Questions 85-92. Sex determination in fruit flies and mammals are both XY type, that is, XX leads to female and XY leads to male.
果蠅和哺乳動物的性別決定是都是 XY 型，即 XX 產生雌性，XY 產生雄性

85. Some organisms have abnormal sex chromosomes such as XO (only have one X chromosome) or XXY (extra X chromosome). The most likely cause of the abnormal sex chromosome is: (1 point)
有些生物具有不正常的性染色體，如 XO (只有一個 X 染色體)或 XXY (額外的 X 染色體)。不正常性染色體產生的原因是：

A. Error occurred in mitosis of fertilized egg.
受精卵的有絲分裂出現錯誤
B. Gene mutation
基因突變
C. Error occurred in meiosis in gamete formation.
在配子形成過程中減數分裂出現錯誤
D. Sex chromosomes in gametes are either lost or doubled in fertilization.
配子中的性染色體在受精過程中丟失或加倍

86. In organisms with XXY chromosome type, there is an extra X chromosome. How do you determine if this X chromosome is from sperm or egg practically? (1 point)
在 XXY 型的生物體中，有一個額外的 X 染色體。你如何判定這個 X 染色體是來自精子還是卵子？

A. Karyotype 核型分析
B. In situ hybridization 原位雜交
C. RFLP (restriction fragment length polymorphism) 多形性限制片段分析
D. DNA sequencing DNA 定序

87. In mammals, XO leads to female and XXY leads to male. In fruit flies, XO leads to male and XXY leads to female. Which of the following is NOT correct? (1 point)
在哺乳動物中，XO 產生雌性，XXY 產生雄性。在果蠅中，XO 產生雄性，XXY 產生雌性。下列哪個是不正確的？（1 分）

A. Y chromosome in mammals is necessary for formation of a male organism.
哺乳動物的 Y 染色體是形成雄性動物所必需
B. The Y chromosome in mammals is required for sex organ to develop.
哺乳動物中的 Y 染色體是性器官發育所必需的

C. The Y chromosome in fruit flies is not functional.
果蠅中的 Y 染色體是無功能的

D. Number of X chromosome in fruit flies has impact on sex determination.
果蠅中的 X 染色體數目可影響性別決定

88. In mammals with abnormal sex chromosomes, the number of individuals with XO chromosome type is far fewer than the number of individuals with XXY chromosome type. It is therefore predicted that: (1 point)
在具有不正常性染色體的哺乳動物中，具有 XO 型染色體的個體數目遠少於具有 XXY 型的個體數。因此可推測：

A. The individuals with XO chromosome are less capable of surviving than that with XXY chromosome.
與具有 XXY 染色體的個體相比，具有 XO 染色體的個體更不易存活

B. The individuals with XO chromosome are less capable of reproducing than that with XXY chromosome.
與具有 XXY 染色體的個體相比，具有 XO 染色體的個體更不易繁殖

C. The difference is related to gender of the individuals (XO leads to female and XXY leads to male).
差異與個體的性別相關（XO 產生雌性，XXY 產生雄性）

D. None of the above. 以上皆非

89. In both fruit flies and mammals, XX leads to female and XY leads to male. The gene products encoded by two X chromosomes of female individuals are nearly identical to those encoded by one X chromosome of male individuals. This is accomplished by gene dosage compensation. In mammals, it is accomplished by converting one X chromosome into Barr body (X inactivation). Which of the following about Barr body is/are correct? (1 point)
在果蠅與哺乳動物中 XX 產生雌性、XY 產生雄性。雌性兩條 X 染色體編碼的基因產物，與雄性一條 X 染色體編碼的基因產物基本相同。這是通過基因劑量補償實現的。在哺乳動物中，這是通過將一條 X 染色體轉換成巴爾氏體（X 失活）實現的。下列有關巴爾氏體的敘述，哪個(些)正確？

(1) Only normal female individuals have Barr bodies.
只有正常的雌性個體具有巴爾氏體
(2) Only normal male individuals don’t have Barr bodies.
只有正常的雄性個體不具有巴爾氏體
(3) Barr body can always be used to determine sex of human beings.
巴爾氏體總是能用來確定人類的性別

(4) The maximum number of Barr body is one
巴爾氏體最多只有一個
(5) The number of Barr bodies equals the number of X chromosomes minus one.
巴爾氏體的數目等於 X 染色體的數目減一

A. 1, 3, 5
B. 2, 5
C. 4
D. 5
E. 1, 4, 5

90. No Barr body can be observed in normal female fruit flies because (1 point)
在正常的雌性果蠅中，為何觀察不到巴爾體？

A. X chromosome of fruit flies is too small
果蠅的 X 染色體太小
B. There is no mechanism of dosage compensation in fruit flies
在果蠅中沒有劑量補償的機制
C. There is no X inactivation in fruit flies
在果蠅中沒有 X 失活
D. Heterochromatin is difficult to detect in fruit flies.
在果蠅中很難檢測到異染色質

91. The fur color of cats is determined by genes on X chromosome. XA is the dominant allele for orange fur, while Xa is the recessive allele for black fur. Which of the following is true about the fur color of the offsprings from a XAXa female cat and XAYmale cat? (1 point)
貓的皮毛顏色是由 X 染色體上的基因決定。XA 是橙色皮毛的顯性等位基因，而 Xa 是黑色皮毛的隱性等位基因。下列有關 XAXa 雌貓和 XAY 雄貓的後代皮毛顏色的敍述，何者正確？

A. They are all orange
牠們都是橙色
B. All the female are orange and half the male are orange
所有雌貓都是橙色，雄貓有一半是橙色
C. Regardless of sex, half are orange, the other half have furs that are mosaic of orange and black.
若不論性別，有一半是橙色，另一半的皮毛則是橙色與黑色相互鑲嵌
D. Those with mosaic furs are all female.

所有具有鑲嵌皮毛顏色的全是雌貓

92. One of the genes controlling sweat gland in human is located on X chromosome. Two twin sisters show different phenotypes of the sweat gland. One has no sweat gland on her left arm while the other has on her left arm. Which of the following statements is/are true? (1 point)
控制人類汗腺的一個基因位於 X 染色體上。一對雙胞胎姐妹具有不同汗腺表型。一個在左臂上沒有汗腺，另一個左臂上有汗腺。下列敍述哪個(些)正確？

(1) The twin cannot be identical twin. 這對雙胞胎不是同卵雙胞胎
(2) They both are heterozygotic of the gene. 她們都是此基因的異基因型
(3) The reason for the different phenotype is random X inactivation.
不同表型的原因是隨機的 X 失活
(4) X inactivation must occur after first division of the zygote.
X 失活一定在受精卵第一次分裂後發生

A. 1, 2, 3, 4
B. 1
C. 2, 3
D. 3
E. 2, 3, 4

93. Mycorrhizae are symbiotic associations of fungi and plant roots.Which of the following is/are true about mycorrhizae? (1point)
菌根是真菌和植物根的共生體。下列有關菌根的敍述，哪個(些)正確？

(1) They are often harmful to plant roots while beneficial to fungi.
它們通常對植物的根有害，而對真菌有益
(2) They are often beneficial to plants but harmful to fungi
它們通常對植物有益，對真菌有害
(3) They are helpful for plants to absorb water and minerals.
它們幫助植物吸收水和礦物質
(4) They could even help the older root region above the root hair area to supply minerals to plants.
它們能幫助根毛區上方較老根區為植物提供礦物質

A. 1, 3, 4
B. 2, 3, 4
C. 3, 4
D. 3

94. Stomata of a plant open when guard cells (1point)
當保衛細胞怎麼樣時，植物的氣孔開放？

A. accumulate water by active transport.
通過主動運輸聚集水

B. sense an increase in CO_2 in the air spaces of the leaf.
感受到葉的氣隙中 CO_2 的含量增加

C. become more turgid because of an influx of K^+, followed by the osmotic entry of water.
變得更加腫脹，因爲 K^+流入，隨後水滲透進入

D. sense that water content of whole plant is low.
感到整株植物水含量低時

95. Which of the following processes of plants could be regulated by phytochrome? (1point)
植物下列的過程中，何者能受光敏色素的調節？

(1) seed germination	種子萌發
(2) flowering	開花
(3) shoot elongation	莖的延伸
(4) open and closure of stomata	氣孔的開閉

A. 1, 2, 3, 4
B. 1, 2, 3
C. 1, 2
D. 1

96. If N represents population size, r represents the difference in per capita birth rates and death rates, K represents the carrying capacity, t represents time, which of the following equations best describes logistic growth of the population? (1point)
如果 N 代表人口數，r 代表人均出生率和死亡率的差異，K 代表最大負荷量，t 代表時間，下列何者最能描述人口的邏輯增長？

A. $\frac{dN}{dt} = rN$

B. $\frac{dN}{dt} = rNK$

C. $\frac{dN}{dt} = r(K-N)$

D. $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

D

~~97. Which of the following is usually the limiting proce~~

98. Which of the following ecosystems has the lowest primary production per square meter? (1point)
下列哪個生態系統中具有最低的每平方米初級生產量？

A. a salt marsh 一塊鹽沼
B. an open ocean 一片開闊的海洋
C. a grassland 一片草原
D. a tropical rain forest 一個熱帶雨林

99. Which of the following is/are true about Archaea and Eubacteria? (1point)
下列有關古細菌與真細菌的敍述，哪個(些)正確？

(1) They don't have nuclear envelope
它們不具有核膜
(2) They both have branched chain in membrane lipids
在它們的膜脂質中都具有分支鏈
(3) They have one kind of RNA polymerase
它們具有一種 RNA 聚合酶
(4) They have circular chromosomes.
它們具有環狀的染色體

A. 1, 2, 4
B. 1, 4
C. 2, 3
D. 1, 2, 3

100. ~~Four major groups of fungi are recognized. They are chytrids, zygote fungi, sac~~

