25th INTERNATIONAL BIOLOGY OLYMPIAD

5 – 13 July, 2014

INDONESIA

PRACTICAL TEST 3

ANIMAL ANATOMY, PHYSIOLOGY, AND SYSTEMATICS
動物解剖、生理及系統分類

Total points: **93.5**

Duration: 90 minutes

COUNTRY: …………………………………………

STUDENT: …………………………………………

Dear Participants 親愛的參賽者

1.   In this test, you have been given the following three tasks:
        本實驗中有三個任務

        Part A. Acute Response of Fish Larvae to Changes in Salinity (19 points)
                魚類幼體(幼魚)對鹽度的急性反應

        Part B. Calaulation of LC_{50} (19.5 points)
                半致死濃度的計算

        Part C. Classification of Prawns (62 points)
                蝦的分類

2.   Use the **Answer Sheet**, which is provided separately, to answer all the questions.
        將答案寫於**答案卷**上

3.   The answers written in the **Question Paper** will **NOT** beevaluated.your answers legibly in ink.
        試題卷上的答案**不會被計分**

4.   Write your answers legibly in ink.
        用原子筆清楚作答

5.   Please make sure that you have received all the materials and equipment listed for each task. **If any of these items are missing, please raise your hand immediately.**
        檢查並確認所有列出的器材，**若有缺少立刻舉手**

6.   Stop answering and put down your pen **immediately** when the bell rings.
        鈴響時立即停筆

7.   At the end of the test, place the **Answer Sheet** and **Question Paper** in the envelope provided.
        Our Assistants will collect the envelope from you.
        考試完畢，將**試卷與答案卷**放入信封中，讓助理收回

8.   **Note:** You are provided with a magnifier glass with lamp, and a desk lamp. Make sure both lamps are working prior to the test.
        注意：檢測並確認放大鏡的燈及桌燈是否正常

9.   You may work on these tasks in any order. Each task is independent of each other.
        題目 A、B、C 三題分別獨立，**自行決定作答順序**

10.   You may use your question paper as note to do math work.

        可在試題卷上計算

Materials and Equipment

Materials	Quantity	Unit
Prawns in tray 蝦放在解剖盤中	6	specimens

Equipment	Quantity	Unit
Dissecting kit 解剖用具	1	set
Magnifier glass with lamp 有燈的放大鏡	1	set
Desk lamp 檯燈	1	set
Pencil 鉛筆	1	piece
Tissue paper 衛生紙	1	box
Tablecloth 桌布	1	piece
Gloves 手套	1	piece
Mask 口罩	1	sheet
Ruler 直尺	1	piece
Calculator 計算機	1	piece
Sharpener 削筆刀	1	piece
Label 標籤紙		

Part A
Acute Response of Fish Larvae to Rapid Changes in Salinity (12 points
幼魚在鹽度劇烈變化時所產生的急性反應

Introduction

In Indonesia, the salt concentration in brackish areas is strongly affected by the season. While heavy rain at headwaters and watersheds lower salt concentration during the rainy season, the lower water volumes during the dry season increase salt concentration.
在印尼半鹹水區域，水的鹽濃度變化深受季節的影響，雨季時，上游的大雨會使鹽濃度下降，旱季時，因水量減少，鹽濃度會上升。

Fish larvae are highly sensitive to changes in salinity of their environment, to which they can respond by osmoregulation if salinity remains within their **tolerance level**. When fish encounter salinity levels outside the tolerance level (either lower or higher), osmoregulation mechanisms fail and salt becomes toxic for these fish. The goal of this experiment is to assess how larvae of milkfish (*Chanos chanos* Lacepede) respond to rapid changes in salinity.

