Country: _____	Student Code: _____

19th INTERNATIONAL BIOLOGY OLYMPIAD
第 19 屆國際生物奧林匹亞競賽

13th – 20th July, 2008

Mumbai, INDIA

PRACTICAL TEST 2

ANIMAL ANATOMY AND PHYSIOLOGY
動物解剖及生理學

Total Points: 66

Duration: 60 minutes
時間 **60** 分鐘

Dear Participants, 親愛的參賽者

- In this test, you have been given the following two tasks:

  Task 1: Study of animal skeletal systems (54 points)

  Task 2: Semi-quantitative estimation of nitrogenous waste products (12 points)

  本試驗須完成下列兩項工作：

  1. 動物的骨骼系統 **(54 points)**

  2. 含氮廢物的半定量估算**(12 points)**

- **You have to write down your results and answers in the ANSWER SHEET. Answers written in the Question Paper will not be evaluated.**

  答案必須寫在「答案卷」上，否則不予計分

- Please make sure that you have received all the materials and equipment listed for each task. In case any of these items is missing, please raise the yellow card.

  確實清點所有材料及設備，如有缺少，請立刻舉起黃色卡片

- At the end of the test, put the Answer Sheet and Question Paper in the envelope. The supervisor will collect this envelope.

  實驗做完，將題目及答案卷放入信封；監考人員會來收信封

Good Luck!!

Country: (國家名)_____

Country Code: (學國家編號)_____

First Name: (英文名)_____

Middle Name: (無)_____

Family Name: (英文姓)_____

Student Code: (學生編號)_____

Task 1 (54 points)

Study of animal skeletal systems

動物解剖及生理學

You should try and complete this task in 45 minutes.

你必須在 **45** 分鐘內完成

Materials and equipment	**Quantity**
材料及裝備	**數量**
1. Set of skeletal specimens labeled 1 to 9 in sealed boxes **(Please do not open the boxes!)**	9
編號 1 號到 9 號的盒子 **(不可打開盒子)**	9
2. A set of photographs of three skulls labelled 1A, 2A and 3A	1
編號爲 1A, 2A 及 3A 三個頭骨的照片	
3. Magnifying hand-lens	1
放大鏡	

Introduction 說明

The skeletal system provides physical support and a scaffold for the body and defines its architecture in animals. The three types of skeletal systems include an external (exoskeleton), internal (endoskeleton) and a fluid-based (hydrostatic skeleton) system.

骨骼系統爲動物提供支持的骨架、也限定動物的結構，骨骼系統有三種類型，包括：外骨骼、內骨骼及水骨骼系統。

The internal skeleton in vertebrates determines its body shape, provides support for its weight and offers sites for muscle attachment. Although structural modifications in the skeleton may occur in different groups of animals, the basic plan by and large remains the same.

內骨骼決定脊椎動物的體型、支持其體重並讓肌肉能夠附著，雖然不同動物群的骨骼在構造上會有變異，但基本的體制是相同的。

In this task, you will observe and compare the internal skeletal systems of three present-day vertebrates. The models of the skeletal parts provided to you include the skull, the vertebral column and the limb bones. At the end of the task, you will match these parts to form the complete skeletal system of each of the three vertebrates.

在本試題中，請你觀察並比較三種現存脊椎動物的內骨骼，給你的骨骼標本包括了頭骨、脊柱及四肢骨，請你正確配對這幾部分以完成三種脊椎動物完整的骨骼系統。

Part A: Comparative study of skulls （頭骨的比較）

(i) Types of skull: （頭骨的類型）

The skull of vertebrates is a bony structure that serves as the general framework for the head. Structurally, the skull comprises four regions – frontal, parietal, occipital and temporal (Figure 1). There are various openings in different regions of the skull, including the nostrils, eye sockets and the temporal openings. The placement of the eyes with respect to each other determines the field of vision of the animal.

脊椎動物的頭骨是作爲其頭部形狀架構的骨質構造，結構上分爲四區：額骨、頂骨、枕骨及顳骨(圖 1)，頭骨在不同區域具有開孔，包括鼻孔、眼窩及顳窗，眼的相對位置決定動物的視野。

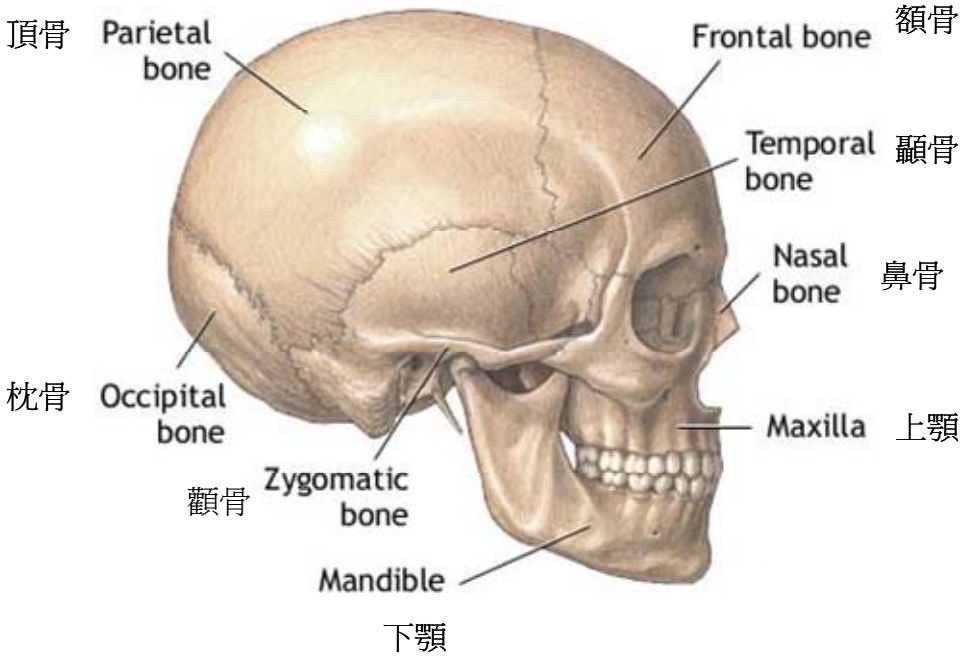


Figure 1

The number of temporal fenestrae (openings) and the position of these openings a re used to broadly classify vertebrate skulls into the following four major categories:

