香港國際科學競賽初賽 **2019 - 2020**（香港賽區）

# HONG KONG INTERNATIONAL SCIENCE OLYMPIAD
# HEAT ROUND 2019 - 2020 (HONG KONG REGION)

中三級 Secondary 3

時限：60 分鐘

Time allowed: 60 minutes

模擬試題

Mock Paper

考生須知：

**Instructions to Contestants:**

1.  本卷包括 試題 乙份，試題紙不可取走。

    Each contestant should have ONE Question-Answer Book which CANNOT be taken away.

2.  本卷共 4 個範疇，每範疇有 5 題，共 20 題，答對得 2 分，空題得 0 分，答錯倒扣 **1** 分。

    There are 4 exam areas and 5 questions in each exam area. There are a total of 20 questions in this Question-Answer Book. Two points for correct answers. No points for incorrect answers. **ONE penalty point will be deducted for incorrect answers.**

3.  請將答案寫在 答題紙 上。

    All answers should be written on ANSWER SHEET.

4.  比賽期間，小學組不得使用計算工具，中學組可以使用計算工具。

    During the contest, NO calculators can be used for PRIMARY GROUP **but calculators can be used for SECONDARY GROUP**.

5.  本卷中所有圖形不一定依比例繪成。

    All figures in the paper are not necessarily drawn to scale.

6.  比賽完畢時，本試題會被收回。

    This Question-Answer Book will be collected at the end of the contest.

本試題不可取走。

請將答案寫在 答題紙 上。

All answers should be written on the ANSWER SHEET.

選擇題（第 1 至 20 題）（答對得 2 分，空題得 0 分，答錯倒扣 **1** 分）

Multiple Choice Questions ($1^{st}$ ~$20^{th}$) (Two points for correct answers. No points for incorrect answers. **ONE penalty point will be deducted for incorrect answers.**)

<u>Physics</u>
<u>物理</u>

1. The Tau Tona gold mine in Carltonville, South Africa is the deepest mine in the world with a depth of 3.9 km. If, on the surface of the mine, a simple pendulum has a period of 1.4 s and the reading on a barometer is 101 kPa, which one of the following statements regarding the period of the pendulum and the reading on the barometer at the bottom of the mine is correct?
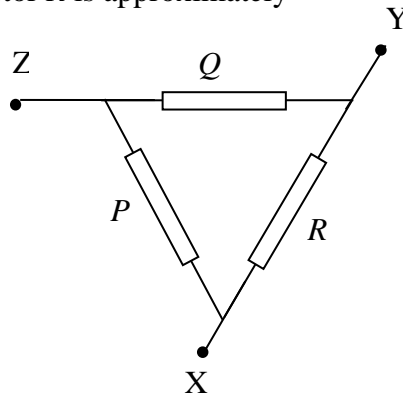
|     | Period of pendulum | Reading on barometer |
| --- | --- | --- |
| A. | Greater than 1.4 s | Greater than 101 kPa |
| B. | Less than 1.4 s | Less than 101 kPa |
| C. | Greater than 1.4 s | Less than 101 kPa |
| D. | Less than 1.4 s | Greater than 101 kPa |
| E. | No reading | No reading |

2. A long solenoid with closely spaced turns carries a direct electric current. Each turn of wire exerts:

   A. An attractive force on the next adjacent turn.

   B. A repulsive force on the next adjacent turn.

   C. Zero force on the next adjacent turn.

   D. Either an attractive or a repulsive force on the next adjacent turn, depending on the direction of current in the solenoid.

   E. None of the above

3. If the difference between the time you see the flash of lightning and the time you hear the thunder is $\Delta t$ in seconds. Taking the speed of sound in air is 340 m/s and the speed of light in vacuum as $3.0 \times 10^8$ m/s, the approximate distance in kilometers between you and the lightning flash is

   A. $\dfrac{\Delta t}{2}$ 　　　 B. $\dfrac{\Delta t}{3}$ 　　　 C. $\dfrac{\Delta t}{4}$ 　　　 D. $\dfrac{\Delta t}{5}$ 　　　 E. $\dfrac{\Delta t}{6}$

4. The diagram shows a circuit consisting of three identical resistors, *P*, *Q* and *R*, each of resistance 4.0 Ω and connected as shown. If 3.0 A of current flows into point X in the circuit and 3.0 A flows out at point Y, then the power generated by resistor *R* is approximately

A. 36 W        B. 4.0 W        C. 16 W        D. 9.0 W        E. 1.0 W

5. Figure 1 shows a metallic disc with a hole at its centre. Which one of the figures from 2 to 5 schematically shows how the disc will appear after it is uniformly heated?
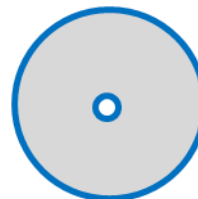
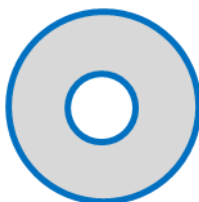Figure 1          Figure 2          Figure 3

Figure 4          Figure 5

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

## Biology
## 生物

6. Why can a person not swallow food and talk at the same time?

   A. The brain cannot control two activities at the same time.

   B. In order to speak, air must come through the pharynx to form sounds.

   C. In order to swallow, the epiglottis must close off the larynx (trachea).

   D. Both B and C are correct.

   E. None of the above

7. Some micro-organisms are pathogenic because they cause diseases. Study the following table which shows a list of diseases in humans in Column X. In Column Y, the main causative agents of the diseases are listed in an incorrect sequence.

