香 港 資 優 教 育 學 苑
The Hong Kong Academy for Gifted Education

International Junior Science Olympiad 2023 – Hong Kong Screening

Question Book

Rules and Regulations:

1. The contest is a 1-hour written test.

2. The paper consists of 45 multiple-choice questions.

3. Point rules:
   Full mark: 45 points
   For each question:
   - correct answer: $+1$ point
   - wrong answer: $-\frac{1}{3}$ point
   - no answer: 0 point

4. Questions are in bilingual version.

5. Put your answers on the MC Answer Sheet.

6. Mark only ONE answer for each question. If more than one answer is marked, it will be regarded as a wrong answer. Please choose the BEST answer.

7. Only calculators approved by The Hong Kong Examinations and Assessment Authority with "HKEAA APPROVED" logo can be used for the contest. Measuring instruments like rulers and compasses may also be used. No stationeries will be provided.

Co-organised by Education Bureau, The Hong Kong Academy for Gifted Education,
and The Hong Kong Association for Science and Mathematics Education

香 港 資 優 教 育 學 苑
The Hong Kong Academy for Gifted Education

國際初中科學奧林匹克 2023–香港選拔賽

問題簿

學生守則：

1. 比賽以筆試形式進行，限時一小時。

2. 本試卷共有 45 題多項選擇題。

3. 評分制度:
   全卷： 45 分
   每條題目：
   - 答對：+1 分
   - 答錯：$-\frac{1}{3}$ 分
   - 沒有作答：0 分

4. 題目中英對照。

5. 請把答案填劃在多項選擇題答題紙上適當的位置。

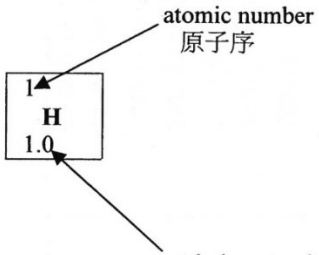
6. 每題只可填劃一個答案。若填劃多個答案，則該題將被視作答錯。請選擇最適當的答案。

7. 比賽時，學生只可使用香港考試及評核局認可型號、並印有 “HKEAA APPROVED” 的計算機。直尺、圓規及其它量度工具亦可作輔助之用。大會不提供任何文具。

PERIODIC TABLE
(for selected elements)

周期表
（部分元素）

GROUP 族



I	II											III	IV	V	VI	VII	0
																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 * **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 ** **Ac** (227)	104 **Rf** (261)	105 **Db** (262)													

List of formulae and relationships which may be useful

可能有用的公式和關係式

Linear motion with constant acceleration
直線均加速運動

$v = u + at$, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$.

Kinetic energy 動能 $= \frac{1}{2}mv^2$

Potential energy 潛能 $= mgh$

Force 力：$F = ma$

Electrical resistance 電阻

$R = V/I$

$R = R_1 + R_2$ in series 串聯

$1/R = 1/R_1 + 1/R_2$ in parallel 並聯

Electrical power 電功率：$P = IV = V^2/R = I^2R$

Centripetal acceleration 向心加速度: $\frac{v^2}{r}$

Law of universal gravitation 萬有引力定理 $F = Gm_1m_2/r^2$

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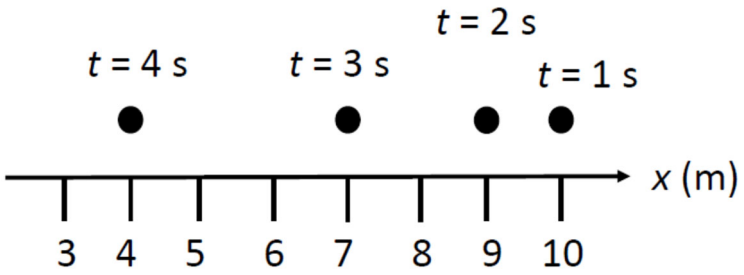
Multiple Choice Questions (45 marks)

1. A box slides down an inclined plane with a constant non-zero acceleration. Which of the following descriptions is correct?

   A. The inclined plane does not exert any force on the box.
   B. The net force acting on the box is equal to the weight of the box.
   C. The net force acting on the box is smaller than the weight of the box.
   D. The net force acting on the box is larger than the weight of the box.

2. The figure shows the position *x* of a particle (moving along a straight line) as a function of time *t*. Which of the following descriptions is correct?



   A. The particle is accelerating toward the positive x direction.
   B. The particle is accelerating toward the negative x direction.
   C. The speed of the particle is decreasing.
   D. The speed of the particle is constant.

3. A coin is thrown vertically upward. During the upward motion of the coin, which of the following descriptions about the acceleration of the coin is correct? You can neglect air resistance.

   A. Its magnitude is increasing.
   B. Its magnitude is decreasing.
   C. Its direction is pointing upward.
   D. Its direction is pointing downward.

4. Referring to the above question, which of the following descriptions is correct when the coin reaches the highest position?

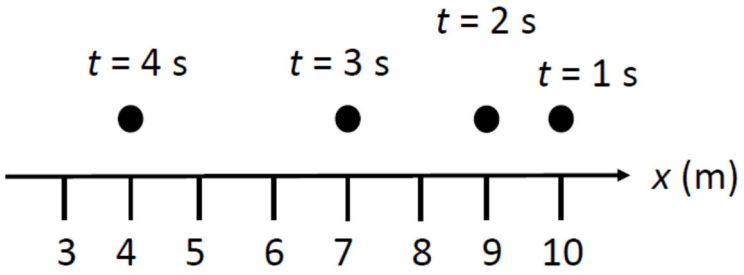
   A. The kinetic energy of the coin reaches a maximum value.
   B. The kinetic energy of the coin reaches a minimum value.
   C. The acceleration of the coin reaches a maximum value.
   D. The acceleration of the coin reaches a minimum value.

多項選擇題 (45 分)

1. 一個盒子在一斜面上以不變的非零加速度滑下。以下哪項描述是正確的?

   A. 斜面沒有任何力作用在盒子上。
   B. 作用在盒子上的淨力等於盒子的重量。
   C. 作用在盒子上的淨力小於盒子的重量。
   D. 作用在盒子上的淨力大於盒子的重量。

2. 下圖顯示一沿直線運動粒子的位置 *x* 跟時間 *t* 的關係。以下哪項描述是正確的?



   A. 粒子向正 x 方向加速。
   B. 粒子向負 x 方向加速。
   C. 粒子的速率在減少。
   D. 粒子的速率保持不變。

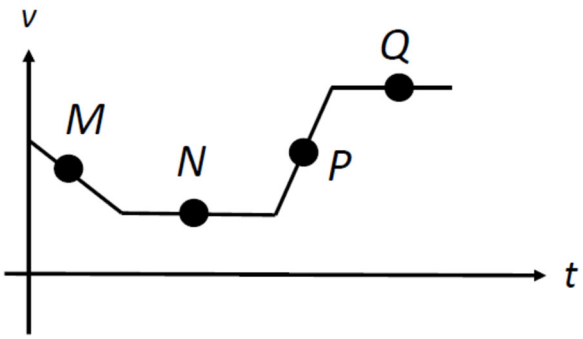
3. 一枚硬幣垂直地被拋起。在向上運動過程中，以下哪項關於硬幣加速度的描述是正確的? 你可以忽略空氣阻力。

   A. 它的量值在增加。
   B. 它的量值在減少。
   C. 它的方向向上。
   D. 它的方向向下。

4. 承上題，當硬幣達至最高點時，以下哪項描述是正確的?