脊椎動物可藉由顳窗的數目及其位置分爲下列四大類：

(A) Anapsid skull: Anapsids get their name from the fact that they have no additional openings in their skulls apart from their eye sockets and nostrils. The temporal region is covered completely by bone. This type of skull is characteristic of fishes, amphibians, and early reptiles (Figure 2).

(A)無弓型頭骨：除了鼻孔及眼窩之外，頭蓋骨上沒有別的開孔，顳骨區域是封閉的，是魚類、兩生類及早期爬蟲類的特徵(圖 2)。

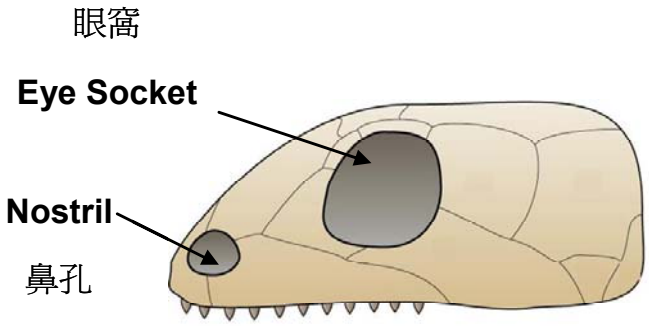


Figure 2

(B) Synapsid skull: It has a single pair of temporal openings. It was found in mammalian ancestors and represented an early divergence from the anapsids. The skull of present day mammals represents a modified synapsid pattern (Figure 3).

(B)合弓型頭骨：特徵爲頭骨有一對顳窗，在哺乳類的祖先中發現，代表其早期由無弓型分岐出來，現代哺乳類的頭骨是一種變化的合弓型 (圖 3)。

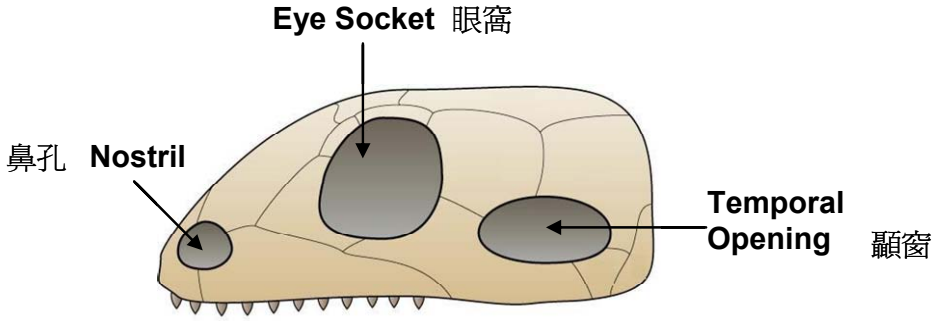


Figure 3

(C) Diapsid skull: It is characterized by two pairs of temporal openings. This type diverged from the anapsids and has undergone extensive modification. It is found in pterosaur and dinosaur fossils, as well as in birds and all living reptiles. One of the highly modified forms of the diapsid skull is found in lizards, where the lower temporal opening is not as distinct as the upper one (Figure 4).

(C)雙弓型頭骨：特徵爲頭骨上具有兩對顳窗，此型頭骨由無弓型分岐出來，並出現極多種變化，在翼手龍及恐龍的化石中發現，也在鳥類及所有現生的爬蟲類中發現。由蜥蜴發現的一個雙弓型頭骨的變種顯示下方顳窗不像上方顳窗那麼顯著(圖 4)。

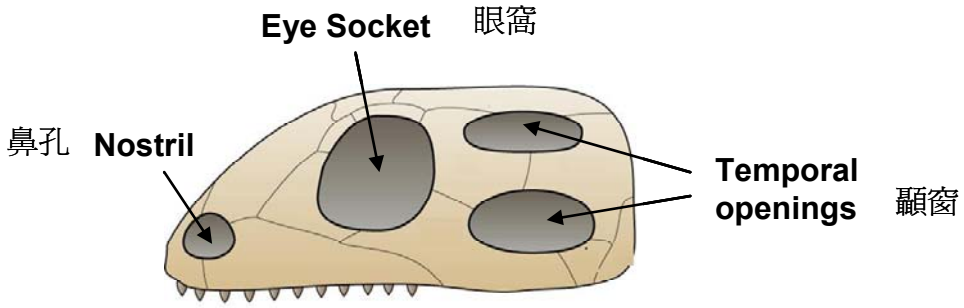


Figure 4

(D) Euryapsid skull: It has a single pair of temporal openings. The euryapsid skull seems to be derived from diapsid ancestors by loss of the lower temporal openings. Two groups of Mesozoic marine reptiles (plesiosaurs and ichthyosaurs) possessed this type of skull (Figure 5).