101. Chlorophyll a is involved in both light energy absorption and initial electron transfer of photosynthesis. Which of the following are true about the chlorophyll a? (1point)
葉綠素 a 參與光能的吸收及光合作用的起始電子傳遞。下列有關葉綠素 a 的敍述，哪些正確？（1 分）

(1) The position of chlorophyll a in photosystems has a strong influence on the function of chlorophyll a.
葉綠素 a 在光合系統中的位置，對葉綠素 a 的功能有極大影響
(2) Chlorophyll a in photosynthetic reaction center is chemically modified so that it performs initial electron transfer.
葉綠素 a 在光合作用反應中心經化學修飾，以便使它進行起始電子傳遞
(3) Part of chlorophyll a is structurally related to haeme group of haemoglobin.
葉綠素 a 的部分結構與血紅素中的血質基相關
(4) Part of chlorophyll a is structurally related to carotenoids.
葉綠素 a 的部分結構與類胡蘿蔔素相關

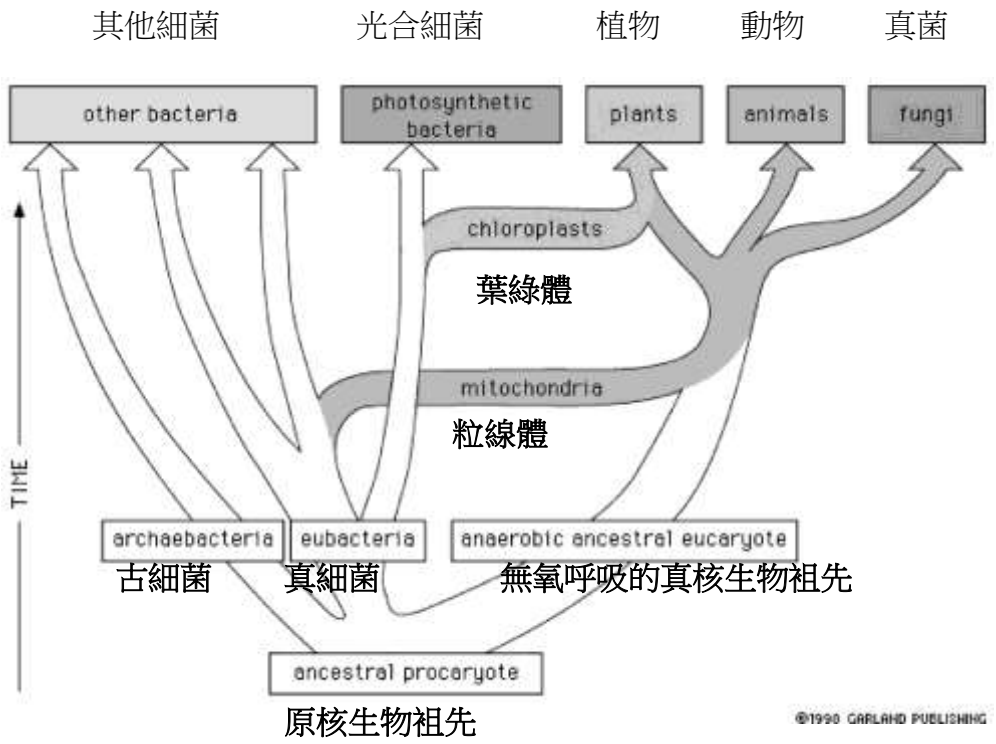
A. 1, 2, 3, 4
B. 1, 3, 4
C. 3, 4
D. 1, 2

102. In measurement of photosynthetic electron transfer, intact chloroplasts are isolated and used for electron transfer rates under different conditions. Which of the following is correct? (1point)
在測定光合作用電子傳遞時，葉綠體可被完整的分離出來，用以測定不同環境下的電子傳遞速率。下列敘述何者正確？

A. Addition of an uncoupler leads to an increased rate of electron transfer.
加入解偶聯劑，導致電子傳遞速率增加
B. Cyclic electron transfer starts only when linear electron transfer is inhibited.
只有當線性電子傳遞被抑制時，循環電子傳遞才開始
C. ATP synthesis could only be observed with continuous light illumination.
只有連續性光照時，才有 ATP 的合成
D. Oxygen evolution by chloroplast suspension is absolutely dependent upon the presence of CO_2.

葉綠素懸浮液的放氧速率完全依賴 CO_2 的存在

103. The figure shown below is a diagram of evolutionary tree. Which of the following statements about evolution are true and deducible from the figure? (2 points)
下圖所示為一演化樹，下列有關演化的敍述，哪些正確並可從圖中推斷？（2分）



(1) All eucaryotic cells contain mitochondria.
所有真核細胞都含有線粒體

(2) Symbiosis of the eucaryotic ancestor with autotrophic cell precede the symbiosis with the cell taking advantage of the oxidative metabolism.
真核細胞祖先與自營細胞的共生，早於其與利用氧化代謝細胞的共生

(3) There is common ancestor of eubacteria and eukaryota, archaebacteria are a group with unique and independent origin.
真細菌與真核生物具有共同的祖先，古細菌是一類具有獨特的、獨立起源的生物群

(4) Ancestral eukaryote was anaerobic.

真核細胞祖先是厭氧的

(5) None of the recent photosynthetic bacteria are related to the chloroplasts.
最近的光合細菌中，沒有一個與葉綠體相關

(6) Mitochondria and chloroplasts has similar genomes.
粒線體與葉綠體具有相似的基因組

(7) Mitochondria are present in the cells of the plants, animals and fungi.
植物、動物及真菌的細胞具有線粒體

(8) Fungi lost chloroplasts during evolution.
在進化過程中，真菌丟失了葉綠體

(9) Bacteria are highly homogenous group of organisms which quickly diversified genomes and metabolisms during the last billion years.
細菌是同源高的一群生物，其基因組及代謝途徑在近十億年中發生很快的分化

(10) Chloroplasts and mitochondria are results of independent endosymbiotic events.
葉綠體和粒線體是兩次獨立內共生事件的結果

A. 1, 2, 5
B. 3, 4, 7
C. 4, 7, 10
D. 6, 8, 10
E. 4, 9, 10

~~104. The figure shown below is an imag~~

105. Siamese cat is an example of the animals with melanin synthesized in both sexes mostly at the body extremities. That makes snout, ears, tail and feet much darker than the rest of the body. Explanation of this type of the body coloration is that: (1 point)
暹羅貓是一個很好的動物例子，在雌、雄貓的身體末端處都合成黑色素。所以在牠們的鼻子、耳朵、尾巴和足部比身體的其他部分更黑。下列何項敘述可以說明這種類型身體著色的現象？（1分）

A. Only at the body extremities the enzyme tyrosinase (responsible for the synthesis of the melanin) is synthesized.
酪氨酸酶（負責黑色素的合成）只在身體末端處合成。

B. The only places where one of the X chromosomes that have dominant allele of the tyrosinase is NOT inactivated
只發生在一條具有酪氨酸酶顯性等位基因的X染色體不失活的部位

C. Melanin is synthesized only in the colder parts of the body because Siamese cat bears temperature sensitive allele for enzyme producing melanin.
因爲暹羅貓產生黑色素的酵素之等位基因為溫度敏感性，所以黑色素只在身體較冷的部位合成。

D. Melanocytes are localized only at the snout, ears, tail and feet – the rest of body is without melanocytes.
黑色素細胞只位於鼻子、耳朵、尾巴和足部，身體的其他部分則沒有黑色素細胞

E. The body extremities are more exposed to the UV-radiation which stimulates production of the melanin.
由於身體末端暴露於紫外線照射較多，因而激發黑色素的產生

106. Retinoblastoma protein (Rbp) and p53 are examples of the anti-oncogens (tumor suppressor). Which of the following statements ~~about these proteins~~ is true? (1 point)
視網膜胚細胞瘤蛋白（Rbp）和p53是抗致癌基因（即瘤抑制子）。下列敍述，何者正確？（1分）

A. Mutation in the p53 gene (when p53 lost its regulatory function) can stop the cell cycle.
p53基因發生突變（使p53失去它的調控功能），會使細胞週期停止

B. Overproduction of the Rbp in the retina can cause cancer.
在視網膜中產生過量的Rbp，會產生癌症

C. Cells with mutated p53 are predisposed to malignancy.
p53發生突變的細胞傾向成爲惡性腫瘤

D. Cells with mutated Rbp are resistant to malignancy.
Rbp突變的細胞抵抗惡性腫瘤的產生

E. Various viruses incorporated homologs of the p53 and Rb into their genomes and use these proteins for the transformation of the host cell.
許多病毒會將p53和Rb的同源基因插入它們的基因組後，他們會表現這些蛋白，使宿主細胞發生轉形

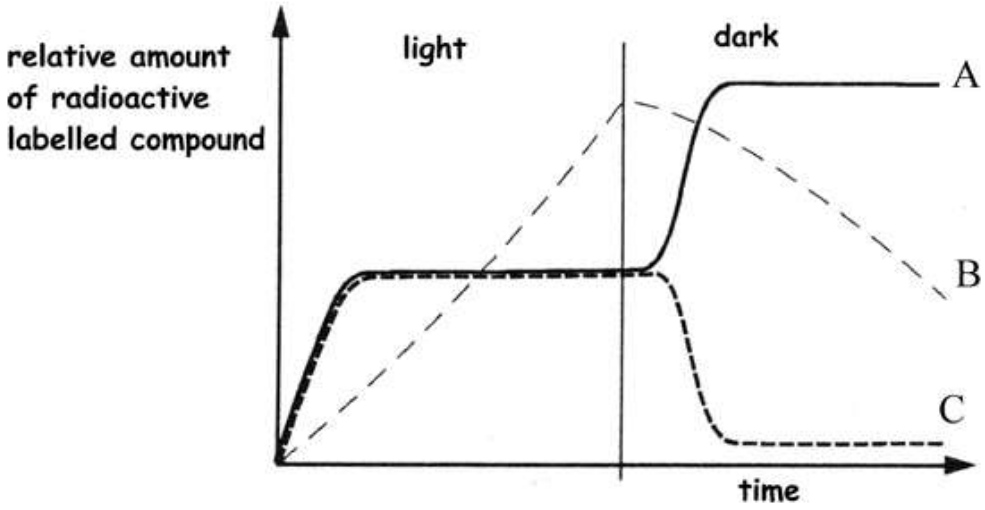
107. Extracellular matrix is responsible for the mechanoelastical properties of the tissues. Which of the following molecules is NOT a component of the extracellular matrix is: (1 point)
細胞外基質負責組織的機械及彈性（mechanoelastical）性質。下列何者不是