   A. 硬幣的動能達至最大值。
   B. 硬幣的動能達至最小值。
   C. 硬幣的加速度達至最大值。
   D. 硬幣的加速度達至最小值。

5. The figure shows the velocity *v* of a particle as a function of time *t*. Which of the following statements about the net force acting on the particle is correct?



A. Its magnitude at *N* is smaller than that at *Q*.
B. Its magnitude at *Q* is larger than that at *M*.
C. Its magnitude at *P* is larger than that at *Q*.
D. Its direction remains unchanged during the motion.

6. If you are standing 1.5 metre in front of a plane mirror, the image of yourself that you see will be ___ metre(s) away from the mirror on the other side.

A. 0
B. 1
C. 1.5
D. 3

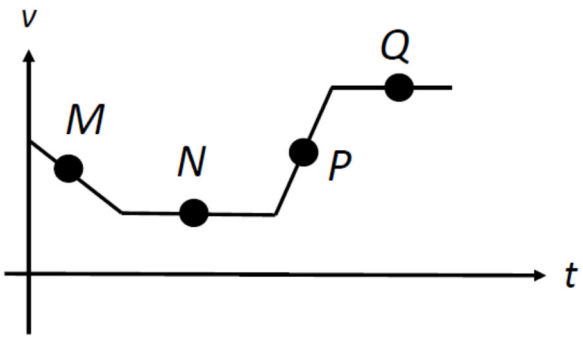
7. Which one of the following types of electromagnetic wave has the lowest frequency?

A. Gamma ray
B. Visible light
C. Radio wave
D. Microwave

8. When a beam of light passes from air to glass,

A. its frequency increases
B. its speed remains unchanged
C. its wavelength increases
D. its frequency remains unchanged

5. 下圖顯示一粒子的速度 *v* 跟時間 *t* 的關係。以下哪項關於作用在粒子的淨力是正確的?



A. 它在 *N* 點的量值少於 *Q* 點的量值。
B. 它在 *Q* 點的量值大於 *M* 點的量值。
C. 它在 *P* 點的量值大於 *Q* 點的量值。
D. 它的方向在運動過程中保持不變。

6. 若你站在一平面鏡前 1.5 米，你將看到鏡中自己的影像位於鏡後 ____ 米。

A. 0
B. 1
C. 1.5
D. 3

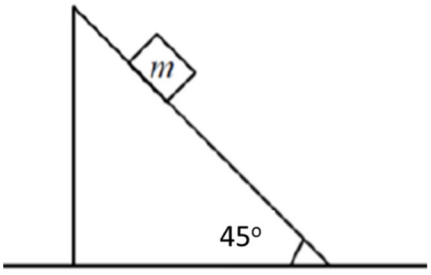
7. 以下哪一種電磁波的頻率最低?

A. 伽瑪射線
B. 可見光
C. 無線電波
D. 微波

8. 當一束光由空氣傳播到玻璃,

A. 它的頻率增加
B. 它的速度維持不變
C. 它的波長增加
D. 它的頻率維持不變

9. A block of mass m is sliding down along an inclined plane with a coefficient of kinetic friction μ=0.5. The inclination angle is 45°; the acceleration due to gravity is g. Find the acceleration of the block. (Hint: friction=μN)

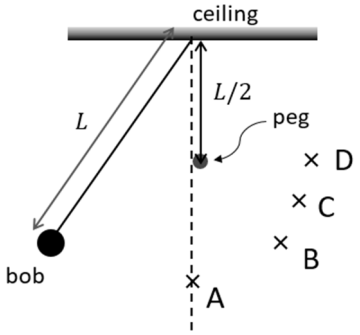


A. $\sqrt{2}g$
B. $g/\sqrt{2}$
C. $g/2$
D. $g/(2\sqrt{2})$

10. Two blocks are on a smooth horizontal surface. Initially, one of them has a mass of 0.6 kg is moving at a velocity v (to the right); the other block has a mass of 0.3 kg and is moving at a velocity 0.5 m/s (to the left). The two blocks collide and then move together at the same velocity 0.1 m/s (to the right). Neglect air resistance. Find the magnitude of v.

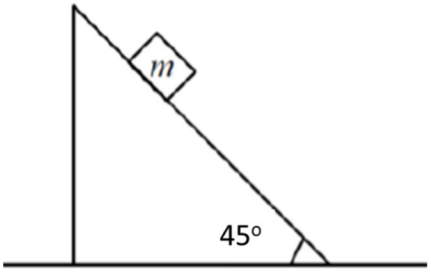
A. 0.2 m/s
B. 0.4 m/s
C. 0.6 m/s
D. 0.8 m/s

11. A student holds the bob of a simple pendulum, and releases it in the position in the following figure. There is a fixed peg in the way of the string. Which of the four points (A to D) best represents the location at which the bob is momentarily at rest?



A. A
B. B
C. C
D. D

9. 一個質量為 m 的方塊在一塊斜板表面(動摩擦係數 μ=0.5)下滑。斜板的傾斜角為 45º; 重力加速度為g。找出方塊下滑時的加速度。(提示:摩擦力= μN)

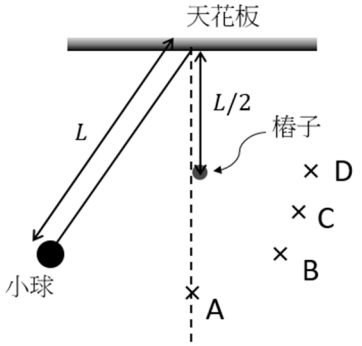


A. $\sqrt{2}g$
B. $g/\sqrt{2}$
C. $g/2$
D. $g/(2\sqrt{2})$

10. 有兩個方塊在平滑的平面上。起始時，其中一個方塊的質量為 0.6 kg 並且以速度 v 移動 (往右方); 另一個方塊的質量為 0.3 kg 並且以速度 0.5 m/s 移動(往左方)。兩個方塊發生碰撞然後共同以相同的速度 0.1 m/s 移動(往右方)。忽略空氣阻力。求 v 的量值。

A. 0.2 m/s
B. 0.4 m/s
C. 0.6 m/s
D. 0.8 m/s

11. 一學生持着一個簡單鐘擺的小球，在圖中顯示的位置放手。有一個固定的樁子阻礙繩子。小球在一個位置短暫地停止。下圖哪一點（A 至 D）最能表達該位置？



A. A
B. B
C. C
D. D

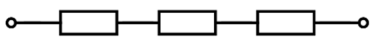
12. A feather of mass m falls down with a constant speed v. What is the net force acted on the feather?

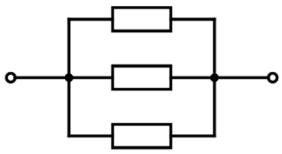
A. 0
B. mv
C. mg
D. $mv^2/2$

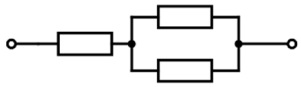
13. A ball is thrown vertically upward with an initial speed u. When it falls back to the original height, the final speed is v. Assume that the air resistance is not negligible. Which of the following statements about the two speeds is correct?

A. $v < u$
B. $v = u$
C. $v > u$
D. There is not enough information to make any conclusion about the two speeds.

14. Three identical resistors are connected by wires. Which of the following configurations has the smallest resistance across the two ends?

A. 

B. 

C. 

D. All three configurations lead to the same resistance across the two ends.

15. In an experiment, the positive and negative poles of a battery are connected to a saline solution. Which of the following statements best describes the experiment?

A. In the solution, all the ions move along the direction of the current.
B. In the solution, the electrons move along the direction of the current.
C. In the solution, the electrons move in the opposite direction of the current.
D. In the solution, some ions move in the direction of the current, some move in the opposite direction of the current.

