群調查，得到以下的表現型頻率：*C*= 0.5; c^g = 0.4, and *c* = 0.1.

31- If the butterflies continue to mate randomly, the frequencies of black-winged, grey-winged, and white-winged butterflies in the next generation will be:

假如此種蝴蝶可繼續隨機交配，其下一代翅的顏色，將呈現下到哪種表現型頻率？

	Black wings 黑翅	**Grey wings 灰翅**	**White wings 白翅**
A)	0.75	0.24	0.01
B)	0.75	0.15	0.1
C)	0.24	0.75	0.01
D)	0.83	0.16	0.01

32- If the population consists of 6,500 butterflies, how many butterflies of each phenotype will there be? 如該族群有 6,500 隻蝴蝶，則各表現型的數量為何？

	Black wings	**Grey wings**	**White wings**
A)	3656	374	2470
B)	4875	1560	65
C)	3595	1040	65
D)	4875	156	1469

**** A small group of butterflies of the Río Cuarto population flies to an isolated neighboring site in Las Higueras, and starts a new population. After several generations, there is a large randomly mating population of butterflies in which the following phenotypic frequencies are observed:**

一小群源自 Río Cuarto 的蝴蝶，放隔離於鄰近的 Las Higueras.並開始形成一個新的族群，經過數代的自由交配後，觀察到其表現型呈現以下的頻率：

PHENOTYPE 表現型	**FREQUENCY 頻率**
black wings	0.00
grey wings	0.75
white wings	0.25

33.a- The allelic frequencies for ***C*** (black wings), ***c*** ^{g} (grey wings), and ***c*** (white wings) under Hardy-Weinberg equilibrium are:

根據哈溫定律，其對偶基因的頻率，應為下列何者？

	C	***c*** ^{g}	***C***
A)	0.25	0.50	0.25
B)	0.00	0.75	0.25
C)	0.00	0.50	0.50
D)	0.25	0.25	0.50

33.b- The change in the allelic frequencies in this population as compared to the original one is an example of: 新族群與原族群間，對偶基因頻率的改變，可作下列何者的範例？

A) migration. 遷移

B) selection. 選擇

C) bottleneck effect. 瓶頸效應

D) founder principle. 先驅者效應

34- A group of birds migrates into this isolated site in Las Higueras. As the birds find it easier to spot and catch the white-winged butterflies, the relative fitness of the white-winged is reduced to 0.2.一群鳥類遷往 Las Higueras，牠們發現白翅的蝴蝶，較易捕捉，白翅蝴蝶的相對存活率下降至 0.2，如下表。

Phenotype 表現型	**Relative fitness 相對存活率**
grey wings	1
white wings	0.2

What will the genotypic frequencies be after one cycle of selection but before the selected population reproduces ?

經過一代的選擇後，且選擇後的蝴蝶仍未繁殖，則其表現型頻率為何？

	$c^g c^g$	$c^g c$	cc
A)	0.3125	0.625	0.0625
B)	0.25	0.5	0.05
C)	0.25	0.5	0.2
D)	0.263	0.526	0.211

**** Human lactoferrin (hLf) is an 80kD monomeric glycoprotein originally found in milk that confers antibacterial and iron transport properties to humans. A group of scientists decided to generate transgenic tobacco plants expressing hLf cDNA (complementary DNA).**

人類的乳鐵蛋白(hLf)是一種 80Kd 的單元糖蛋白，最先在乳汁被發現，具有抗菌及運送鐵質的功能，科學家希望利用基因轉殖菸草，以表現 hLf cDNA。根據提示，回答 35-42 題

35- In order to prepare a cDNA library in *Escherichia coli*, total cellular RNA was extracted from human mammary gland and the mRNA was isolated Then, they converted the mRNA into cDNA. Look at the following figure, and employing the answer code, determine the correct order of steps (01-07) to obtain cDNA.

為了製備一個大腸桿菌的 cDNA 庫，先自人類乳腺細胞中純化出 mRNA，再將之轉換成 cDNA，請先觀看下圖，按照取得 cDNA 的工作流程，將答案代碼(01-07)的正確順序填入答案卷中

Answer code: 答案代碼

01. C bases added to 3´end.

在 3´end.加上 C

02. Add terminal transferase + dCTP.

加入末端轉移酶及 dCTP

03. Add reverse transcriptase + 4 dNTPs + oligo dT primer (TTTT).

加入反轉錄酶、4 dNTPs + oligo dT primer (TTTT).

04. Second DNA strand synthesized from GGGG primer to 3´ end.

由 GGGG primer3´ end 合成出第二股 DNA

05. ssDNA strand synthesized from TTTT primer to 3´ end.

