Student Code: _____

22nd INTERNATIONAL BIOLOGY OLYMPIAD

July 10-17, 2011

Taipei, Taiwan

THEORETICAL TEST: PART A

Duration: 120 minutes

Dear participants,

- Check your **Student Code** on the **Answer Sheet** before starting the test.
- The questions in Part A have **only one** correct answer. Fill your answer in the **Answer Sheet**. Mark the correct answer with "X" on the **Answer Sheet** clearly, as shown below.

No.	A	B	C	D	E	F
A0	X					

- You can use a ruler and a calculator provided.
- Write down your results and answers in the **Answer Sheet**. **Answers written in the Question Paper will not be evaluated.**
- Some of the questions may be marked "DELETED". DO NOT answer these questions.
- The maximal point of Part A is 116 (2 points each for each question).
- Stop answering and put down your pen IMMEDIATELY after the end bell rings.

- 在開始作答之前，請先檢查**答案紙**上的**學生編號**是否正確
- A 部分的試題只有一個正確答案，將答案以**"X"**在**答案紙**適當空格上作記．**(如上圖)**
- 你可以用尺及所提供的計算機
- **只在答案紙上作記，寫在試題上的答案將不記分**
- 有些標示"已刪除"的題目，請勿作答
- A 部分的總分爲１１６(每題 2 分)
- 鈴聲響起時，應立刻放下原子筆停止作答

Good Luck!!

I. Cell Biology　細胞學

A1. Endorphin is a natural analgesic secreted by the pituitary gland and other brain cells. Upon binding to its receptor in brain cells, endorphin can relieve pain and create a sense of euphoria. Morphine can achieve similar pain relief effects by binding to the endorphin receptor. Why do both endorphin and morphine bind to the endorphin receptors in brain cells?

內啡肽 (endorphin) 是由腦下腺與部分腦細胞所分的天然止痛藥。當他與大腦中的內啡肽受體結合後，內啡肽會產生止痛效果與幸福感。嗎啡 (morphine) 也能與內啡肽受體結合，並產生類似的止痛效果。有關內啡肽與嗎啡均可與內啡肽受體結合的說明，何者正確？

(A) Sizes of both molecules are similar.　兩者分子大小相似

(B) Molecular weights of both molecules are similar.　兩者分子量相似

(C) Both are isomers.　兩者爲同分異構物

(D) Shapes of both molecules are similar.　兩者具相似外型

(E) Net charges of both molecules are identical.　兩者靜電荷相同

A2. Most biological macromolecules are made by the polymerization of small principal components. The major structural polysaccharide of the insect exoskeleton is a polymer. Which of the following statements regarding this kind of polysaccharide is **NOT correct**?
許多生物的大分子都是由小分子的單體聚合而成。昆蟲的外骨骼也是由多醣類聚合而成。有關此種多醣類的敘述，下列何者 **錯誤**？

(A) It is made by polymerization of glucose. 完全由葡萄糖聚合而成

(B) It contains C, H, O and N atoms. 含有 C, H, O 與 N 原子

(C) Its structure is similar to that of cellulose. 結構類似於纖維素

(D) It can be used to produce glucosamine in industry.
工業上可以用來製造葡萄糖胺

(E) This polymer can also been found in the cell wall of fungi.
真菌的細胞壁上也可以發現

A3. In some cells, synthesis of isoleucine from threonine is catalyzed by the sequential action of five enzymes a, b, c, d and e which produce 4 intermediates A, B, C, and D, and the end product isoleucine, respectively. What is most likely to happen when isoleucine is overproduced and there is an ample supply of threonine in cells?

細胞中 isoleucine 的生合成來自一連串催化 threonine 的反應。其間經過 a, b, c, d, e 五種酵素，並產生 A, B, C, D 四種中間產物與 isoleucine 的最終產物。當 isoleucine 生產過剩與過量提供 threonine 時，會出現下列何種現象？

(A) Isoleucine associates with threonine to inhibit the activity of enzyme a.
isoleucine 與 threonine 會聯手抑制 酵素 a 的活性

(B) Isoleucine associates with intermediate D to inhibit the activity of enzyme e.
isoleucine 會與 中間產物 D 會聯手抑制 酵素 e 的活性

(C) Isoleucine binds to enzyme a and inhibits its activity.
isoleucine 會與 酵素 a 結合並抑制它的活性

(D) Isoleucine binds to enzyme e and inhibits its activity.
isoleucine 會與 酵素 e 結合並抑制它的活性

(E) Threonine is converted into isoleucine continuously through the 5 enzymes.
threonine 會持續經由 5 種酵素持續產生 isoleucine

A4. In some prokaryotic organisms, SO_4^{2-} is used as the final electron receptor at the end of electron transport chain during cellular respiration. Which of the following statements regarding cellular respiration in these prokaryotic organisms is **NOT correct**?

許多原核生物會利用 SO_4^{2-} 作爲細胞呼吸作用電子傳遞鏈中最終的電子受體。有關原核生物細胞呼吸作用的敘述，下列何者 **錯誤**？

(A) It is anaerobic respiration.

爲無氧呼吸

(B) The reception of electron by SO_4^{2-} is accompanied by the production of H_2O.

SO_4^{2-} 接受電子後，會伴隨水的生成

(C) Operation of the electron transport chain builds up a proton motive force.

電子傳遞鏈會產生質子驅動力 (proton motive force)

(D) ATP can be produced.

產生 ATP

(E) Production of ATP is correlated with the mobility of H^+.

H^+ 的移動與 ATP 產生有關

A5. Three stages in the growth of a bacterial culture are:

I. Lag phase

II. Log phase

III. Stationary phase

In which phase or phases can penicillin inhibit the synthesis of the bacterial cell wall?

細菌生長可以分成三個時期，I. 延滯期，II. 指數期，III. 靜止期。盤尼西林會抑制細胞壁的合成，請問可以作用在上述哪些時期？

(A) Only I

(B) Only II

(C) Only III

(D) Only I and II

(E) Only I and III

(F) I, II and III

A6. Which structural or physiological feature of bacteria is commonly used as a drug target to kill bacteria effectively but with very little harm to human cells?

根據細菌的結構與生理，下列何者可以用來做爲有效殺死細菌但是卻幾乎無害人類細胞的藥物開發標的？

(A) Glycolysis　糖解作用

(B) Components of plasma membrane　細胞膜組成

(C) Components of ribosome　核糖體組成

(D) Components of the electron transport chain in aerobic respiration
有氧呼吸時電子傳遞鏈組成

(E) Requirement of oxygen　對氧氣的需求

A7. Histones are small basic proteins that assemble with DNA molecules to form chromosomes. There are five histones, including H1, H2A, H2B, H3 and H4, in eukaryotic cells. The formation of which of the following structural feature of chromosomes is driven by Histone H1?

組織蛋白是一種鹼性蛋白，會參與染色體中 DNA 分子的組裝。在真核細胞中，共有五種組織蛋白，H1, H2A, H2B, H3 與 H4。有關組織蛋白 H1 參與染色體結構的說明，下列何者正確？

(A) Telomere　端粒

(B) Nucleosome fiber (10-nm fiber) 核小體纖維 (10-nm 纖維)

(C) 30-nm fiber　30-nm 纖維

(D) Looped domains　圈環階段

(E) Centromere　中心粒

A8. DNA is a double helix molecule containing four different types of nitrogen bases. Which of the following statements regarding both the replication and chemical composition of DNA is correct?

DNA 是由四種含氮鹼基所組成的雙螺旋構造，有關 DNA 化學組成與複製的說明，下列何者正確？

(A) Base sequences of both strands are the same.

DNA 雙股的鹼基序列均相同

(B) The amount of purine is equal to that of pyrimidine in a double-stranded DNA.

雙股 DNA 中嘌呤與嘧啶的含量相同

(C) Both strands are synthesized continuously in 5'→3' direction.

雙股合成的方向均爲 5'→3'，而且都是連續的

(D) The first base of the newly synthesized nucleic acid is catalyzed by DNA polymerase.

剛開始合成的核酸片段，是由 DNA 聚合酶所催化

(E) The proof-reading activity of DNA polymerase proceeds in the 5'→3' direction.

DNA 聚合酶會依 5'→3' 方向進行鹼基對的校正

A9. Mister Spiderman has compared the DNA, the corresponding RNA and protein sequences of many human genes. What conclusion can be drawn from the sequence comparison?

蜘蛛先生比對許多人類基因的 DNA，與其相對應的 RNA 與蛋白質序列後。下列何者可以作爲上述分析的結論？

(A) The number of exons is always more than that of introns.

外顯子數目多於內插子數目

(B) The translation start codon is located within the first exon.

轉譯起始密碼子位在第一個外顯子上

(C) The translation stop codon is located within the last exon.