細胞外基質的組成分子？

A. elastin　　彈性蛋白
B. cytokeratin　　細胞角質蛋白
C. laminin　　層粘連蛋白
D. collagen　　膠原蛋白
E. chondroitin sulphate　　硫酸軟骨素

108. ~~Prions are unique infectious agents formed only from protein called PrP. W~~

109. Algae were supplied with a radioactive isotope of Carbon, ^{14}C, and allowed to photosynthesis. After a period of time, the light was switched off and the algae were left in the dark. The graph shows the relative amount of some radioactive labelled compounds over the period of the experiment. (1 point)
提供藻放射性碳同位素 ^{14}C 後，進行光合作用。一段時間後，關閉燈光，並將藻置於黑暗中。下列曲線圖顯示在實驗期間，一些放射性標記的化合物的相對量。（1 分）



Which line is representing the amount of glycerate 3-phosphate (3GP), ribulose biphosphate (RuBP) and sucrose? (1 point)
Fill out the correct number of the line in the correct box.

哪條曲線代表甘油酸-3-磷酸（G-3-P）、二磷酸核酮糖（RuBP）和蔗糖？請在下列表格中，填寫正確線條的字母。（1 分）

Compound	Line

化合物	曲線
(1) 3GP	A
(2) RuBP	C
(3) Sucrose 蔗糖	B

110. Methylene blue acts as a hydrogen acceptor. It is blue in oxidised state, but goes colourless when it is reduced by accepting hydrogen atoms. (1 point)
亞甲基藍作為一個氫受體。在氧化狀態下，它是藍色的；當它接受氫原子而被還原時，它會變成無色。（1 分）

Methylene blue + hydrogen → reduced methylene blue
(blue) *(colorless)*
亞甲基藍（藍色）+氫 → 還原型亞甲基藍（無色）

A student likes to investigate this reaction. He prepares four test tubes as shown below
一個學生喜歡研究這個反應。他準備了四個試管，內含各種反應物質，如下表所示。

	Tube A	Tube B	Tube C	Tube D
Distilled water 蒸餾水	-	2 ml	2 ml	2 ml
Glucose solution 葡萄糖溶液	2 ml	2 ml	-	2 ml
Methylene blue solution 亞甲基藍溶液	1 ml	1 ml	1 ml	-
Yeast solution 酵母溶液	2 ml	-	2 ml	2 ml

All tubes were incubated at a temperature of 30 ℃. The colour was recorded at the start and after intervals of 5 and 15 minutes. The results are shown in the table.
所有的試管都培養在 30 ℃。分別在培養後 5 分鐘和 15 分鐘時紀錄顏色。結果如下表所示。

Colour of content 溶液的顏色	Tube **A**	Tube B	Tube C	Tube D
At start 在開始時	Blue 藍	Blue 藍	Blue 藍	Colourless 無色

After 5 minutes 5 分鐘後	Colourless 無色	Blue 藍	Blue 藍	Colourless 無色
After 15 minutes 15 分鐘後	Colourless 無色	Blue 藍	Pale blue 淺藍	Colourless 無色

Which test tube can be characterized as a control in this investigation and which test tube is useless? (1 point)
Fill out the correct letter
哪個試管在這個實驗中可以作爲對照組，哪個試管是沒用的？在下列表格中，填寫正確的字母（1 分）

	Tube
(1) Control 對照	B
(2) Useless 無用的	D

111. Morgan crossed *Drosophila* of two known genotypes, *BbVv* x *bbvv*, where *B*, the wild-type (grey) body, is dominant over *b* (black body) and *V* (wild-type wing) is dominant over *v* (vestigial, a very small wing). Morgan expected to see four phenotypes in a ratio 1:1:1:1. But he observed:

Morgan 將兩種已知基因型的果蠅進行雜交，即 *BbVv* x *bbvv*；其中，*B* 是野生型（灰色身體），相對於 *b*（黑色身體）是顯性的；*V*（野生型翅膀）相對於 *v*（發育不全，一個非常小的翅膀）是顯性的。莫干(Morgan)期待看到四種表型的比例是 1:1:1:1。但是他看到的如下：

Wild type	野生型:	965
Black vestigial	黑色，發育不全:	944
Grey vestigial	灰色，發育不全:	206
Black normal	黑色，正常:	185

These results were explained in assuming linkage of alleles together with genetic recombination (crossing over).
這些結果可以用假定的等位基因的連鎖和遺傳重組（互換）來解釋。

In this particular example the recombinant frequency (defined as the ratio of recombinants in relation to the total offspring) is: (1 point)
這些結果可以用假定的等位基因的連鎖和遺傳重組（互換）來解釋。
在這個特例中，互換率（定義爲重組子代相較於全部後代的比值）是多少？

A. 0.205
B. 0.170
C. 0.108
D. 0.900
E. 0.080

112. 70% of the population of Beijing is able to taste phenylthiocarbamide. The ability to taste (T, taster) is dominant over the inability to taste (t, non-taster).
What percentage of the offspring of 'tasters' will be non-tasters? (2 points)
北京 70%的人口能夠辨別苯基硫脲的味道。辨味的能力（T，taster）相對於不能辨味者(t，non-taster)是顯性的。試問有辨味能力者（taster）的後代中為不能辨味（non-taster）的比例是多少？（2 分）
A. 25%
B. 15%
C. 13%
D. 20%
E. 7.5%

Questions 113-116. Wild type individuals of *Drosophila* have red eyes and straw-coloured bodies. A recessive allele of a single gene in *Drosophila* causes *glass eye* and a recessive allele of a different gene causes *ebony body*.
果蠅的野生型個體具有紅色的眼睛和淡黃色的身體。果蠅中一個單基因的隱性等位基因會產生玻璃眼(*glass eye*)的表型，而另一個基因的隱性等位基因則產生烏黑身體(*ebony body*)的表型。

A student crosses pure breeding wild type flies with pure breeding flies having glass eye and ebony body and the resulting F1 flies showed all the wild type phenotype for both features. On crossing the F1 flies among themselves the student expect a 9:3:3:1 ratio but the results are not like that. The actual offspring showed:

一個學生將純品系的野生型果蠅與另一個具有玻璃眼和烏黑身體的純品系果蠅進行雜交，產生的第一代(F1)果蠅全部是野生型的表型。以第一代(F1)果蠅進行雜交，此學生期待一個 9:3:3:1 的比例；然而結果並不是這樣。後代實際的表現情形如下表所示：

Eye 眼	Body 身體	Number of flies in F2 F2 代中果蠅的數目
Wild 野生型	Wild 野生型	164
Wild 野生型	Ebony 烏黑	37
Glass 玻璃	Wild 野生型	59
Glass 玻璃	Ebony 烏黑	28

There are two possibilities:

- The differences from 9:3:3:1 are coincidental (null hypothesis accepted).
- The differences do not occur by coincidence (null hypothesis rejected).

有兩種可能性：

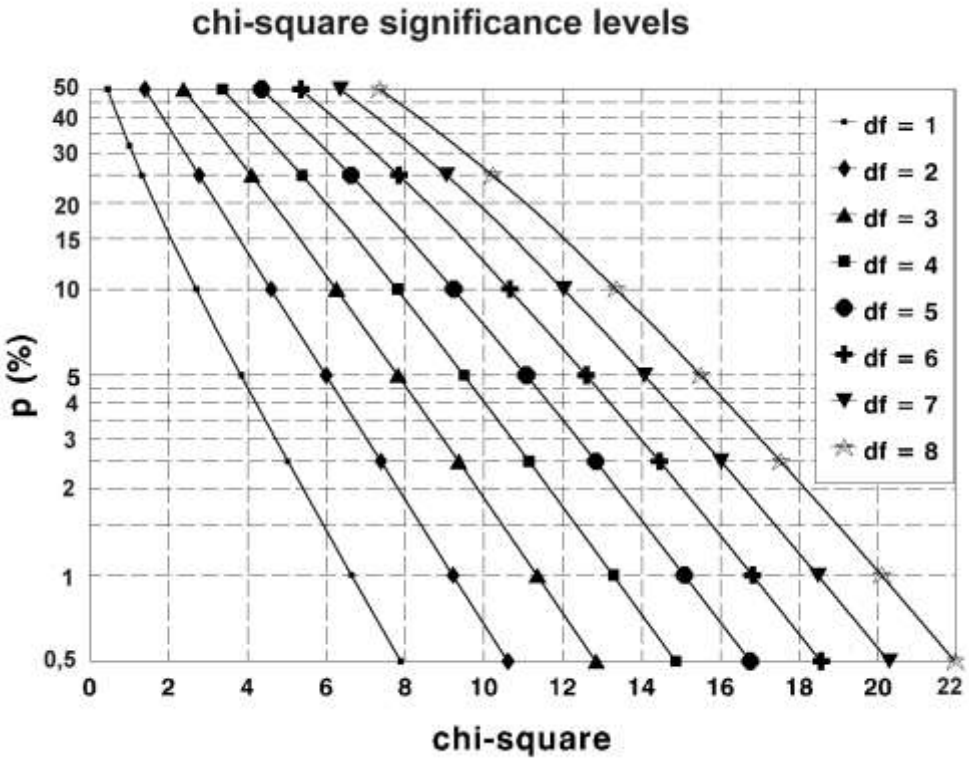
(1) 比例不同於 9:3:3:1 是巧合（接受虛無假設）。

(2) 比例的不同並不是巧合發生的（反對虛無假設）。

You are required to check this applying the χ^2 (chi square) test.

