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

# International Junior Science Olympiad 2020 - 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: +1.00 points
   Wrong answer: -0.33 points
   No answer: 0.00 point

4. Questions are in bilingual version.

5. Put your answers on the MC Answer Sheet.

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

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

Co-organised by The Hong Kong Academy for Gifted Education,
the Gifted Education Section of the Education Bureau, 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

# 2020 國際初中科學奧林匹克 – 香港選拔賽

**學生守則：**

問題簿

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: +1.00 分
   答錯: -0.33 分
   沒有作答: 0.00 分

4. 題目中英對照。

5. 請把答案填畫在多項選擇題答題紙上適當的位置。

6. 每題只可填畫一個答案，並請選擇最適當的答案。若填畫多個答案，則該題被視作答錯。

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

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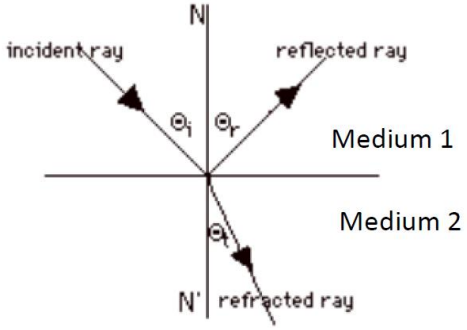
## Multiple Choice Questions (45 marks)

1. An object moving with a constant acceleration (greater than zero) along a horizontal path covers the distance between two points 60 m apart in 6 s. Its speed as it passes the second point is 15 m/s. What is the speed of the object at the first point?

   A. 0 m/s
   B. 5 m/s
   C. 10 m/s
   D. 12 m/s

2. Consider reflection and refraction of an incident ray at a plane boundary as shown in the following diagram:




   Which of the following statement(s) is (are) correct?

   (I) The angle of incidence $\theta_i$ must be the same as the angle of reflection $\theta_r$.
   (II) The refractive index of Medium 2 is greater than that of Medium 1.
   (III) The angle of refraction (transmission) $\theta_t$ may be 90° for some values of $\theta_i$.

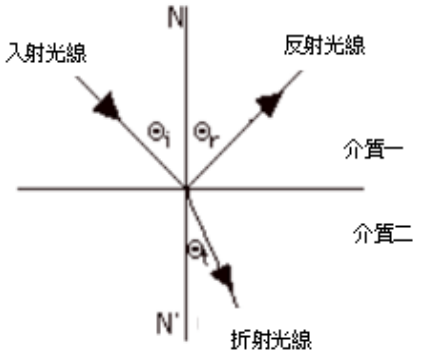
   A. (I) only
   B. (II) only
   C. (I) and (II) only
   D. all of them

## 多項選擇題 (45 分)

1. 一物體以恆加速度（大於零）沿一水平路徑直線前進，並於 6 秒間經過兩定點間 60 米的距離。已知該物體經過第二定點時的速率為 15 米/秒，那麼該物體經過第一定點時的速率是多少？

   A. 0 米/秒
   B. 5 米/秒
   C. 10 米/秒
   D. 12 米/秒

2. 根據下圖，考慮入射光線在平坦介面的反射及折射情況：




   以下哪個陳述是正確的？
   (I) 入射角度 $\theta_i$ 必定相等於反射角度 $\theta_r$。
   (II) 介質二的折射率大於介質一的折射率。
   (III) 在某些入射角度 $\theta_i$ 下，折射角度（透射角度）$\theta_t$ 可達 90°。

   A. 只有(I)
   B. 只有(II)
   C. 只有(I)及(II)
   D. 全部正確

3. An object of mass m = 2kg is moving in uniform circular motion on a horizontal frictionless plane. The radius of the circular path is 0.4 m and the speed of the object is 2.0 m/s. What is the magnitude of the acceleration of the object?

   A. 5.0 $m/s^2$
   B. 10.0 $m/s^2$
   C. 15.0 $m/s^2$
   D. 20.0 $m/s^2$

4. Rank the following electromagnetic waves according to their wavelengths (from the shortest to the longest).

   (I) Infrared
   (II) Ultraviolet
   (III) Microwave

   A. (I), (II), (III)
   B. (II), (III), (I)
   C. (II), (I), (III)
   D. (III), (I), (II)

5. An object of weight 2 N is pulled up an inclined smooth plane with constant velocity. If the pulling force is 1.5 N, what is the angle between the inclined plane and the horizontal?

   A. 48.6 °
   B. 41.4 °
   C. 67.5 °
   D. 22.5 °

6. A coin is thrown vertically upward. During the upward motion of the coin,

   A. the speed of the coin is increasing.
   B. the acceleration of the coin is increasing.
   C. the speed of the coin remains unchanged.
   D. the acceleration of the coin remains unchanged.

3. 一質量為 2 千克的物體在在水平平滑面上進行勻速圓周運動，圓形路徑的半徑為 0.4 米，物體速度為 2.0 米/秒，那麼物體的加速量值是多少？

   A. 5.0 米/秒 $^2$
   B. 10.0 米/秒 $^2$
   C. 15.0 米/秒 $^2$
   D. 20.0 米/秒 $^2$

4. 依據波長長短，排列下列電磁波（由最短至最長）。

   (I) 紅外線
   (II) 紫外線
   (III) 微波

   A. (I), (II), (III)
   B. (II), (III), (I)
   C. (II), (I), (III)
   D. (III), (I), (II)

5. 一重量為 2 牛頓的物體以恆速度沿一平滑斜坡上拉，若上拉力為 1.5 牛頓，那麼斜波與平面的角度是多少？

   A. 48.6°
   B. 41.4°
   C. 67.5°
   D. 22.5°

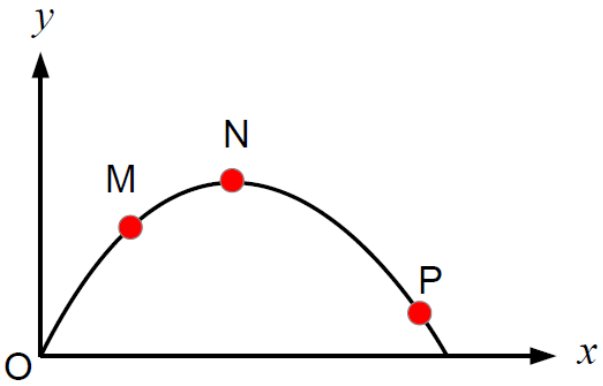
6. 一枚硬幣從地面垂直地被向上拋起。硬幣在向上的運動過程中，

   A. 它的速率增加。
   B. 它的加速度增加。
   C. 它的速率保持不變。
   D. 它的加速度保持不變。

7. A dog sits at rest inside an elevator which is accelerating upward. The magnitude of force that the elevator floor exerts on the dog

   A. is smaller than the weight of the dog.
   B. is equal to the weight of the dog.
   C. is larger than the weight of the dog.
   D. and the weight of the dog is an action-reaction pair.