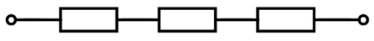
12. 一根質量為 m 的羽毛以固定速度 v 掉落。羽毛上的淨力是多少？

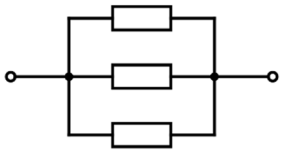
A. 0
B. mv
C. mg
D. $mv^2/2$

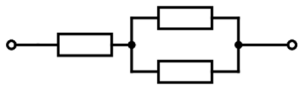
13. 一個球被向上垂直拋。其起始速度為 u。當球跌回本來的高度時，最後的速度為 v。假設不能忽略空氣阻力。以下哪一句關於這兩個速度的句子是正確的？

A. $v < u$
B. $v = u$
C. $v > u$
D. 沒有足夠的資料作任何關於這兩個速度的結論

14. 三個相同的電阻器以電線連接。以下哪一個方法連接，兩端之間的電阻最小？

A. 

B. 

C. 

D. 三個連接方法，兩端之間的電阻相同。

15. 在一個實驗裏，一個電池的正負極都連接到鹽溶液。以下哪一句句子最能描述這個實驗？

A. 在溶液裡，所有離子順着電流的方向移動。
B. 在溶液裡，電子順着電流的方向移動。
C. 在溶液裡，電子向電流相反的方向移動。
D. 在溶液裡，一些離子順着電流的方向移動，一些離子向電流相反的方向移動。

16. A solute weighed 1.5 g is dissolved in 3.0 g of solvent. The density of the resulting solution is measured as 1.5 g/ml. Calculate the concentration of the solution.

A. 0.4 g/ml
B. 0.5 g/ml
C. 0.8 g/ml
D. 1.5 g/ml

17. Consider following information of a molecule：
- The molecular formula is CO_2NH_3.
- The C, O and N atoms are connected in the following pattern: C~O~N~O, in which each "~" may be single, double, or triple bond.
- The molecule obeys the octet rule.

Which of the following is true for the above molecule?
(I) There are two N–O single bonds.
(II) There are one N–O single bond and one N=O double bond.
(III) The O atoms do **not** bond to any H atom.

A. (I) only
B. (II) only
C. (I) and (III) only
D. (II) and (III) only

18. It was once said that "lithium-6" was for sale in the market of a certain country. This news attracted considerable attention because lithium-6 is an important material for the nuclear reaction in hydrogen bomb. What does the number "6" in lithium-6 refers to?

A. The atomic number of lithium.
B. A mass number.
C. The number of lithium atoms in molecule Li_6.
D. The charge of the most common lithium cation.

16. 重量為 1.5 g 的溶質在 3.0 g 的溶劑中溶解，量出所得溶液的密度為 1.5 g/ml。計算該溶液的濃度。

A. 0.4 g/ml
B. 0.5 g/ml
C. 0.8 g/ml
D. 1.5 g/ml

17. 考慮以下一個分子的資料：

- 分子式是 CO_2NH_3。
- C、O 及 N 等原子依照以下方式連結：C~O~N~O，其中「~」會是單鍵、雙鍵或叁鍵。
- 該分子遵守八隅體規則。

對上述分子來說，以下何者正確？

(I) 有兩個 N–O 單鍵。
(II) 有一個 N–O 單鍵和一個 N=O 雙鍵。
(III) 兩個 O 原子都<u>沒有</u>跟任何 H 原子鍵合。

A. 只有 (I)
B. 只有 (II)
C. 只有 (I) 和 (III)
D. 只有 (II) 和 (III)

18. 據說「鋰-6」一度在某個國家的市場上出售。這消息引起相當的關注，因鋰-6 是氫彈內核反應的重要物料。在鋰-6 中的數字"6"所指為何？

A. 鋰的原子序。
B. 質量數。
C. 鋰原子在 Li_6 分子中的數目。
D. 最常見鋰陽離子的電荷。

19. Q, R, X, and Z are metal elements. To arrange their reactivities, a student carried out experiments and found that:
    (I) When metal Q is put into Z^{2+}(aq) solution, Z^{2+}(aq) ion is converted to metal Z.
    (II) When a mixture of oxide RO(s) and metal X is heated, metal R and oxide XO(s) are obtained.
    (III) Heating oxide ZO(s) gives metal Z. But there is no reaction when oxides RO(s) and XO(s) are heated separately.

    Among the following four ascending order of reactivities of these four metal elements, which one is **most likely** to be correct?

    A. R < Q < X < Z
    B. Z < Q < R < X
    C. Q < R < X < Z
    D. X < Q < Z < R

20. Assume elements A, B, C, and D can only form stable A^{2+}, B^{3+}, C^{-}, and D^{2-} ions, respectively. Which of the following chemical formulae for ionic compounds must be **wrong**?

    (I) $A_3C_2D_2$
    (II) A_2BD_4

    A. None of them
    B. (I) only
    C. (II) only
    D. All of them

21. Calculate the mass percentage of oxygen in $(NH_4)_2CO_3 \cdot H_2O$.

    A. 14%
    B. 42%
    C. 50%
    D. 56%

19. Q、R、X 及 Z 是金屬元素。為了把它們的活性排序，一名學生進行實驗並找出：

(I) 當把金屬 Q 放進 $Z^{2+}(aq)$ 溶液時，$Z^{2+}(aq)$ 離子轉化為金屬 Z。

(II) 把氧化物 RO(s) 與金屬 X 的混合物加熱，得到金屬 R 及氧化物 XO(s)。

(III) 把氧化物 ZO(s) 加熱得到金屬 Z。但當分別把氧化物 RO(s) 及 XO(s) 加熱時，卻沒有反應。

在以下四個關於這四個金屬活性的遞增次序中，何者**最有可能**是正確的？

A. R < Q < X < Z
B. Z < Q < R < X
C. Q < R < X < Z
D. X < Q < Z < R

20. 假設元素 A、B、C 和 D 分別只能生成穩定的 A^{2+}、B^{3+}、 C^{-} 和 D^{2-}離子。以下離子化合物的化學式，何者必定是錯誤的？

(I) $A_3C_2D_2$
(II) A_2BD_4

A. 以上皆非
B. 只有 (I)
C. 只有 (II)
D. 全部

21. 計算在$(NH_4)_2CO_3 \cdot H_2O$ 中，氧所佔的質量百分率。

A. 14%
B. 42%
C. 50%
D. 56%

22. In the following balanced chemical equation,

$$a\,X + b\,Y_3Z_4^{2-} \rightarrow c\,X^- + d\,YZ^- + e\,Z^{3+}$$

a, *b*, *c*, *d* and *e* are positive integers in simplest ratio [e.g., (*a*, *b*, *c*, *d*, *e*) = (1, 1, 2, 2, 3) are in simplest ratio, but (*a*, *b*, *c*, *d*, *e*) = (2, 2, 4, 4, 6) are not]. What is the value of *a*?

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

23. When excess magnesium (Mg) metal is burnt in limited air, a mixture of two products, X and Y, are formed. When water is added to this mixture, gas Z is produced from the reaction between Y and water. Which of the following is/are correct?

(I) Both X and Y are ionic compounds.
(II) Y is MgO.

A. None of them
B. (I) only
C. (II) only
D. All of them

24. The following three solutions were used in neutralization reactions:

Solution X: HCl(aq) solution, concentration: 0.6 g/mL
Solution Y: NaOH(aq) solution, concentration: unknown
Solution Z: HCl(aq) solution, concentration: unknown

Determine the concentration of solution Z based on the following results of neutralisation.

(I) 9.0 mL of solution X requires 15 mL of solution Y to neutralise.
(II) 21 mL of solution Z requires 27 mL of solution Y to neutralise.