(D)寬弓型頭骨：特徵爲具有一對顳窗，此型頭骨似乎是由雙弓型祖先失去下方顳窗而分岐出來的，有兩群中生代的海棲爬蟲類(蛇頸龍及魚龍)具有此類型的頭骨 (圖 5)。

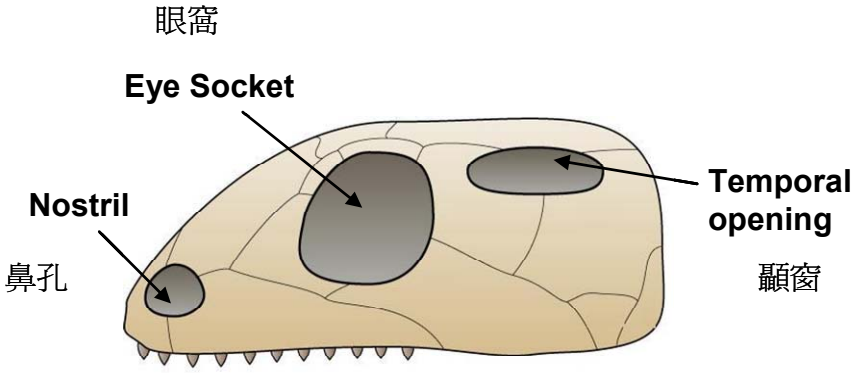
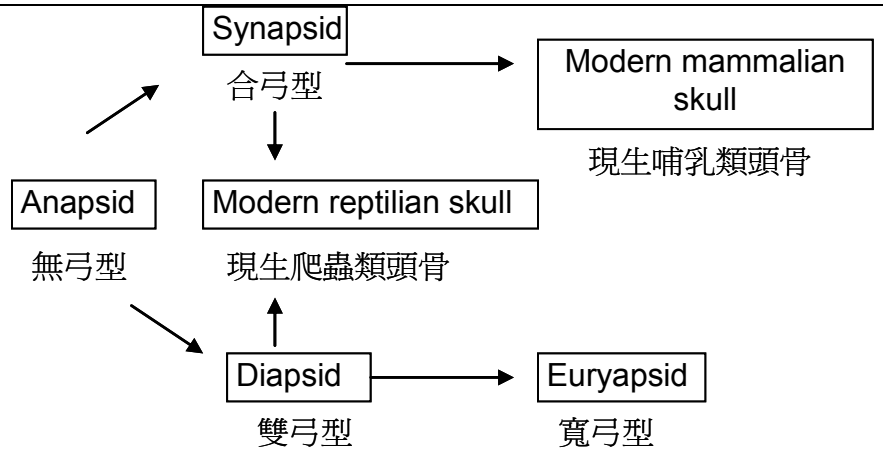


Figure 5

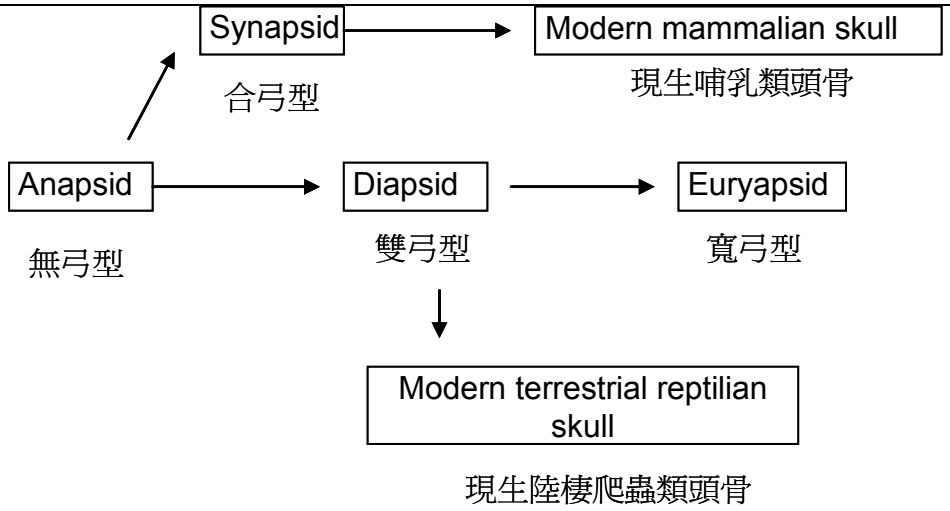
Q. 1.A.1. (2 points): Based on the information provided earlier, choose the cladogram that most likely depicts the evolution of skulls by putting a tick mark (√) in **Q. 1.A.1. in the Answer Sheet**.