8. A ball is kicked from ground level at the coordinate origin O. The figure shows the path of the ball. Rank the points M, N, and P on the path according to the kinetic energy of the ball at these points. You can ignore the effect of air resistance.




   A. M = N = P
   B. M > P > N
   C. P > M > N
   D. N > M > P

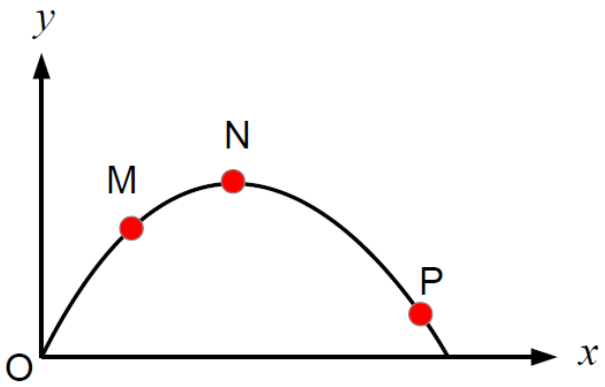
9. Referring to the above question, rank the points M, N, and P on the path according to the potential energy of the ball at these points.

   A. M = N = P
   B. M > P > N
   C. P > M > N
   D. N > M > P

7. 一隻小狗靜坐在一架向上加速的電梯內。電梯地面給予小狗的力的量值

A. 小於小狗的重量。
B. 跟小狗的重量同樣大小。
C. 大於小狗的重量。
D. 跟小狗的重量組成一對作用力和反作用力。

8. 一個皮球從地面的座標原點 O 被踢出。下圖顯示皮球的軌跡。請將皮球軌跡上的 M，N 和 P 點依據皮球在這些點上的動能排列。你可以忽略空氣阻力影響。




A. M = N = P
B. M > P > N
C. P > M > N
D. N > M > P

9. 參照上述問題，請將皮球軌跡上的 M，N 和 P 點依據皮球在這些點上的勢能排列。

A. M = N = P
B. M > P > N
C. P > M > N
D. N > M > P

10. An object slides down a smooth inclined plane. Which of the following is correct?

    A. The net force acting on the object is increasing during the motion.
    B. The velocity and acceleration of the object are increasing.
    C. The velocity and acceleration of the object are decreasing.
    D. The force that the plane exerts on the object remains unchanged.

11. Block X is denser than block Y, whereas block Y has a larger volume than block X. If the two blocks are released from rest from the same height from the top of a smooth inclined plane, and they slide down the slope, which of them arrives the bottom first?

    A. Block X
    B. Block Y
    C. They arrive at the same time
    D. The answer depends on the ratio of densities and the ratio of the volumes

12. An asteroid moves in a circular orbit around the Earth, and the orbital radius is about twice of the lunar distance. Which among the speed of the asteroid and the speed of the moon is larger?

    A. The speed of the asteroid is larger
    B. The speed of the moon is larger
    C. Their speeds are the same
    D. The answer depends on the mass and distance of the asteroid

10. 一物件在一光滑的斜面上滑下。以下哪項是正確的?

A. 作用在物件上的淨力在運動過程中增加。
B. 物件的速度和加速度增加。
C. 物件的速度和加速度減小。
D. 斜面作用在物件上的力保持不變。

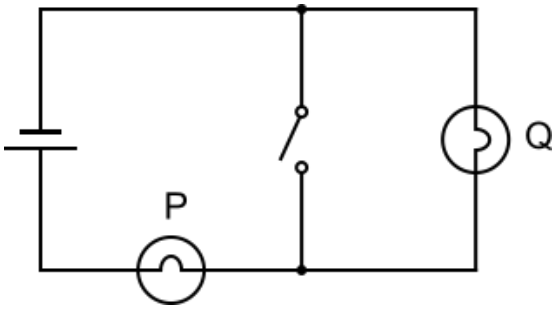
11. 盒子 X 的密度比盒子 Y 高，而盒子 Y 的體積則比盒子 X 大。兩個盒子均由靜止狀態自同一高度的光滑斜面頂部滑下，哪一個盒子先到達斜面底部？

A. 盒子 X
B. 盒子 Y
C. 它們同時到達
D. 答案決定於盒子的密度比和體積比

12. 一個小行星以圓形軌道環繞地球移動。軌道半徑約為月球距離的兩倍。小行星的速度和月球速度比較，哪一個比較大？

A. 小行星的速度較大
B. 月球的速度較大
C. 它們的速度一樣
D. 答案決定於小行星的質量和距離

13. There are two identical light bulbs (P and Q), a switch, and a battery in the following circuit. The switch is initially opened. How do the brightnesses of P and Q change if the switch is closed?




A. P becomes brighter, the brightness of Q drops to zero
B. P becomes brighter, Q becomes brighter
C. P becomes dimmer, the brightness of Q drops to zero
D. P becomes dimmer, Q becomes brighter

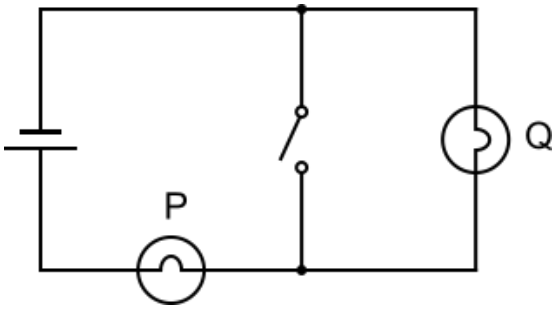
14. Assume air resistance is NOT negligible. A stone is thrown vertically upward with a speed $v$. What is the speed of the stone when it falls back to the original height?