A. 0.16 g/mL
B. 0.46 g/mL
C. 0.81 g/mL
D. 2.3 g/mL

22. 在以下已配平的化學方程式中，

$$a\,X + b\,Y_3Z_4^{2-} \rightarrow c\,X^- + d\,YZ^- + e\,Z^{3+}$$

a、*b*、*c*、*d* 和 *e* 是成最簡單比的正整數 [舉例：(*a*, *b*, *c*, *d*, *e*) = (1, 1, 2, 2, 3) 是成最簡單比，但(*a*, *b*, *c*, *d*, *e*) = (2, 2, 4, 4, 6) 則否]。 *a* 的值是多少？

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

23. 當過量的鎂 (Mg) 金屬在限量空氣中燃燒，生成兩個產物 X 和 Y 的混合物。當把水加進該混合物時， Y 與水的反應生成氣體 Z。 以下何者正確？

(I) X 與 Y 均是離子化合物。
(II) Y 是 MgO。

A. 以上皆非
B. 只有 (I)
C. 只有 (II)
D. 全部

24. 下列三個溶液用於中和反應：

溶液 X ： HCl(aq) 溶液，濃度： 0.6 g/mL
溶液 Y ： NaOH(aq) 溶液，濃度： 未知
溶液 Z ： HCl(aq) 溶液，濃度： 未知

根據下列各中和反應的結果，測定溶液 Z 的濃度。

(I) 9.0 mL 的溶液 X 需用 15 mL 的溶液 Y 中和。
(II) 21 mL 的溶液 Z 需用 27 mL 的溶液 Y 中和。

A. 0.16 g/mL
B. 0.46 g/mL
C. 0.81 g/mL
D. 2.3 g/mL

25. A scientist received a mixture of gases X (boiling point: 10 °C) and Y (boiling point: –10 °C) in a container. He carried out the following procedure to separate the two gases.

(I) The container was cooled in a mixture of ice and water.
(II) The gas portion was pumped out.
(III) The temperature of the container was changed so that the content remained in the container became gas.

Which gas was pumped out in Step (II) and how was the temperature of the container changed in Step (III)?

	Gas pumped out in Step (II)	***How the temperature was changed in Step (III)***
A.	X	Increased
B.	X	Decreased
C.	Y	Increased
D.	Y	Decreased

26. Which of the following gases is used in water purification process?

A. Chlorine
B. Fluorine
C. Hydrogen
D. Oxygen

27. “Methane ice” is a natural source of methane gas. Which one of the following statements about methane ice is correct?

A. Methane gas is trapped in ice.
B. Methane gas is liquified by ice.
C. Methane gas is frozen to solid state which has a structure of ice.
D. It is a mixture of ice and an organic compound which react with each other to form methane slowly.

25. 一名科學家收到一個盛載氣體 X (沸點： 10 °C) 和氣體 Y (沸點： –10 °C) 混合物的容器。他進行下列步驟來把這兩氣體分離。

(I) 用冰和水的混合物把容器冷卻。
(II) 泵走氣體部分。
(III) 改變容器的溫度，使在容器餘下的內含物變為氣體。

在步驟 (II) 泵走了哪個氣體，以及在步驟 (III) 怎樣改變容器的溫度？

	在步驟 (II) 泵走的氣體	***在步驟 (III) 溫度如何改變***
A.	X	提升
B.	X	降低
C.	Y	提升
D.	Y	降低

26. 在淨水過程中使用以下哪個氣體？

A. 氯
B. 氟
C. 氫
D. 氧

27. 「甲烷冰」是甲烷氣體的天然資源。以下哪一項關於甲烷冰的陳述是正確的？

A. 甲烷氣體被困在冰中。
B. 甲烷氣體被冰液化。
C. 甲烷氣體被冷凍為具冰結構的固體。
D. 這是冰與一個有機化合物的混合物，彼此緩慢反應生成甲烷。

28. Once upon a time in Hong Kong, bleaching water was out of stock in market. Hence, there was a proposal for producing bleaching water at home by electrolysis of saturated salt water. What is/are the disadvantage(s) of this method?

(I) It produces a gas which is harmful to human body.
(II) It needs expensive raw material(s).
(III) It needs dangerously high electrical voltage.

A. (I) only
B. (II) only
C. (I) and (III) only
D. (II) and (III) only

29. It is known that the chemical reaction between 200 g of element X and 600 g of element Y results in compound Z with 200 g of Y left. Based on the above information, the chemical reaction between 600 g of element X and 200 g of element Y will result in compound Z with

A. 200 g of X left.
B. 300 g of X left.
C. 400 g of X left.
D. 500 g of X left.

30. Consider the following reaction:

$$\mathbf{NaOH(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)}$$

Which of the following can decrease the reaction rate?

(I) Using HCl(aq) of lower temperature
(II) Using HCl(aq) with higher concentration
(III) Using finer solid of NaOH(s)

A. (I) only
B. (II) only
C. (I) and (III) only
D. (II) and (III) only

28. 香港市面上的漂白水曾一度缺貨，因此有人提出在家居電解飽和鹽水來製造漂白水的建議。這個方法有什麼缺點？

(I) 它會產生對人體有害的氣體。
(II) 它需要昂貴的原料。
(III) 它需要危險的高電壓。

A. 只有 (I)
B. 只有 (II)
C. 只有 (I) 和 (III)
D. 只有 (II) 和 (III)

29. 已知 200 g 的元素 X 與 600 g 的元素 Y 起化學反應得到化合物 Z，並餘下 200 g 的 Y。 根據以上資料，600 g 的元素 X 與 200 g 的元素 Y 起化學反應得到化合物 Z，並

A. 餘下 200 g 的 X。
B. 餘下 300 g 的 X。
C. 餘下 400 g 的 X。
D. 餘下 500 g 的 X。

30. 考慮以下反應：

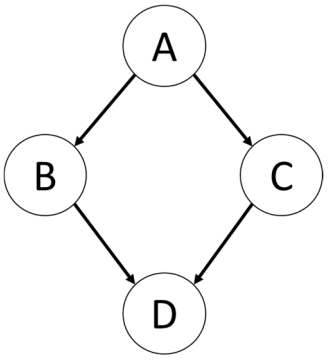
$$NaOH(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$$

下列何者能降低反應速率？

(I) 使用溫度較低的 HCl(aq)
(II) 使用濃度較高的 HCl(aq)
(III) 使用較細碎的 NaOH 固體

A. 只有 (I)
B. 只有 (II)
C. 只有 (I) 和 (III)
D. 只有 (II) 和 (III)

Answer **Q31** and **Q32** based on the diagram below showing a food web observed in a terrestrial habitat.



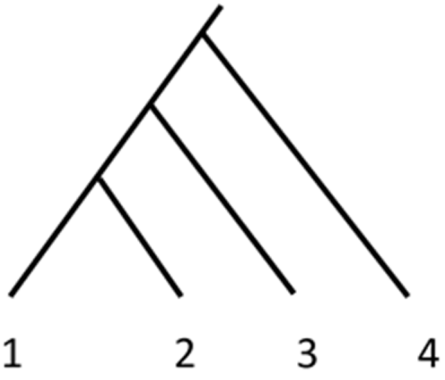
31. Shortly after organism B is removed from the habitat, which of the following is most likely to happen?