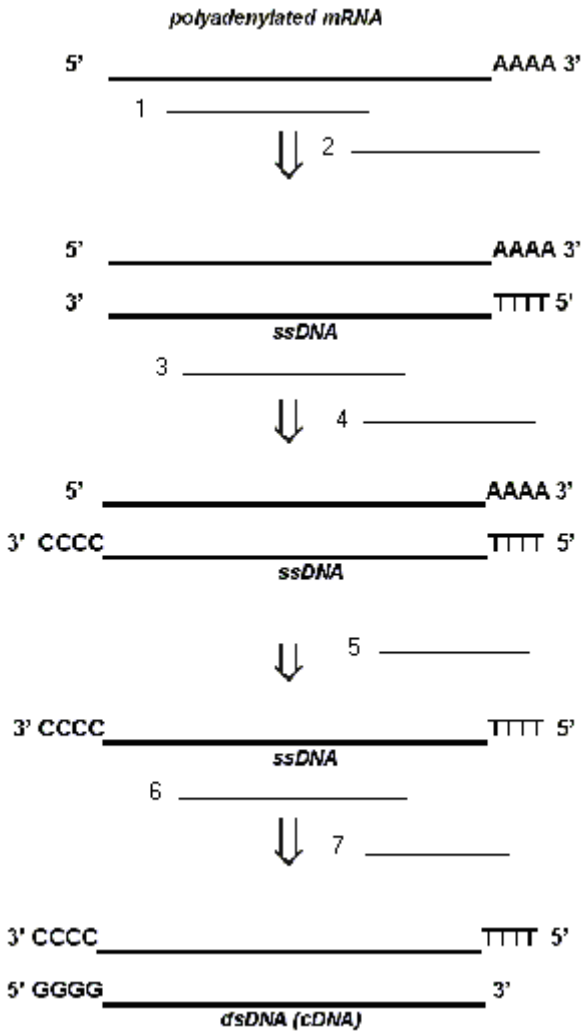
由 TTTT primer 向 3´ end 合成出單股 DNA

06. hydrolyzed RNA leaving DNA.

水解 RNA 以釋出 DNA

07. Add DNA polymerase + 4 dNTPs + oligo-dG primer (GGGG).

加入 DNA 聚合酶、4 dNTPs + oligo-dG primer (GGGG).


polyadenylated mRNA
5' AAAA 3'
1
2
5' AAAA 3'
3' TTTT 5'
ssDNA
3
4
5' AAAA 3'
3' CCCC TTTT 5'
ssDNA
5
3' CCCC TTTT 5'
ssDNA
6
7
3' CCCC TTTT 5'
5' GGGG 3'
dsDNA (cDNA)

Answer: _____.....

36- The scientists constructed a cDNA library in a lambda vector. They chose a lambda vector instead of a plasmidic vector because lambda vectors: 科學家利用λ載體建造 cDNA 資料庫。他們選擇用λ載體而不是質體載體，因為λ載體_____。

I. can be packaged *in vitro.* 可在試管內被包裝

II. can accommodate larger DNA foreign fragments than plasmid vectors.
比質體載體能裝下更大的外來 DNA 片段

III. don´t have to be cut with restriction enzymes. 不必被限制酶切割

IV. are introduced in *Escherichia coli* cells by transformation. 可藉細胞轉型進入大腸桿菌

V. are introduced in *Escherichia coli* cells by infection. 可藉感染進入大腸桿菌

VI. carry antibiotic-resistance genes. 傳播抵抗抗生素的基因

VII. lambda libraries are easier to screen. 用λ資料庫較易作篩選

VIII. lambda vectors form larger colonies. λ載體可形成更大的菌落

Select the combination of the correct options: 選擇正確的組合：

A) I, II, VII.

B) III, V, VI.

C) II, IV, VIII.

D) I, II, V.

37- They identified in the library the cDNA clone encoding *hLf* using the sequence of the *hLf* gene (with a chemical label) as a probe. The screening procedure employed was:

用 *hLf* 基因(具有一個化學標籤)的序列為探針，科學家在資料庫中鑑定出 *hLf* 編碼的 cDNA 株落(克隆)。所用的篩選過程為何？

A) Southern hybridization. 南方雜交

B) colony hybridization. 菌落雜交

C) Northern hybridization. 北方雜交

D) plaque hybridization. 噬菌斑雜交

E) immunological. 免疫學

38- Once the desired cDNA clone was identified, the scientists isolated and sequenced the insert in order to be sure it was the *hLf* cDNA. Deduce the nucleotide sequence of the original strand of this small fragment sequenced with the dideoxi method.

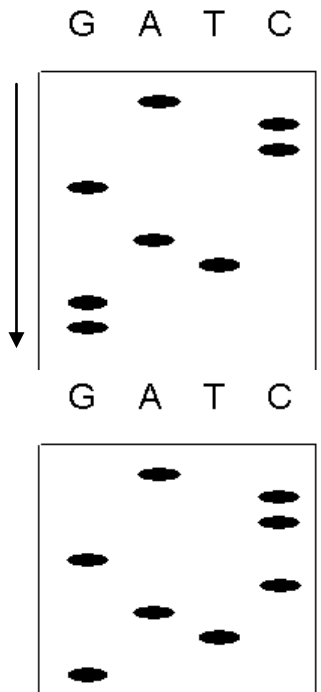
一旦目標 cDNA 株(克隆)被鑑定出來，為確定哪些是 *hLf* cDNA，科學家分離並定序那些插入基因。 並用 dideoxi 方法定序的這個片段，根據定序結果判斷原本核苷酸(非模版股)的序列為何？

A) 5´ TGGCTACC 3´.

B) 3´ TGGCTACC 5´.

C) 5´ ACCGATGG 3´.

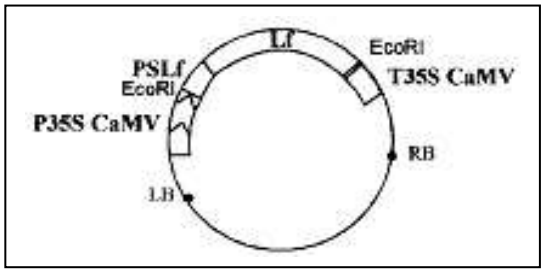
D) 3´ ACCGATGG 5´.