你需要應用卡方 (chi 的平方) 分析法進行核對。

For this situation, e.g. degree of freedom, the following diagram with χ^2 values should be used: 在這種情況下，比如自由度，你應該用下面χ^2數值的圖：



Question 113. The calculated χ^2 is? (3 point)
計算得到的χ^2是多少？（3 分）

A. 10.11

B. 2.84

C. 14.33

D. 11.40

Question 114. Indicate the degree of freedom (df) for this test: (1 point)
指出該實驗的自由度（df）是多少？（1 分）

A. 2

B. 3

C. 4

Question 115. Determine the probability that the deviation of the observed results from expected results is due to chance alone. (1 point)
決定觀察的結果偏離預期的結果是起因於巧合的可能性是多少？

A. About 1%

B. About 2%

C. About 5%

D. About 8%

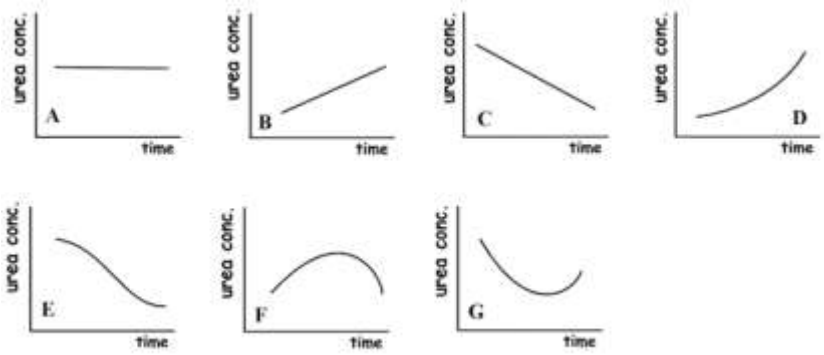
Question 116. To explain the observed deviation of the 9:3:3:1 ratio the student suggested some possibilities.
由於觀察到的結果偏離 9:3:3:1 比率，該學生提出了幾種可能的解釋

(1) linkage of both the alleles 兩個等位基因連鎖
(2) crossing over 互換
(3) incomplete dominance 不完全顯性

Which combination of suggestions is the correct explanation? (1 point)
下列何者是正確的解釋？

A. 1, 2
B. 1, 3
C. 2, 3
D. 1, 2, 3

117. Which of the following diagram offers a correct representation of the urea urine of a person in hunger strike, who finally died. (1 point)
因饑荒而最終餓死的人，其尿中尿素含量的變化曲線圖為下列何者？G



118. Wilhelm von Osten gave performances with his horse called *smart Hans*. He stated that he taught his horse to make calculations. But in fact this isn't true at all. He had taught the horse to mind his hidden but trigging indications. As a result the horse made the desired movements: swinging the correct number of times with his foreleg. After that the horse got some reward.

Wilhelm von Osten 宣稱他的馬匹 *smart Hans* 經過訓練後可運算數學，事實上並不正確，他只是教會他的馬匹辨識他隱藏起來的訊號，當正確答案出現時，馬匹便會揮動前腳並獲得獎賞。

What kind of learning behaviour is this? (1 point)
這屬於何種學習行為？

A. adaptation 適應
B. conditioning 條件化作用
C. habituation 習慣化作用
D. imitation 初始作用
E. imprinting 印痕
F. insight 頓悟
G. Fixed action pattern（FAP）固定動作模式

119. A snail crawling across a board will withdraw into its shell when you drop a marble on the board. Repetition of dropping marble will lead to weaker withdraw action and in the end the snail will ignore the marble dropping. Which of the following terms do apply for the disappearance of the withdraw action? (1 point)
在爬行中的蝸牛身旁投下一顆小石頭，會促使蝸牛把身體縮進殼中，重複投下石頭，其收縮反應會越來越小，最後甚至會完全忽略不再反應。下列何者可解釋此種現象？

(1) Adaptation 適應
(2) Conditioning 條件化
(3) Habituation 習慣化作用
(4) Imprinting 印痕
(5) Insight 頓悟
(6) learned behaviour 學習行為

A. 1
B. 2,4
C. 3,6
D. 4, 5
E. 5, 6

120. Bonsai trees need water with very low lime content. Which types of water could be used to water them? (1 point)
Bonsai 樹需要含有少量石灰的水分方可存活，下列何者是合用於灌溉？

(1) Carbonated mineral water 碳酸礦泉水
(2) Rain water 雨水
(3) Tap water with high water hardness 硬水

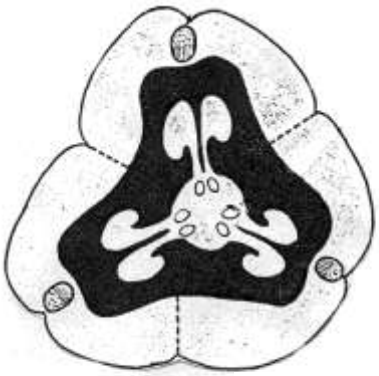
(4) Tap water with high water hardness treated by leaving it over night with a mix of peat and crushed stones and filtrating it before use 放置過夜再利用泥碳過濾後的硬水

(5) Molten snow 溶雪

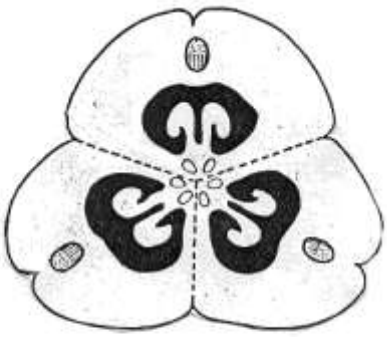
A 1, 5
B 2, 5
C 1, 3
D 4, 5
E. 2, 4, 5

121. Observe the diagrams 1 to 4 representing cross sections of the ovaries of different flowers.
圖 1 到圖 4，描繪了不同花的子房橫截面。

Match the numbers in front of the placentation type (A-D) with the corresponding diagram.
請將胎座式類型（A-D）與相應的圖匹配起來。



1



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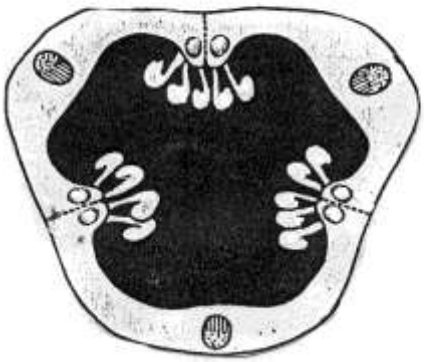

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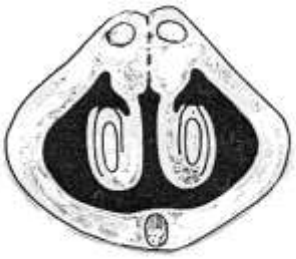


4

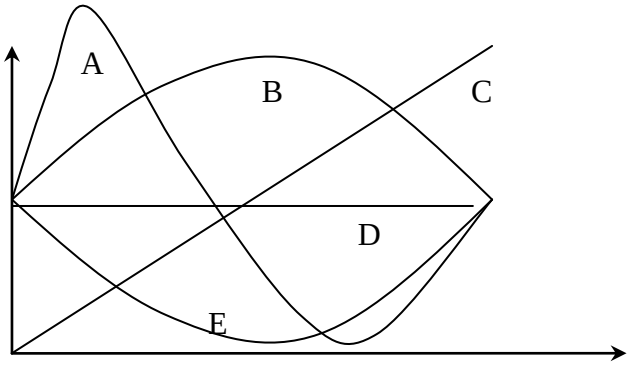
A. Axile placentation. 中軸胎座
B. free central placentation. 自由中樞胎座式，或稱中央獨立胎座
C. Marginal placentation. 邊緣胎座式，即邊緣胎座。
D. Parietal placentation. 側膜胎座

Match the number with correct placenta type. (1 point)
將圖上編碼和正確的胎座式類型（A-D）匹配起來（1 分）

Type 類型	Answer 答案
1	B
2	A
3	D
4	C

122. Which curve shows the correct time course of the production of saliva in a human after the intake of citric acid? (1 point)
以下哪一條曲線正確的表示了人服用檸檬酸後，唾液生成的時間過程？ B

B



Questions 123-125. The behavior of eight Humboldt penguins (*Spheniscus humboldti*) is investigated in a larger group of penguins in a zoo enclosure. The animals can be distinguished by marks or their individual pattern of black dots on their white thorax. To document the relationship of the penguins, their nearest neighbor (closest animal in the enclosure) was recorded in short time intervals during day time in a period of several weeks. The table shows the relatively stable mean values for the frequency of neighbors for the four male (M1 – M4) and four female (F1 – F4) penguins.