A. Biomass of C drops.
B. Biomass of A increases.
C. Biomass of C increases.
D. Biomass of D increases.

32. Given that B and C are mammals which each individual is more than 20kg while the number of A is much less than the sum of B and C, A can be a species of

A. giant brown alga.
B. herbaceous plant.
C. tree.
D. more than one of the above.

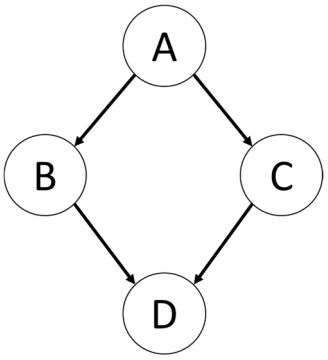
33. Below shows an evolutionary tree in which 1-4 are four living organisms.



Which of the following combinations is **incorrect**?

	1	***2***	***3***	***4***
A.	Human	Chimpanzee	Fruit fly	Jawless fish
B.	Bird	Crocodile	Turtle	Frog
C.	Chimpanzee	Human	Fruit fly	Bacterium
D.	Chicken	Pigeon	Turtle	Shark

根據下圖，回答 **Q31** 和 **Q32**。下圖顯示某陸上生境的一個食物網。



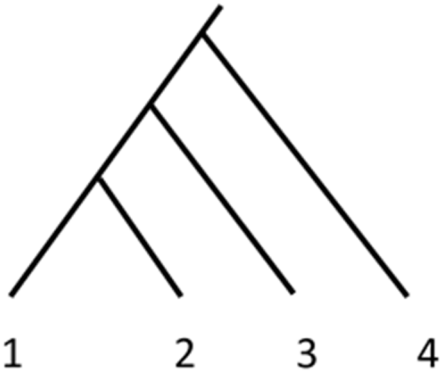
31. 生物 B 由這個生境被移除後不久，以下哪項會最可能發生?

A. C 的生物量減少。
B. A 的生物量增加。
C. C 的生物量增加。
D. D 的生物量增加。

32. 已知 B 和 C 是哺乳動物，各自的重量超過 20kg。A 的數目則遠少於 B 和 C 的數目總和，A 的物種可以是

A. 巨型褐藻。
B. 草本植物。
C. 樹。
D. 多於以上一類的物種。

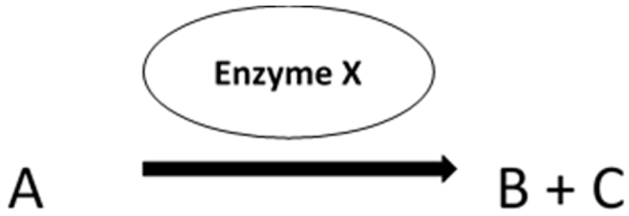
33. 以下顯示四種生物的進化樹。



以下哪項組合是**不正確**的?

	1	***2***	***3***	***4***
A.	人類	黑猩猩	果蠅	無頷魚
B.	鳥類	鱷	龜	蛙
C.	黑猩猩	人類	果蠅	細菌
D.	雞	鴿	龜	鯊

Answer **Q34** and **Q35** based on the information below:



Enzyme X is found in human livers. To study its enzymatic activity, a student mixed 1g of A with a fixed amount of Enzyme X, and then incubated the mixture under different temperatures. After 30 minutes of incubation, the student measured the amount of remaining A. The experiment was repeated for three times and the result is shown in the below table.

Temperature (°C)	Amount of A (g)			
	Exp 1	Exp 2	Exp 3	mean
20	0.70	0.72	0.62	0.68
30	0.50	0.40	0.35	0.42
40	0.65	0.55	0.45	0.55
50	0.80	0.92	0.84	0.85
60	1.00	1.00	1.00	1.00

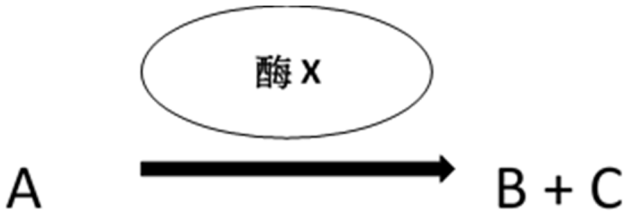
34. Based on the data, which of the following conclusions is/are valid?
    (I) Enzyme X is a protein which denatures at 60°C.
    (II) Enzyme X works best under 60°C.
    (III) The rate of reaction decreased up to 30°C.
    (IV) The rate of reaction increased up to 30°C.

    A. (I) and (III) only.
    B. (I) and (IV) only.
    C. (II) and (III) only.
    D. (II) and (IV) only.

35. Which of the following is/are the purpose(s) for repeating the experiment?

    A. To reduce the impact of experimental error.
    B. To allow the use of statistical analysis to evaluate the reliability of the data.
    C. To practise the experimental skills.
    D. A and B.

根據以下資料，回答 **Q34** 和 **Q35**。



酶 X 見於人類的肝臟，為探究它的活性，一名學生將 1g 物質 A 與定量的酶 X 混合，然後將混合物置於不同溫度下進行反應。經過 30 分鐘的反應後，該名學生量度物質 A 餘下的質量。該實驗重覆三次，結果如下表所示。

溫度 (ºC)	物質 A 的質量(g)			
	實驗 1	實驗 2	實驗 3	平均值
20	0.70	0.72	0.62	0.68
30	0.50	0.40	0.35	0.42
40	0.65	0.55	0.45	0.55
50	0.80	0.92	0.84	0.85
60	1.00	1.00	1.00	1.00

34. 基於實驗數據，以下結論是正確的?

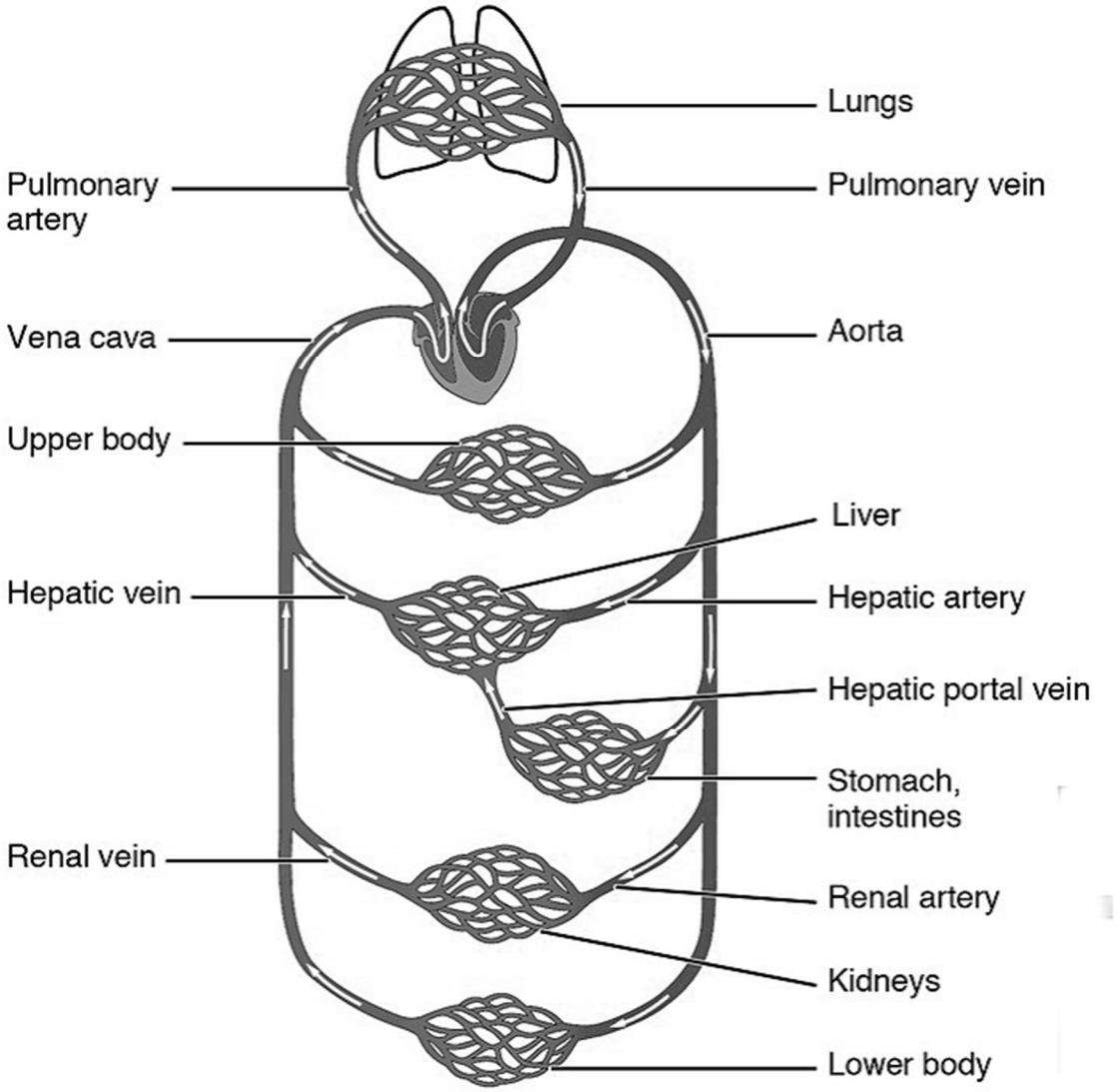
(I) 酶 X 是蛋白質，在 60ºC 時會變性。
(II) 酶 X 在 60ºC 時發揮最佳作用。
(III) 反應速率下降，直至 30ºC 時為止。
(IV) 反應速率上升，直至 30ºC 時為止。