Q. 1.A.1. (2 分): 根據上面提供的資訊，選出最能顯示頭骨演化的分支圖，在**答案卷的 Q. 1.A.1.**處打鉤(√)。

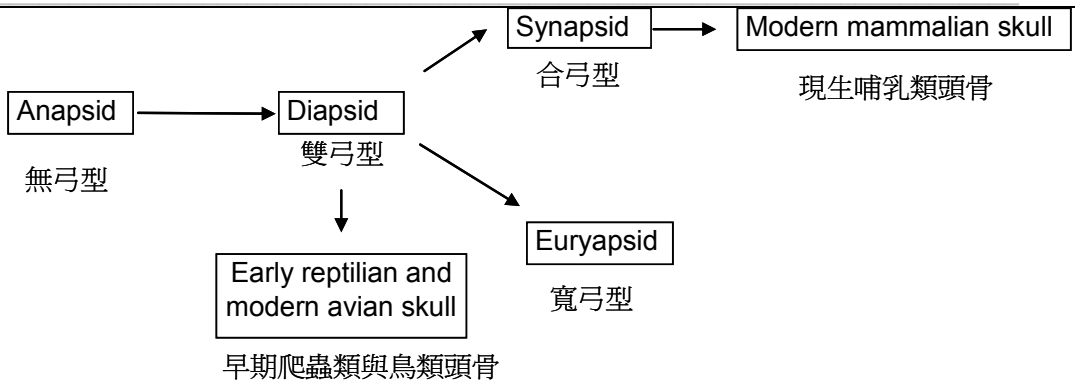
a



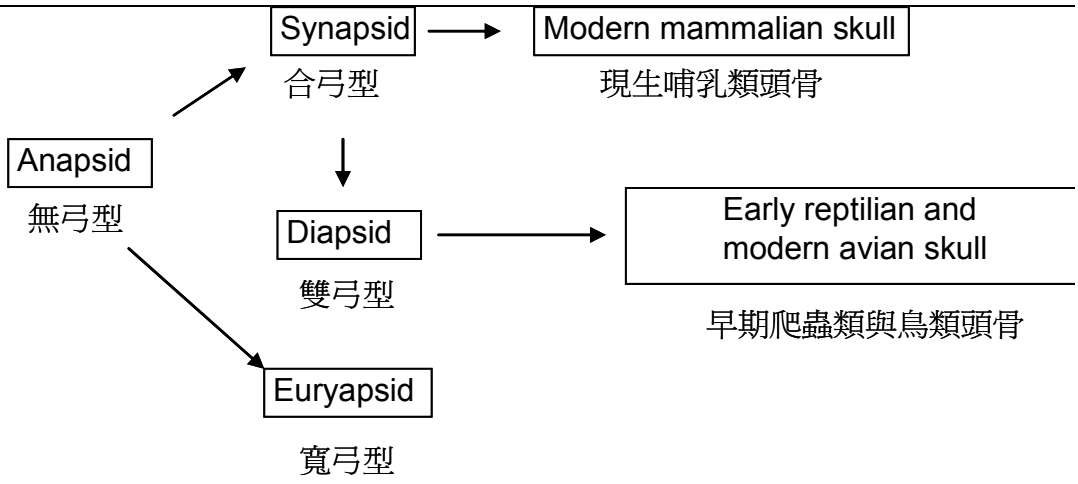
b



c


Synapsid
Modern mammalian skull
合弓型
現生哺乳類頭骨
Anapsid
Diapsid
雙弓型
無弓型
Euryapsid
寬弓型
Early reptilian and
modern avian skull
早期爬蟲類與鳥類頭骨

d


Synapsid
Modern mammalian skull
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Anapsid
無弓型
Diapsid
雙弓型
Early reptilian and
modern avian skull
早期爬蟲類與鳥類頭骨
Euryapsid
寬弓型

a.	
b.	
c.	
d.	

(ii) Dentition: Dentition refers to the type and arrangement of teeth in an animal and is an adaptation to its feeding habit. Based on the dentition, vertebrates can be broadly classified as homodont or heterodont. Depending on the number of times the teeth are replaced during the life span of an animal, they can be further classified as diphyodont or polyphyodont.

(ii) 齒型：齒型就是動物牙齒的類型與排列，是動物對其食性適應的一種。根據其齒型，脊椎動物大致可分爲同型齒的及異型齒的兩類；根據動物在一生中會換牙幾次，動物可再分爲雙套齒的及多套齒的兩類。

Q. 1.A.2. (6 points) Observe the Specimens 1, 2 and 3 for the type of skull and the respective photographs 1A, 2A, and 3A for their dentition. Put tick marks (√) in the appropriate boxes in **Table 1.A.2. in the Answer Sheet**.

Q. 1.A.2. (6 分) 觀察樣本 1, 2 及 3 的頭骨類型和 1A, 2A 及 3A 三個頭骨照片中所對應的齒型，在**答案卷的表 1.A.2** 中的正確位置打鉤(√)。

Table 1.A.2.

Character 特徵		1	2	3
Type of skull 頭骨類型	Anapsid 無弓型			
	Diapsid 雙弓型			
	Synapsid 合弓型			
	Euryapsid 寬弓型			
Type of dentition 牙齒類型	Homodont 同型齒			
	Heterodont 異型齒			

Q. 1.A.3. (6 points) Observe the specimens for position of orbit (the eye sockets), and for types of teeth. Fill in the **Table 1.A.3. in the Answer Sheet** by putting tick marks (√) in the appropriate boxes.

Q. 1.A.3. (6 分) 觀察樣本中的眼窩位置及牙齒的類型，在**答案卷的表 1.A.3** 中的正確位置打鉤(√)。

Table 1.A.3.

Features 特徵		1	2	3
Vision 視覺	Predominantly stereoscopic vision 以立體視覺爲主			
	Predominantly non-stereoscopic vision 以非立體視覺爲主			
Feeding habit 食性	Predominantly carnivorous 肉食爲主			
	Predominantly herbivorous 草食爲主			

Part B: Comparative study of vertebral columns and ribs

The vertebral column and ribs are components of the axial skeletal system. The vertebral column defines the major body axis and comprises a series of separate bones (vertebrae) joined to form a backbone (Figure 6).