幼魚對鹽濃度的改變非常敏感，在鹽度仍可忍受的範圍內，可藉由滲透調節，在鹽度(過高或過低)超過可忍受的範圍時，無法經由滲透調節，因此對魚類幼體會產生毒害。本實驗目的是要測定虱目魚幼魚對鹽度劇烈改變時產生的反應。

Experimental procedure 實驗步驟

To determine the mortality of fish larvae as a result of rapid change in salinity, 10 fish larvae were each transferred from 0.4 M solution to different concentrations of salt and the number of fish that died in 5 minutes were recorded. The table below shows the results of three replicates of the experiment.

為測定鹽度劇烈改變所造成幼魚的死亡率，10 條幼魚各由 0.4 M 溶液移至不同鹽濃度中並計算 5 分鐘內魚死亡的數目，下表顯示三個重複的實驗結果。

Salinity 鹽度	Number of dead fish larvae 幼魚死亡數			Position of dead fish larvae in the tubes 死亡幼魚在試管中之位置		
	Replicate 1 重複 1	Replicate 2 重複 2	Replicate 3 重複 3	Surface 上層	Middle 中間	Bottom 底部
2 M	9	10	8	26	1	0
1.6 M	7	6	9	18	3	1
1.2 M	5	5	6	12	4	0
0.8 M	2	3	2	1	5	1
0.4 M	1	2	0	0	2	1
0 M	4	3	3	0	1	9

Data Analysis

Question 1.1 Draw a line graph showing the average mortality rate across replicates (label "M") as a function of salinity (label "S") in the **Answer Sheet (6 points).**

在答案紙上作折線圖，畫出各鹽濃度(S)對各重複平均致死率(M)的線性關係**(6 分)**

Question 1.2 Mark on the graph the concentration that caused mortality of 50% of the fish larvae **(2 points)**.

在該圖上標示出會造成 50%的幼魚死亡時的濃度**(2 分)**

Question 1.3 What is the most probable cause of death for the majority of fish that died in this experiment? **(2 points)**

下列何者是本實驗中造成魚體死亡的最主要原因？**(2 分)**

A. Compared to the solutions, the fish are hypertonic and thus suffer from water entering their tissues.
與溶液相比較魚體為高張，因此水進入組織中

B. High concentrations of salt increase the viscosity of water, and hence increase the energy demand of the fish for movement and respiration.
高鹽度會增加水的黏度，因此魚體呼吸及運動須消耗更高的能量

C. High concentrations of salt reduce the oxygen available to the fish.
高鹽度會降低魚體可使用的氧氣

D. The fish suffer from anoxia due to damages in the gill tissues, caused by the high difference in water potential between their bodies and the environment.
溶液與魚體間的水勢差異很大，使魚體因鰓組織受損而缺氧

Question 1.4 In this experiment, what is the most probable cause for the dead fish to float in the water with high salt concentration? **(2 points)**

本實驗中，下列何者是高鹽度造成死亡魚體浮在水面的最主要原因？**(2 分)**

A. Their body weight is reduced because water diffuses from their tissues.
因為水分由組織往外擴散，使魚體的體重降低

B. Their body density is reduced because the tissue fluids are more dilute than the surrounding salt solution.
因為組織液比周遭鹽液更稀薄，使魚體的密度降低

C. Gas accumulates inside their bodies as a result of decomposition.
因為分解作用產生的氣體累積在魚體的內部

D. They lose control over their swim bladders.
因為失去調控其魚鰾的功能

Part B:
Calculation of LC$_{50}$ (19.5 points) 半致死濃度計算

Introduction

Indonesian aquaculture in brackish areas benefits from the natural inflow of fresh water from nearby rivers. Recently, these cultures have come under threat from various chemicals such as insecticides washed into the rivers. A common method to assess the toxicity of such substances is to determine the concentration at which 50% of the tested animals die. The corresponding concentration is named "lethal concentration 50%" or LC$_{50}$.

在印尼半鹹水區域的養殖業，受惠於附近河流淡水的自然流入，但養殖業近來因殺蟲劑等化學藥品流入河流中而受威脅，分析這些藥品毒性的常用方法是檢測造成半數實驗動物死亡的濃度，這個濃度即是半致死濃度或 LC$_{50}$.