A. Larger than $v$
B. Smaller than $v$
C. Equal to $v$
D. The answer depends on the mass and size of the stone

15. A student connects a power supply to a thin metal wire, and the wire starts to glow. Which of the following statements is correct regarding the experiment?

A. Electrons jump from the metal wire into the eyes of the student.
B. If the current is larger, the wire is dimmer.
C. If the wire is cut into two halves, and only one of the halves is connected to the power supply, the connected wire is dimmer.
D. When the power supply is switched on, the temperature of the wire increases.

13. 以下的電路中有兩個相同的電燈泡(P 和 Q)、一個開關定好和一個電池。開關的起始狀態為開啟。關閉開關後，P 和 Q 的光度如何變化？




A. P 變得較光，Q 的光度跌至零
B. P 變得較光，Q 變得較光
C. P 變得較暗，Q 的光度跌至零
D. P 變得較暗，Q 變得較光

14. 假設空氣阻力不可忽略。一塊石頭被人以速度 $v$ 垂直向上投擲。石頭跌回原來的高度時，速度是多少？

A. 比 $v$ 大
B. 比 $v$ 小
C. 等於 $v$
D. 答案決定於石頭的質量和大小

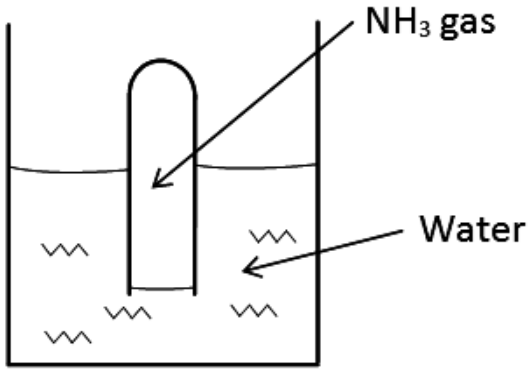
15. 一個學生把電源連接一條幼金屬線，金屬線便開始發光。以下哪句關於這個實驗的句子正確？

A. 電子從金屬線跳出，進入學生的眼睛。
B. 如果電流加強，金屬線會變得較暗。
C. 如果金屬線被分為兩份，只有其中一份連上電源，連上電源的金屬線會變得較暗。
D. 當電源開啟，金屬線的溫度上升。

16. A solute weighed 1.2 g is dissolved in 2.4 g of solvent. The density of the resulting solution is measured as 1.2 g/ml. Calculate the concentration of the solution.

A. 0.4 g/ml
B. 0.8 g/ml
C. 1.2 g/ml
D. It cannot be calculated because the densities of the solute and solvent are not given.

17. A test tube containing ammonia ($NH_3$) gas was inverted and inserted into water as shown below.




After that, the ammonia gas dissolved and then the following three changes occurred.

(I) The volume of the gas decreased.
(II) The number of the gas molecules decreased.
(III) The pressure of the gas decreased.

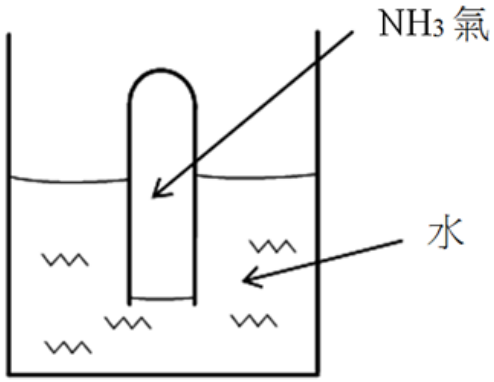
Which of the following is the correct sequence of the changes?

A. (I)→(II)→(III)
B. (I)→(III)→(II)
C. (II)→(I)→(III)
D. (II)→(III)→(I)

16. 質量為 1.2 g 的溶質在 2.4 g 的溶劑中溶解，量出所得溶液的密度為 1.2 g/ml。計算該溶液的濃度。

A. 0.4 g/ml
B. 0.8 g/ml
C. 1.2 g/ml
D. 由於沒有給出這溶質及這溶劑的密度，所以無法計算。

17. 將一枝盛有氨($NH_3$)氣的試管倒轉並插入水中，如下所示：




跟著氨氣溶解，然後發生下列三項變化。

(I) 氣體的體積減小。
(II) 氣體分子的數目減少。
(III) 氣體的壓強下降。

以下何項是該些變化的正確次序？

A. (I)→(II)→(III)
B. (I)→(III)→(II)
C. (II)→(I)→(III)
D. (II)→(III)→(I)

18. Which of the following is/are appropriate method(s) to collect ammonia ($NH_3$) gas?

(I) Upward delivery (downward displacement of air)
(II) Downward delivery (upward displacement of air)
(III) Over water (displacement of water)

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

19. Which of the following chemical species may obey the octet rule?

(I) NO
(II) $N_2O$
(III) $NO_2$

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

20. Which of the following is/are involved in $NH_4Cl$?

(I) Hydrogen bond
(II) Covalent bond
(III) Ionic bond

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

18. 以下何者是收集氨($NH_3$)氣的適當方法？

(I) 向上導氣法 (向下排空氣法)
(II) 向下導氣法 (向上排空氣法)
(III) 在水中集氣 (排水集氣法)

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

19. 以下化學物種，何者會遵從八隅體規則？

(I) NO
(II) $N_2O$
(III) $NO_2$

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

20. $NH_4Cl$ 涉及：

(I) 氫鍵
(II) 共價鍵
(III) 離子鍵

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

21. In some submarines, oxygen gas is produced from sea water. Which of the following can be used for this process?

(I) Neutralisation
(II) Electrolysis
(III) Vaporisation

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

22. Which of the following is a pair of isotopes? (X, Y, and Z may not be the same element.)

A. $^{50}_{22}\mathrm{X}$ and $^{50}_{23}\mathrm{Y}$
B. $^{50}_{22}\mathrm{X}$ and $^{51}_{23}\mathrm{Z}$
C. $^{50}_{23}\mathrm{Y}$ and $^{51}_{23}\mathrm{Z}$
D. None of the above

23. Which of the following gases can relight a glowing splint?

A. Carbon dioxide
B. Hydrogen
C. Nitrogen
D. Oxygen

24. Which of the following statements is correct for the ionic compound $Fe_3O_4$?

A. It consists of $Fe^{2+}$ and $O^{2-}$ ions only.
B. It consists of $Fe^{3+}$ and $O^{2-}$ ions only.
C. It consists of $Fe^{2+}$, $Fe^{3+}$, and $O^{2-}$ ions only and the numbers of $Fe^{2+}$ and $Fe^{3+}$ ions are in a ratio of 1:2.
D. It consists of $Fe^{2+}$, $Fe^{3+}$, and $O^{2-}$ ions only and the numbers of $Fe^{2+}$ and $Fe^{3+}$ ions are in a ratio of 2:1.