39- As the sequencing confirmed it was the *hLf* cDNA, they inserted it into the *Eco*RI site of a plasmid. The plasmid contained: a) the wild type of *hLf* coding sequence including its signal peptide (PSLf) under the control of the 35S strong promoter and the 35S terminator of the cauliflower mosaic virus, and b) the left (LB) and right (RB) borders of T-DNA. It was transformed into *E. coli* and then transferred to *Agrobacterium tumefaciens* by conjugation.

當這些序列被確定是 *hLf* cDNA 之後, 它們被插入一個質體的 *Eco*RI 切位上, 此質體含有 a)野生型的 *hLf* 編碼序列, 包括在花椰菜鑲嵌病毒(CMV)之 35S 啟動子與終結子的控制下, 所產生之訊號胜肽(PSLf)

b) T-DNA 的左側(LB)及右側(RB), 在大腸桿菌中轉型(transformation)，並藉由接合作用(conjugation)轉移至 *Agrobacterium tumefaciens.*



The promoter sequence of the cauliflower mosaic virus was necessary because:

為何需要花椰菜鑲嵌病毒(CMV)之啟動子序列?

A) they wanted to sequence the *hLf* cDNA again.

他們希望再進行一次 *hLf* cDNA 的定序

B) they wanted to express the *hLf* gene throughout the biomass of the transgenic tobacco plant. 他們希望藉由轉殖菸草產生的生物量，大量表現 *hLf* 基因

C) they wanted to express the *hLf* gene in the cauliflower as well.

他們希望在花椰菜表現 *hLf* 基因

D) without a promoter the gene does not replicate.

若沒有啟動子則基因無法複製

40- Discs of tobacco (*Nicotiana tabacum*) leaves were infected with recombinant *Agrobacterium tumefaciens*. To determine which tobacco plants were transgenic, the scientists performed:

當一小片菸草葉被重組的 *Agrobacterium tumefaciens* 感染時, 下列何者可用來決定哪些菸草已經轉殖成功?

A) a Western blot analysis. 西方墨點分析

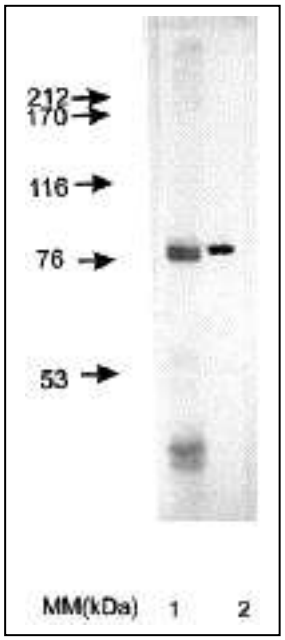
B) a Northern blot analysis. 北方墨點分析

C) a Southern blot analysis. 南方墨點分析

D) microscopic observation. 顯微鏡觀察

41- Twenty tobacco transgenic plants were screened for the expression of the *hLf* gene:

1g of fresh weight of transgenic leaf tissue was ground in liquid nitrogen and total soluble proteins were extracted. The following figure shows the Western analysis of the total soluble protein extract from transgenic leaves (1. concentrated protein extract; 2. milk hLf. The position of protein standards is shown on the left). The blot was:



以 20 棵基因轉殖菸草, 篩選 *hLf* 基因的表現, 取一克新鮮的轉殖葉片組織於液態氮中研磨, 以萃取所有可溶性蛋白, 右圖顯示將這些由轉殖葉片萃取之蛋白進行西方墨點分析的結果 (樣本 1 為濃縮之蛋白萃取液, 樣本 2 為牛奶的 hLf, 而標準蛋白質(marker)位於左側). 則此墨點為・・・

A) immunostained with anti-milk hLf antibodies.

用抗牛奶 hLf 抗體來作免疫染色

B) hybridized with *hLf* mRNA. 與 *hLf* mRNA 進行雜合

C) hybridized with the cDNA encoding human lactoferrin.

與人類的乳鐵蛋白之 cDNA 進行雜合

D) hybridized with the *Eco*RI fragment containing the *hLf* cDNA.

與含有 *hLf* cDNA 的 *Eco*RI 片段進行雜合

42- After the transformation of tobacco (*N. tabacum*) with a human lactoferrin cDNA under the control of the 35S promoter from cauliflower mosaic virus, using *A. tumefaciens*-based gene transfer, the authors **concluded that**:

人類的乳鐵蛋白之 cDNA, 在花椰菜鑲嵌病毒的 35S 啟動子控制下, 轉型於菸草上之後, 利用 *A. tumefaciens* 為基礎的基因轉移, 科學家可得到下列哪些結論?

I. it leads to the production of full-length 80-kDa hLf transgenic plants.
它製成可產生全長80-kDa hLf的轉殖植物

II. the human lactoferrin obtained is different from the hLf produced by human mammary gland. 人類乳鐵蛋白與從人類乳腺所產生的 hLf不同

III. the human lactoferrin obtained is not a monomeric glycoprotein.
人類乳鐵蛋白並非單元醣蛋白

IV. transgenic plants are able to produce human lactoferrin.
轉殖植物能生產人類乳鐵蛋白

V. the transgenic tobacco plants produce milk with human lactoferrin.
轉殖菸草能生產人類乳鐵蛋白

VI. the tobacco hLf protein produced, presents a molecular mass closely identical to the native protein. 菸草產生的hLf蛋白的分子量與原有蛋白極相近的種類

VII. carbohydrate compositions of tobacco hLf and milk hLf are the same.
菸草的hLf與牛奶hLf的碳水化合物組成相同

VIII. the human lactoferrin obtained confers antibacterial and iron transport properties to humans. 人類乳鐵蛋白可供給人類抗菌及鐵輸送的特性

Select the correct combination of options:
選擇正確的組合

A) I, IV, VI.
B) I, V, VII.
C) III, IV, VIII.
D) II, V, VIII.