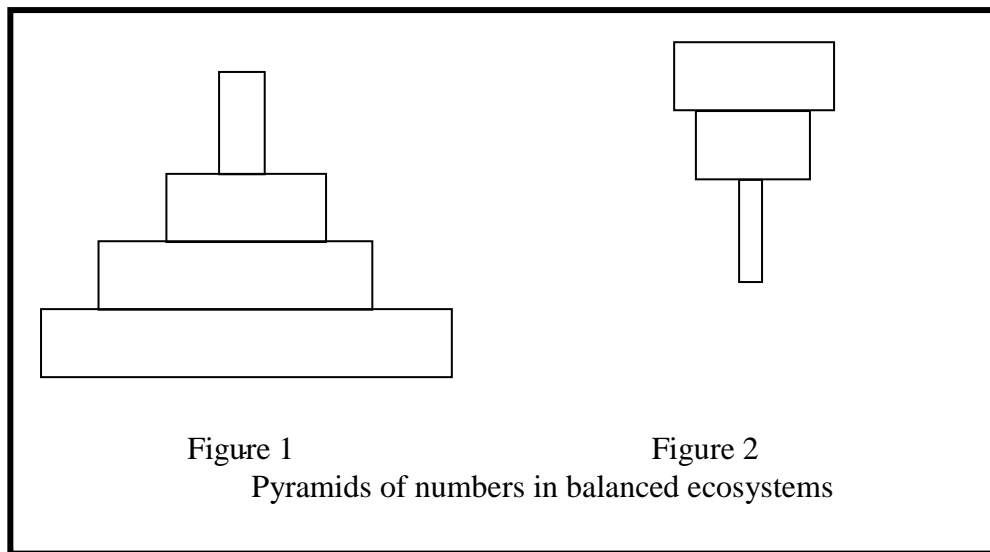   |   | Column X |   | Column Y |
   |---|---|---|---|
   | a | Food poisoning (Botulism) | I | Fungus |
   | b | AIDS | II | Protozoan |
   | c | Mycosis | III | Bacterium |
   | d | Malaria | IV | Virus |

   The correct sequence of the main causative agents, which match diseases (a), (b), (c) and (d) respectively, may be represented by …

   A. III; II; IV; I

   B. III; IV; I; II

   C. I; IV; II; III

   D. IV; III; I; II

   E. None of the above

8. The following ecological pyramids represent the number of organisms involved in feeding relationships.

Figure 1                    Figure 2
Pyramids of numbers in balanced ecosystems

Choose the LETTER (A, B, C or D) which is most likely to represent the organisms in each of the figures.

| | Figure 1 | Figure 2 |
|---|---|---|
| A. | grass → locust → snake → frog | grass → locust → frog |
| B. | tree → ant → spider → lizard | tree → bird → parasites |
| C. | grass → locust → frog → snake | tree → bird → parasites |
| D. | snake → frog → locust → grass | tree → ant → spider |
| E. | None of the above | |

9. According to Darwin's theory, the more closely related two different organisms are,

A. the more similar their habitats.

B. the less similar their DNA sequence.

C. the more recently they shared a common ancestor.

D. the more similar they are in size.

E. none of the above

10. Examine the two graphs (Figures 3 and 4) which were provided by the Department of Environmental Affairs in South Africa. The graphs show the average temperature increase during the period 1975 to 2010, and related species decline in South Africa.
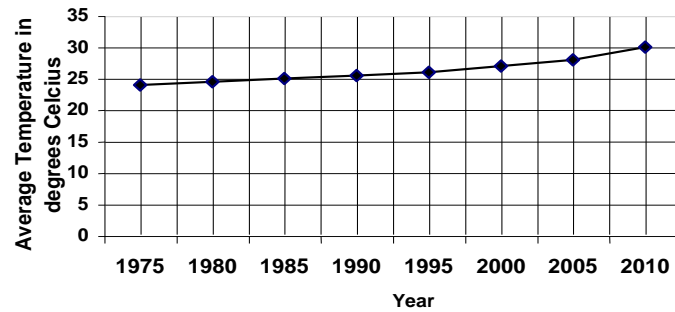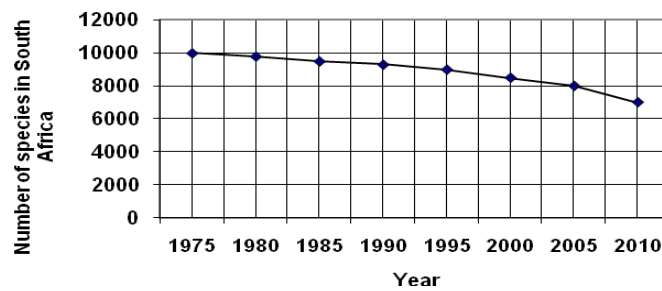