21. 在某些潛艇中，使用海水生產氧氣。以下何者可用於該過程？

(I) 中和
(II) 電解
(III) 蒸發

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

22. 以下何者是一對同位素？ (**X**、**Y** 和 **Z** 不一定是相同的元素。)

A. $^{50}_{22}\mathrm{X}$ and $^{50}_{23}\mathrm{Y}$
B. $^{50}_{22}\mathrm{X}$ and $^{51}_{23}\mathrm{Z}$
C. $^{50}_{23}\mathrm{Y}$ and $^{51}_{23}\mathrm{Z}$
D. 以上皆非

23. 下列氣體，何者能令帶火星／餘燼的木條重燃？

A. 二氧化碳
B. 氫
C. 氮
D. 氧

24. 以下對於離子化合物 $Fe_3O_4$ 的陳述，何者是正確的？

A. 它只含有 $Fe^{2+}$ 及 $O^{2-}$ 離子。
B. 它只含有 $Fe^{3+}$ 及 $O^{2-}$ 離子。
C. 它只含有 $Fe^{2+}$、$Fe^{3+}$及 $O^{2-}$離子，其中 $Fe^{2+}$對 $Fe^{3+}$ 離子數目比是 1 : 2。
D. 它只含有 $Fe^{2+}$、$Fe^{3+}$及 $O^{2-}$離子，其中 $Fe^{2+}$對 $Fe^{3+}$ 離子數目比是 2 : 1。

25. The chemical reaction between 60 g of element X and 120 g of element Y results in compound Z with 30 g of Y left. Based on the above information, the chemical reaction between 120 g of element X and 60 g of element Y will result in compound Z with

A. 30 g of X left.
B. 45 g of X left.
C. 60 g of X left.
D. 80 g of X left.

26. Calculate the mass percentage of oxygen in $CoCl_2 \cdot 6H_2O$.

A. 40%
B. 47%
C. 55%
D. 62%

27. Which of the following is a correct balanced chemical equation?

A. $2\ NO_2 + H_2O \rightarrow HNO_3 + HNO_2$
B. $4\ NO_2 + 2\ H_2O \rightarrow HNO_3 + 3\ HNO_2$
C. $4\ NO_2 + 2\ H_2O \rightarrow 3\ HNO_3 + HNO_2$
D. None of the above

28. In which of the following options do the items arrange in ascending order of their pH?

***Increasing pH →***

A. Gastric juice, tomatoes, rain water, baking soda
B. Gastric juice, baking soda, tomatoes, rain water
C. Gastric juice, rain water, baking soda, tomatoes
D. Rain water, gastric juice, tomatoes, baking soda

25. 60 g 元素 X 與 120 g 元素 Y 所起的化學反應，得到化合物 Z，並餘下了 30 g 的 Y。根據以上資料，120 g 元素 X 與 60 g 元素 Y 所起化學的反應得到化合物 Z，並

A. 餘下 30 g 的 X。
B. 餘下 45 g 的 X。
C. 餘下 60 g 的 X。
D. 餘下 80 g 的 X。

26. 計算在 $CoCl_2 \cdot 6H_2O$ 中氧所佔的質量百分率。

A. 40%
B. 47%
C. 55%
D. 62%

27. 以下哪一條是正確的已配平化學方程式？

A. $2\ NO_2 + H_2O \rightarrow HNO_3 + HNO_2$
B. $4\ NO_2 + 2\ H_2O \rightarrow HNO_3 + 3\ HNO_2$
C. $4\ NO_2 + 2\ H_2O \rightarrow 3\ HNO_3 + HNO_2$
D. 以上皆非

28. 在下列各選項中，何者內的物品是依其 pH 遞增次序排列？

***增加 pH →***

A. 胃液、蕃茄、雨水、小蘇打
B. 胃液、小蘇打、蕃茄、雨水
C. 胃液、雨水、小蘇打、蕃茄
D. 雨水、胃液、蕃茄、小蘇打

29. 1 kg of water is heated from 25 °C to 68 °C by burning 200 g of a fuel. How much heat is given out by burning 1 g of the fuel? Given: the specific heat capacity of water = 4.2 J $g^{-1}$ $°C^{-1}$

A. 900 J
B. 500 J
C. 250 J
D. 50 J

30. Consider the following reaction:

$$Mg(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Which of the following can increase the reaction rate?
(I) Carrying out the reaction at higher temperature
(II) Using more concentrated HCl(aq)
(III) Using more finely divided solid for Mg(s)

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

31. Which of the following features is common between prokaryotic and eukaryotic cells?

A. A membrane-bound nucleus.
B. Linear chromosomes which are composed of DNA and proteins.
C. Ribosomes.
D. Nucleolus.

29. 燃燒 200 g 某燃料可把 1 kg 的水，從 25 °C 加熱至 68 °C 。燃燒 1 g 的該燃料可釋出多少熱？已知水的比熱容 = 4.2 J $g^{-1}$ $°C^{-1}$。

A. 900 J
B. 500 J
C. 250 J
D. 50 J

30. 考慮以下反應：

$$Mg(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

下列何者可增加它的反應速率？
(I) 讓反應在較高溫進行
(II) 使用較濃的 HCl(aq)
(III) 使用較微小固體的 Mg(s)

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

31. 以下哪項特徵同時見於原核細胞和真核細胞？

A. 有核膜包圍的細胞核。
B. 由 DNA 和蛋白質組成的線狀染色體。
C. 核糖體。
D. 核仁。

32. In vertebrates the kidneys play a role in osmoregulation. This function of the kidney is achieved through

A. maintaining a constant plasma composition.
B. regulating osmotic processes.
C. controlling the volume of blood entering the kidneys.
D. maintaining the buffering capacity of the plasma.