轉譯終止密碼子位在最後一個外顯子上

(D) The G nucleotide of RNA capping is the first nucleotide transcribed from DNA

構成 RNA 5 端帽的 G 核苷酸，源自 DNA 轉錄出的第一個核苷酸位置

(E) The polyA tail is transcribed from the poly-dT of DNA.

多腺核苷酸尾 (polyA tail) 源自 DNA 轉錄的多胸核苷 (poly-dT)

A10. Miss Ling-Ling conducts DNA amplification and transcription reactions in two separate test tubes. Which of the following substances needs to be added to both reactions?

玲玲小姐分別在兩支試管中進行 DNA 增殖放大與轉錄實驗。下列何種物質必須同時添加到兩種實驗中？

(A) ATP

(B) DNA template　　DNA 模板

(C) RNA primer　　RNA 引子

(D) DNA polymerase　　DNA 聚合酶

(E) DNA ligase　　DNA 接合酶

A11. The Nobel Prize in Physiology or Medicine 2009 was awarded jointly to Blackburn, Greider and Szostak for the discovery that chromosomes are protected by telomeres and the enzyme telomerase is highly correlated with aging and cancer in animals. Which of the following statements regarding telomere and telomerase is correct?

Blackburn, Greider 與 Szostak 因爲發現染色體端粒上的端粒酶會保護染色體，並與動物的老化與癌症有關，因而獲得 2009 年諾貝爾生理與醫學獎。有關端粒與端粒酶的敘述，下列何者正確

(A) Telomerase is a DNA exonuclease. 端粒酶爲一種 DNA 外切酶

(B) Telomerase is an RNA polymerase. 端粒酶爲一種 RNA 聚合酶

(C) Embryonic cells possess long telomeres and high telomerase activity.
胚胎細胞 具有較長的端粒與較高活性的端粒酶活性

(D) Telomeres are longer and telomerase is inactive in cancer cells.
癌症細胞 具有較長的端粒與較低活性的端粒酶活性

(E) Telomeres are longer and telomerase is highly active in somatic cells.
體細胞 具有較長的端粒與較高活性的端粒酶活性

A12. *Eco*RI restriction enzyme is a DNA endonuclease that can recognize the sequence GAATTC. It was first discovered in *Escherichia coli*, therefore it was named *Eco*RI. To produce a large quantity of the endonuclease, the DNA fragment encoding the gene was subcloned into an expression plasmid and the resultant recombinant plasmid was transformed into *E. coli* cells to produce recombinant enzyme for a study. Why is the host DNA not cleaved by the recombinant *Eco*RI?

*Eco*RI 爲一種限制酶，具有 DNA 內切酶的特性，並且要辨認到 GAATTC 序列才會作用。由於是在大腸菌中發現，因此命名爲 *Eco*RI。爲了要產生大量的內切酶，因此會藉由質體將 *Eco*RI 的基因片段轉殖到大腸菌中。試問，作爲宿主的大腸菌它的 DNA 爲何不會被產物 *Eco*RI 所切割作用？

(A) The host DNA does not contain *Eco*RI cleavage sites.

宿主 DNA 中缺乏 *Eco*RI 切割位置

(B) *Eco*RI is secreted out of the host cells.

*Eco*RI 會分泌到宿主細胞外面

(C) Environmental factors such as temperature and pH value inhibit *Eco*RI activity.

環境中的溫度與 pH 值會影響 *Eco*RI 的活性

(D) The *E. coli* host produces inhibitors to block *Eco*RI activity.

宿主會產生抑制劑抑制 *Eco*RI 的作用

(E) The *Eco*RI cleavage sites within the host DNA are modified.

宿主 DNA 上的 *Eco*RI 切割位置被修飾過

II. Plant anatomy and physiology

A13. Hypersensitive response is one of the plant defense responses to pathogens. Each of four pathogen strains, **a** to **d,** produce a distinct range of effectors. One of the effectors, Avr, recognized by a specific receptor protein encoded by the resistance (R) gene in the host plant is present in strains **b** and **c**. Host plants **B** and **D** produce the R protein. Which plant(s) are likely to develop a hypersensitive response after the host plants **A** to **D** are infected by pathogens **a** to **d** (**a→A**, **b→B**, **c→C**, **d→D**), respectively?

過敏反應是當植物遭遇病菌入侵時會產生的一種防禦性反應，這四種病菌菌株(a-d)，每一種皆有其特定範圍的作用因子，其中有一種稱爲”Avr”的作用因子可被寄主植物體內的抗病基因(R)表現而得的特殊 R 接受蛋白所辨識，而病菌 **b** 及 **c** 具有 Avr 作用因子，寄主植物 **B** 及 **D** 可產生 R 接受蛋白， (**a→A**, **b→B**, **c→C**, **d→D**) 分別代表以病菌 **a** 感染植物 **A..(**以此類推**)**方式處理後，下列哪種（或哪些）植物可能會產生過敏反應？

(A) **A** only

(B) **B** only

(C) **C** only

(D) **D** only

(E) **B** and **C**

(F) **B** and **D**

A14. Plant movement occurs when plant organs change their spatial distribution after being exposed to stimuli, and may be caused either by differential growth or by differential turgor change among cells within the organs. Which of the following plant movements uses a mechanism distinct from the others?

當植物受到刺激時，其器官會改變其在空間上的分布位置，此現象稱爲植物的運動，此可能是因爲器官內的細胞在生長上發生差異或是膨壓改變所造成的。下列植物的運動中，哪一種所利用的機制與其他的不同？

(A) The gravitropic movement of corn roots

玉米根的向地運動

(B) The closure of soybean leaflets during night time

黃豆的小羽葉在夜間閉合

(C) The tendrils of cucumber moving along the trellis

黃瓜的捲鬚在物體上纏繞

(D) The phototropic movement of mungbean seedlings

豆類幼苗的向光運動

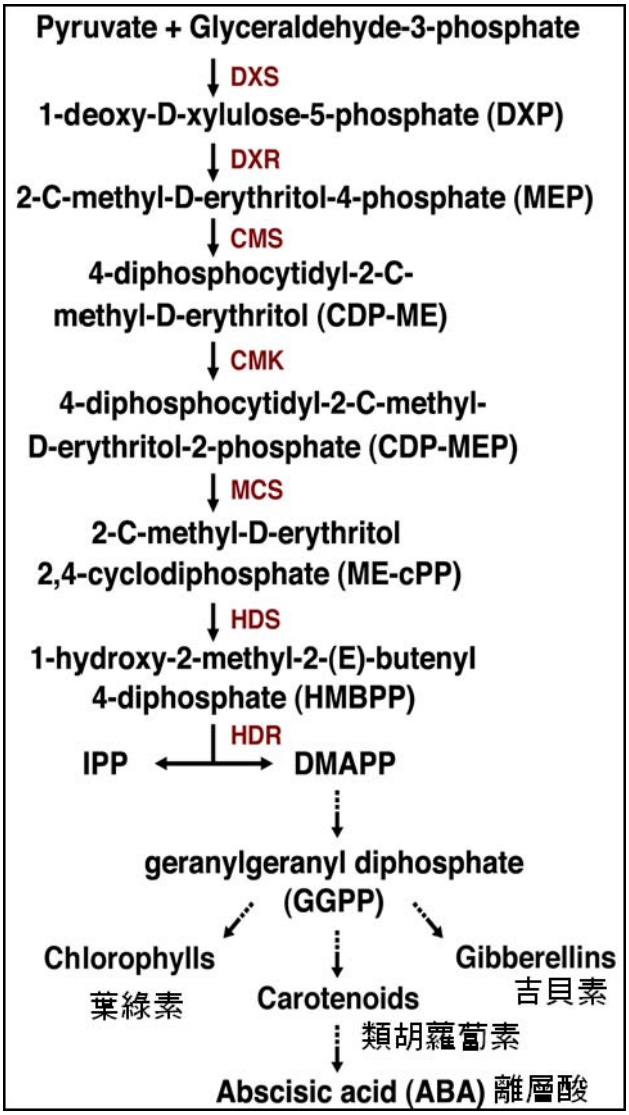
(E) The downward bending of the tomato leaves after flooding treatment

番茄葉片在淹水處理後下垂

Questions 15 and 16 are a **problem set　第１５－１６題爲題組**

A15. In the model plant Arabidopsis, the DXS, DXR, CMS, CMK, MCS, HDS and HDR enzymes are involved in the methyl erythritol phosphate (MEP) pathway of isopentenyl diphosphate (IPP) and dimethylallyl diphosphate (DMAPP) biosynthesis. The Arabidopsis *white devil* albino mutant is impaired in the enzyme HDS. Assuming Arabidopsis can efficiently take up the intermediate metabolites of the MEP pathway, the *white devil* albino mutant will grow and turn green if given which of the following compound?