The table below shows the results of such an experiment to assess thety of a common insecticide for fish larva. Determine the LC$_{50}$ of this insecticide for the fish larvae.

下表顯示某一殺蟲劑對幼魚的實驗結果，計算該殺蟲劑的半致死濃度

No	Concentration [μM] 濃度	Tested Animals 測試動物	Number of Dead Animals 死亡動物個體數
1	10.2	50	44
2	7.7	50	42
3	6.5	50	35
4	5.1	46	24
5	4.4	50	22
6	3.8	50	16
7	3.2	50	11
8	2.6	50	6

Probit Analysis 偏差值分析

A powerful way to estimate LC_{50} from such data is Probit (Probability Unit) analysis based on linear regression. The basic idea is to model relationship between the $\log_{10}$ concentration of the insecticide (x) and the probit conversion value of mortality rate (y) as a linear function of the form $y = a + bx$. To ensure the relationship is approximately linear, the mortality rates are first transformed into probits, defined as the position of the value in the cumulative distribution of a standard normal. You can conduct this transformation on Finney's table (Finney, 1952) (Table 1). As an example on how to use this table consider a mortality rate of 17%, for which the corresponding probits of -0.95 is indicated in row "10" and column "7".The probit of a mortality rate of 50% is 0.00.

估計 LC_{50} 的有效方法是根據線性回歸作偏差值(或然率單位)分析，基本觀念是算出殺蟲劑濃度的對數值(x)與致死率偏差轉換值(y)在 $y = a + bx$ 上的線性關係，為了讓此關係趨近於直線，先將致死率轉換為偏差值，即標準化常態分布上累積數值的位置。此轉換可用芬尼表進行 (Finney, 1952) (表 1)。下例說明如何使用該表，致死率 17%就是在標示為 "10"那一列中找到在標示為"7"的那一欄，其偏差值為 -0.95；而半致死濃度(LC_{50})的偏差值為 0.00.

Table 1.

%	0	1	2	3	4	5	6	7	8	9
0		-2.33	-2.05	-1.88	-1.75	-1.64	-1.55	-1.48	-1.41	-1.34
10	-1.28	-1.23	-1.18	-1.13	-1.08	-1.04	-0.99	-0.95	-0.92	-0.88
20	-0.84	-0.81	-0.77	-0.74	-0.71	-0.67	-0.64	-0.61	-0.58	-0.55
30	-0.52	-0.5	-0.47	-0.45	-0.41	-0.39	-0.36	-0.33	-0.31	-0.28
40	-0.25	-0.23	-0.2	-0.18	-0.15	-0.13	-0.1	-0.08	-0.05	-0.03
50	0.00	0.03	0.05	0.08	0.1	0.13	0.15	0.18	0.2	0.23
60	0.25	0.28	0.31	0.33	0.36	0.39	0.41	0.44	0.47	0.5
70	0.52	0.55	0.58	0.61	0.64	0.67	0.71	0.74	0.77	0.81
80	0.84	0.88	0.92	0.95	0.99	1.04	1.08	1.13	1.18	1.23
90	1.28	1.34	1.41	1.48	1.55	1.64	1.75	1.88	2.05	2.33

Question 2.1 For data points 2, 4 and 7, transform the concentrations with $\log_{10}$, calculate the mortality rates and transform them to probits. Report your results in the table in the **Answer Sheet (4.5 points)**.
根據2, 4 和 7欄位中的數據資料, 將 $\log_{10}$ 濃度轉換為致死率，致死率用或然率單位表示。將計算結果寫在答案卷表格的空格中。

Note: Use a precision of two digits after the decimal point for all calculations in this task. Except for calculation of mortality rate where no decimal required for calculation result.
注意：準確度至小數點後兩位，但計算致死率時則無需用小數點。