A. 只有 (I) 和 (III)。
B. 只有 (I) 和 (IV)。
C. 只有 (II) 和 (III)。
D. 只有 (II) 和 (IV)。

35. 以下哪項是重覆該實驗的目的?

A. 減低實驗誤差的影響。
B. 以統計分析的方法來評估數據的可靠性。
C. 練習實驗技巧。
D. A 和 B.

Answer **Q36** and **Q37** based on the below diagram, which shows the blood circulation in human body.



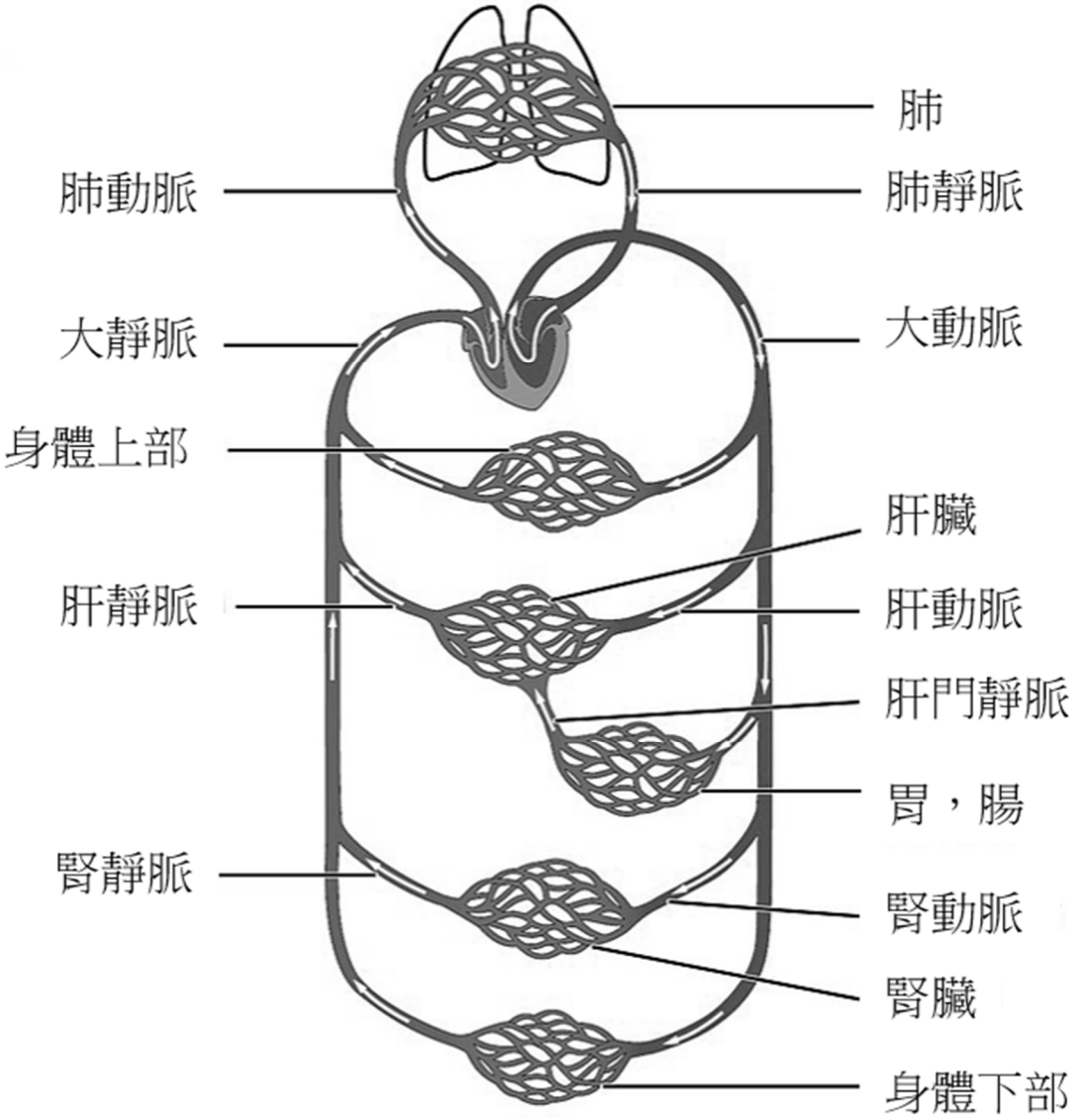
36. Shortly after drinking a glass of fruit juice, which of the following is **correct**?

	Highest concentration of CO_2	***Highest level of glucose***
A.	Pulmonary artery	Aorta
B.	Pulmonary vein	Hepatic vein
C.	Pulmonary artery	Hepatic portal vein
D.	Vena cava	Hepatic portal vein