Part B: （脊柱與肋骨的比較）

脊柱與肋骨組成中樞骨骼系統，脊柱是身體的主軸、由一串分開的骨頭 (脊椎骨) 所組成，相連而形成脊椎(圖 6)。

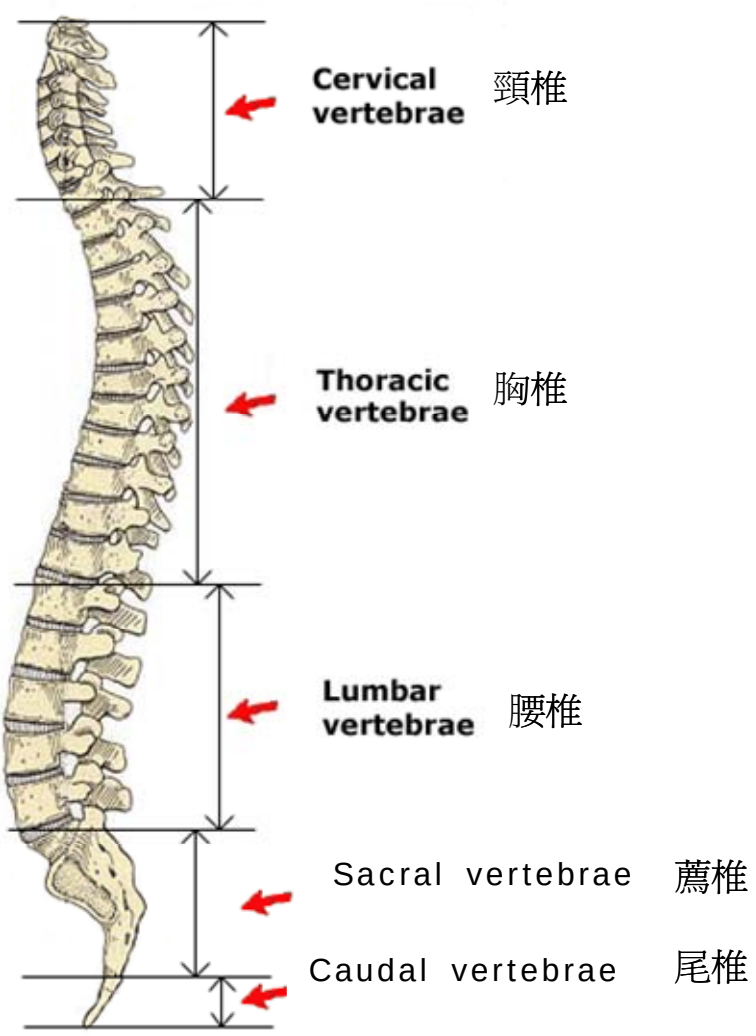


Figure 6

Cervical vertebrae, the first set of vertebrae, are characterized by highly reduced transverse processes in contrast to the following set of vertebrae, the thoracic vertebrae. The number of cervical vertebrae is usually correlated with the degree of neck movement.

最上端是頸椎，特徵是其橫向突起極度退化，頸椎骨的數目通常與頸部能運動的程度相關。

In higher animals, the thoracic vertebrae are important because they articulate with the ventral sternum and ribs to form a rib cage.

Ribs also provide sites for secure muscle attachment, help suspend the body, form a protective case around the viscera and sometimes serve as accessory breathing devices (Figure 7).

高等動物的胸椎很重要，因爲各節胸椎能與在腹面的肋骨及胸骨組成肋骨腔。肋骨也能讓肌肉附著，在內臟外形成保護腔，有時並可作爲呼吸作用的輔助構造(圖 7)。

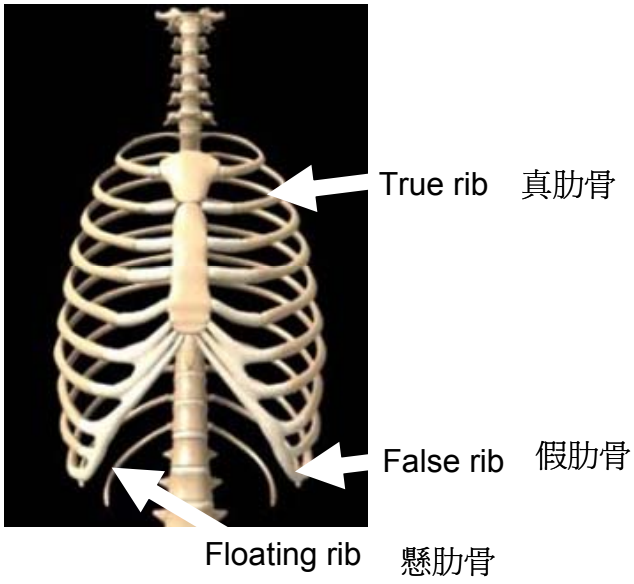


Figure 7

The sternum is a mid-ventral skeletal structure that offers a site of origin for chest muscles and secures the ventral tips of true ribs to complete the protective rib cage. A well-developed rib cage is characteristic of mammals.

胸骨是在腹面中央的骨頭構造，供胸肌附著，並固定住真肋骨的前端形成保護性的肋骨腔，發育良好的肋骨腔是哺乳動物的特徵。

The classification of ribs in tetrapods is based on the type of association they establish with the sternum. The three kinds of ribs are:

四足類動物肋骨的分類是根據其與胸骨建立關係的類型。三種的肋骨分別爲：

True ribs – these ribs meet ventrally with the sternum.

真肋骨 – 在腹面能與胸骨相接的肋骨

False ribs – these ribs articulate with each other but not with the sternum.

假肋骨 – 會彼此連接，但不與胸骨相接的肋骨

Floating ribs – these ribs do not articulate with the sternum or any other structure. These ribs, when present in large numbers offer flexibility to the body during locomotion.

懸肋骨 – 不與胸骨或其他構造連接，懸肋骨數目多、運動時的自由活動度大

Q. 1.B.1. and Q.1.B.2. (8 + 3 = 11 points) Observe the Specimens 4, 5 and 6 and put tick marks (√) in the appropriate boxes in **Tables 1.B.1. and 1.B.2. in the Answer Sheet**.