33. Salamanders are amphibians which life history features an aquatic larval stage followed by a terrestrial adult stage. Distinct populations of a temperate high mountain salamander species are found in two streams with different environmental characteristics. While most members in a population undergo metamorphosis and migrate from the stream to land thereafter, most members of the other population do not metamorphose and live aquatically as a larval form throughout life. Which of the following statements best explains this phenomenon?

A. The two populations have not been able to interbreed and individuals are changing to suit their specific environment.
B. The differences in the environments between the two streams have changed the life history of the respective populations.
C. The terrestrial environment in the vicinity of one of the streams might be unfavorable for the survival of adult salamanders. Over successive generations, the selection force will eliminate the individuals carrying genetic traits for migrating to land.
D. The two populations of salamanders were originally two different species.

34. The ultimate source of variation in a population is _____, which _____.

A. sexual reproduction, creates new combinations of alleles
B. sexual reproduction, creates new alleles directly
C. mutation, creates new alleles
D. crossing over, creates new combinations of alleles

32. 脊椎動物的腎臟在滲透調節中具有一定的角色，腎臟通過以下過程以達成其功能：

A. 維持血漿各組成成份的穩定。
B. 調節滲透作用的過程。
C. 控制進入腎臟的血液容積 / 流量。
D. 維持血液的緩沖容量。

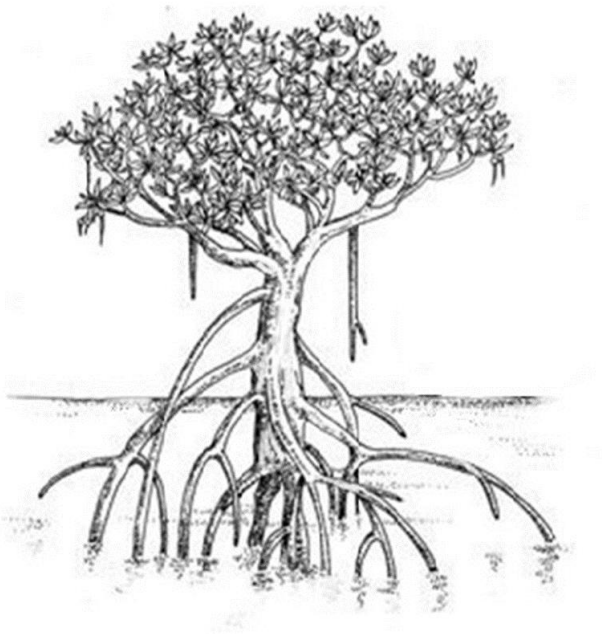
33. 蠑螈是兩棲類，其生命史的特徵是以水生的幼體期開始，繼而是陸生的成體期。在兩條環境因素迥異的溫帶高山溪流中，分別發現某蠑螈物種的兩個獨特的種群。其中一個種群的大多數個體在進行變態後由溪流移居陸地；另一個種群的大多數個體則不進行變態，終生以幼體形態在水中生活。以下哪項陳述最能解釋這個現象？

A. 這兩個種群未能雜交，種群的個體發生變化以適應其特定的生活環境。
B. 兩條溪流在環境上的差異，分別改變了該兩個種群的生活史。
C. 其中一條溪流週圍的陸地環境，可能不利於成年蠑螈存活，經歷很多世代之後，具有移居陸地的遺傳性狀的個體，便會被選擇壓力所淘汰。
D. 這兩個種群的蠑螈根本是兩個不同的物種。

34. 種群中的變異，其終極來源是 _____，這樣會 _____。

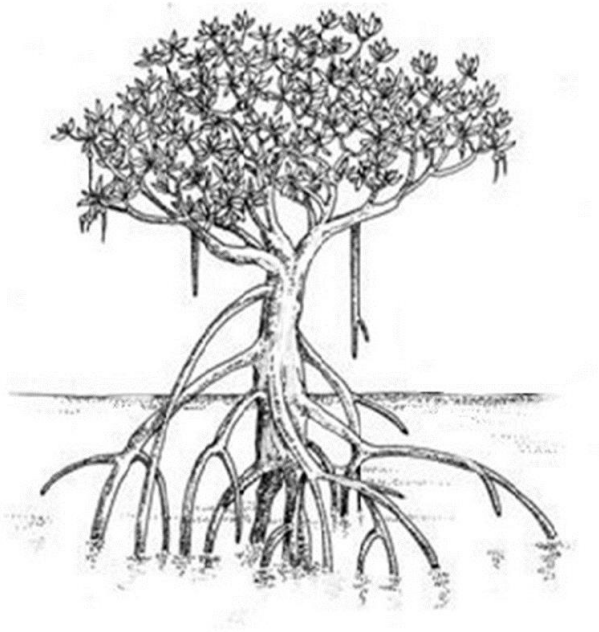
A. 有性生殖，產生新的等位基因的組合。
B. 有性生殖，直接產生新的等位基因。
C. 突變，產生新的等位基因。
D. 交換，產生新的等位基因的組合。

35. Mangrove plants are specialized to live in tropical estuaries where the soil is salty, silty and few land plants can survive. Among the various adaptations of mangroves given below, the least likely adaptation enabling the mangrove to survive in their native environment should be