ECOLOGY (7 questions, 12 points)

**** In order to determine the mulitas' (*Dasypus novemcinctus*) eating habitat, a group of scientists conducted a vegetation survey and compared it with the food remains found in the excrements.**

為了找出犰狳的食性, 科學家進行了植被調查, 並與動物排泄物中的殘渣作比較.

43- The scientists walked in a straight line through a sunflower and a corn fields, and a natural pasture. They conducted a vegetation census in a $1m^2$ square every 50 metres recording the species diversity, the coverage and the fenological stage. Which of the following techniques were employed?

科學家分別在向日葵田, 玉米田及天然草地三種環境下, 進行直線行走式的調查法. 他們以每 50 公尺取 1 平方公尺的樣區, 記錄物種歧異度, 覆蓋程度及開花結果的階段. 必須用到下列哪些技術?

I. soil sampling. 土壤取樣

II. systematic sampling. 系統取樣

III. a graphical presentation of life forms by means of a bar diagram. 用柱狀圖來表示不同植物的生長型態

IV. coverage estimation (% of the ground covered by the species). 覆蓋程度的估算(植物覆蓋地表的百分比)

V. collection of vegetation biomass. 採集植物的生物量

VI. use of a transect. 利用直線截取調查法

VII. data analysis (species and census). 資料分析(物種及數量統計)

VIII. species listing. 物種名錄

~~IX. random sampling. 逢機取樣~~

Select the combination of the correct options:

請選擇一個正確的組合

A) I, III, V, VII.

B) II, IV, VI, VIII.

C) II, V, VI, VIII.

D) I, II, III, IV.

E) V, VI, VII, VIII.

**** The results of the samples of the mulitas´ excrements (I), of the vegetation in the sunflower field (II), in the corn field (III), and in the natural pasture (IV), are shown below. Column I shows plant remains found in the excrements and in which percentage. In columns II, III and IV, the fenological state and the percentage of coverage of each species are presented. The excrement and vegetation samplings were performed at the same time.**

由犰狳糞便樣本分析的結果(I), 在向日葵田中的植物(II), 在玉米田中的植物(III), 及在天然草地中的植物(IV), 分別列於下表中. I 欄為糞便中的植物殘渣及其所佔百分比, II, III 及 IV 欄為植物生長階段及所佔百分比, 糞便的收集與植物取樣的工作兩者同時進行.

Species	I	II	III	IV
Species 1			Fruit, 90%	
Species 2		Fruit 果實, 90%		
Species 3	Epidermis 表皮, 100%	Flower 花, 5%	Flower, 10%	Flower, 2%
Species 4		Flower, 10%	Flower, 6%	Flower, 3%
Species 5	Epidermis, 10%	Vegetative, 6%	Vegetative, 2% 營養器官	Vegetative, 7%
Species 6		Vegetative, 5%	Vegetative, 20%	
Species 7			Vegetative, 8%	Vegetative, 40%
Species 8	Epidermis, 40%	Vegetative, 5%	Vegetative, 90%	Vegetative, 15%
Species 9	Seeds, 20%	Fruit, 30%	Fruit, 40%	Fruit, 5%
Species 10	Epidermis, 10%	Fruit, 30%	Vegetative, 15%	Fruit, 28%
Species 11	Epidermis, 60%	Flower, 10%	Flower, 6%	Flower, 30%
Species 12	Seeds, 80%	Vegetative, 90%	Fruit, 90%	Fruit, 40%
Species 13	Seeds, 100%	Flower, 10%	Fruit, 6%	Flower, 3%

44- In which environment have the mulitas fed? 犰狳在何種環境中覓食?

A) Only in II.

B) Only in III.

C) Only in IV.

D) both A and B are correct.

E) both A and C are correct.

45- With the purpose of comparing the population size of mulitas between a corn field and a natural pasture, another group of scientists carried out two samplings. In the first one, they caught 130 specimens in each environment, marked them without interfering with their survival, and released them. Three days later, a second random sample was taken. Of the 125 animals captured in the corn field, 72% were marked. In the natural pasture 45% of the 144 specimens caught were marked. Assuming no changes in the population size within the three days, which environment had the largest population and which was its size?

為了比較犰狳在玉米田及天然草地中的族群大小差異, 另一群研究人員進行了 2 次取樣. 第一次, 他們分別在兩處各捕捉 130 隻動物, 在不影響牠們生存的情況下, 分別上標後, 再予以釋放, 3 天後, 再進行第二次取樣, 在玉米田捕到 125 隻犰狳, 其中有 72%為前次上標者; 在天然草地上捕到的 144 隻中, 有 45%為前次上標者. 假設在此 3 天內犰狳族群沒有任何變化. 請問哪種環境之犰狳數量最多?其數量為何?