在阿拉伯芥中，DXS, DXR, CMS, CMK, MCS, HDS 及 HDR 是 methyl erythritol phosphate (MEP)及 dimethylallyl diphosphate (DMAPP)的生物合成過程（如圖）中的參與酵素。白子突變株 *white devil* 是因爲 HDS 酵素發生缺陷。假設阿拉伯芥可有效地吸收在 MEP 過程中的中間產物，若提供下列哪種化合物，則白子突變株 *white devil* 可繼續生長並轉爲綠色。



(A) MEP

(B) CDP-ME

(C) CDP-MEP

(D) ME-cPP

(E)HMBPP

A16. The plant MEP pathway is located in which of the following organelle?

在植物，MEP 的生成過程是位於哪個胞器中？

(A) nucleus　細胞核

(B) vacuole　液胞

(C) chloroplast　葉綠體

(D) mitochondrion　粒線體

(E) endoplasmic reticulum　內質網

A17. Dennis dissected a plant leaf and found bundle sheath cells full of starch granules. Which of the following characteristics can be observed in this plant?

丹尼解剖一種植物的葉片發現其葉鞘細胞中充滿澱粉粒，據此判斷此植物具有下列哪些特徵？

I. Stomata open at night

氣孔在夜間打開

II. Presence of PEP carboxylase in mesophylls

PEP 羧化酶存在於葉肉組織中

III. Presence of Rubisco in bundle sheath cells

Rubisco 存在於葉鞘細胞中

IV. High photorespiration rate on hot summer days

在炎熱夏天時，光呼吸率高

V. Carbon fixation can occur in both mesophyll and bundle sheath cells

碳固定發生在葉肉組織及葉鞘細胞中

VI. Carbon assimilation rate is saturated in the early morning on summer days

碳的同化作用速率在夏天早晨達到最高

(A) Only I, IV

(B) Only II, IV, V

(C) Only II, IV, VI

(D) Only II, III, V

(E) Only II, III, V, VI

(F) Only II, IV, V, VI

A18. It has been estimated that around 124 million children are vitamin A deficient, causing about 500,000 children to go blind each year. To help children who suffer from vitamin A deficiency, scientists have developed a variety of rice (*Oryza sativa* L.), Golden Rice, through genetic engineering. The original Golden Rice was produced using the japonica variety Taipei 309, which is genetically enriched in

據估計約有一億二千四百萬個兒童患有維他命 A 缺乏症，導致每年有５０萬個兒童喪失視力．爲幫助維他命 A 缺乏症兒童，科學家利用遺傳工程研發出一變種黃金米，其來源是利用另一個變種 Taipei 309，其具有富含下列哪種物質的基因表徵？

(A) auxin　植物生長素

(B) starch　澱粉

(C) β-carotene　β-胡蘿蔔素

(D) iron　鐵

(E) anthocyanins 花青素

A19. Abscisic acid (ABA) is one of the important growth regulators of plants. It often antagonizes the functions of hormones that promote growth. Plant biologists have been interested in elucidating the signaling pathway of ABA by genetic approaches. They screened mutants of the model plant *Arabidopsis thaliana* that respond abnormally to ABA treatment to identify the involving components of the pathway. One type of mutant phenotype is ABA-insensitive (*abi*). Which of the following phenotypes are likely to be observed in the *abi* mutants?

離層酸(ABA)是調節植物生長的重要因子，它通常與可促進生長功能的激素呈拮抗關係，植物學家利用遺傳方法篩選阿拉伯芥不能對 ABA 處理產生正常反應的突變株，試圖找出參與 ABA 訊息傳遞過程的組成。一種突變表徵(*abi*)爲對 ABA 不敏感，下列何者可能是可在 *abi* 突變株看到的表徵？

(1) Seeds germinate at the presence of exogenous ABA. 當外加 ABA 時，種子可萌發

(2) Seeds become dormant at the presence of exogenous ABA.
當外加 ABA 時，種子變成休眠狀態

(3) Stomata do not close in response to drought. 在乾旱時，氣孔不會關閉

(4) More tolerant to drought than the wild-type plants. 比野生型更耐乾旱

(5) Leaf does not abscise when it becomes senescent. 當葉子老化時，不會脫落

(6) Leaf is prematurely abscised even when greenish. 當葉子尚年輕時，即提早脫落

(A) Only (1), (3)

(B) Only (2), (3)

(C) Only (2), (5)

(D) Only (2), (4), (5)

(E) Only (1), (3), (6)

(F) Only (2), (4), (6)

A20. Ethylene is a hormone that influences plant's growth and development. It is known that treatment with 10 ppm of 1-methylcyclopropene (MCP) can block the signal transduction of ethylene. If certain plant tissues were treated with 10 ppm MCP, which of the following phenotypes could be observed in MCP-treated tissues?

乙烯是影響植物生長與發育的激素，以 10 ppm 1-methylcyclopropene (MCP)處理會阻擋乙烯的訊息傳遞．若某植物組織用 10 ppm MCP 處理，可出現下列何種表徵？

(A) Shorter hypocotyl in etiolated mung bean seedling

使未照光的豆類幼苗有較短的下胚軸

(B) Increased degradation of chlorophyll in detached leaves

對摘下來的葉片施以此處理，有加速葉綠素降解的作用

(C) Increased synthesis of ethylene in banana fruits

促進香蕉果實中的乙烯合成

(D) Inhibition of the ripening of tomato fruits

抑制番茄果實的成熟

(E) Induction of the senescence of carnation cut flowers

誘導所摘下來的康乃馨花的老化

A21. During leaf development in water lily, the sclereid-initials grow and elongate along the palisade mesophyll cells or the intercellular space between them. After elongation they gradually form calcium oxalate crystals in the cell wall along the cell membrane. Thereafter, they form the secondary cell wall. Four cell wall structures are: (I) primary cell wall; (II) secondary cell wall; (III) middle lamella; (IV) calcium oxalate crystals. What is the final sequence of structures in the mature sclereids of water lily, starting from the plasma membrane as the innermost layer to the outermost layer?

在睡蓮葉片的發育過程中，將特化爲厚壁細胞的起始細胞會隨著柵狀組織的細胞伸長或在細胞間隙生長．在伸長之後，這些細胞會先在細胞壁與細胞膜之間逐漸產生草酸鈣結晶，之後再形成次生細胞壁，四種細胞壁的構造爲：(I) 初生細胞壁；(II) 次生細胞壁；(III) 中膠層；(IV) 草酸鈣結晶．從細胞膜向外依序列出睡蓮的成熟厚壁細胞之壁層次，下列何者正確？

(A) I → IV → II → III

(B) III → IV → I → II

(C) I → II → IV → III

(D) III → I → IV → II

(E) II → IV → I → III

A22. *Agrobacterium tumefaciens*-mediated transformation, a widely used method to transfer foreign genes into the plant genome, has contributed to the considerable successes that plant biotechnology has already achieved. For instance, a gene encoding the coat protein (CP) of papaya ringspot virus (PRSV) was used to generate the virus-resistant transgenic SunUp papaya in Hawaii. The construct used for transformation includes the *CP* gene and a selectable marker gene (*nptII*) conferring kanamycin resistance. Both *CP* and *nptII* genes are driven by a constitutive cauliflower mosaic virus (CaMV) 35S promoter. According to the above information, which of the following statements is **NOT correct**?

植物生技研究常以農桿菌 *Agrobacterium tumefaciens* 進行將外來基因轉入植物基因組中（稱爲轉型作用），例如在夏威夷，負責木瓜環斑病毒(PRSV)外套蛋白(CP)的編碼基因，常被利用來製成可抗病毒的轉殖木瓜 SunUp．在轉型作用的建構過程包括 *CP* 基因和可以對抗 kanamycin 毒素的選擇標誌基因 *nptII*，*CP* and *nptII* 兩種基因可被花椰菜鑲嵌病毒(CaMV)的 35S 啓動子所驅動．根據上述資訊，下列何者**錯誤**？

(A) The SunUp papaya is resistant to kanamycin.

轉殖木瓜 SunUp 對 kanamycin 毒素有抗性

(B) The SunUp papaya contains some DNA sequences from CaMV.

轉殖木瓜 SunUp 含有一些來自花椰菜鑲嵌病毒(CaMV)的 DNA 序列

(C) The SunUp papaya contains some chromosomal DNA of *Agrobacterium tumefaciens.*

轉殖木瓜 SunUp 含有一些農桿菌 *Agrobacterium tumefaciens* 的染色體 DNA

(D) The SunUp papaya contains a portion of the Ti plasmid termed T-DNA.

轉殖木瓜 SunUp 含有載體 T-DNA 的一部份

(E) The SunUp papaya contains the *nptII* gene.

轉殖木瓜 SunUp 含有基因 *nptII*

III. Animal anatomy and physiology 動物解剖與生理

A23. Which of the following is the only vertebrate in which blood flows directly from respiratory organs to body tissues without returning to the heart first?