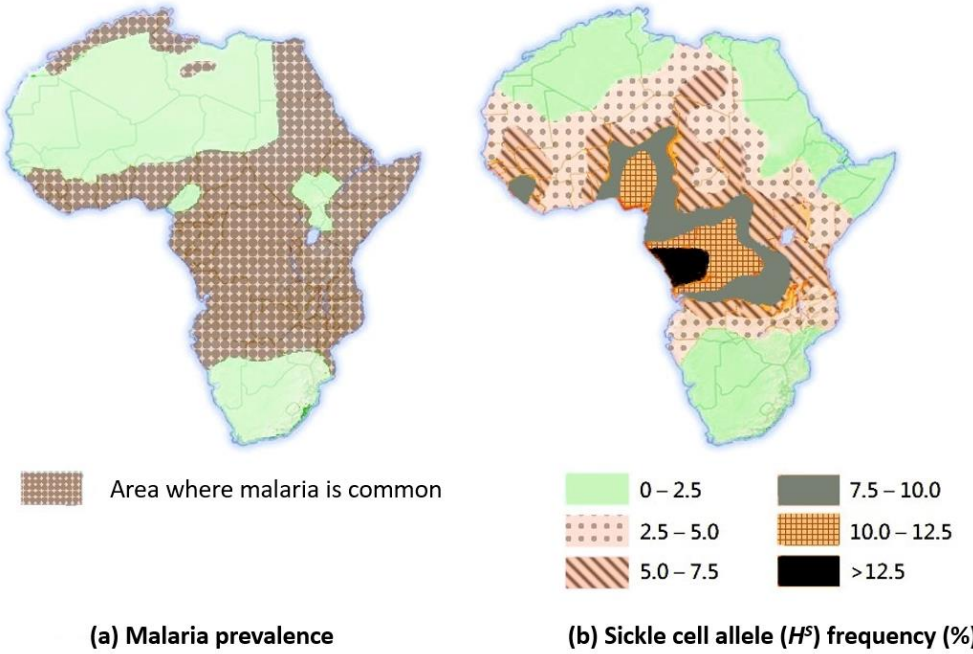
A. respiration.
B. osmoregulation.
C. grazing prevention.
D. reproduction.

35. 紅樹林植物已特化生活於熱帶河口區域，這些區域的土壤鹽度高、淤泥多，只有極少數陸生植物能在此存活。以下各項適應中，<u>最不可能</u>有助紅樹林植物在當地環境存活的，應該是



A. 呼吸作用。
B. 滲透調節。
C. 草食防衛。
D. 生殖。

36. Sickle cell anaemia is a human genetic disease which is caused by a single autosomal mutation in the haemoglobin gene. The 3-dimensional shape of the mutated haemoglobin molecules are altered and cause the red blood cells (RBCs) to become sickle-shaped, eventually affecting the physiological functions of the RBCs. The frequency of the sickle cell allele ($H^S$) in populations is usually low, and the homozygous condition in which an individual carries two copies of the sickle cell allele is usually lethal. Surprisingly, it was found that in Sub-Saharan Africa the frequency of the sickle cell allele is abnormally high. More interestingly, the distribution of the sickle cell allele in the region was found to coincide with that of the occurrence of malaria, a lethal infectious disease featuring a reproductive stage of the malaria parasite within human RBCs.

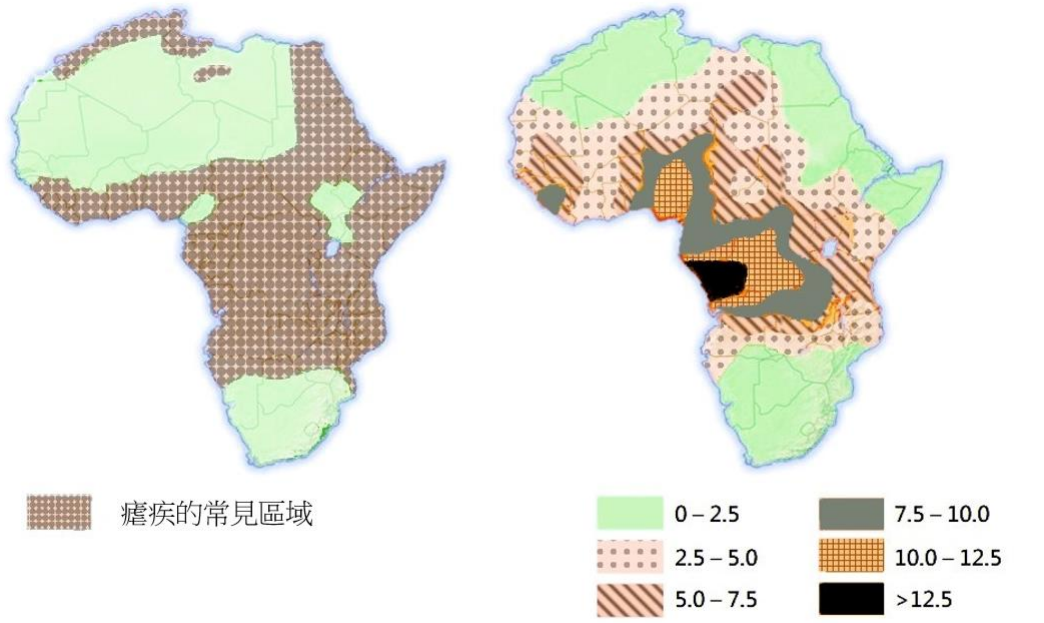



**(a) Malaria prevalence** **(b) Sickle cell allele ($H^S$) frequency (%)**

Which of the statements below regarding the overlapping range of the sickle cell allele and malaria occurrence in Africa is most appropriate?

A. The malaria parasite could provide some protection against the lethal effects of sickle cell anaemia.
B. Gene products of the sickle cell allele could prevent the invasion of the malaria parasite into human body.
C. The sickle-shaped RBCs could affect the life cycle of the malaria parasite adversely within the human body.
D. The overlapping range of the sickle cell allele and malaria occurrence is simply a coincidence and the two phenomena are not related.

36. 鐮狀細胞性貧血是一種人類遺傳病，由常染色體上血紅蛋白基因發生單一突變所引致。由基因突變而產生的血紅蛋白，其三維/立體形狀已被改變，使血紅細胞變成鐮刀狀，最終影響了血紅細胞的生理功能。鐮狀細胞等位基因($H^S$)在人類種群中的基因頻率通常是低水平的；人若含有兩個純合的鐮狀細胞等位基因，則通常會致命。在非洲下撒哈拉地區，鐮狀細胞等位基因的基因頻率異常的高，令人詫異；更有趣的是，鐮狀細胞等位基因在該地區的分佈範圍，與發生瘧疾的範圍重疊。瘧疾是一種致命的傳染病，其病徵是寄生於人類血紅細胞內的瘧原蟲進行繁殖所致。