Slope *b* and intercept *a* of a linear equation can be estimated from the *n* data points using the least squares approach as:
線性方程式中的斜率b和截距a，可用下列矩陣方程式來估算

$$b = \frac{\sum_{i=1}^{n} x_i y_i - \frac{1}{n} \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i^2 - \frac{1}{n} \left(\sum_{i=1}^{n} x_i \right)^2} \qquad a = \frac{1}{n} \left(\sum_{i=1}^{n} y_i - b \sum_{i=1}^{n} x_i \right)$$

Question 2.2 Calculate x_i^2 and $x_i y_i$ for data points 2, 4 and 7 and report your results in the table in the **Answer Sheet (3 points)**.
計算2, 4 和 7欄位中數據資料的x_i^2 and $x_i y_i$，並將結果寫於答案卷上，**除致死率外，其他數值準確度至小數點後兩位**

Question 2.3 Calculate all required sums **(4 points)**.
 計算表中所要求的4個數值總和**準確度至小數點後兩位(4分)**

Question 2.4 Use the equations provided above to estimate both slope and intercept **(4 points)**.
利用所提供的方程式計算斜率及截距數值**準確度至小數點後兩位(4分)**

Question 2.5 Use your estimates of the slope and intercept to estimate the LC_{50} concentration of this insecticide for the fish larvae. Report your result in μM **(4 points)**
利用你所計算的斜率及截距數值，估計該殺蟲劑對幼魚的半致死濃度**準確度至小數點後兩位**，以μM為單位。**(4分)**

Part C (62 points)

Classification of Prawns

蝦的分類

Introduction 簡介

Indonesia is one of the main producers of prawns with many small to large scale aquacultures along the long coastline. Due to differences in environmental conditions along the coast, different prawn species are cultured in various locations. The goal of this task is to identify specimens of Indonesia's famous prawn species and to study their phylogenetic relationships based on morphological characters. You may use the magnifying glass, dissecting kit, forceps and the needle provided.
印尼的海岸線很長，有許多大小不一的蝦類養殖場。因海岸環境不同，在不同區域會有不同的蝦種分佈。本題的目的是對許多印尼著名的蝦類作樣本鑑定，並依據形態特徵進行親緣關係研究。實驗過程中會用到放大鏡、解剖工具、鑷子與解剖針。

Note: Damage to the specimens will not lead to point subtraction. There is possibility there are two specimens actually belong to one species.

注意：傷害到樣本並不會影響評分，但可能會因此把同種生物歸為不同種類。

Identification of Prawn Specimens 蝦類的鑑定

Question 3.1 Identify all prawn specimens using the following identification key. Consult the figure below to identify the required morphological features **(15 points)**.
問題 3.1：依據以下的檢索表對蝦類樣本進行分類，參考下圖所標示的形態特徵進行。
（15 分）

Identification Key for Prawns
蝦類檢索表

Note: A dash "-" in b indicates the absence of the pattern described in a.

注意：b 若標示"－"表示不具有 a 所描述的特徵

1.	a.	Second pereiopod bigger and longer than the other pereiopods 第二步足大且長於其他步足	(2)
	b.	-	(4)
2.	a.	Antennal scale anterior margin strongly produced forward at or near mid-line 觸角鱗前緣在靠近中線處有明顯地突出	*Macrobrachium rosenbergii* 泰國長臂大蝦
	b.	-	(3)
3.	a.	Thoracic sternite 4 with distinct median suture 第四胸腹片有明顯的中縫（接縫）	*Macrobrachium australiense* 澳洲長臂大蝦
	b.	-	*Macrobrachium koomboolomba* 庫姆布倫姆巴長臂沼蝦
4.	a.	Rostrum with ventral teeth 喙出現腹齒	(12)
	b.	-	(5)
5.	a.	Telson with fixed subapical spines 尾節出現固定的近尖端刺	(6)
	b.	-	(9)
6.	a.	Telson with 1 pair of fixed subapical spines 尾節出現 1 對固定的近尖端刺	(7)
	b.	Telson with 3 pairs of fixed subapical spines 尾節出現 3 對固定的近尖端刺	(11)
7.	a.	Maxilliped 3 and pereiopod 2 with spine on inside of basis 第三顎足與第二步足基部內側出現刺	*Metapenaeopsis barbata* 紅斑赤蝦
	b.	-	(8)