~~Total population/ Number of individuals initially marked = Total of individuals caught in the second sampling / Number of individuals marked and recaptured~~

~~族群數量 / 動物個體上標數量 = 第二次取樣的動物總數量 / 第二次取樣中有前次上標的動物數量~~

Answer:

A) corn field, 288 individuals. 玉米田, 288 隻

B) grassland, 180 individuals. 草地, 180 隻

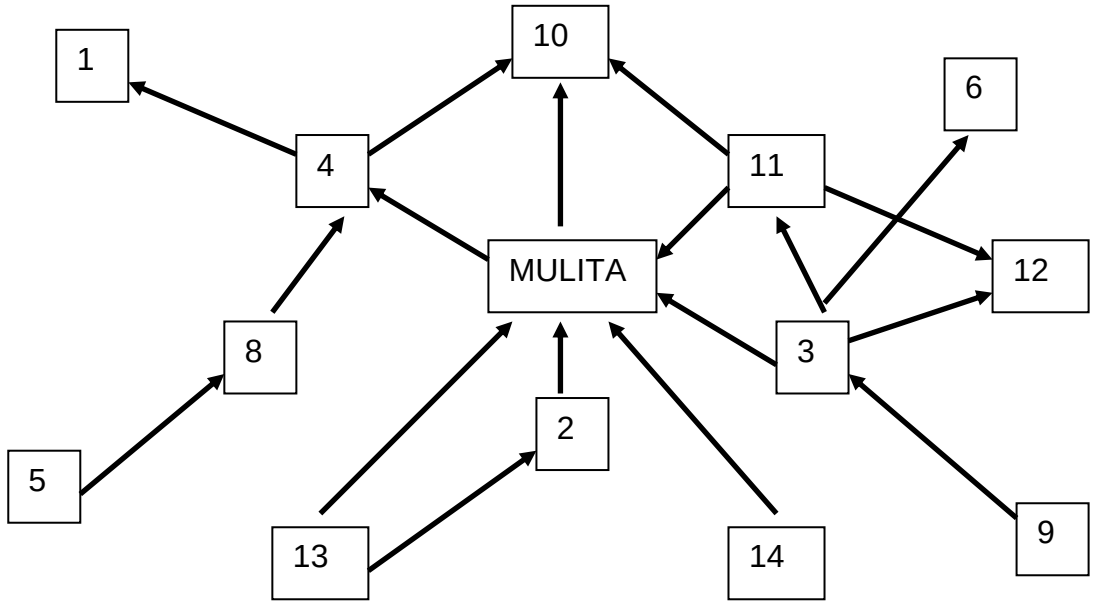
C) corn field, 180 individuals. 玉米田, 180 隻

D) natural pasture, 288 individuals. 草地, 288 隻

E) corn field, 280 individuals. 玉米田, 280 隻

**** The following diagram corresponds to a trophic web in which the mulita is present. The numbers represent other species, and the arrows, the energy transfer pathway in an ecosystem.**

下圖顯示犰狳所在環境之食物網, 數字代表其他物種, 箭頭表示能量在生態系的傳遞方向.



46- This mulita species is: 此犰狳的食性為

A) Herbivorous. 草食性

B) Carnivorous. 肉食性

C) Omnivorous. 雜食性

D) Saprophagous. 腐食性

47- An example of a long food chain is: 舉出一個長的食物鏈之例子

A) 5, 8, 4, 11, 1.

B) 9, 3, mulita, 10, 4.

C) 13, 2, mulita, 11, 12.

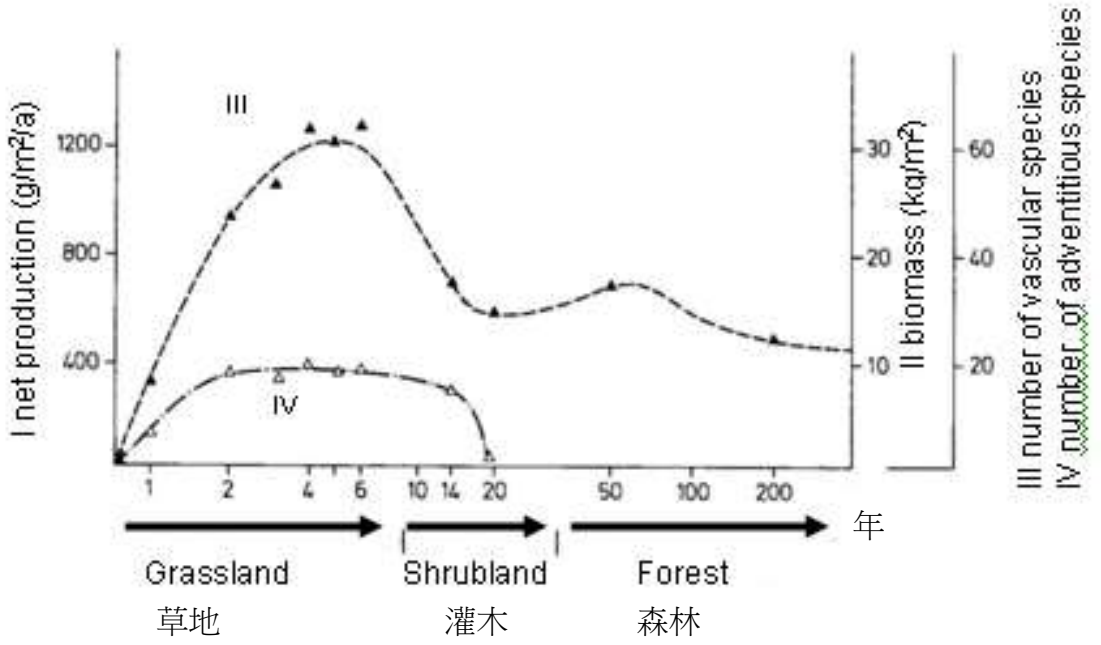
D) 13, 2, mulita, 4, 1.