Q. 1.B.1. and Q.1.B.2. (8 + 3 = 11 分) 觀察樣本 4, 5 及 6，在**答案卷的表 1. B.1. 及 1.B.2.**中的正確位置打鉤(√)。

Table 1.B.1.

Characters 特徵		4	5	6
Ribs 肋骨	Present 有			
	Absent 無			
Major type of ribs 肋骨主要類型	True 真			
	False 假			
	Floating 懸			
Tail 尾	Present 有			
	Reduced /Absent 退化/無			

Table 1.B.2.

Feature 特徵		4	5	6
Neck movement 頸部運動	Restricted 受限制			
	Free 不受限制			

Part C: Comparative study of limb bones （四肢骨的比較）

The transition of vertebrates from aquatic to terrestrial and from terrestrial to aerial has had an impact upon the design and redesign of the appendicular system. The appendicular skeleton includes the paired fins or limbs and the girdles. Schematic figures of representative limb arrangements are given below (Figures 8 and 9).

脊椎動物由水中到陸地、陸地到空中各階段會對附肢系統的設計造成衝擊，附肢骨骼包括成對的鰭或四肢及肩(腰)帶，其排列的示意圖如下(圖 8 及 9)。

Figure 8: Schematic representation of the articulation of a sprawled limb 攤開式四肢的關節示意圖

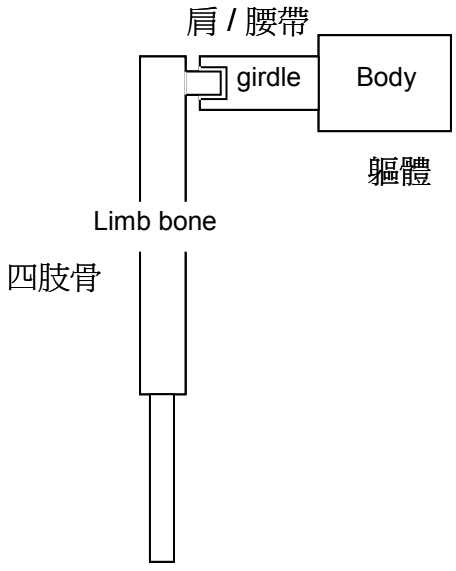


Figure 9: Schematic representation of the articulation of an underneath limb 體下式(在身體下方)四肢的關節示意圖

Q. 1.C.1. (12 points) Carefully study the Specimens 7, 8 and 9, and fill in **Table 1.C.1. in the Answer Sheet** by putting tick marks (√) in the appropriate boxes.

Q. 1.C.1. (12 分) 小心觀察樣本 7, 8 及 9，在**答案卷表 1. C.1** 的正確位置打鉤(√)。

Characters 特徵		7	8	9
Position of limb with respect to body 四肢與身體相對位置	Sprawled 攤開式			
	Underneath 體下式			
Length of fore- and hindlimbs 前後肢的長度	Similar 相似			
	Fore limbs longer 前肢較長			
	Hind limbs longer 後肢較長			
Claws 爪	Present 有			
	Absent 無			
Modifications 變化	Tibia and fibula completely fused 股骨下端之脛骨與腓骨完全癒合			
	Tibia and fibula partially separate 股骨下端之脛骨與腓骨部份分開			

Q. 1.C.2. (8 points) Based on your observations, fill in **Table 1.C.2. in the Answer Sheet** by putting tick marks (√) in the appropriate boxes.

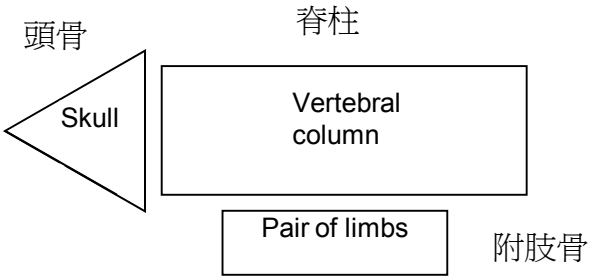
Q. 1.C.2. (8 分) 根據你的觀察，在答案卷的表 **1. C.2** 的正確位置打鉤**(√)**。
Table 1.C.2.

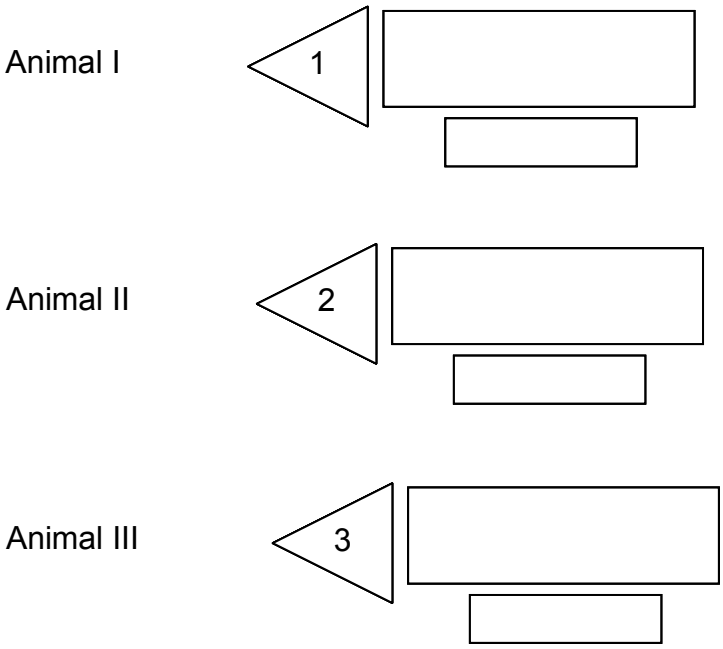
Features 特徵		7	8	9
Limb movement during locomotion 運動時四肢的移動	Swinging (rotational movement) 游泳(旋轉式移動)			
	Pendulum-like 擺動式移動			
Habit of the animal 動物的習性	Saltatorial (jumping)跳躍式			
	Cursorial (walking)行走式			
	Fossorial (digging)挖掘式			