37. Which of the following blood vessel(s) has/have the thickest wall?

A. Aorta only.
B. Vena cava only.
C. Pulmonary artery.
D. Aorta and Vena cava.

根據下圖，回答 **Q36** 和 **Q37**。下圖顯示人體的血液循環系統。



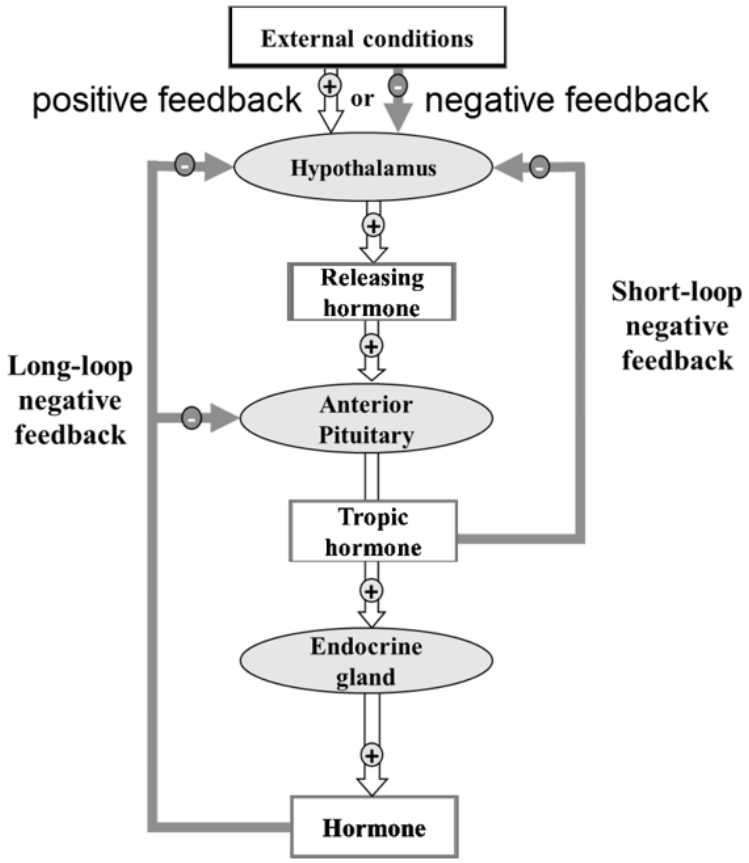
36. 飲用一杯果汁後不久，以下哪項是**正確**的?

	CO_2 濃度最高	**葡萄糖濃度最高**
A.	肺動脈	大動脈
B.	肺靜脈	肝靜脈
C.	肺動脈	肝門靜脈
D.	大靜脈	肝門靜脈

37. 以下哪血管具有最厚的壁?

A. 只有大動脈
B. 只有大靜脈
C. 肺動脈
D. 大動脈和大靜脈

Answer **Q38** and **Q39** based on the figure below which shows the metabolic control of various hormones by the hypothalamus via feedback reactions. The "+" and "-" signs on the arrows signifies positive and negative feedback reaction, respectively. In a positive feedback loop, the output of the system amplifies the system reactions, while the output of a negative feedback loop inhibits the system reactions.



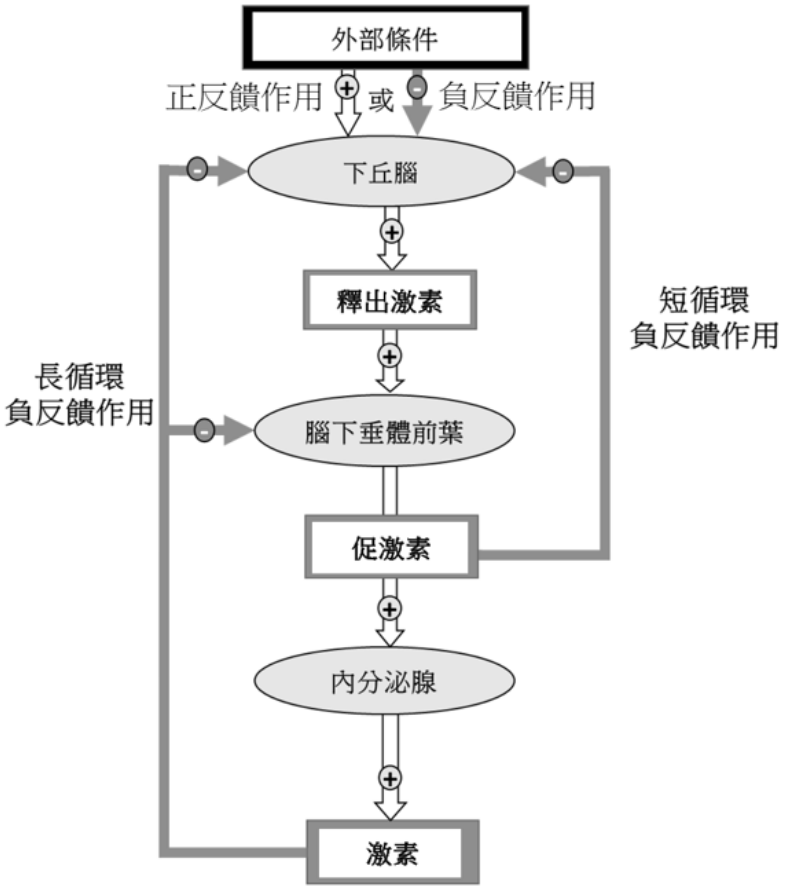
38. Which of the following statements is **FALSE**?

A. The presence of short-loop negative feedbacks can effectively minimise the amount of materials (and hence energy) utilized.
B. The presence of both short-loop and long-loop negative feedbacks allows temporal control on the amount of a particular hormone being produced.
C. The presence of both short-loop and long-loop negative feedbacks prevents any fluctuations in the amount of a particular hormone being produced.
D. All the statements given above are true.

39. In mammals, which of the following external conditions is the least-likely condition which may trigger seasonal changes in hormone production?

A. Temperature.
B. Light-dark cycle.
C. Humidity.
D. Food availability.

根據下圖，回答 **Q38** 和 **Q39**。下圖顯示下丘腦通過反饋作用對來控制不同激素的代謝。箭咀上的“+”和“-”符號分別表示正反饋和負反饋作用。在正反饋循環中，系統的產物會擴增系統的反應；在負反饋循環中，系統的產物會抑制系統的反應。



38. 以下哪項陳述是**不真確**的?

A. 負反饋短循環能有效地利用最少份量的物料 (因此能量也如是) 。
B. 負反饋短循環和負反饋長循環同時存在，得以即時控制特定激素產生的份量。
C. 負反饋短循環和負反饋長循環同時存在，防止特定激素產生的份量出現波動。
D. 以上所有陳述均是真確的。

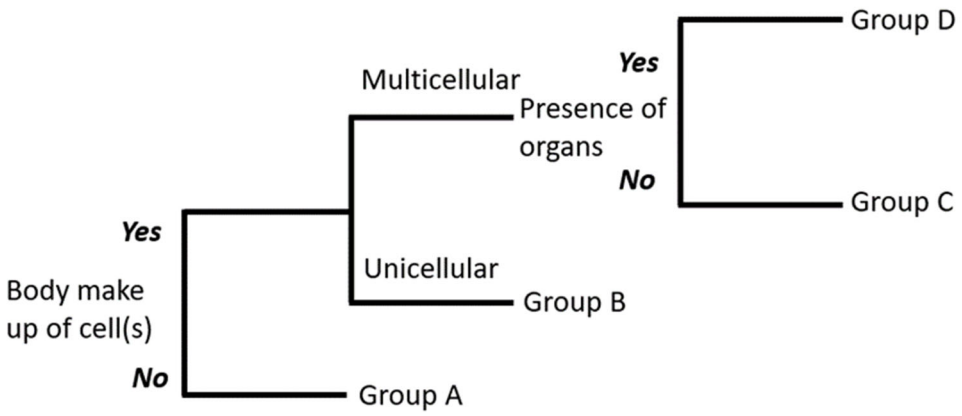
39. 以下哪項外部條件是最少機會觸發哺乳動物的激素生產出現季節性的變化?

A. 溫度。
B. 光-暗循環。
C. 濕度。
D. 食物供應。

40. There were multiple mass extinction events in the history of life on Earth. For example, a mass extinction event could be caused by a volcanic eruption that greatly increased the atmospheric concentration of a toxic gas such as sulfur dioxide. According to the concept of evolution, individuals which possess the ability to deal with the toxic gas will be able to survive the extinction event. Which of the evolutionary forces given below would be the key driving force for the spread of resistance to the toxic gas among survivors of the catastrophic event?

A. Mutation
B. Gene flow
C. Selection
D. Recombination

41. Which of the following statements regarding the different groups of organisms as shown in the diagram below is TRUE?



A. Organisms from Group A are exclusively parasites.
B. Organisms from Group B do not have organelles.
C. Organisms from Group C are usually sessile.
D. Organisms from Group D possess organs which are usually multi-functional.