下列脊椎動物中，何者的血液可直接由呼吸器官流向身體組織不先回心臟？

(A) Fish 魚類

(B) Amphibians 兩生類

(C) Mammals 哺乳類

(D) Reptiles 爬蟲

(E) Birds 鳥類

A24. How does the hemocyanin of arthropods differ from the hemoglobin of mammals?

(A) The oxygen dissociation curve of hemocyanin is not a S-shape

(B) Hemocyanin carries considerably more carbon dioxide

(C) Hemocyanin is a single-chain respiratory pigment

(D) Hemocyanin is a protein coupled with magnesium

(E) Hemocyanin is a protein coupled with copper

節肢動物血青素與哺乳動物的血紅素有何不同？

(A) 血青素的氧分離曲線不呈 S-型

(B) 血青素能攜帶更多二氧化碳

(C) 血青素單鏈的呼吸色素

(D) 血青素是與鎂偶合的蛋白質

(E) 血青素是與銅偶合的蛋白質

A25. A shark is more likely to survive for an extended period of food deprivation than is a dolphin with equivalent size because

(A) The shark maintains a higher basal metabolic rate

(B) The shark expends more energy/kg body weight than the dolphin

(C) The shark invests much less energy in temperature regulation

(D) The shark metabolizes its stored energy more readily than the dolphin does

(E) The shark has a better insulation on its body surface

以相近體型大小比較，當食物長期缺乏時，鯊魚比海豚能存活更久的原因？

(A) 鯊魚維持較高的基礎代謝率

(B) 鯊魚每公斤體重要消耗比海豚更多能量

(C) 鯊魚花費在溫度調節上的能量較少

(D) 鯊魚比海豚更容易代謝儲存的能量

(E) 鯊魚體表的絕緣性較好

A26. Increased arteriolar resistance contributes to hypertension. Which one of the following factors contribute to the increased vascular resistance most significantly?

動脈阻力增加會導致高血壓，下列何者所增加的血管阻力最爲顯著？

(A) Vessel length 血管長度

(B) Blood viscosity 血液黏滯度

(C) Vascular diameter 血管直徑

(D) Total leukocyte counts 白血球數目

(E) Heart rate 心跳速率

A27. A method to estimate an mammal's blood volume uses a specific radioactive isotope of iodine (123I). This isotope, usually produced synthetically, has a half-life time of 13 hours. It decays to 123Te, which is almost perfectly stable. To estimate the blood volume, 10 mL of iodine solution are injected into the animal's vein. The activity of the solution at the injection is 2mSv. A sample of 10 mL of the animal's blood, taken 13 hours after the injection, is 0.0025mSv. The estimate volume of the animal's blood volume is?

碘的輻射性同位素(^{123}I) 可用以估計一動物血液的體積。此同位素通常是合成的，半衰期爲 13 小時，會衰退爲非常穩定的 ^{123}Te，在估計動物血量時會由靜脈注射 10 mL 的碘液。一動物被注射了 10 mL 活性爲 2mSv 的碘液，13 小時後抽血 10 mL 測其活性爲 0.0025mSv，估計此動物血液的體積爲多少？

(A) 10.0 L

(B) 8.0 L

(C) 4.0 L

(D) 2.5 L

(E) 1.25 L

A28. Which of the following events will result in an excitatory postsynaptic potential?

下列何者會引起突觸後神經元的興奮電位？

a. Increasing sodium influx. 增加鈉離子流入

b. Blocking potassium out-flux. 阻止鉀離子外流

c. Increasing calcium influx. 增加鈣離子流入

d. Closing a chloride channel. 關閉氯離子通道

(A) Only a & b 只有 a &, b

(B) Only b & c 只有 b & c

(C) Only a, c & d 只有 a, c & d

(D) Only b, c & d 只有 b, c & d

(E) a, b, c & d. a, b, c & d

A29. Compared to a healthy individual what are the levels of the following hormones in an individual with primary hyperthyroidism (hypersecretion of thyroid hormone)?

Thyrotropin-releasing hormone (TRH), thyroid-stimulating hormone (TSH), Thyroid hormones T3 and T4

與健康人比較，下列激素濃度在原發甲狀腺亢進（甲狀腺分泌過多）患者體內高低爲何？

促甲狀腺素釋放激素(TRH)、促甲狀腺素(TSH)、甲狀腺素 T3、甲狀腺素 T4

↑: increase 增加　　↓: decrease 減少　　—: remains unchanged 不變

	TRH	TSH	T3	T4
A	↑	↑	—	↑
B	↑	↑	↑	—
C	↓	↓	↑	↑
D	↓	↓	↓	↓
E	↓	↑	↑	↑

A30. Which of following receptors/molecules are required for the activation of Helper T cells trigged by antigen-presenting cells.

在抗原呈獻細胞活化 T 輔助細胞時，需要下列何種受體/分子的參與？

1. CD8 CD8
2. CD4 CD4
3. Class I MHC molecule 第Ⅰ型 MHC 分子
4. Class II MHC molecule 第 II 型 MHC 分子
5. T cell receptor T 細胞受體

(A) Only 1, 3 & 5

(B) Only 2, 4 & 5

(C) Only 3, 4 & 5

(D) Only 2 & 4

(E) Only 1 & 3

A31. Inspect the following table which is revealed to the function of kidneys in vertebrate.

下表顯示脊椎動物腎臟的功能：

What　發生事件	1. Urine concentration by NaCl reabsorption 藉由 NaCl 的再吸收來濃縮尿液 2. Urine concentration by urea reabsorption 藉由尿素的再吸收來濃縮尿液 3. Aquaporin mediated water reabsorption 藉由水孔蛋白進行的水分再吸收
How　如何	4. Countercurrent multiplier system 逆流多層系統 5. Countercurrent exchange 逆流交換
Where　在何處	6. Loop of Henle　亨耳氏套 7. Collecting duct　集尿管 8. Proximal tubule　近曲小管

Figure out which of the following alternatives show a correct combination.

下列何者爲正確的組合？

(A) 1-4-6

(B) 1-4-8

(C) 2-4-6

(D) 2-5-8

(E) 3-5-7

A32. When people lose blood quickly as happens in a car accident and his/her physiological parameters are monitored right away, which of the following situations will **NOT** occur

(A) Decrease of sodium concentration in urine

(B) Blood volume decreases but interstitial fluid increases

(C) Increase in the resistance of blood vessel

(D) Stroke volume increases; cardiac output increases

(E) Decrease in the proportion of red blood cells in blood.

在人在快速失血時，例如發生車禍，立刻檢視其生理參數，下列何者 不會 發生？

(A) 尿液中鈉的離子濃度降低

(B) 血液體積減少、組織間液增加

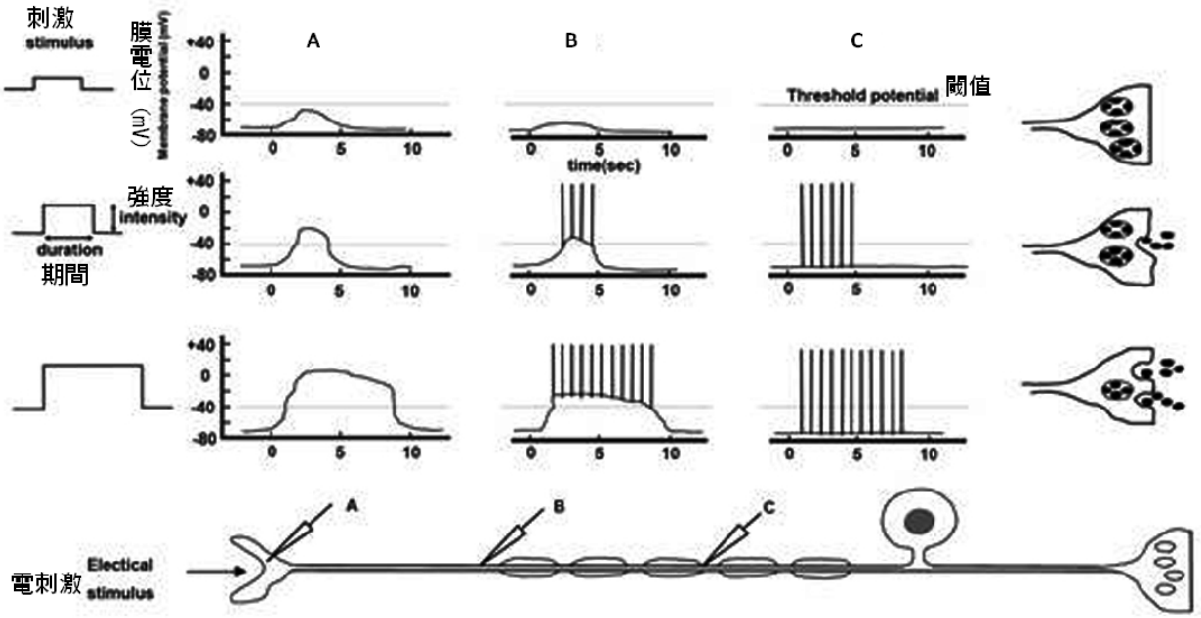
(C) 血管阻力增加

(D) 心搏出量增加、心輸出總量增加

(E) 血液中紅血球比例降低

A33. The following figure illustrates the membrane potential changes measured at three different sites (A, B, C) along a sensory neuron and the release of neurotransmitters from the axon termini when depolarizing electrical stimuli with varied intensities were applied to the dendrite. Based on the information provided in the figure below, choose the correct statements in the following list.