8. a. Carapace with longitudinal suture (seam)
        背甲出現縱走縫（接縫）   (10)

    b. -   ***Penaeopsis eduardoi***
                                                            雙刺擬對蝦

9. a. Pereiopod 5 with exopod   ***Trachypenaeus curvirostris***
        第五步足出現外肢   鷹爪蝦

    b. -   ***Metapenaeus monoceros***
                                                            沙蝦

10. a. Rostrum as long as peduncle of antennule and antennal scale   ***Parapenaeus australiensis***
        喙與小觸角柄、觸角鱗柄等長   澳洲擬對蝦

    b. Rostrum shorter than peduncle of antennule and antennal   ***Parapenaeus sextuberculatus***
        scale   六側突對蝦
        喙短於小觸角柄與觸角鱗柄

11. a. Rostrum with 4-6 dorsal teeth   ***Funchalia villosa***
        喙有 4-6 個背齒   長柔毛刺顎蝦

    b. Rostrum with 10-13 dorsal teeth   ***Funchalia woodwardi***
        喙有 10-13 個背齒   吳氏刺顎蝦

12. a. The height of the gastro-orbital carina is at least half of the
        height of the carapace at the same location   (13)
        胃－眼眶龍骨瓣高度至少為 1/2 背甲高度

    b. -   ***Penaeus merguiensis***
                                                            墨吉對蝦

13. a. Rostrum with 6-7 dorsal teeth and 3 ventral teeth   ***Penaeus monodon***
        喙有 6-7 個背齒與 3 個腹齒   草蝦

    b. Rostrum with 8-9 dorsal teeth and 2 ventral teeth   ***Litopenaeus vannamei***
        喙有 8-9 個背齒與 2 個腹齒   白蝦

Compiling Character and Similarity Matrices 編纂特徵與相似度矩陣

In this task, you reconstruct the phylogenetic relationships among the six prawn specimens from morphological characters. You will first need to compile a character matrix, which is a list of the presence or absence of the morphological characters, listed below, for each specimen. Use the figure provided under Question 3.1 to identify the required morphological characters.

在本題中受試者被要求針對六種蝦類標本進行親緣關係的重建。下表為六種蝦類 (SpA ~SpF) 的形態特徵，根據特徵之有無進行特徵矩陣編纂。利用問題 3.1 後方的圖進行形態特徵鑑定，並寫於答案卷上。

Number	Description
1	Second pereiopod bigger and longer than the other pereiopods 第二步足大且長於其他步足
2	Distinct median tubercle on ocular peduncle 眼柄上的中結明顯
3	Upper antennular flagellum subequal to lower one, attached to apex of third antennular segment 上觸角鬚約與下觸角鬚等長，並連於第三觸角節
4	Antennal scale anterior margin strongly produced forward at or near mid-line 觸角鱗前緣在靠近中線處有明顯突出
5	The height of the gastro-orbital carina is at least half of the height of the carapace at the same location 胃－眼眶龍骨瓣高度至少為 1/2 背甲高度
6	Rostrum with ventral teeth 喙有多個腹齒
7	Blade of rostrum high, broadly triangular in shape 喙的邊緣接隆起，並形成寬底三角形
8	Telson with one pair of fixed subapical spines 尾節出現固定的近尖端刺
9	Adrostral carina and groove extending as far as, or slightly ahead of epigastric tooth 額角龍骨瓣與額角龍骨溝延伸止於上胃齒處或略超過
10	In adult males, dactyle of third maxilliped half (0.5 to 0.6 times) as long as propodus 成熟雄蝦，第三顎足趾長度為掌節的 1/2（約 0.5 – 0.6 倍）
11	Pereiopod 5 without exopod and telson without fixed subapical spines 第五步足缺少外肢，而且尾節缺少固定的近尖端刺
12	Body white yellowish, yellow reddish with black or green spots 體色呈黃白色、黃紅色，並具有黑色或綠色斑點
13	Rostrum with 6-9 dorsal teeth and 2-3 ventral teeth 喙有 6-9 個背齒與 2-3 個腹齒
14	The movable finger of the chela has very short and fine spinules 鉗螯上的動趾覆被有極短的細刺
15	Fifth pereiopod without an exopod 第五步足缺少外肢