**** When a plant community develops by the process of ecological succession, population age structure also varies in the participating species causing changes in the net productivity and in the community biomass. The following figure shows an example of the outcome of a study of reforestation of an abandoned land.**

當一個植物群落經由生態演替形成, 再此群落中各物種族群之年齡結構亦隨之變異, 造成淨生產力以及群落生物量之改變. 下圖顯示一處廢棄地歷經回復為森林的研究成果

48- On the answer sheet, complete the figure indicating: net primary production evolution (I) in red pencil, and biomass (II) in green. Use the graph axes help.

在答案卷上, 完成圖上的說明, 用紅鉛筆指出淨初級生產力(I)之演變, 用綠筆標示生物量(II). 用圖的縱, 橫兩軸來輔助



I	淨初級生產力(g/m2/yr)
II	生物量
III	維管束植物(？)數量
IV	偶生種(？)數量

49- Using the answer code, say whether the following statements are correct or incorrect according to results shown in the above figure.

根據上圖所顯示的結果, 用下列代號表示下列各敘述是正確(01)或錯誤 (02)

Answer code:

01. Correct 正確

02. Incorrect. 錯誤

STATEMENTS	**CODE**
A) In advanced stages of succession, species richness increases. 在演替後期, 物種多樣性增加	
B) During the first stage of succession, the number of vascular species (III) increases. 在演替初期, vascular(維管束植物?)物種數量(III)增加	
C) Adventitious species (IV) would be eliminated in the shrub phase by competition. Adventitious(偶生種?, IV)會自在灌叢期經由競爭而消失	
D) Between the 5th and 14th years there is a shift in the trajectory of the four characteristics analysed in this study. 此研究中在第 5-14 年間，此四種特性的變化趨勢產生變化	
E) Richness of vascular and adventitious species are inversely proportional. 維管束植物(?)與偶生種(?)的豐富度呈現互補現象	
F) The number of vascular species fluctuates until reaching an equilibrium. 維管束植物(?)的物種數量在達到平衡前, 呈現波動變化	

BIOSYSTEMATICS (3 questions, 6 points)

50- The characteristics of eight taxonomic groups indicated with A up to H are shown in the following table.

8 種分類群的特徵 A 至 H 列於下表中

Group	Amniotic egg 羊膜卵	Chorda 脊索	Hair 毛	Legs 腳	Bony skeleton 硬骨骨骼	Teeth/ Jaws 牙/下頜
A	-	+	-	-	-	-
B	+	+	+	+	+	+
C	-	+	-	-	+	+
D	-	+	-	+	+	+
E	+	+	+	+	+	+
F	+	+	+	+	+	+
G	-	+	-	-	-	+
H	-	-	-	-	-	-

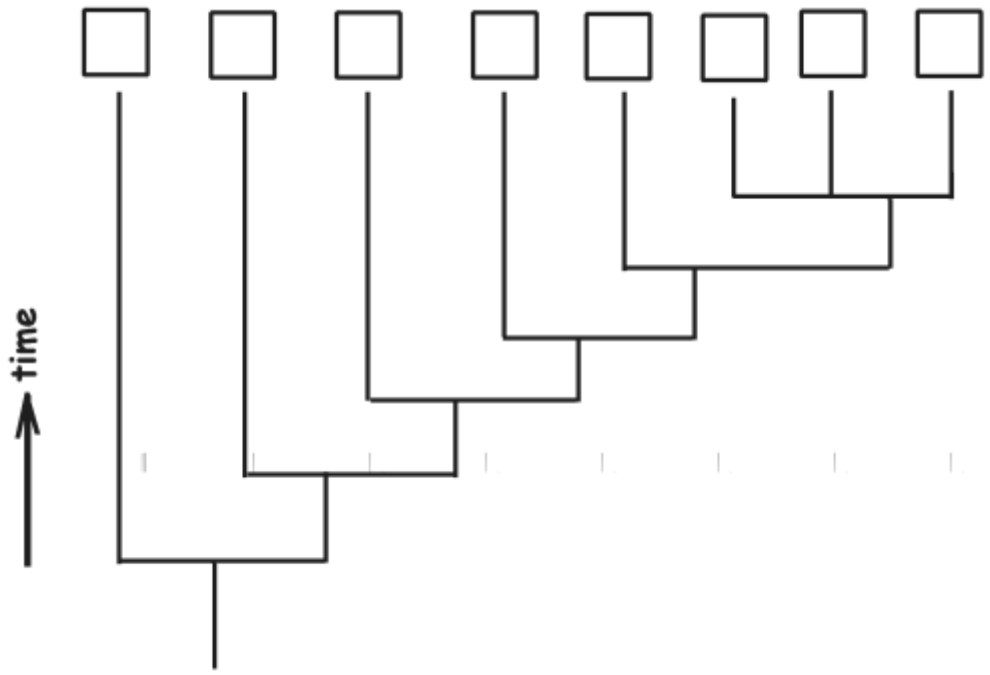
References:

+ feature present “+”代表有特徵

- feature absent “-“代表無特徵

Based upon these features complete the following evolutionary tree by writing the correct taxon group letters in the corresponding branches.