Part D: Assembly of the skeletal systems （骨骼系統的裝配）

Q. 1.D.1 (6 points) The nine specimens (three skulls, three vertebral columns and three sets of limb bones) belong to three different animals (I, II, and III). In the schemes given below, write the respective specimen numbers (4 to 9) in the appropriate boxes to construct the three animals in **Q. 1.D.1. in the Answer Sheet**.

Q. 1.D.1 (6 分) 九個標本 (三個頭骨、三個脊柱骨、三個四肢骨) 分別屬於三種不同的動物 (I, II, and III)。將下方示意圖中標本的代碼 (4 到 9) 寫在**答案卷 Q. 1.D.1.**的正確位置組建三種動物。


頭骨
脊柱
Skull
Vertebral column
Pair of limbs
附肢骨


Animal I
1
Animal II
2
Animal III
3

.**Q. 1.D.2 (3 points):** Assign each of the three animals to the most probable class. Choose from the options given below and write appropriate letter in **Q. 1.D.2. in the Answer Sheet.**

Q. 1.D.2 (3 分)： 三種動物分別爲何？由下方選項 (A~E) 中選擇，且將答案寫在**答案卷 Q. 1.D. 2.**中的正確位置。

Animal I: Class: _____

Animal II: Class: _____

Animal III: Class: _____

Options:

A. Mammalia

B. Reptilia

C. Aves

D. Amphibia

E. Pisces

Task 2 (12 points) 試題二 (12 分)

Semi-quantitative estimation of nitrogenous waste products

含氮廢物的半定量估算

You should try and complete this task in 15 minutes

你必須在 **15** 分鐘內回答本試題

.

Materials (材料)		**Quantity (數量)**
1.	Porcelain spot plates, each with 6 cavities 六孔瓷盤	3 個
2.	Toothpicks 牙籤	20 支
3.	Permanent marker pen 油性筆	1 支
4.	Tissue paper roll 衛生紙	1 卷
5.	Container for wash and discard 裝廢棄物與洗液的容器	1 個
6.	Reagents (given in a plastic box) 試劑 (裝在塑膠盒中)	1 bottle each 一種一瓶

Label (標示)	**Reagent** (試劑)
A	Phosphotungstic acid (磷鎢酸)
B	Sodium carbonate (20% w/v) (碳酸鈉)
C	Uric acid (standard solution) (尿酸)(標準液)
D	Ehrlich's reagent (mildly corrosive)(賀氏試劑) (小心操作)
E	Urea (standard solution) (尿素)(標準液)
F	Sodium nitroprusside ($NaFe(CN)_5NO$)
G	Oxidizing solution (氧化溶液)
H	Phenol solution (mildly corrosive)(酚溶液)(小心操作)
I	Ammonia (standard solution) (氨)(標準液)
S1	Simulated Sample 1 (樣本 1)
S2	Simulated Sample 2 (樣本 2)
S3	Simulated Sample 3 (樣本 3)
H_2O	Distilled water (蒸餾水)

Introduction 簡介

Vertebrates have evolved different modes of excretion of nitrogenous wastes, which are mostly derived from degradation of proteins and nucleic acids. They use different ways of excretion of these wastes during their transition from an aquatic to terrestrial mode of life. The three major forms of these wastes are ammonia, urea and uric acid. While ammonia is highly soluble in water, uric acid is the least soluble. Ammonia, being most toxic, needs to be excreted in a highly diluted form. Uric acid is mostly excreted as semisolid crystals.
脊椎動物擁有許多排除含氮廢物的方法，這些含氮廢物大多來自蛋白質與核酸的代謝。他們從水生移向陸地生活便適應了許多排泄的策略。有三種主要的含氮廢物分別爲氨、尿素與尿酸。氨是最易溶於水中，尿酸則是最難溶解的。氨是最具毒性的，需要以大量稀釋的形式來排泄。尿酸則以半固體的形式排泄。

Three simulated samples (S1, S2 and S3), representing nitrogenous wastes from three groups of animals, are provided. Follow the protocols given below to find out the relative levels of uric acid, urea and ammonia in these samples.
三種含氮廢物樣本 (S1, S2 and S3) 分別來自三種不同的生物。分別依照實驗步驟，找出三種含氮廢物樣本中何者爲氨、尿素與尿酸。

***General Instructions* 說明**

1. ***For each test, run a positive control and a negative control using the standard solutions and distilled water, respectively.***
   每個實驗，分別用標準液與蒸餾水作爲陽性對照與陰性對照。
2. ***Grade the colour of positive control as '+++' and that of negative control as ' – '.***
   有關顏色等級，陽性對照標記爲 "+++"，陰性對照標記爲 "-"。
3. ***Please note that the recording of the results for the positive and negative controls carries NO points.***
   紀錄結果時，陽性與陰性對照組不列入計分。

Protocols for estimation 實驗步驟

1. Estimation of uric acid by phosphotungstic acid reduction method

利用磷鎢酸還原法測定尿酸

Principle 原理

Under alkaline conditions, uric acid reduces phosphotungstic acid to give a blue- coloured product.