某人調查某動物園圍欄裏的一大群洪保德企鵝中八隻企鵝的行爲，利用戴標記或根據各企鵝白胸上黑點的不同樣式來辨識。爲了證明企鵝彼此的關係，在長達數週的時間中，於白天時段多次記錄（各有短時間間隔）最靠近牠們的企鵝。下表為四隻雄企鵝（M1 – M4）和四隻雌企鵝（F1 – F4）鄰居的相對頻率平均值。

	M1	M2	M3	M4	F1	F2	F3	F4	Σ
M1		2	5	1	0	3	7	77	95
M2	2		0	9	9	75	1	2	98
M3	5	0		0	0	0	78	6	89
M4	1	9	0		80	8	0	0	98
F1	0	9	0	80		7	0	0	96
F2	3	75	0	8	7		0	0	93
F3	7	1	78	0	0	0		7	93
F4	77	2	6	0	0	0	7		92
Σ	95	98	89	98	96	93	93	92	

Several months later the same animals were observed again yielding the following values.
幾個月後同樣又觀察這些相同的動物，得出了下面的數值。

	M1	M2	M3	M4	F1	F2	F3	F4	Σ
M1		4	8	2	1	4	11	60	90
M2	4		0	12	12	65	1	5	99
M3	8	0		0	0	1	62	9	80
M4	2	12	0		70	14	0	1	99
F1	1	12	0	70		10	0	1	94
F2	4	65	1	14	10		0	3	97
F3	11	1	62	0	0	0		10	84
F4	60	5	9	1	1	3	10		89
Σ	90	99	80	99	94	97	84	89	

During the following years the tendency of these values remained the same.
在以後的幾年裏這些數值的趨勢保持相同。

123. Analyze the tables and determine the mating system of the Humbodt penguins. (1 point)　分析以上表格，以確定洪保德企鵝的配對系統是

A. promiscuity　亂交的
B. polyandry　一雌多雄的
C. polygyny　一雄多雌的
D. monogamy　一雌一雄的

124. Which is the most common polygamous relationship? (1 point)
哪一個是最常見的多配偶關係？

A. promiscuity　亂交的
B. polyandry　一雌多雄的
C. polygyny　一雄多雌的
D. monogamy　一雌一雄的

125. Which group of animals do the penguins belong to? (1 point)
企鵝屬於哪一種類群的動物？

A. Ratitae (birds with flat breast and weak breast muscles)
平胸總目（平胸且胸肌較弱的鳥）
B. Carinatae (birds with strong breast muscles)　突胸總目（胸肌強壯的鳥）
C. Neither, they are not birds　都不是，它們不是鳥

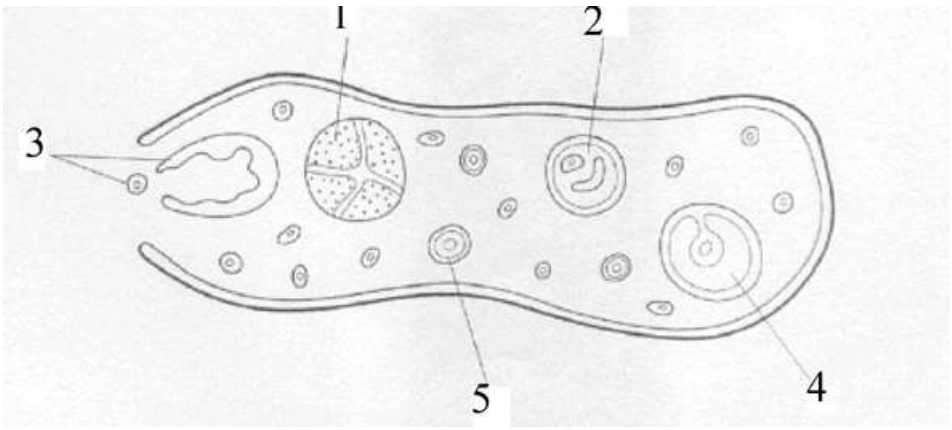
126. Substrate(s) of RUBISCO is (are): (1 point) 酵素 RUBISCO 的受質是：

(1) Phosphoenolpuruvate (PEP) 磷酸烯醇丙酮酸
(2) Ribulose-bis-phosphate (RuBP) 二磷酸核酮糖
(3) Oxaloacetic acid (OAA) 草醋酸
(4) Phosphoglyceric acid (PGA) 磷酸甘油酸
(5) Carbon dioxide (CO_2) 二氧化碳
(6) Phosphoglyceraldehyde (GAP) 磷酸甘油醛
(7) Oxygen (O_2) 氧氣

A. 1, 2, 5
B. 1, 5
C. 2, 5
D. 1, 2, 6
E. 2, 5, 7

127. The diagram shows a section through a mammalian ovary. The numbers indicate different develop stages. (1 point)
下列為哺乳類卵巢構造示意圖，數字代表不同的發育階段

Choose the correct sequence of numbers in which the structures develop.
請選擇正確的發育過程



A. 1, 2, 3, 4, 5
B. 5, 4, 3, 2, 1
C. 5, 2, 4, 1, 3
D. 5, 2, 4, 3, 1
E. 2, 4, 1, 3, 5

Questions 128-131. PKU and albinism are two autosomal recessive disorders, unlinked in human. If a normal couple produced a boy with both disorder, they want to have the second child:
苯丙酮尿症與白化症為兩種隱性染色體遺傳疾病，假如一對正常的夫婦生下一個同時具有兩種疾病的男孩，他們想再次生育。

128. What is the chance of the second child with PKU? (1 point)
第二個小孩得到苯丙酮尿症的機率為何？

A.1/2
B. 1/4
C. 2/3
D. 1/16

129. What is the chance of the second child with both traits? (1 point)
第二個小孩同時得到苯丙酮尿症和白化症的機率為何？

A. 1/2
B. 1/4
C. 1/8
D. 1/16

130. What is the chance of the second child with either PKU or albinism?（1point）
第二個小孩得到苯丙酮尿症或白化症中任何一種的機率為何？

A. 1/2
B. 3/4
C. 3/8
D. 3/16

131. What is the chance for them to have a normal child? (1 point)
第二個小孩為正常的機率為何？

A. 1/16
B. 4/9
C. 9/16
D. 6/16

~~132. How is the trait inherited? (1 point)~~

~~133. If D= dominant, d = re(1 point)~~

~~134. What is the genoty~~

~~135. If IV-2 married to a man from an unrelated family,~~

~~136. For the alleles D and d, which individua~~

~~137. If this trait is instead quite common in the population,~~

138. There are several types of human blood cells such as erythrocytes and monocytes. They all come from stem cells. Which of the following is/are correct about the stem cells of blood cells? (1 point)
人體具有紅血球及單核球等多種血球細胞，他們全來自幹細胞，下列有關血球幹細胞的敘述何者正確？

(1) B cells come from lymphoid stem cells. B 細胞源自淋巴幹細胞
(2) T cells come from lymphoid stem cells. T 細胞源自淋巴幹細胞
(3) Erythropoietin stimulates production of erythrocytes from myeloid stem cells
紅血球生成素可刺激骨髓幹細胞產生紅血球

(4) Neutrophils and basophils have same stem cells.
嗜中性球和嗜鹼性球源自相同幹細胞
(5) Lymphoid stem cells come from myeloid stem cells.
淋巴幹細胞源自骨髓幹細胞

A. 1, 2, 3, 4, 5
B. 1, 2, 3, 4
C. 1, 3
D. 1, 2, 4

139. Which of the following role(s) does platelets play in clotting process? (1 point)
下列何者為血小板在凝血過程中所扮演的角色？

(1) They help to form plug for protection against blood loss.
協助形成血栓以減少血液喪失
(2) They release chemical signals for fibrin formation.
釋放化學訊號促使血纖維蛋白形成
(3) They release chemical signals for reducing blood pressure.
釋放化學訊號以降低血壓

A. 1, 2
B. 1, 2, 3
C. 2, 3
D. 1, 3

140. Which of the following is NOT involved in allergic response in human? (1 point)
下列何者與人體的過敏反應**無關**？

A. Histamine. 組織胺
B. Mast cell. 肥大細胞
C. Plasma cell 漿細胞
D. Platelets 血小板

141. There are several sensory receptors in human skin. Which of the following is located in deepest position of the skin? (1 point)
人體皮膚中具有多種受器，下列何種受器位於皮膚最深層的構造中？

A. Sensory receptor for pain. 痛覺受器
B. Sensory receptor for cold. 冷覺受器
C. Sensory receptor for heat. 熱覺受器
D. Sensory receptor for strong pressure. 強力壓覺受器

142. One of the mutant zebra fish has a reduced number of hair cells in neuromast of its lateral line system. Which of the following will happen? (1 point)
某一突變種斑馬魚，其測線系統中神經瘤上的毛細胞大量減少，下列何者將會發生？

(1) The mutant fish will not be able to detect depth of water.
此變種魚無法偵測水的深度
(2) The mutant fish swims slowly.
此變種魚的游泳速率變慢
(3) The mutant fish could not detect sound of its prey.
此變種魚無法偵測獵物的聲音
(4) The mutant fish could be impaired in detecting water movement around its body.
此變種魚偵測身旁水流運動的能力受損

A. 1, 2
B. 3, 4
C. 4
D. 2, 4

143. Hemoglobin is responsible for transporting oxygen from lung to tissues. Bohr shift is one of the most important properties of hemoglobin. Which of the following is NOT true about Bohr shift? (1 point)
血紅素可將氧氣由肺運至組織細胞，波耳效應(Bohr shift)是紅血球的一項重要特徵，有關波耳效應下列何者**錯誤**？

A. Additional oxygen is bound by hemoglobin in lung when pH decreases.
當血液 pH 值下降時，紅血球可在肺部結合更多的氧氣
B. Additional oxygen is released from hemoglobin at a lower pH.
當血液 pH 值下降時，紅血球可釋出更多氧氣
C. CO_2 is involved in Bohr shift.
二氧化碳與波耳效應有關
D. Bohr shift helps tissues to obtain more oxygen in exercise.
波耳效應可幫助組織在運動時獲得更多氧氣

144. Which of the following is/are NOT true about the difference in digestive tracts of carnivores and herbivores? (1 point)
下列有關肉食性及草食性動物消化道構造差異的敘述，何者**錯誤**？

(1) Carnivores usually have a bigger stomach.
肉食性動物常具有較大的胃
(2) Carnivores usually have a shorter colon.
肉食性動物常具有較短的結腸
(3) Herbivores usually have a longer cecum.
草食性動物腸常有較長的盲腸

A. 1, 2
B. 1
C. 2, 3
D. 3

Questions 145-148. Hemophilia and color blindness are X-linked recessive traits. When a color-blind woman married to a hemophiliac man,
血友病和色盲是 X-性聯遺傳隱性性狀。當一位色盲的女性和一位患有血友病的男性結婚。

145. What is the chance for them to have a normal son? (1 point)
他們生出一個正常兒子的機率為何？

A. 50%
B. 0%, all their sons will suffer from color-blind
他們的兒子都將患有色盲
C. 0%, all their sons will suffer from hemophilia
他們的兒子都將患有血友病
D. It depends on the recombinant frequency.
他們的兒子是否患病完全由重組機率所決定

146. If their son was married to a woman whose mother was color-blind, and whose father was not color-blind what is the chance for them to produce a normal daughter? (1 point)
如果他們的兒子和一名其母親是色盲的女性結婚，該女性的父親並無色盲，他們生出一名正常的女兒的機率是多少？

A. 0%
B. 50%
C. 75%
D. 100%

~~147. If their daughter was married to a n~~

~~148. If they have a color-blind daughter, (1 point)~~

Questions 149-152. Huntington disease is a rare fatal disease. People with this disease start to show symptoms in their 40's. Peter's father (John) has Huntington disease. John's father (Peter's grandfather), who also had this disease, had 11 children (5 sons and 6 daughters). Among them, 6 (3 sons and 3 daughters) of them had got the disease and five died from it.