根據這些特徵選取上述物種的代號填入方格中, 以完成下列的演化樹



51- In the table below you will find several statements about three families of *Liliopsida* class. Match both columns and identify the correct answer.

下表中多個敘述與單子葉植物綱的三個科有關, 對應敘述與科, 並選出適當答案

01. The inflorescence of almost all species of this family is an unbranched fleshy spike composed of numerous very small flowers subtended by a spathe. 本科的花序大多是肉穗狀, 內含多數小花, 外有佛焰苞 02. Most species of this family are bulbiferous. The bulbs are tunicated or, sometimes, have numerous imbricate fleshy scales. 本科多具鱗莖, 其形狀為平截狀或有時為多個覆瓦狀互疊的肉質鱗片 03. The vegetative body is usually a trunk that terminates in a crown of leaves. Histologically, the woody stem consists of primary tissues, which were originated from the growing tip. 營養體通常為樹幹, 葉片叢生頂端, 就組織而言, 其木質的莖為初級組織, 源自頂端生長	I. *Araceae 天南星科* II. *Arecaceae 棕櫚科* III. *Liliaceae 百合科*

04. Stems of most species of this family are short and each one usually ends in an umbel-like inflorescence. 本科的莖多短且頂端多為繖狀花序 05. Leaves are usually pinnate or palmate, and differ enormously in size at maturity, sometimes reaching a length of about 25 m. They can bear a crest or hastula at the junction of the petiole and blade. 葉片多為羽狀或掌狀, 成熟時大小變化大, 有時長達 25 公尺, 在葉柄與葉片交接觸多有突起 06. Most species of this family are adapted to disperse their fruits by animals, but some have their fruits dispersed by water due to a very thick fibrous mesocarp. 本科的種類多以動物傳播種子, 但有些果實可由水傳播(因具厚的纖維中果皮 07. The species of this family include a wide range of life forms, many of them are epiphytes, hemiepiphytes, or root climbers. 本科的種類包含大範圍的形態, 多為附生, 半附生或具攀爬根 08. Fenestrate or perforated leaves are a special peculiarity of some genera of this family. 本科有些屬特別具有多孔洞的葉 09. The fruit is usually a loculicidal capsule with several seeds. 果實多為胞背開裂的蒴果, 內含多量的種子	

	I	II	III
A)	01, 05, 07	04, 08, 09	02, 03, 06
B)	04, 07, 08	01, 05, 06	02, 03, 09
C)	01, 07, 08	02, 05, 06	03, 04, 09
D)	01, 07, 08	03, 05, 06	02, 04, 09
E)	03, 06, 08	02, 05, 07	01, 04, 09

52- In the table below you will find several statements. Using the answer code, indicate whether you consider the statement correct or incorrect.

以正確代碼(01)及錯誤代碼(02)回答下表之敘述是否正確?

Answer code:

01. Correct. 正確

02. Incorrect. 錯誤

STATEMENTS	**CODE**
A) Careful examination, using cleared and stained leaves of *Ginkgo biloba*, reveals that the venation is reticulate. 經由銀杏葉片之透明化及染色後, 可見葉脈呈網狀	
B) Lycopodiaceae family is terrestrial or epiphytic. The outer walls of megaspores and microspores have taxonomic significance. 石松科植物為地生型或附生型,大孢子及小孢子外壁為分類重要特徵	
C) The leaves of *Equisetum* are small and whorled. Antherozoids are multiflagellate. 木賊的葉片小且輪生, 雄配子為多鞭毛	
D) *Pinus* species have female cones with woody scales at maturity. 松屬植物的雌毬果, 其果鱗在成熟時木質化	
E) The indusium is a structure that protects sporangia in true ferns. 真蕨中的孢膜是保護孢子囊的構造	

ETHOLOGY (2 questions, 4 points) 行為學

刪除本部分

~~ Guppys are among the first fish that beginners in acquaculture get. They are commonly called "millionaire fish" because of their abundant progeny.~~**

~~孔雀魚為水產養殖的初學者最先養殖的魚種，牠們一般被稱為“百萬富豪魚”，是因為牠們產生極多的子代。~~

~~In 1966, professor C. M. Breder, then director of the New York aquarium, decided to conduct an experiment to investigate the causes of their proliferation.~~

~~紐約水族館的**C. M. Breder**教授在**1966**年決定進行實驗來探索牠們多產的原因，~~

~~In a small aquarium - with a capacity of 27.5 liters of water- sufficiently supplied with food and oxygen to maintain up to 500 fish meticulously taken care of, he introduced a couple of guppys (1 adult male and 1 adult female). In the course of the following 6 months and at 4-week intervals between each breeding (these fish are ovoviviparous), the female produced 102, 87, 94, 71 and 89 offspring, that is a sum total of 443 guppys. A later recount showed that only 9 out of all the newborns remained alive: 6 females and 3 males. All the rest had been devoured by the mother.~~

~~他利用一個可容納**27.5**公升水的小水族箱，若提供足夠的食物及氧氣，並小心照顧時，最多可飼養**500**條魚。他引進了一對孔雀魚**(**雌、雄成體各一**)**，在其後的六個月中**(**於每四週生產一次**)**，雌魚分別產下**102, 87, 94, 71**及**89**隻稚魚，總數為**443**隻，其後的統計顯示，眾多稚魚中只有**9**隻存活，包括**6**雌**3**雄，其他的稚魚皆被母魚吞食。~~

~~At the same time in another aquarium of equal size and identical conditions, the researcher put 8 adult males, 8 adult females and 8 young fish, that is to say, a total of 24 guppys. The females had also abundant offspring here. The data of the proliferation survey along the 6 months following the introduction of the original~~

group of 24 guppys in the aquarium, are shown in the following tables.