Question 3.2 Compile the character matrix in the **Answer Sheet.** Use **"1"** for presence and **"—"** for absence **(22.5 points)**.

問題 3.2：在答案卷上完成特徵矩陣。"1" 表示具有該項特徵，"－" 表示不具有該項特徵。（22.5 分）

Reconstructing phylogenetic relationships using UPGMA 利用 UPGMA 法進行親緣關係重建

UPGMA (**U**nweighted **P**air **G**roup **M**ethod with **A**rithmetic **M**ean) is considered the simplest method for reconstructing phylogenetic trees with assumption the data provide has constant rate of evolution. In this method, the pair of clusters with the shortest distance is combined into a higher-order cluster at each iteration. To illustrate this concept, consider the number of character differences between the Taxa A, B, C and D.

UPGMA （非加權組平均法）為最簡易的親緣樹重建法，所提供的數據在演化速率相同的前提下。在這種計算方式中，重複將距離最短的兩物種歸到一個較高層階的類群中，以下會詳述計算方式。為說明方便，A, B, C 與 D 各類群特徵的間距可用如下表中的數字表示。

	A			
A	0	**B**		
B	6	0	**C**	
C	7	8	0	**D**
D	8	9	4	0

Iteration 1: The pair of clusters with the smallest distance is the pair C and D, which is thus combined into a higher-order cluster (C,D). The **relative age** of the newly formed cluster is computed as half the distance between the two original clusters. In this case, the relative age of the cluster is 2.

說明 1：由於 C 與 D 兩類群間的距離最短，因此被歸一個高階類群，其**相對年齡**便可用 1/2 C-D 原始距離表示，因此，C-D 的相對年齡則為 2。

Next, a new matrix of all distances is generated by computing the distance between clusters as the average distance between all taxa from one cluster to all taxa of the other cluster. The distance between Cluster A and Cluster (C,D), for instance, is computed as the average between d(A,C) and d(A,D), where d(x,y) is a notation to indicate the distance between Clusters x and y.

接著，一個新的距離矩陣將成為這個高階類群與各個類群間的距離，如下表所示。 A 群與 C-D 群的距離便被標示為 A-C 與 A-D 的平均值，分別以 d(A,C) 與 d(A,D) 表示。之後，d(x,y) 便可以作為 x 群與 y 群的距離。

	A		
A	0	**B**	
B	6	0	**(C,D)**
(C,D)	7.5	8.5	0

Iteration 2: The pair of clusters with the smallest distance is now the pair of A and B, which is thus combined into a higher-level cluster (A,B) with a relative age of 3.

說明 2：在此，最短距離的高階類群 A-B 便誕生了，且 A-B 的距離為 3。

Again, a new matrix is constructed by calculating all distances as indicated above. The distance d((A,B),(C,D)) is defined as the average between d(A,C), d(A,D), d(B,C) and d(B,D).

進一步，另一個新的距離矩陣形成如下表所示。 d((A,B),(C,D)) 的距離為 d(A,C), d(A,D), d(B,C) 與 d(B,D) 四項的平均值。

	(A,B)	
(A,B)	0	(C,D)
(C,D)	8	0

Iteration 3: In the last iteration, the two remaining taxa are combined into the new cluster ((A,B),(C,D)) and the relative age of this cluster is 4.

說明 3：在最後的說明中，一個新的類群被形成 ((A,B),(C,D))，其相對年齡為 4。

Question 3.3 Calculate the distance matrix based on the character matrix provide at **Table 2**. The distance between two specimens is defined as the number of characters at which the two specimens show different character states (one present and the other absent) **(7.5 points)**.