下圖顯示在一感覺神經元的三不同位置(A, B, C)測得的膜電位變化，及當樹突受不同強度刺激時在軸突端去極化而釋放神經傳導物質。根據下圖資料選擇出正確的敘述。



1. The membrane potential changes evoked at A site would be proportional to the intensity of the electrical stimuli applied to the dendrite.
   在 A 處激起的膜電位變化與在樹突處施與的電刺激強度成正比
2. An action potential would be recorded at B site only when the intensity of the applied current stimulus causes the membrane potential to be higher than the threshold potential in the axon hillock.
   電流刺激強度引起的膜電位超過軸突丘閥值電位時，方能在 B 處記錄到動作電位
3. The frequency of the action potentials at B site is dependent on the duration of the applied current stimulus at A.
   在 B 處動作電位的頻率與在 A 處電流刺激的時間長短有關
4. The quantity of the neurotransmitters released from the axon termini is unlikely to depend on the frequency of the action potential at C site.
   軸突末端神經傳遞物質釋放量與 C 處的動作電位頻率無關

(A) Only 1 and 2

(B) Only 1 and 3

(C) Only 2 and 3

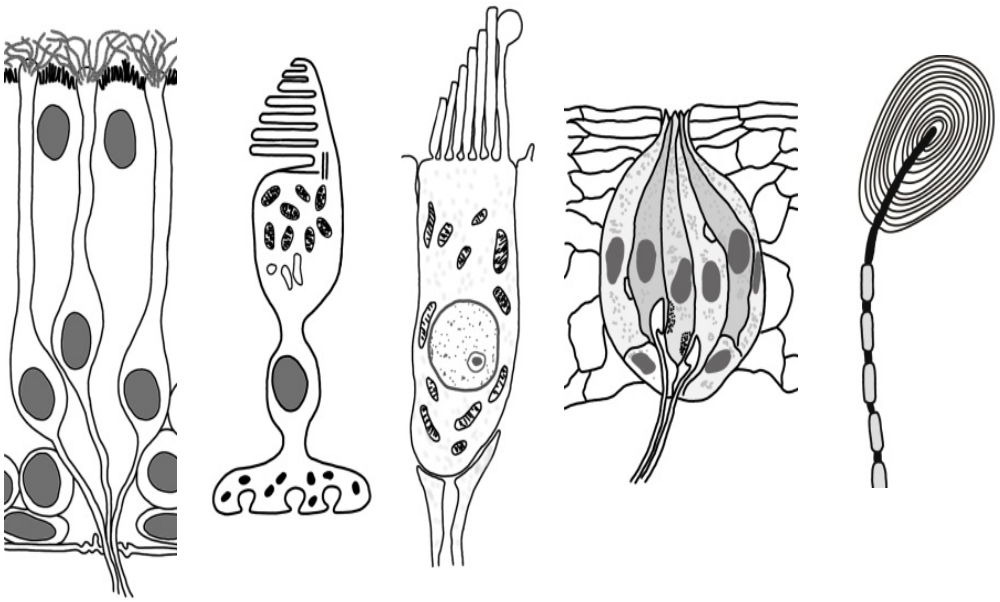
(D) Only 3 and 4

(E) Only 1, 2, and 3

A34. The perception of the messages from the environmental changes is carried out by specialized sensory cells. Their structural composition is in a strict accordance to their functions. ~~Please analyze the following pictures and answer the question below:~~

Which of the following receptors in human receptors will be activated by a stimulation and consequently close a Na^+ channel leading to hyperpolarization?

對環境變化訊息的感受是由特化的感覺細胞來執行，其構造能與其功能緊密配合。下列人體受器中，何者被一刺激活化後會很快關閉 Na^+通道而引起過極化？



A **B** **C** **D** **E**

IV. Ethology (行爲學)

A35. There are three types of chemical substances that organisms emit to mediate interspecific interactions: kairomone, allomone, and synomone. Which of the following descriptions regarding to this essential oil is correct? This essential oil acts as a:

調控生物種間行爲的化學傳訊物質有三大類：開落蒙、阿落蒙與辛落蒙。開落蒙對接收者(receiver)有利但對製造者(emitter)有害。阿落蒙對製造者有利而對接收者有害或無益。至於辛落蒙對皆收者與製造者皆有利。有一種植物分泌揮發性物質吸引植食性甲蟲在其葉片上取食與產卵。但同時這種揮發性物質也會吸引寄生蜂使得寄生蜂可以搜尋到甲蟲的幼蟲並產卵在其體內。那麼以下有關此揮發性物質角色的敘述何者正確？

Participant 參與者 / Chemical 化學物質	Emitter 製造者	Receiver 接收者
Kairomone 開落蒙	Disadvantage 無益	Benefit 有益
Allomone 阿落蒙	Benefit 有益	No benefit/harm 無益或有害
Synomone 辛落蒙	Benefit 有益	Benefit 有益

(A) Synomone between the plant and the beetle, allomone between the plant and the parasitoid wasp. 它在植物與甲蟲間爲辛落蒙，但在植物與寄生蜂間爲阿落蒙

(B) Kairomone between the plant and the parasitoid wasp, synomone between the beetle and the parasitoid wasp. 它在植物與寄生蜂間爲開落蒙，但在甲蟲與寄生蜂間爲辛落蒙

(C) Kairomone between the plant and the beetle, synomone between the plant and the parasitoid wasp. 在植物與甲蟲之間爲開落蒙，但在植物與寄生蜂間爲辛落蒙

(D) Kairomone between the plant and the beetle, allomone between the beetle and the parasitoid wasp. 在植物與甲蟲間爲開落蒙，在甲蟲與寄生蜂間爲阿落蒙

(E) Kairomone between the plant and the parasitoid wasp, as well as kairomone between the beetle and the parasitoid wasp. 在植物與寄生蜂間爲開落蒙，在甲蟲與寄生蜂間也是開落蒙

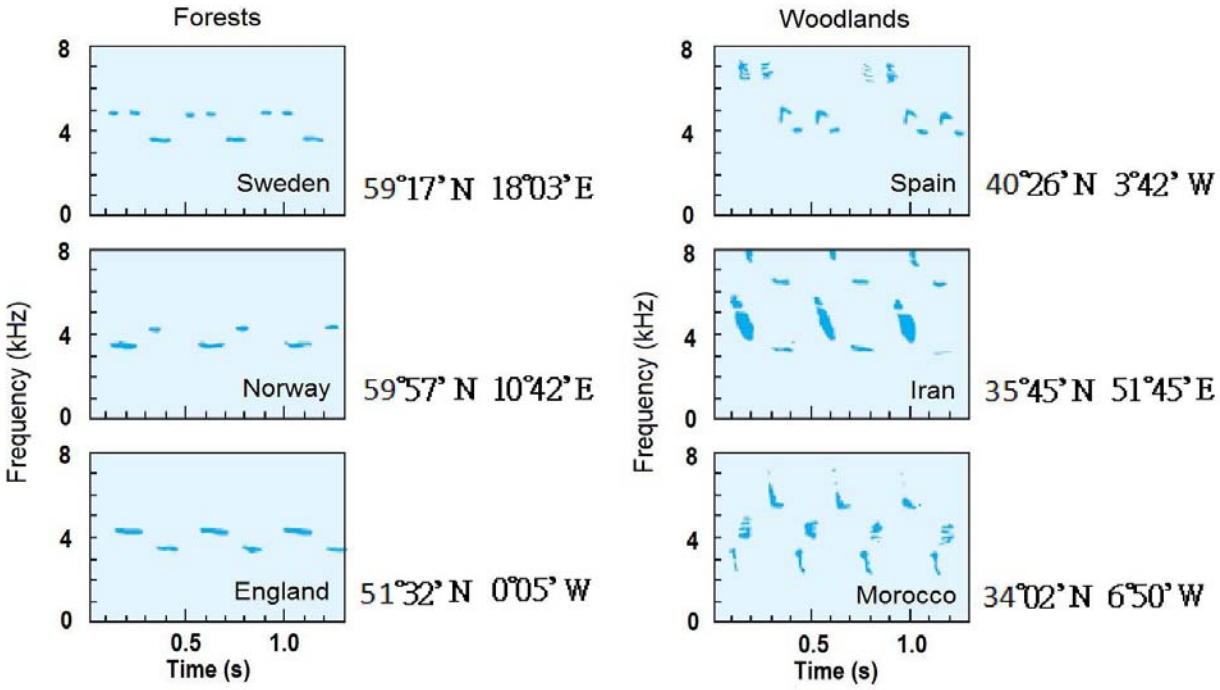
A36. In terms of the benefits and harms received by each of the two parties interacting, which of the following pairs of biological interactions are most similar to each other?