在此同時，同樣情況下的另一個水族箱，研究者放入24隻魚(8隻雄魚成體、8雙雌魚成體及8隻年輕的小魚)，雌魚也產生了許多子代，在飼養的六個月間，牠們產生的稚魚數量如下表：

FEMALE 1 (雌魚1)						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	29	24	31	30	33
	Females	58	48	64	58	68
	Total	87	72	95	88	101
N° of offspring recounted hours after breeding產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by their own mother 發現：新生子代被牠們的母親吞食						

FEMALE 2						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	32	26	33	28	29
	Females	65	50	66	56	58
	Total	97	76	99	84	87
N° of offspring recounted hours after breeding產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by the own mother 發現：新生子代被牠們的母親吞食						

FEMALE 3						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	32	29	25	34	28
	Females	64	56	51	69	55
	Total	96	85	76	103	83
N° of offspring recounted hours after breeding 產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by the own mother 發現：新生子代被牠們的母親吞食						

FEMALE 4						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	28	25	35	30	29
	Females	57	49	69	61	60
	Total	85	74	104	91	89
N° of offspring recounted hours after breeding 產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by the own mother 發現：新生子代被牠們的母親吞食						

FEMALE 5						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	33	30	30	23	30
	Females	67	59	64	47	60
	Total	100	89	94	70	90
N° of offspring recounted hours after the breeding產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by their own mother 發現：新生子代被牠們的母親吞食						

FEMALE 6						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	30	29	26	35	25
	Females	62	57	53	70	52
	Total	92	86	79	105	77
N° of offspring recounted hours after breeding產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by their own mother						

FEMALE 7						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	29	24	33	28	29
	Females	60	50	71	57	62
	Total	89	74	104	85	91
N° of offspring recounted hours after breeding產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by their own mother 發現：新生子代被牠們的母親吞食						

FEMALE 8						
		4° week	8° week	12° week	16° week	20° week
N° of offspring in each breeding 每次產生子代數	Males	26	32	33	28	28
	Females	52	65	64	58	57
	Total	78	97	97	86	85
N° of offspring recounted hours after breeding產出後數小時內的子代數	Males	0	0	0	0	0
	Females	0	0	0	0	0
	Total	0	0	0	0	0
Observations: The newborns were devoured by their own mother 發現：新生子代被牠們的母親吞食						

ORIGINAL GROUP—原始族群			
	ADULTS—成體		YOUNGSTERS 年輕個體
	Males雄性	Females	
Original number of individuals 原始個體數	8	8	8
N° recounted after a year 飼養一年後個體數	3	6	0
Observations:發現 - The youngsters of the original group were devoured by the adults of the original group 原始族群中年輕的魚被族群中的成體吃掉 - Some adults of the original group died by unknown causes 原始族群中部分個體死於不明原因			

53- Which of the following statements can be made from the analysis of the previous data?
分析上述資料，你可以得到下述何種結論？

I. Guppys eat their own offspring (infanticide behavior).
孔雀魚吃他們自己的子代(殺嬰行為)

II. Guppys show indiscriminate cannibalism devouring their own offspring until exterminating them.
孔雀魚吞食他們自己的子代, 直到完全殲滅, 是一種不分對象的自相殘殺行為

III. Guppys show selective cannibalism, that is to say, they preserve the life of their offspring as long as a certain population density is maintained.
孔雀魚表現出選擇性的自相殘殺行為, 可藉由保留部分子代, 使其族群維持一定的密度

IV. Guppys show indiscriminate cannibalism by devouring their own offspring, although they always allow the survival of a random number of them.
孔雀魚吞食子代的過程中會隨機存留部分個體, 此行為屬於一種不分對象的自相殘殺,

Choose the corresponding combination of answers: 下列相關組合, 何者正確?

A) I, II.

B) I, III.

C) I, IV.

D) IV.

E) I.

54- Which of the following statements is more likely to explain the above mentioned behavior in guppys? 下列何敘述較可用於解釋上述孔雀魚的行為?

I. Lack of maturity of the instincts in the young mothers (preadult).

年輕母魚的本能未達成熟

II. Instinctive conflicts caused by a premature "reawakening" of female heat that, in reaction to male heat, causes the break of mother-offspring bonds.

本能衝突是因雌魚面臨雄魚追求提早表現出交配的本能, 因而破壞其育幼的母性本能

III. Instinctive conflicts with addictive impulses such as gluttony.

本能的衝突加上上癮的衝動(如暴飲暴食)

IV. The aggressiveness caused by excessive hunger.

由於過度饑餓所造成的攻擊性

V. An increase of the stress levels, and the consequent increase of aggressiveness due to the overpopulation.

由於族群過量, 緊迫程度(壓力)增加, 造成個體攻擊性變大

VI. An increase of the stress levels, and the consequent increase of aggressiveness caused by lack of vital space.

由於空間缺乏, 緊迫程度(壓力)增加, 造成個體攻擊性變大

Choose the corresponding combination of answers: 下列相關組合, 何者正確?

A) I, II.

B) III, IV.

C) V, VI.

D) V.

E) III.

THE END!!!