問題 3.3：利用表 2 中提供的特徵矩陣計算距離矩陣。樣本間的距離定義為兩種樣本間特徵差異（一方具有而另一方不具該特徵）的數目（7.5 分）

Table 2.

Character	I	II	III	IV	V	VI
1	-	-	-	1	-	-
2	-	-	-	-	1	-
3	-	-	-	1	-	-
4	-	-	1	-	-	1
5	-	-	-	1	-	-
6	1	-	1	-	1	1
7	1	-	1	-	1	1
8	1	-	1	-	-	1
9	-	1	-	-	-	-
10	-	-	1	-	-	1
11	-	1	-	-	-	-
12	1	-	-	-	1	-
13	-	-	-	1	-	-
14	-	-	-	1	-	-
15	-	1	-	-	1	-
16	1	1	1	-	1	1
17	-	1	1	1	-	1
18	1	-	1	1	1	1
19	-	1	-	-	-	-
20	1	-	-	-	1	-

Question 3.4 Resolve the phylogenetic relationships of all six specimens (I-VI), showed at table 2, iteratively using the UPGMA method and based on the distance matrix you already create based on data of table 2 (**Q.3.3**). Make sure to report the names of the clusters using the specimen codes I through VI **(12 points)**.

問題 3.4：在答案卷的表 2 中，利用 UPGMA 法與所完成的距離矩陣數據對六個樣本 (I-VI) 進行親緣關係重建。並以樣本編號 I – VI 進行回答。（12 分）

Question 3.5 Draw a phylogenetic tree (dendrogram) based on the UPGMA results. Indicate the relative length of each branch by writing the correct number next to it **(5 points).**

問題 3.5：利用 UPGMA 結果畫出親緣樹（樹狀圖），以相對長度畫出每個分支，並標出正確數字。（5 分）

25th INTERNATIONAL BIOLOGY OLYMPIAD

5 – 13 July, 2014

INDONESIA

PRACTICAL TEST 3

ANIMAL ANATOMY, PHYSIOLOGY AND SYSTEMATICS

ANSWER SHEET

動物解剖、生理及系統分類答案卷

Total points: **93.5**

Duration: 90 minutes

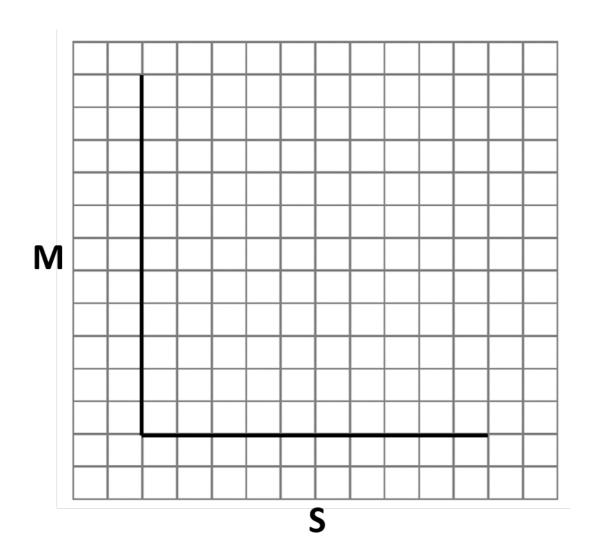| COUNTRY:	....
STUDENT:	....