亨丁頓症是罕見的致命疾病。患有這種疾病的人在 40 歲後開始顯現病症。彼得的爸爸（約翰）患有亨丁頓病。約翰的爸爸（彼得的爺爺）也有這種病，並且生了 11 個孩子（5 個兒子和 6 個女兒）。他們中有 6 個人（三個兒子和三個女兒）患有此病，五個人死於此病。

149. How is the trait inherited? (1 point) 遺傳特徵為何？

A. autosomal recessive 體染色體隱性
B. autosomal dominant 體染色體顯性
C. sex-linked recessive 性染色體隱性
D. sex-linked dominant 性染色體顯性

150. What is the possibility that Peter will also develop the disease? (1 point)
彼得患有此病的機率為何？

A. 50%
B. 25%
C. 75%
D. 67%

151. Peter is married to a normal woman, what is the possibility that their first child will eventually develop the disease? (1 point)
彼得和一個正常的女性結婚，他們的第一個孩子患有此病的機率為何？

A. 50%
B. 25%
C. 75%
D. 67%

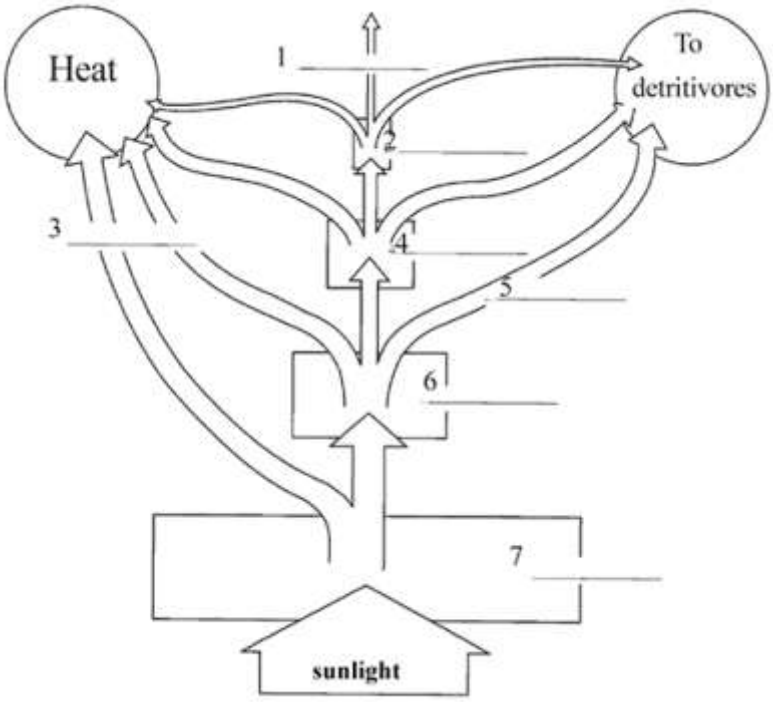
E. 0

152. If Peter's mother-in-law died from the same disease, what is the possibility that their first child will eventually develop the disease? (1 point)
如果彼得的岳母死於同一種病，他們的第一個孩子患有此病的機率為何？

A. 3/16
B. 4/16
C. 7/16
D. 9/16
E. 12/16

153. Trophic levels are indicated below with numbered lines in the flowchart. Write the appropriate tropic level name in the space provided next to its number. Write ONLY the letter of the tropic characteristic. (1 point)
下列流程圖為不同營養層及能量流向的示意圖，各營養層及能量流向以數字標示，請將代表正確敘述的**英文代號**填入答案欄中，**注意第一題無須填寫答案**

NOTE: Left-hand circle in flowchart is *Heat*; right-hand circle in flowchart is *To detritivores*.
流程圖中左方圓形代表熱能，右方圖形代表吃碎屑動物



1. **no answer required**

2. _C_____

3. __A_____

4. ___B_____

5. __D_____

6. __F_____

7. ___E_____

A. energy used in cellular respiration

用於細胞呼吸作用的能量

B. secondary consumers 次級消費者

C. tertiary consumers 三級消費者

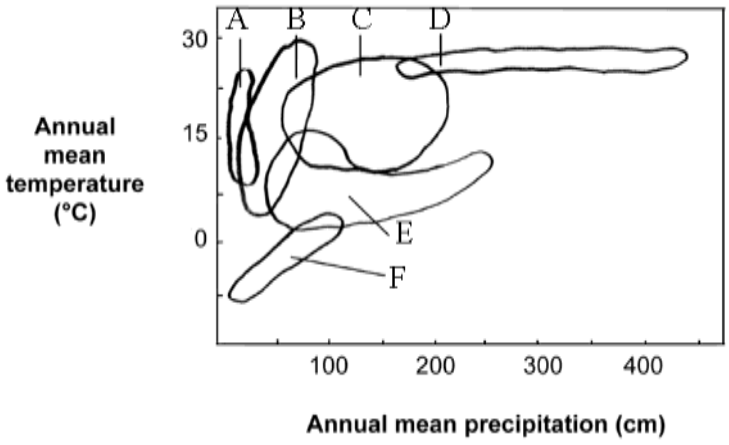
D. energy in wastes 耗損掉的能量

E. primary producers 初級生產者

F. primary consumers 初級消費者

【C A B D F E】

154. Match the biome in the figure below with the appropriate plotted area (a, b, c, d, e, and f) in the climograph. (1 point)請將下圖中的生物群落區和氣象圖中小區塊(a, b, c, d, e, 和 f)相配對（1 分）



1. ___F____ arctic and alpine tundra 極地和高山凍原

2. ___E____ coniferous forest 針葉林

3. ___A____ desert 沙漠

4. ___B____ grassland 草原

5. ____C____ temperate forest 溫帶

森林

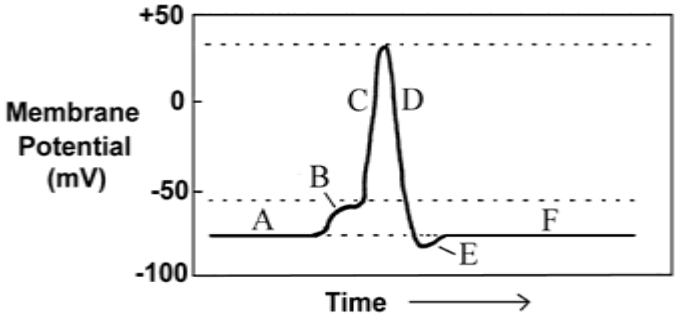
6. ___D_____ tropical forest 熱帶森林

橫軸：年平均降雨量（cm）
縱軸：年平均氣溫(℃)　　【E F A B C D】

155. Referring to the action potential graph below, write the letter (from the graph) that corresponds with the appropriate action potential action on the right of what is occurring at that stage of the action potential. (1 point) **Note, there could be more than one choice for each question.**

請看以下動作電位變化圖，圖右為發生動作電位各個階段的電位變化，請將圖中的字母寫到相應的電位變化描述欄。(1 分) **注意，每一個問題可能有多個答案。**

【E　DF　AE　B】



1.___E____ The membrane is unable to respond to any further stimulation regardless of intensity 無論刺激強度多大，膜都不能產生反應

2.___DE_____ Sodium gates close, and potassium gates re-open
鈉離子通道關閉，鉀離子通道門再度開啓

3.___AF____ Both sodium and potassium voltage-gated channels are closed 鈉離子和鉀離子電壓敏感型通道關閉

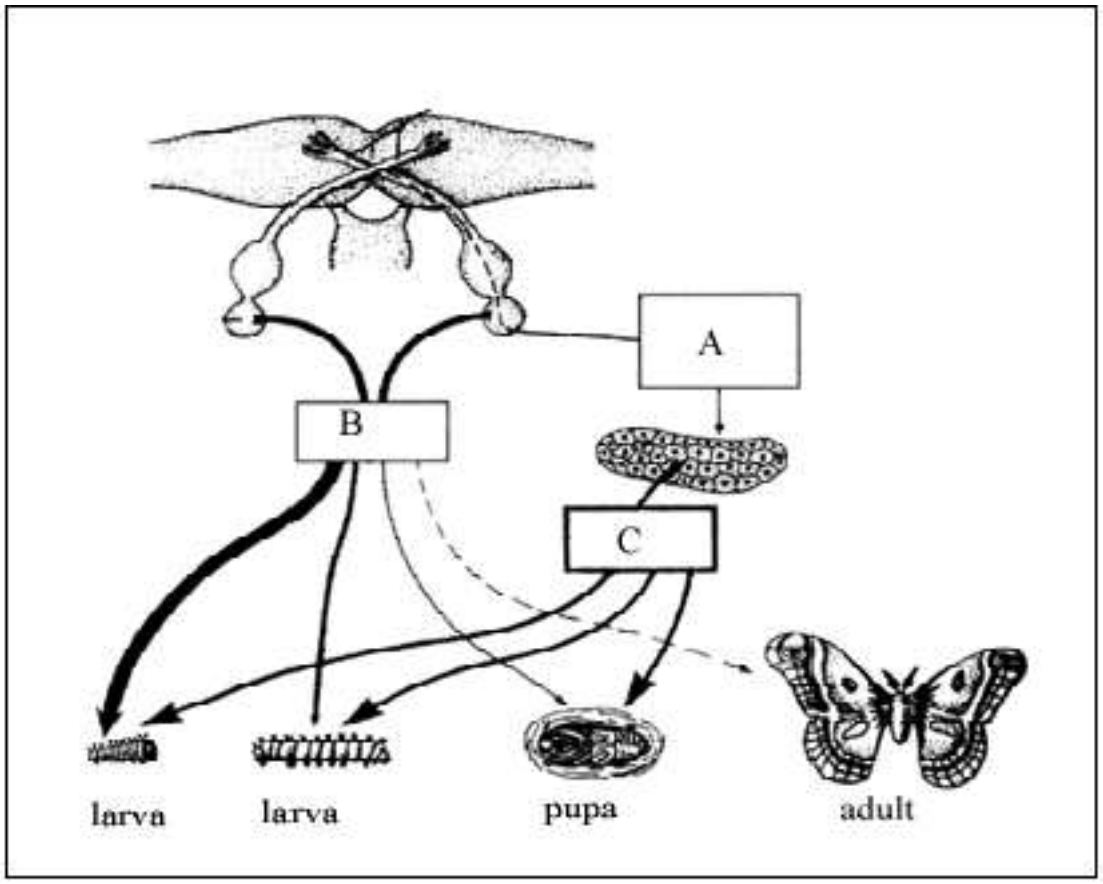
4.____B____ Stimulus opening of some sodium channels 促使部分鈉離子通道開啓