鹼性條件下，尿酸會還原磷鎢酸成爲藍色產物。

Method 步驟

(i) Put three drops each of Samples S1, S2 and S3 in separate cavities of a given spot plate.
三種含氮廢物樣本 (S1, S2 and S3) 各取三滴，分別加在磁孔盤中的不同孔洞中。

(ii) Add one drop each of solutions A followed by B to each cavity. Mix with separate toothpicks and observe the developed colour.
在每個檢體中，先加入一滴試劑 B，之後再加入一滴試劑 A。分別用乾淨的牙籤混合均勻，觀察混合後的呈色反應。

(iii) Grade the colour of the positive control as '+++' and that of the negative control as ' – '.
標出欲測樣本的顏色等級，陽性對照的顏色等級爲 "+++"，陰性對照的顏色等級爲 "-" 作爲標準進行等級劃分。

Q. 2.1.1. (3 points)(3 分)

Record the results in **Table 2.1. in the Answer Sheet** by putting '+++', '++' or '+' for positive results depending on the intensity of the colour developed and '–' for negative results.

在**答案卷表 2.1** 中分別標出 '+++', '++' 或 '+' 記號來代表陽性等級結果，'–' 記號來代表陰性結果。

2. Estimation of urea using Ehrlich's reagent

利用賀氏試劑 (Ehrlich's reagent) 測定尿素

Principle 原理

Under strong acidic conditions, urea reacts with Ehrlich's reagent (*p*-dimethylaminobenzaldehyde) to form a yellow-coloured dye (protonated Schiff's base).

強酸的條件下，尿素會與賀氏試劑 (Ehrlich's reagent)(*p*-dimethylaminobenzaldehyde) 反應形成黃色染劑 (Schiff's base)。

Method 步驟

(i) Put three drops each of Samples S1, S2 and S3 in separate cavities of a given spot plate.
三種含氮廢物樣本 (S1, S2 and S3) 各取三滴，分別加在磁孔盤中不同的孔洞。

(ii) Add one drop of solution D to each cavity. Mix with separate toothpicks.
在每個檢體中，加入一滴試劑 D。分別用乾淨的牙籤混合均勻，觀察混合後的呈色反應。

Q. 2.1.2. (3 points)(3 分)

Record your results **immediately** in **Table 2.1. in the Answer Sheet** by putting '++++', '+++', '++' or '+' for positive results depending on the intensity of the colour developed and '-' for negative results. For comparison, grade the colour of the positive control as '+++' and that of the negative control as ' – '.

立即在答案卷表 **2.1** 中分別標出 '++++', '+++', '++' 或 '+' 記號來代表陽性等級結果，'–' 記號來代表陰性結果。等級劃分依照陽性對照標記爲 "+++"，陰性對照標記爲 "-" 進行。

3. Estimation of ammonia by indophenol blue method

利用吲哚酚藍測定氨

Principle 原理

In an alkaline solution, ammonium ions react with oxidizing solution to form monochloramine. In the presence of phenol and an excess of oxidizing solution, the monochloramine forms a blue-coloured product, indophenol, when nitroprusside is used as a catalyst.

在鹼性溶液中，銨離子會與氧化劑作用形成單氯胺。在有酚與過量的氧化劑參與下，單氯胺會形成藍色的吲哚酚，此時加入 nitroprusside 是做爲催化劑之用。

Method 步驟

(i) Put three drops each of Samples S1, S2 and S3 in separate cavities of a given spot plate.

三種含氮廢物樣本 (S1, S2 and S3) 各取三滴，分別加在磁孔盤中不同的孔洞。

(ii) Add one drop each of solutions F, followed by G and finally H to each cavity. Mix with separate toothpicks.

在每個檢體中，先加入一滴試劑 G，之後再加入一滴試劑 F，最後加入一滴試劑 H。分別用乾淨的牙籤混合均勻。

Q. 2.1.3. (3 points) Record your results **after two minutes** in **Table 2.1. in the Answer Sheet** by putting '++++', '+++', '++' or '+' for positive results depending on the intensity of colour developed and '-' for negative results. For comparison, grade the colour of positive control as '+++' and that of negative control as ' – '.

2 分鐘後在答案卷表 2.1 中分別標出 '++++', '+++', '++' 或 '+' 記號來代表陽性等級結果，'–' 記號來代表陰性結果。等級劃分依照陽性對照標記爲 "+++"，陰性對照標記爲 "-" 進行。

Table 2.1.

Samples	Uric acid test 尿酸	Urea test 尿素	Ammonia test 氨
S1			
S2			
S3			
Positive control			
Negative control			

Q. 2. 2. (3 points)(3 分):

Based on the results obtained, match each of the samples with the appropriate class of vertebrates listed below. Fill in your answer by putting the appropriate letter in **Q. 2.2. in the Answer Sheet**.

依照上述的結果，從 a – g 中選出一個正確脊椎動物綱的組合，填在答案卷 Q.2.2. 中

Answer: _____

a.	S1: Pisces	S2: Mammalia	S3: Reptilia
b.	S1: Amphibia	S2: Aves	S3: Pisces
c.	S1: Mammalia	S2: Reptilia	S3: Aves
d.	S1: Mammalia	S2: Pisces	S3: Aves
e.	S1: Aves	S2: Pisces	S3: Mammalia
f.	S1: Reptilia	S2: Amphibia	S3: Mammalia
g.	S1: Aves	S2: Reptilia	S3: Amphibia

Pisces: 硬骨魚綱；Amphibia: 兩生綱；Reptilia: 爬蟲綱；Aves: 鳥綱；Mammalia: 哺乳綱

********** END OF PRACTICAL TEST 2 **********