以下選項各有兩組生物種間的交互關係，那兩組的關係是最接近的？

	Pairs	
A	Clownfish and sea anemones 小丑魚與海葵	mistletoes and apple trees 寄生植物與蘋果樹
B	Sea stars and bivalves 海星與雙殼貝	locusts and grasshoppers 飛蝗與稻蝗
C	Lichens and maples 地衣與楓樹	mistletoes and oaks 寄生植物與橡樹
D	Caterpillars and parasitic wasps 毛蟲與寄生蜂	food plants and caterpillars 毛蟲食草與毛蟲
E	HIV virus and human HIV 病毒與人類	mushrooms and rotten woods 洋菇與腐木

A37. Great tit birds (*Parus major*) inhabiting forests (dense vegetation) and woodlands (patchy vegetation) have different song patterns. It is documented that high frequency sounds become less degraded in open habitat than in places with dense vegetation. Consider the following graphs showing song characteristics of great tits from 6 locations. Which of the following statements is correct?

棲息在森林(forest)與疏林(woodland)中的大山雀會有不一樣的鳴叫聲。高頻率的聲音在空礦的棲地比起有濃密植被的棲地來說傳播較遠。以下六圖顯示六個不同地點的大山雀的鳴唱特質，請問以下說明何者正確？



(A) There is less variability in song frequency in low-latitude regions.

聲頻在低緯度地區沒什麼變化

(B) Forest inhabitants are more varied in song frequency than woodland inhabitants.

森林性大山雀的聲頻變化大於疏林性大山雀

(C) Songs of forest inhabitants have more notes per phrase than those of woodland inhabitants.

森林性大山雀的一個鳴唱句比疏林性大山雀多了更多音符

(D) The variation of song type has nothing to do with habitat type

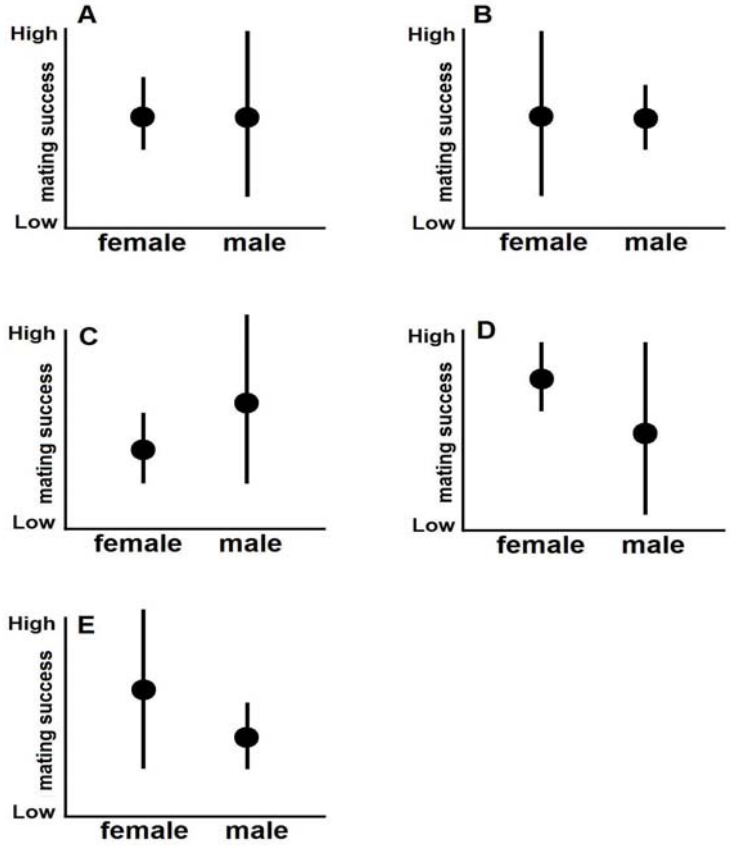
聲音型式與棲地類型無關

(E) If an individual moves from forests to open grassland, the variation of the song among its descendents is likely to increase.

若將森林中的大山雀個體移到草原，那麼其平均聲響頻率有可能會增加

A38. A hypothetical insect species employs the polygynous mating system, in which the males are capable of multiple mating with many females, but the females mate only once. Mating season is autumn. All adults of this species die off soon after the mating season. The sex ratio of this species is 1:1. The mating success, defined as the number of mating in a given season is compared for both male and female in this species. Which one of the graphs below (A to E) best describes the mean and variance of the mating success for both male and female in this species? Solid dots represent mean of mating success, and lines denote the ranges of variance.

現在有一種假想的可多次交配的昆蟲：雄性可交配多次但雌性只可交配一次、成蟲只在秋天繁殖季出現、在交配後所有的成蟲就會死亡、且其性別比是 1:1。考量以上前提，以下這些圖顯示的是雄性與雌性配對成功(也就是在一個繁殖季中交配的數量)的比較。那麼由 A 至 E 的圖何者最能描述雄性與雌性配對成功的標準差？實心點代表配對成功的平均數，而線段代表此數值的變異範圍。



V. Genetics and evolution

A39. Frank has subcloned a cDNA fragment from an animal into an expression plasmid. The recombinant plasmid was transformed into bacteria to produce recombinant protein. What is the main reason that the expressed protein is non-functional ?

Frank 將一個動物基因的 cDNA 建構於一個可表現此 cDNA 基因的質體上。當將此一重組質體轉殖入細菌中去製造此重組基因之蛋白質時，得到的蛋白質卻是沒有功能的，下列哪一選項是最主要的原因？

(A) Differences in codon usage between animals and bacteria

動物和細菌使用不同的轉譯密碼

(B) Differences in protein processing between animals and bacteria

動物和細菌有不同的蛋白質的修飾作用

(C) Components of bacterial culture media

細菌培養基的成分導致

(D) Modulators of gene transcription

基因轉錄的控制導致

(E) Secretion signal of proteins

蛋白質上的分泌訊號導致

A40. Gregor Mendel discovered that segregation of genes on non-homologous chromosomes is independent of each other in his garden pea hybridization experiments. Four genes A, B, C and D are located on four non-homologous chromosomes. Which of the following genotypes will have the highest chance to produce the dominant trait in all four loci when it mates with an organism with the genotype AaBbCcDd?

孟德爾由他的豌豆雜交實驗中發現位於非同源染色體上的基因是獨立分離的。A, B, C 和 D 四個基因分別位於四條非同源染色體上，下列哪一種基因型的個體，當與基因型爲 AaBbCcDd 的個體雜交時，其所得到的子代中，四個基因都表現顯性性狀的比率最高？

(A) aabbccdd

(B) AaBbCcDd

(C) AaBBccDd

(D) AaBBCCdd

(E) aaBBCCdd

A41. An X-linked allele determines the coat color of cats with orange being dominant and black being recessive. Which of the following statements regarding the inheritance pattern of orange/black mosaic cats is correct?

貓的皮毛顏色由 X 染色體上的一個基因所控制，表現橘色的等位基因是顯性的，表現黑色的等位基因是隱性的。下列哪一個有關 橘/黑雜合(色)貓 遺傳模式的敘述是正確的？

(A) Half of all male cats are mosaic.

一半的公貓是雜合貓

(B) The mosaic phenotype is a consequence of gene interaction.

雜合的外表型是由不同基因間的交互作用造成的

(C) The mosaic phenotype is correlated with genetic recombination.

雜合的外表型與基因重組有關

(D) The mosaic phenotype results from random X-chromosomal inactivation.

雜合的外表型是因爲 X 染色體的逢機去活化造成的

(E) The offspring from matings of orange males and black females are mosaic.

橘色公貓和黑色母貓交配所生的子代都是雜合體

Questions 42 and 43 are a **problem set**

42 題和 43 題是一個**題組**

A42. On a remote island, Dr. Yeh discovered a new plant species, which can produce either white or blue flowers. This species is mainly cross pollinated by insects. Genetic experiments showed that the white-flower phenotype is recessive to the blue-flower phenotype. Statistical analysis revealed that 91% of these plants on the island produce blue flowers. If one is to randomly select two blue-flower plants and cross them, then what is the approximate probability that they are capable of producing white-flowered F1 offspring?