**(a) 瘧疾的分佈情況**　　**(b) 鐮狀細胞等位基因 ($H^S$) 的頻率 (%)**

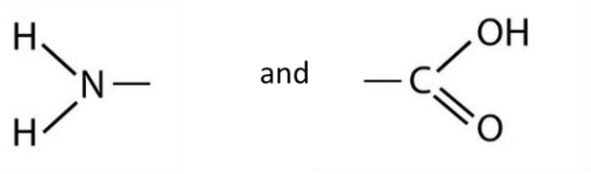
就非洲地區鐮狀細胞等位基因與瘧疾的分佈範圍出現重疊一事，以下哪項是最恰當的陳述？

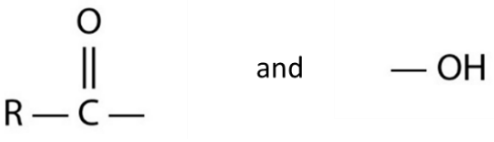
A. 瘧原蟲能提供某些保護作用，對抗鐮狀細胞性貧血的致命效應。
B. 鐮狀細胞等位基因的基因產物能防止瘧原蟲入侵人體。
C. 鐮狀血紅細胞對人體內的瘧原蟲的生命週期構成負面的影響。
D. 鐮狀細胞等位基因與發生瘧疾的分佈範圍出現重疊，只是簡單的巧合，這兩個現象並無關係。

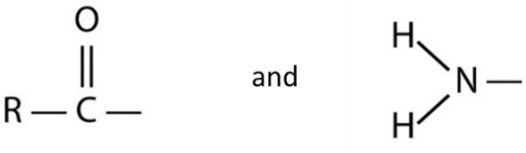
37. Which of the following statements best support the hypothesis that mitochondria are derived from endosymbiotic bacteria-like cells?

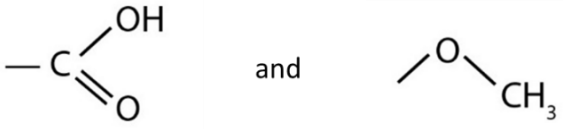
A. Both mitochondria and bacteria possess similar DNA and ribosomes.
B. Both mitochondria and bacteria possess similar nuclei.
C. Glycolysis occurs both in mitochondria and bacteria.
D. Both mitochondria and bacteria possess microtubules.

38. Which of the following pairs of functional groups characterizes the structure of an amino acid?

A. 


B. 


C. 


D. 

37. 以下哪項陳述，最能支持線粒體是由類似內共生細菌的細胞衍生而成的假說？

A. 線粒體和細菌均具有相似的 DNA 和核糖體。
B. 線粒體和細菌均具有相似的細胞核。
C. 糖酵解均發生於線粒體和細菌。
D. 線粒體和細菌均具有微管。

38. 以下哪對官能團是氨基酸典型的結構？

A. 


B. 


C. 


D. 

Answer **Q39** and **Q40** based on the following information.

| Organism | Cell wall | Nucleus | Mode of Nutrition |
|---|---|---|---|
| I | Present | ***Absent*** | Saprotrophic |
| II | Present | ***Absent*** | Parasitic |
| III | Present | Present | Parasitic |
| IV | Present | Present | Autotropic |
| V | ***Absent*** | Present | Heterotrophic |

39. Athlete's foot is caused by the growth of an organism which produces elongated cells (hyphae) and spores. Which of the organisms listed in the table can be the Athlete's foot causative agent?

A. II
B. III
C. IV
D. V

40. Which of the following organisms shows the closest evolutionary relationship to Organism **V**?

A. I
B. II
C. III
D. IV

41. Sally married to John while Sally's identical twin sister married to John's identical twin brother. Each couple has a daughter. What is the most probable genetic relatedness between the cousins?

A. 25%
B. 50%
C. 75%
D. 100%

根據以下資料，回答**第 39 題**和**第 40 題**。

| 生物 | 細胞壁 | 細胞核 | 營養模式 |
|---|---|---|---|
| I | 有 | *沒有* | 腐生營養 |
| II | 有 | *沒有* | 寄生營養 |
| III | 有 | 有 | 寄生營養 |
| IV | 有 | 有 | 自養營養 |
| V | *沒有* | 有 | 異養營養 |

39. 腳蘚是由一種生物所引致，這種生物生長時會產生長型的細胞(菌絲)和孢子。表中列舉的生物，哪種會是腳蘚的病原體？

A. II
B. III
C. IV
D. V

40. 以下哪種生物在演化關係上，與生物 **V** 最為密切？

A. I
B. II
C. III
D. IV

41. 兆莉與俊偉結婚，兆莉的同卵孿生的妹妹則與俊偉的同卵孿生的弟弟結合。每對夫婦各生育一名女兒。這兩位表姊妹在遺傳上的關聯，最可能達致什麼程度？

A. 25%
B. 50%
C. 75%
D. 100%

42. Below shows the central dogma of molecular biology.


With reference to the diagram, which of the following ways fails to increase the amount of an enzyme in a cell?

A. Increase the number of copies of the corresponding gene.
B. Block the degradation of the corresponding mRNA.
C. Block the translation of the corresponding mRNA.
D. Increase the transcriptional activity of the corresponding gene.

43. Which statement is CORRECT about our colour perception?

A. There are seven types of cone cells in our eyes, each responsible for one rainbow colour.
B. There are $2^{24}$ types of cone cells in our eyes, each detecting a specific wavelength of light to give a true colour image.
C. There are three types of cone cells in our eyes, specific for red, green and blue colours respectively.
D. There are three types of cone cells in our eyes, responsible for short, medium and long wavelength of light respectively.