Task (98.5 points)

Acute Response of Fish Larvae to Rapid Change in Salinity, Calculation of LC_{50}, and Classification of Prawns

幼魚對鹽度的急性反應、半致死濃度的計算及蝦的分類

Part A. Acute Response of Fish Larvae to Rapid Changes in Salinity (19 points)
幼魚對鹽度的急性反應

Q 1.1 and Q.1.2 (6 + 3 points)

Q 1.3. (2 points)

Mark the appropriate answer with a tick "✓" 在正確的答案處打勾

A	B	C	D

Q 1.4. (2 points)

Mark the appropriate answer with a tick "✓" 在正確的答案處打勾

A	B	C	D

Part B. Calculation of LC$_{50}$ (19.5 points) 半致死濃度的計算

Q 2.1 (4.5 points; @0.5) and Q2.2 (3 points; @0.5)

No	Concentration (μM) 濃度	Test Animals 動物數	Death 死亡	Mortality Rate 致死率 (%)	Log$_{10}$ Concentration 濃度對數 (x)	Probit (y) 偏差值	x^2	xy
1	10.2	50	44	88	1.01	1.18	1.02	1.19
2	7.7	50	42					
3	6.5	50	35	70	0.81	0.52	0.66	0.42
4	5.1	46	24					
5	4.4	50	22	44	0.64	-0.15	0.41	-0.1
6	3.8	50	16	32	0.58	-0.47	0.34	-0.27
7	3.2	50	11					
8	2.6	50	6	12	0.41	-1.18	0.17	-0.48
					Σx	Σy	Σx^2	Σxy

Q 2.3 (4 points; @1)

Q 2.4 (4 points)

a	b

Q 2.5 (4 points)

LC$_{50}$ Concentration [µM] 半致死濃度

Part C. Classification of Prawns (62 points) 蝦的分類

Q 3.1. (15 points @ 2.5 points)

Mark the appropriate answers with a tick "✓"　在正確的答案處打勾

Species 標本	SpA	SpB	SpC	SpD	SpE	SpF
Funchalia villosa 長柔毛刺顎蝦						
Funchalia woodwardi 吳氏刺顎蝦						
Litopenaeus vannamei 白蝦						
Macrobrachium australiense 澳洲長臂大蝦						
Macrobrachium koomboolomba 庫姆伯倫姆巴長臂沼蝦						
Macrobrachium rosenbergii 泰國長臂大蝦						
Metapenaeopsis barbata 紅斑赤蝦						
Metapenaeus monoceros 沙蝦						
Parapenaeus australiensis 澳洲擬對蝦						
Parapenaeus sextuberculatus 六側突對蝦						
Penaeopsis eduardoi 雙刺擬對蝦						
Penaeus merguiensis 墨吉對蝦						
Penaeus monodon 草蝦						
Trachypenaeus curvirostris 鷹爪蝦						

3.2 (22.5 points @0.25)

Mark presences with **"1"** and absences with **"—"**

"1" 表示具有該項特徵， "－" 表示不具有該項特徵。

Character 特性	SpA	SpB	SpC	SpD	SpE	SpF
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16	1	-	-	-	1	-
17	-	1	1	1	-	1
18	-	1	-	-	-	-
19	-	-	-	1	-	-
20	1	-	1	-	1	1

Q 3.3 (7.5 points @ 0.5 point)

Specimen 標本	I	II	III	IV	V	VI
I	0.00					
II		0.00				
III			0.00			
IV				0.00		
V					0.00	
VI						0.00

Q 3.4 (12 points)

Iteration 1 (1 + 1 + 2.5 = 4.5 points)

階層 1

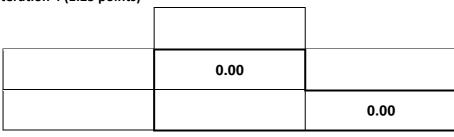|					Age of newly formed cluster 新形成類群的年齡
	0.00				
		0.00			
			0.00		
				0.00	
					0.00

Iteration 2 (1 + 1 + 1.5 = 3.5 points)

	0.00			
		0.00		
			0.00	
				0.00

Age of newly formed cluster 新形成類群的年齡

Iteration 3 (1 + 1 + 0.75 = 2.75 points)

	0.00		
		0.00	
			0.00

Age of newly formed cluster 新形成類群的年齡

Iteration 4 (1.25 points)

	0.00	
		0.00

Age of newly formed cluster

Q 3.5 (5 points)