在一個孤島上，葉博士發現一種新植物，此植物開白花或是藍花，主要是由昆蟲媒介雜交。由遺傳實驗發現白花是隱性，藍花是顯性。統計分析顯示島上 91%的這種植物開藍花。如果逢機選擇二株開藍花個體進行雜交，則在這些雜交組合中能夠產生開白花 F1 子代的機率是多少？

(A) 0.09 (B) 0.21 (C) 0.42 (D) 0.49 (E) 0.91

A43. Dr. Yeh treated the seeds of the above-mentioned homozygous blue-flower plants with chemical mutagen to produce a mutant population. Three recessive mutants, *wf1, wf2,* and *wf3*, produced white flowers were selected. He crossed the mutants and obtained the following results: *wf1* x *wf3* produced F2 offspring with only white flowers, and *wf2* x *wf3* produced F2 offspring with blue and white flowers in a ratio of 9:7. According to these data, which of the statements below is **NOT correct**?

葉博士用化學誘變劑處理藍花同型合子的種子去產生突變體。從這些突變體中，他選了三個開白花的隱性突變體(*wf1, wf2,* 和 *wf3*)分別進行雜交試驗，並得到以下結果：*wf1* x *wf3* 的 F2 只有開白花的個體；*wf2* x *wf3* 的 F2 中藍花個體：白花個體 = 9:7。根據這些資料，下列哪一個敘述是**錯誤的**？

(A) *wf1* and *wf3* are unable to complement each other.

wf1 and *wf3* 不能彼此互補

(B) *wf2* and *wf3* are able to complement each other.

wf2 and *wf3* 能彼此互補

(C) *wf1* and *wf3* are in the same locus.

wf1 and *wf3* 發生在相同的基因

(D) *wf2* and *wf3* are not in the same locus

wf2 and *wf3* 發生在不同的基因

(E) The F1 offspring from crossing *wf1* and *wf2* will all produce white flowers

wf1 和 *wf2* 雜交的 F1 個體全開白花

VI. Ecology

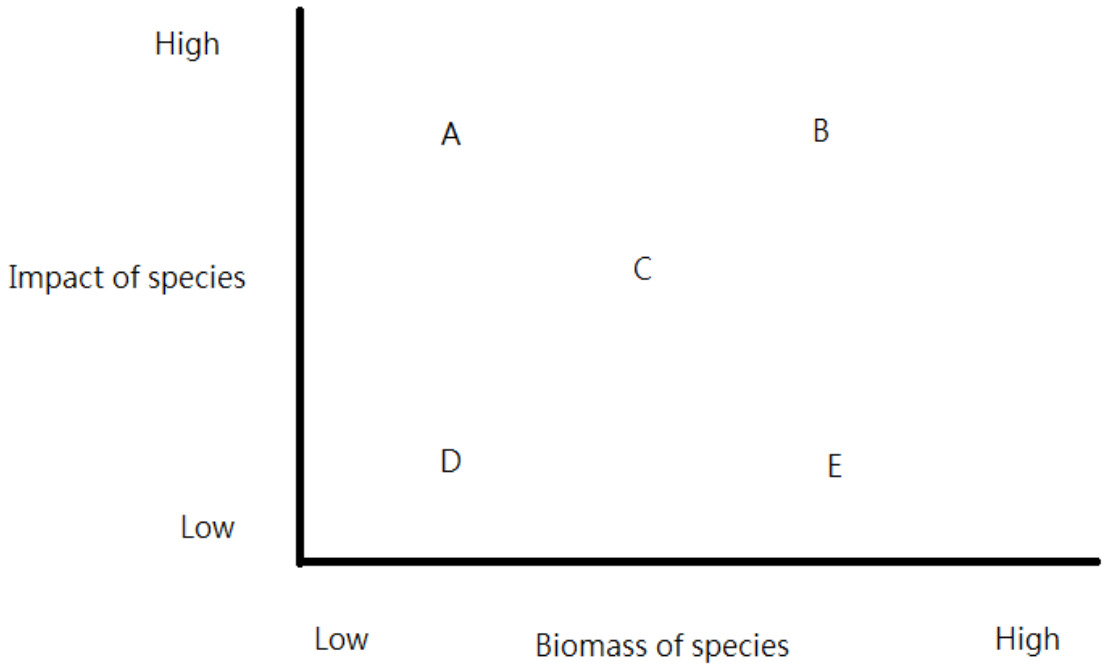
A44. Biogeography researchers found that continental islands tend to have a species composition similar to that of the mainland, but a lower degree of species differentiation compared to oceanic islands. If one compares the biome of an oceanic island (X) to that of a continental island (Y), assuming the two have approximately the same area, and are located in the same latitudinal range, which of the following descriptions is correct?

生物地理學者發現大陸性島嶼上的物種組成與大陸上的物種組成相似，但其物種分化程度卻低於海洋性島嶼。假設有一個海洋性島嶼(X)與大陸性島嶼(Y)大致上位於相同地區，然後緯度也相同，若有一個人對 X 與 Y 的生物相加以比較，以下何敘述正確？

	Proportion of endemic species 特有種比例	Total number of species 物種總數
A	X<Y	X>Y
B	X>Y	X>Y
C	X>Y	X<Y
D	X<Y	X<Y
E	X=Y	X<Y

A45. In the figure below, A to E denote five different species in an ecosystem. Which of the species is most likely to be a keystone species?

下圖中，A 到 E 代表一個生態系中的五個物種，請問何者比較可能是保育上的基石物種(keystone 關鍵物種)？橫軸爲物種的生物量(biomass)，而縱軸爲干擾該物種後生態系所受到的衝擊



A46. A group of students would like to know how the discharge of waste water from a factory might influence water quality of a river. The picture shows 7 potential sampling locations (① to ⑦) in relation to the locations of the factory and the river. Which locations are essential to be included in the sampling in order to draw valid conclusions about the pollution of the river by the factory?

有一組學生打算瞭解工廠排放的廢水是否影響河川水質。以下的圖顯示七個(1-7)可以取水樣的地點，請問那些地點是一定要被取樣的？

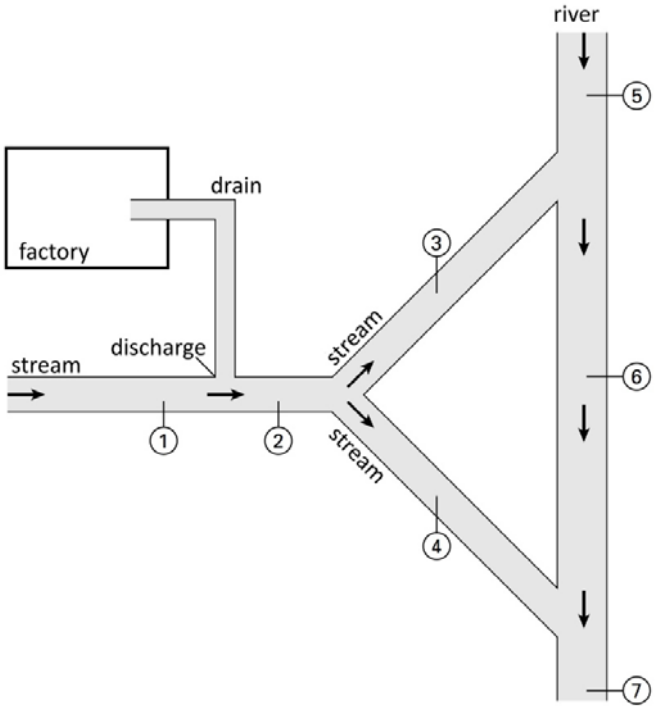
(A) Locations 1, 2, 4, 7

(B) Locations 1, 3, 4, 7

(C) Locations 1, 2, 5, 7

(D) Locations 2, 3, 4, 6

(E) Locations 2, 5, 6, 7



A47. Biogeography researchers have long recognized that terrestrial biomes on islands are often associated with dispersal and colonizing ability of different organisms. Based on dispersal and colonizing ability of the following groups of organisms, which one is least likely to occur on an oceanic, tropical island with a large area, numerous mountains, a dense vegetation cover, and a high level of biodiversity?

生物地理學者認爲島嶼上的陸生生物相取決於不同物種的播遷與拓植能力。請問以下那些生物最不可能出現在一個面積大、多山、植被濃密且物種多樣性高的熱帶海洋性島嶼？

(A) Insects 昆蟲

(B) Birds 鳥

(C) Ferns 蕨類

(D) Amphibians 兩生類

(E) Reptiles 爬蟲類

A48. A male guppy (*Poecilia reticulata*) with large, bright spots on the body is more likely to attract females, which increases his opportunity to reproduce. In the meantime, he is also more easily detected by the natural enemy, which increases his predation risk. Consider male guppies from three different rivers: X, Y and Z, males from X have the largest spots, males from Y have the intermediate-sized spots, and males from Z have the smallest spots. Which of the following descriptions about the guppies in the three rivers is correct?