42. 以下顯示的是分子生物學的中心法則。

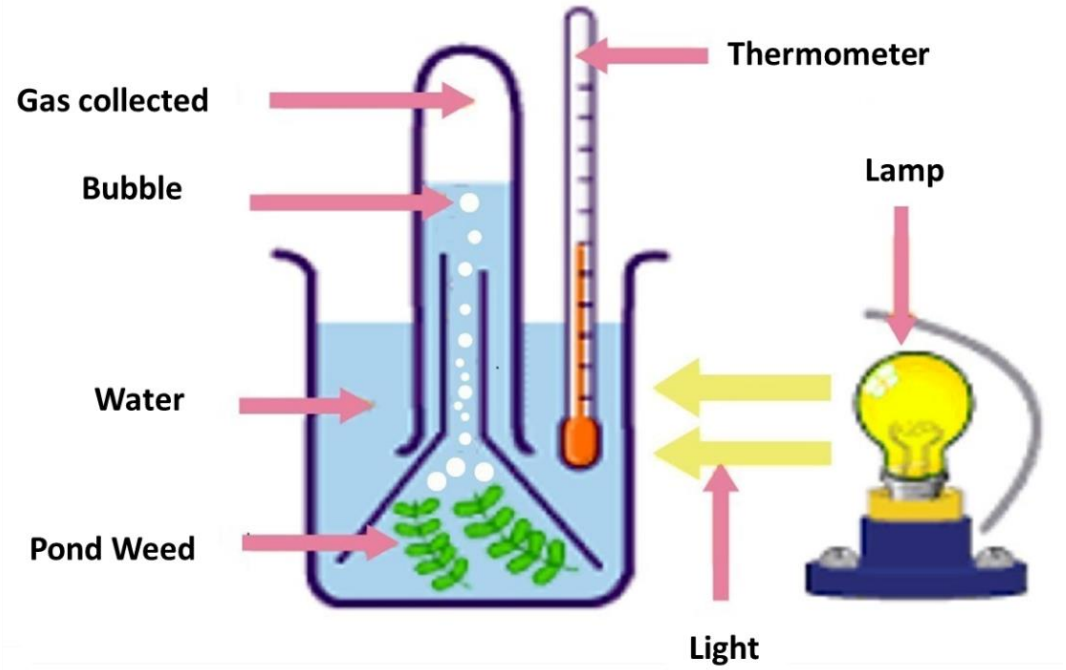

參考上圖，下列哪項不能增加細胞內某種酶的數量？

A. 增加相應的基因的拷貝數目。
B. 阻止相應的 mRNA 的降解。
C. 阻止相應的 mRNA 的轉譯。
D. 增加相應的基因的轉錄活動。

43. 哪項關於人類色覺的陳述是<u>正確</u>的？

A. 眼睛內有七種視錐細胞，各自負責探測天虹中的其中一種顏色。
B. 眼睛內有 $2^{24}$ 種視錐細胞，各自探測特定波長的光，產生與真正顏色相符的影像。
C. 眼睛內有三種視錐細胞，分別專責探測紅、綠和藍色。
D. 眼睛內有三種視錐細胞，分別探測短、中和長波長的光。

Answer **Q44** and **Q45** based on the following information.




44. Which of the following processes determine(s) the amount of gas collected?

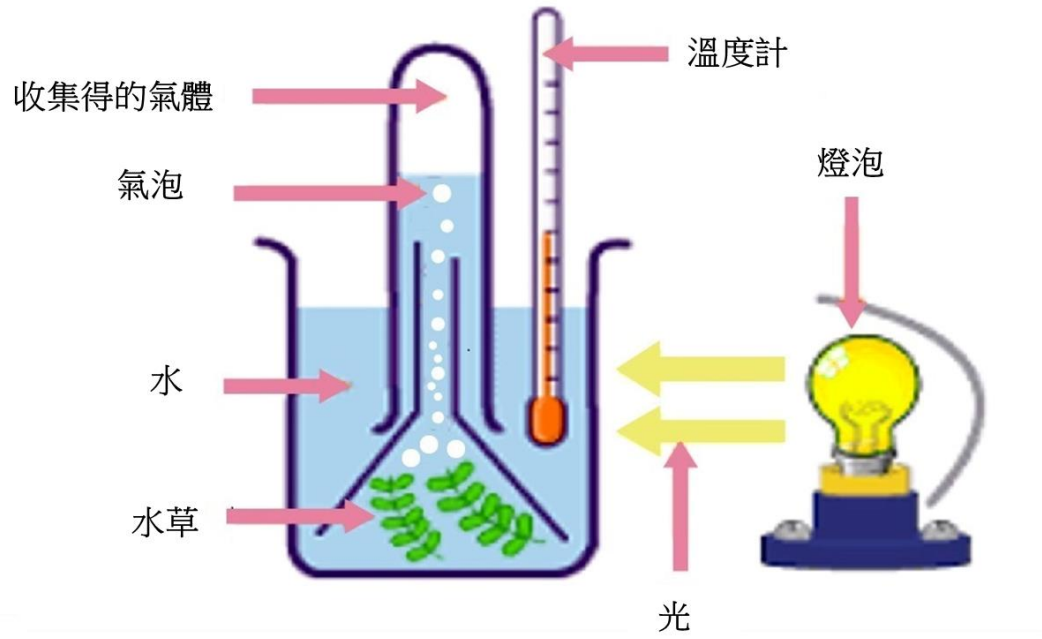
A. Photosynthesis.
B. Respiration.
C. Transpiration.
D. More than one of the above.

45. Which of the following events is most likely to happen after turning off the light for an hour?

A. The gas collected is flammable.
B. The plant dies.
C. The pH of the water drops.
D. There is a net increase of starch formation.

**End of Paper**

根據以下資料，回答**第 44 題**和**第 45 題**。




44. 下列哪個過程決定收集到的氣體的數量？

A. 光合作用。
B. 呼吸作用。
C. 蒸騰作用。
D. 多於一個以上的作用。

45. 關燈一小時後，下列哪樣事情最可能發生？

A. 收集到的氣體是易燃的。
B. 植物死亡。
C. 水的 pH 下降
D. 澱粉生成出現淨增加。

**全卷完**

# International Junior Science Olympiad 2020 - Hong Kong Screening

## Answer

| | | | | | |
|---|---|---|---|---|---|
| Q1 | B | Q16 | A | Q31 | C |
| Q2 | C | Q17 | D | Q32 | A |
| Q3 | B | Q18 | A | Q33 | C |
| Q4 | C | Q19 | B | Q34 | C |
| Q5 | A | Q20 | C | Q35 | C |
| Q6 | D | Q21 | B | Q36 | C |
| Q7 | C | Q22 | C | Q37 | A |
| Q8 | C | Q23 | D | Q38 | A |
| Q9 | D | Q24 | C | Q39 | B |
| Q10 | D | Q25 | D | Q40 | C |
| Q11 | C | Q26 | A | Q41 | B |
| Q12 | B | Q27 | A | Q42 | C |
| Q13 | A | Q28 | A | Q43 | D |
| Q14 | B | Q29 | A | Q44 | D |
| Q15 | D | Q30 | D | Q45 | C |