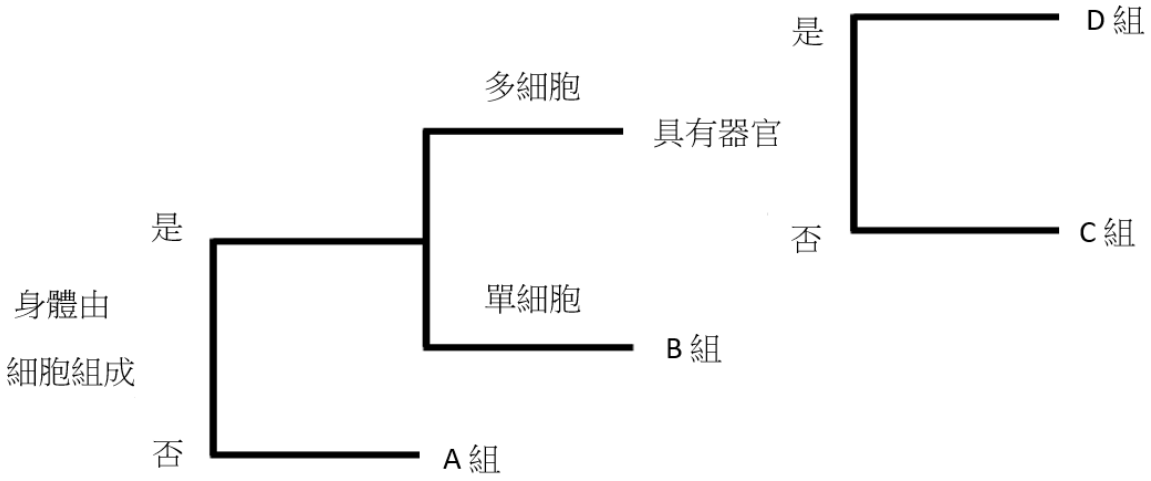
42. In some deep sea fish, individuals may have functional sex organs of both sexes at the same time, and this phenomenon is known as simultaneous hermaphroditism. Which of the following statements is the best explanation for this phenomenon?

A. The extremely high static pressure in the deep sea environment induced mutational changes so that sex organs of both sexes are produced.
B. Population density is extremely low in the deep sea.
C. Being capable of serving as either a male or female will allow individuals to find a mate easier in the absence of light.
D. Reproduction is self-sufficient when every individual can fertilize their own eggs.

40. 地球的生物史上曾有多次的大滅絕事件，例如火山爆發可導致大滅絕，因為火山爆發會大幅增加大氣中有毒氣體(例如二氧化硫)的濃度。根據演化的概念，有能力應付有毒氣體的個體，將能夠在大滅絕中存活。在該次災難性事件的倖存者中，以下哪項的進化力量最有可能使對有毒氣體的抗性得以散佈?

A. 突變
B. 基因流勤
C. 選擇
D. 重組

41. 就下圖所示的不同生物的組別，以下哪項陳述是**真確**的?



A. A 組生物全是寄生生物 。
B. B 組生物沒有細胞器。
C. C 組生物通常是固著的。
D. D 組生物的器官，通常是多功能的。

42. 某些深海魚類的個體同時具有功能正常的雌雄性器官，這種現象稱為同時雌雄同體。以下哪項陳述是這個現象的最佳解釋?

A. 深海環境的極端高壓力誘導魚類出現突變，產生兩種性別的性器官。
B. 深海中種群密度極低。
C. 魚能成為雄性或雌性的個體，令牠們在沒有光的情況下較容易找到交配對象。
D. 每一個體都能令自己的卵子受精，令生殖過程能自我完成。

43. Vertical zonation, a phenomenon in which different species settles at different tidal heights, is typically seen in tropical rocky shores. Which of the following statements regarding the formation of distinct banding of organisms in rocky shores is FALSE?

A. The upper limit of distribution of organisms is influenced by physical factors such as temperature or dehydration.
B. The lower limit of distribution of organisms is influenced by predation or grazing activities.
C. Competition among organisms exists throughout the entire height of distribution.
D. All the above statements are true.

44. Two experiments were conducted to investigate the effect of light intensity and CO_2 concentration on plant growth. In the first experiment, a plant is grown at varying level of light and in a certain fixed concentration of CO_2.Oxygen production increases with increasing light intensity up to a point and then levels off. In the second experiment, the same conditions of increasing light intensity is maintained, but under a higher level of CO_2. Oxygen production in the second experiment continues to increase beyond the point where it levelled off in the first experiment. From these observations, one might conclude:

A. CO_2 concentration is the only limiting factor.
B. Light intensity is the only limiting factor.
C. Both light intensity and CO_2 concentration are limiting factors throughout the time course of the reaction.
D. Light intensity is limiting up to a point and then CO_2 becomes a limiting factor.

45. In the experiments conducted in the question above, light intensity and CO_2 concentration are the independent variables, while other parameters such as water supply, humidity, air movement, and incubation temperature etc. are controlled variables. If light intensity and CO_2 concentration are kept constant, which of the following conditions would most likely affect the rate of oxygen production by the plant?

A. Incubation at 10^{o}C below the original temperature.
B. Lack of air movement.
C. Reduced oxygen concentration in air.
D. Increased oxygen concentration in air.

End of Paper

43. 垂直成帶，是指不同物種棲息於不同的潮汐高度，是熱帶岩岸的典型可觀現象。就岩岸生物明顯的成帶分佈，以下哪項陳述是**不真確**的?

A. 生物分佈的上限高度受物理因素(例如溫度和脫水)影響。
B. 生物分佈的下限高度受捕食作用或攝食活動影響。
C. 分佈於整個潮汐高度的生物之間均存在競爭。
D. 以上所有陳述均是真確的。

44. 為探究光強度和 CO_2 濃度對植物生長的效應，進行兩項實驗。在第一項實驗中，植物置於不同光強度但固定的 CO_2 濃度下生長，氧的產量隨光強度增加而上升，直至某一數值然後保持水平。在第二項實驗中，採用相同的光強度增加的方案，但 CO_2 濃度較高；這時，氧的產量在到達首個實驗的最高水平後，仍繼續上升。基於這些觀察所得，可得到的結論是:

A. CO_2 濃度是唯一的限制因素。
B. 光強度是唯一的限制因素。
C. 在整個反應的時程中，光強度和 CO_2 濃度均是限制因素。
D. 光強度為限制因素，當光強度增加至某水平時， CO_2 濃度隨後成為限制因素。

45. 在上題所進行的實驗中，光強度和 CO_2 濃度是獨立變項，其他參數如供水量、濕度、氣流和溫度等，都是控制變項。若光強度和 CO_2 濃度保持不變，以下哪項狀況會最可能影響植物產生氧的速率?

A. 温度降低 10°C。
B. 缺乏空氣流動。
C. 減少氧氣濃度。
D. 增加氧氣濃度。

全卷完

香 港 資 優 教 育 學 苑
The Hong Kong Academy for Gifted Education

International Junior Science Olympiad 2023 – Hong Kong Screening

Multiple Choice Questions (45 marks)

1. C	16. B	31. B
2. B	17. D	32. C
3. D	18. B	33. A
4. B	19. B	34. B
5. C	20. C	35. D
6. C	21. D	36. C
7. C	22. B	37. A
8. D	23. B	38. C
9. D	24. B	39. C
10. B	25. C	40. C
11. B	26. A	41. A
12. A	27. A	42. B
13. A	28. A	43. D
14. B	29. D	44. D
15. D	30. A	45. A