156. Molting is a process observed in insects. Which of the following statements is/are true? (1 point)
昆蟲的蛻皮過程中，下列何者正確？（1 分）

(1) The exoskeleton of insects is largely made of protein and chitin.
昆蟲的外骨骼大部分是由蛋白質和幾丁質組成的。
(2) The structure of chitin is similar to that of bacterial cell wall peptidoglycan.
幾丁質的結構和細菌細胞壁肽聚糖的結構相似。
(3) No enzyme has been found to digest chitin.
還沒有發現可以消化幾丁質的酶。
(4) Molting can be observed in all arthropods.
所有的節肢動物都可以觀察到蛻皮。
(5) The only place that is not covered by exoskeleton is the joints between the body and walking legs.
唯一未覆蓋著外骨骼處是身體和腿間的連結點。

A. 1, 2, 4, 5
B. 1, 4
C. 1, 3,4, 5
D. 1, 5

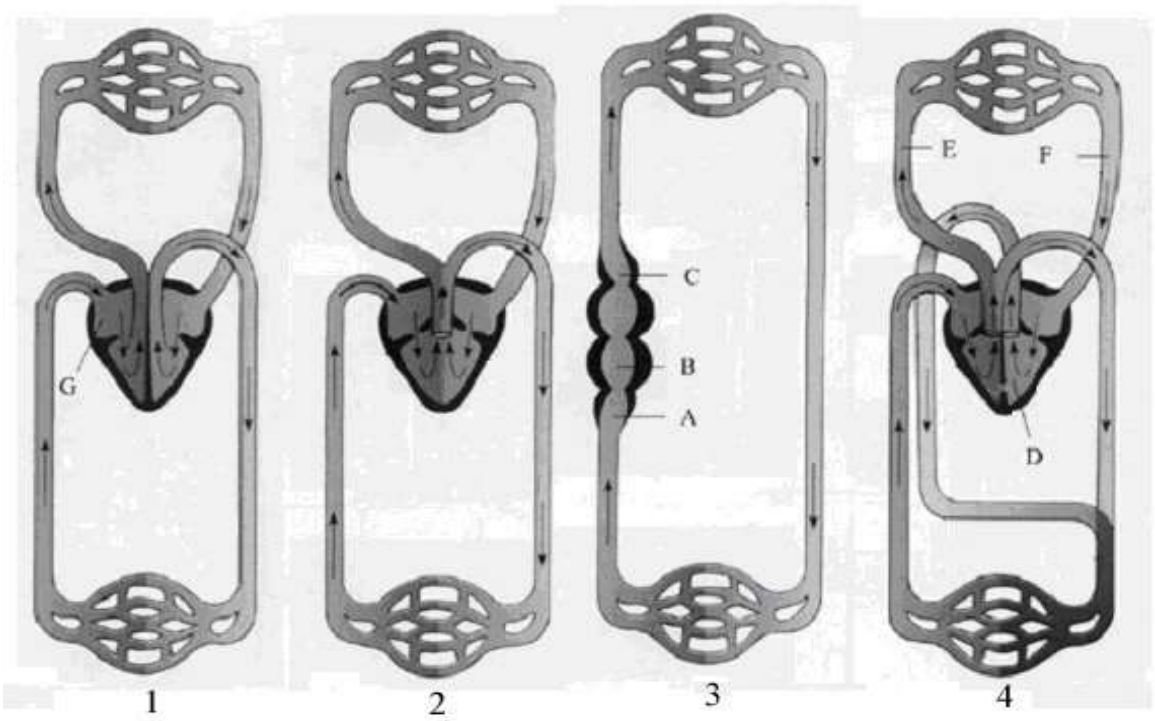
157. The mechanism of molting has largely been revealed. The figure below is a diagram of such a process. Boxes A, B and C represent 3 different growth hormones and molting hormones. Fill in the answer boxes by choosing correct letter. (1 point)
下圖為蛻皮過程的示意圖，方格中 A、B 與 C 分別代表三種荷爾蒙或與蛻皮作用有關的荷爾蒙，請於正確敘述旁的答案欄中填入正確的英文代號。



	Answer: A-C
1. brain hormone (BH) 腦激素	A
2. juvenile hormone (JH) 青春期激素	B
3. molting hormone MH) 蛻皮激素	C

158. The figure below shows 4 different circulation systems of vertebrates. From left to right, these are the circulation systems of (1 point)

下圖為四種脊椎動物循環系統的示意圖，由左至右分別為哪些動物的循環系統？



A. mammals, reptiles, amphibians, and fish, respectively.
哺乳類、爬蟲類、兩生類、魚類

B. fish, amphibians, reptiles, and mammals, respectively.
魚類、兩生類、爬蟲類、哺乳類

C. mammals, amphibians, reptiles, and fish, respectively.
哺乳類、兩生類、爬蟲類、魚類

D. mammals, amphibians, fish, and reptiles, respectively.
`哺乳類、兩生類、魚類、爬蟲類

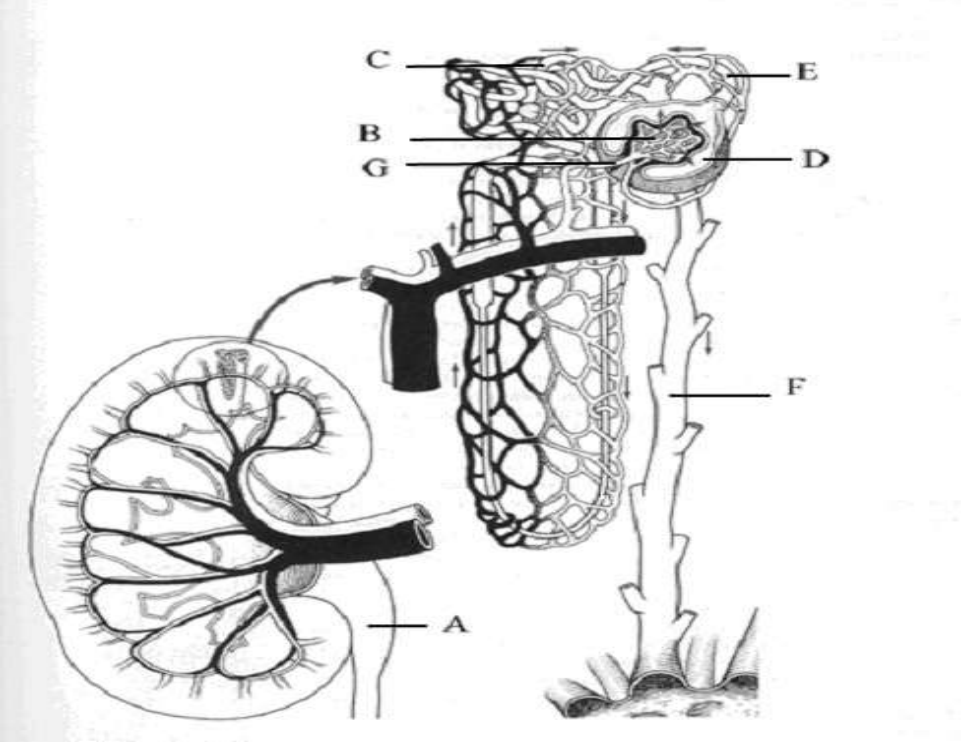
159. Match the numbers shown below with correct structures in the figure in question above (question158). (1 point)

請將**上圖中**用英文字母所標示的構造，與下表中的名稱進行配對

	Answer A-G
1 Sinus venosus 靜脈竇	A
2. Atrium 心房	G
3 Pulmonary vein 肺靜脈	F
4 Pulmonary artery 肺動脈	E
5 Conus arteriosus 動脈錐	C
6 right Atrium 右心房	G
7 Left ventricle 左心室	D

Questions 160-162. The structure of a mammalian kidney is shown below.