身上有大型鮮豔斑紋的雄性孔雀魚比較容易吸引雌魚並增加其繁殖機會，但同時也比較容易吸引掠食者並提高被捕食的風險。現在有來自 X、Y 與 Z 三條河流的雄孔雀魚，其中 X 有最大的斑點、Y 有中間大小的斑點，而 Z 有最小的斑點。以下何者可正確敘述來自這三條河雄魚的狀況？

The density of

(A) male guppies in X is higher than in the other rivers. X 河雄魚密度較其它河川高

(B) male guppies in Z is higher than in the other rivers. Z 河雄魚密度較其它河川高

(C) natural predator of guppies in X is higher than in the other rivers. X 河掠食者密度較高

(D) natural predator of guppies in Z is higher than the other rivers. Z 河掠食者密度較高

(E) female guppies in X is higher than the other rivers. X 河雌魚密度比其它河高

A49. Species M had been introduced multiple times (few individuals or small population) to an ecosystem outside its native distribution, but could not establish itself. Although no parameter in ecosystem changed between the different attempts, the final one introduction was eventually successful, and led to a rapid and wide-spread expansion of species M in the ecosystem. Which of the followings is the most plausible explanation for why species M was not natively distributed in this ecosystem?

M 物種曾被多次引進到一個非原生地區，但過去從來沒有在非原生地區成功建立族群。然而在環境沒有什麼改變的情況下最後一次引入居然成功了，而且使得這個物種可快速建立族群並廣布於生態系中。以下何者可解釋爲何這個物種以往沒有分布在這個生態系中呢？

(A) There are too many competitors of species M in the ecosystem.
生態系中有太多 M 物種的競爭者

(B) There are too many predators of species M in the ecosystem.
生態系中有太多 M 物種的掠食者

(C) Species M is not able to disperse to the ecosystem on it own.
M 物種在過去無法自行播遷到這個生態系

(D) The abiotic environment in the ecosystem is not suitable for the growth of species M.
此生態系的非生物環境對 M 物種來說不太合適

(E) The ecosystem is frequently under disturbance, which creates an unfavorable condition for species M to sustain.
這個生態系經常受到干擾，所以這種條件對於 M 物種的存續是不利的

A50. A large forest is cleared. The land is rapidly colonized by species with which of the following characteristics?

如果有一大片森林被砍掉了，那麼能夠快速地在這種地方拓殖的生物應該具有以下何種特質？

(1) long lifespan (壽命長), (2) rapid reproduction (快速繁殖), (3) fast growth (生長快速), (4) strong dispersal ability (播遷能力好), (5) strong defense against natural enemies or predators (對天敵與掠食的防禦強).

(A) Only 1, 2, 3
(B) Only 1, 2, 5
(C) Only 1, 4, 5
(D) Only 2, 3, 4
(E) Only 3, 4, 5

A51. A large proportion of angiosperms are pollinated by animals. Assign the following flower descriptions (I to V) to the most likely pollinator (a to e).

有很多被子植物是由動物所授粉的。請將下列的花部特質(I-V)與可能授粉動物(a-e)進行配對

I. Flower white, open during night, intensive fragrant, nectar hidden in long, tight tubes.
白色花、晚上開、香氣濃、蜜腺藏在又長又窄的花筒中

II. Flower often with ultraviolet coloring pattern, open during daytime, pleasant fragrant.
花可反射 UV 光、在白天開、有香氣

III. Flower large and coarse, bright red, open during daytime, no fragrance but large amounts of nectar
花很大朵、紅色、白天開、沒啥香味但有很多蜜腺

IV. Flower large and coarse, far opened, open during night, intensive fragrant, large amounts of nectar
花很大朵、晚上開、香味濃且有很多蜜腺

V. Flower reddish brown, no nectar, smell of rotten flesh
花是紅褐色、沒蜜腺但聞起來臭臭的

a. bats 蝙蝠

b. birds 鳥

c. bees 蜜蜂

d. flies 蠅蚋

e. moths 蛾

Which of the following statement is correct? 以下配對何者是正確的？

(A) I-a, II-b, III-c, IV-e, V-d

(B) I-b, II-c, III-d, IV-a, V-e

(C) I-d, II-e, III-a, IV-b, V-c

(D) I-e, II-c, III-b, IV-a, V-d

(E) I-e, II-d, III-c, IV-b, V-a

A52. It has been demonstrated that house roaches show less threat to human health than mosquitos in terms of serving as disease vectors. Which feature possessed by roaches given below may explain this observation?

以下那項觀察可以說明爲何就散播病媒的觀點來說，家中的蟑螂其實比起蚊子來說對人類健康的危害較小？

(A) piercing mouthpart, injecting saliva into the tissue which it feeds upon
有刺吸式口器，並把唾液注入其吸取的組織

(B) chewing mouthpart, swallowing food without saliva
咀嚼式口器，並不需要唾液就可把食物吞下去

(C) mouthpart sponge-like, secreting saliva upon the food they feed on
吮舔式口器，把唾液分泌在牠們取食的食物上

(D) microhabitats they prefer much more cleaner than those by mosquitos
牠們的棲地比蚊子乾淨

(E) by natural they are anthropophobia
牠們本來就很怕人

VII. Biosystematics

[Questions 53-55] The following table shows the main characters of 8 different animals (taxa 1 to 8). A "+" sign indicates that the animal possesses a character, and a "blank" indicates that the animal does not possess a character:

[問題 53-55] 下表顯示 1-8 這些分類群的主要特徵，"+"表示有，空格表示沒有。

Characters	**Taxon**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Amnion 羊膜			+	+	+			
Limbs with fingers 有趾的四肢	+		+		+			
Mammary glands 乳腺					+			
Lateral line system 側線	+	+				+		
Cycloid scales 圓形鱗		+						
Sternum 胸骨	+		+		+			
Semicircular canals 半規管	+	+	+	+	+	+	+	
Ventral nerve cords 腹神經索								+

Please answer questions A53 to 55 using the information in the table above.

請使用上表資訊回答 A53 – A55 問題

A53. Which of the following taxa most likely belongs to the same Class as "Taxon 4"?

請問何者比較可能與 Taxon 4 屬於同一綱？

(A) Taxon 1

(B) Taxon 2

(C) Taxon 3

(D) Taxon 5

(E) Taxon 6

A54. "Taxon 8" is least likely to be which of the following organisms?

Taxon 8 最不可能是以下何動物？

(A) Earthworm 蚯蚓

(B) Grasshopper 蝗蟲

(C) Lobster 龍蝦

(D) Sea star 海星

(E) Spider 蜘蛛

A55. "Taxon 1" is most likely to be which of the following organisms?

Taxon 1 最可能是何動物？

(A) Shark 鯊魚

(B) Eel 鰻魚

(C) Sea lion 海獅

(D) Turtle 龜

(E) Frog 蛙

A56. Table A is a data matrix for characters of four kinds of animals. The entries denote shared characters if animal have the same values (e.g. 0.0 or 1.1) or different characters if animals have different values (e.g. 0,1).

表 A 是四種動物的特徵矩陣，編號一樣就表示共享特徵，不同的編號表示非共享特徵

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Animal A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Animal B	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
Animal C	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
Animal D	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	0	0	0	0

If relationship among organisms can be inferred from the degree of similarity, and the degree of similarity is defined as a coefficient S:

若物種間的關係可由”相似程度”來推測，而這個相似度可由相似性係數 S 來定義：

S = number of shared characters/(number of shared characters + number of different characters)

S = 共享特徵的數量/(共享特徵的數量 + 不共享特徵的數量)

According to the data matrix given by Table A, which animal is the most closely related to animal A, and which one is to C? Please give your animal in the format of (the animal most closely related to A, the animal most closely related to C).

根據表 A，與 A 動物以及 C 動物最爲相近的動物分別爲何？

(A) (B，A)

(B) (B，B)

(C) (C，B)

(D) (C，A)

(E) (D，A)

A57. Mary bought rice, potatoes, tomatoes, kelp, pine nuts, mushrooms, dates, bird nest fern, bananas, and corn cobs from the supermarket. Based on hierarchical classification, how many different divisions do these items belong to?

瑪麗在市場中買了米、馬鈴薯、蕃茄、海帶、松子、洋菇、棗子、鳥巢蕨、香蕉以及玉米，請問這些生物所屬的”門”共有幾個？

(A) 4

(B) 5

(C) 6

(D) 7

(E) 8

A58. A scientist unearthed four plant fossils (I to IV) with some prominent structures intact.

These are listed in the following table:

有位科學家挖出 I 到 IV 四種植物化石，並把化石上存留的特徵羅列在下表：

Structure 結構 / Fossil # 化石編號	Spore 孢子	Ovary 子房	Embryo 胚胎	Pollen 花粉	Xylem 木質部	Ovule 胚珠
I			✓		✓	
II			✓	✓	✓	✓
III		✓		✓	✓	✓
IV	✓		✓			

According to this table, which sequence below correctly represents the order of evolution of these plants?

根據此表，請問這些植物的在演化上的出現時序何者正確？

(A) I→II→III→IV

(B) II→III→IV→I

(C) III→IV→I→II

(D) IV→I→II→III

(E) II→I→IV→III

(F) IV→I→III→II