下圖為哺乳類腎臟構造的示意圖



160. Match the following terms with correct structures shown in the figure. (1 point)
請將上圖中用英文字母(A~G)所標示的構造，與下列名稱進行配對

①collecting duct 集尿管
②glomerulus 腎小球
③distal tubule 遠端腎小管
④Bowman`s capsule 鮑氏囊
⑤proximal tubule 近端腎小管
⑥ureter 輸尿管
⑦afferent arteriole 入球小動脈

	Answer A-G
①	F
②	B
③	C
④	D
⑤	E
⑥	A
⑦	G

161. The substances that be reabsorbed by proximal tubule is/are: (1 point)
下列哪些物質可由近端腎小管所吸收？

(1) Na^+
(2) Cl^-
(3) Water 水
(4) Glucose 葡萄糖
(5) Amino acids 胺基酸
(6) Urea 尿素

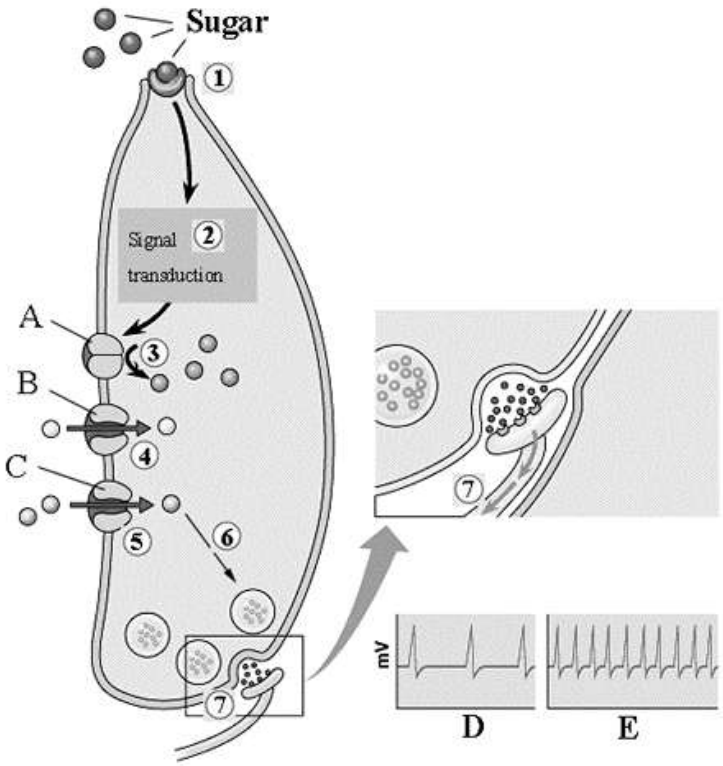
A. 1, 2, 3
B. 6,
C. 1, 2, 4, 5,
D. 1, 2, 3, 4, 5
E. 4, 5

162. In the kidney, ultra-filtration occurs in which of the following structures? (1 point)
在腎臟中超濾過作用發生在下列哪些構造？

(1) Nephrons 腎元
(2) Bowman's capsule 鮑氏囊
(3) Proximal tubule 近端腎小管
(4) Distal tubule 遠端腎小管
(5) Collecting duct 集尿管

A. 1, 2
B. 2, 3, 4, 5
C. 3, 4, 5
D. 2, 3, 4
E. 1, 2, 3, 4

Questions 163-166. The sensory transduction by a taste receptor is shown the figure below. Structure A, B, and C different channels, The sequential events of the transduction is labeled by number 1 through number 7. A portion of the cell is magnified.
下圖為味覺受器感覺訊息傳導的示意圖，構造 A、B、C 分別為三種不同的離子通道，其訊息傳導過程依序以數目字 1~7 標示，部分的細胞構造並已放大。



163. Structure A which is responsible for event 3 is a (1 point)
與傳導過程 3 有關的 A 構造為：

A. Potassium channel 鉀離子通道
B. Calcium channel 鈣離子通道
C. Sodium channel 鈉離子通道
D. Neurotransmitter channel 神經傳導物通道
E. Glycine channel 甘胺酸通道

164. Structure C which is responsible for event 5 is a (1 point)
與傳導過程 5 有關的 C 構造為：

A. Potassium channel 鉀離子通道
B. Calcium channel 鈣離子通道
C. Sodium channel 鈉離子通道
D. Neurotransmitter channel 神經傳導物通道
E. Glycine channel 甘氨酸通道

165. Event 4 by structure B (1 point)
由構造 B 負責的傳導過程是為：

A. depolarizes membrane potential. 去極化膜電位
B. increases membrane permeability 增加膜的通透性
C. transports more sugars molecules into the cell.
傳送更多糖分子進入細胞膜內
D. transports signal molecules into the cell so that the cell starts to synthesize neurotransmitters.
傳送訊息分子進入細胞膜內，增加神經傳導物質的合成
E. transports precursor molecules of neurotransmitters into the cell so that the cell can synthesize neurotransmitters.
傳送前驅分子進入細胞膜內，增加神經傳導物質的合成

166. Which of the following statements is/are true about the action potentials shown as D and E in the figure? (1 point)
有關動作電位(圖 D 與 E)的敘述何者正確？

(1) They were recorded after and before sugar molecules were present, respectively.
圖 D 與 E 分別於糖分子出現後和出現前紀錄到的動作電位
(2) They were recorded before and after sugar molecules were present, respectively.

圖 D 與 E 分別於糖分子出現前和出現後紀錄到的動作電位

(3) The action potential observed after sugar reception is triggered by an increase of calcium ions which stimulate neurotransmitter release.
檢測到糖後觀察到的動作電位，是由鈣離子的增加引起的，鈣離子刺激釋放神經傳導物

(4) The a ction potential observed after sugar reception is triggered by an increase of Potassium ions which stimulate neurotransmitter release.
檢測到糖後觀察到的動作電位，是由鉀離子的增加引起的，鉀離子刺激釋放神經傳導物

(5) The action potential is recorded from taste sensory receptor cells.
動作電位是記錄自受體感覺細胞

A.2, 3
B.1, 3
C.2, 4
D.2, 5
E.2, 4, 5

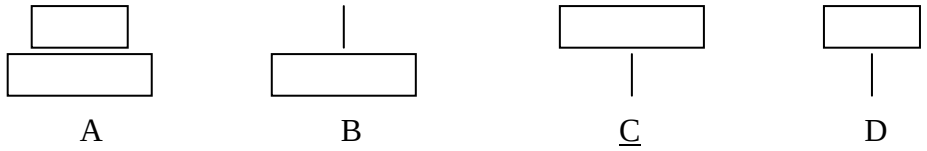
167. ~~Wh 定位~~

168. Both snake and weasel hibernate. Which of the following is correct? (1 point)
蛇和黃鼠狼都會冬眠，下列敘述何者正確？（1 分）

A. They will die when temperature decreases below the critical temperature.溫度若降至臨界低溫以下，牠們均將死亡。
B. Weasel will die when temperature decreases below the critical temperature. 溫度若降至臨界的低溫以下，黃鼠狼將死亡。
C. Snake will die and weasel will wake up when the temperature decreases below the critical temperature.溫度若降至臨界低溫以下，蛇會死而黃鼠狼會醒來。
D. Weasel keeps low body temperature and slow heart rate during whole period of hibernation. 黃鼠狼在冬眠中始終保持低的體溫和慢的心跳速率。

169. ~~It is possible to predict bird diversity based on forest types.~~

170. Four quantity pyramids are shown below. Which is representative for plant-aphid-ladybug? (1 point)
下列 4 個**數量**金字塔中，何者代表植物－蚜蟲－瓢蟲？

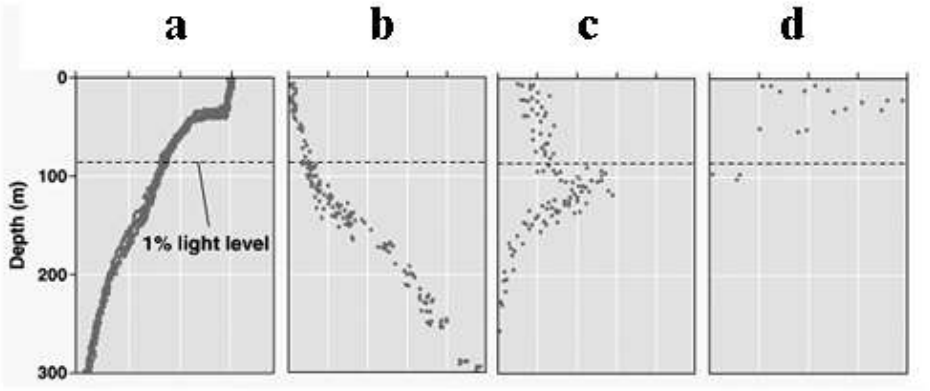


A　　B　　C　　D

171. Which of the following ecosystems has the highest net primary productivity? (1 point)　　下面哪個生態系統具有最高的淨初級生產力？（1 分）

A．Tropical rain forest　熱帶雨林
B．Open ocean　公海
C．Northern coniferous forest　北方針葉林
D．Farm lands　農場

172. The Figure below shows vertical distribution of some parameters (Chlorophyll, Phosphate, Primary production and Temperature) of North Pacific during summer.
下圖為夏季北太平洋中一些參數（包括葉綠素、磷酸鹽、初級生產和溫度）的垂直分佈。



From left to right, letter a through letter d represent: (1 point)
由左至右（字母 a 至字母 d）分別代表：（1 分）

A. Temperature, phosphate, chlorophyll and primary production
溫度、磷酸鹽、葉綠素和初級生產
B. Chlorophyll, phosphate, temperature and primary production
葉綠素、磷酸鹽、溫度和初級生產
C. Primary production, phosphate, temperature, chlorophyll
初級生產、磷酸鹽、溫度和葉綠素
D. Phosphate, temperature, primary production and chlorophyll.
磷酸鹽、溫度、初級生產和葉綠素。

173. The length of a food chain in a food web is often quite short. Usually, the

length is shorter than 5 links. Which is mostly likely reason for the shortness of the food chain? (1 point)
食物網中一個食物鏈的長度經常很短，通常其長度少於 5 個聯結。下面何者是食物鏈如此之短的最可能原因？（1 分）

A. The population of final predator is often too large.
最終捕食者的族群經常都太大。
B. The primary producers can sometimes be indigestible.
初級生產者有時不能被消化。
C. Only about 10% of energy in on link can be converted to organic matters in next trophic level.
一個聯結中只有大約 10%的能量可以被轉化至下一個營養級的有機物。
D. Wintertime is too long and low temperature limits primary productivity.
冬天太長，低溫限制了初級生產力。