Figure 3



Figure 4

It can be deduced that, during the period 1995 to 2005:

A. an average temperature increase of 10 °C resulted in extinction of 2000 species.

B. an average temperature increase of 2 °C resulted in extinction of 3000 species.

C. an average temperature increase of 5 °C resulted in extinction of 2000 species.

D. an average temperature increase of 2 °C resulted in extinction of 1000 species.
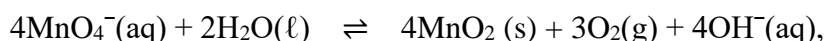
E. none of the above

## Chemistry
## 化學

11. The change in the oxidation state of Mn in $MnO_4^-$ and O in $H_2O$ in the following redox reaction,

$$4MnO_4^-(aq) + 2H_2O(\ell) \quad \rightleftharpoons \quad 4MnO_2 (s) + 3O_2(g) + 4OH^-(aq),$$

is:

A. $Mn^{7+}$ to $Mn^{2+}$ and $O^{2-}$ to $O^-$

B. $Mn^{7+}$ to $Mn^{4+}$ and $O_2^-$ to $O^0$

C. $Mn^{7+}$ to $Mn^{2+}$ and $O^{2-}$ to $O_2^{2-}$

D. $Mn^{7+}$ to $Mn^{4+}$ and $O^{2-}$ to $O^0$

E. None of the above

12. The atomic mass of a hypothetical element X is 33.42 amu. A 27.22 g sample of X combines with 84.10 g of another hypothetical element Y to form the compound XY.   The atomic mass of Y is:

A. 68.50 amu   B. 69.84 amu   C. 103.3 amu   D. 111.3 amu   E. 123.3 amu

13. For the complete combustion of 47 g of gasoline (octane, $C_8H_{18}$), the mass of oxygen consumed is:

A. 69.20 g       B. 82.45 g       C. 138.5 g       D. 164.9 g       E. 170.3 g

14. The average relative atomic mass of chlorine is 35.45. It consists of two naturally occurring isotopes chlorine-35 and chlorine-37.   What is the fractional abundance of chlorine-37?

A. 0.3650       B. 0.2200       C. 0.2250       D. 0.4500       E. 0.6300

15. Which of these pairs of ions will have the same total number of electrons?

   (i) $Na^+$ and $Mg^{2+}$     (ii) $F^-$ and $Cl^-$     (iii) $O^-$ and $O^{2-}$     (iv) $Ga^{3+}$ and $Fe^{3+}$

A. (i), (ii)

B. (i) only

C. (i), (ii), (iii)

D. (i), (ii), (iii), (iv)
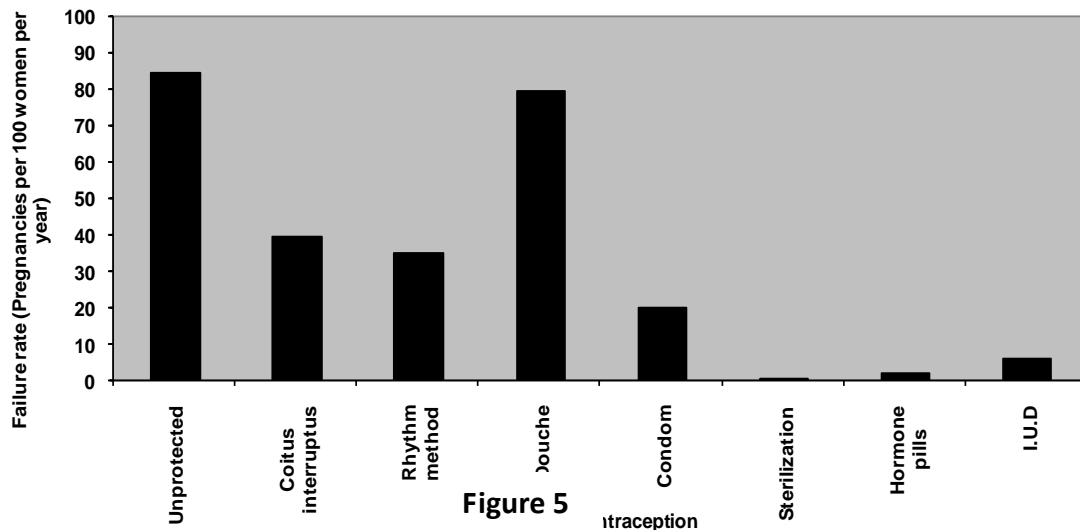
 E. None of the above

## Integrated Science
綜合科學

16. Stem cells are self-renewing, undifferentiated cells that divide by mitosis to produce specific body cell types. There are two broad types of stem cells, namely, adult and embryonic. Which of the following is correct?

A. An injury to the nerves of the spinal cord can always be corrected by adult stem cells.

B. Embryonic stem cells cannot differentiate into adult nerve cells.

C. Embryonic stem cells can potentially replace damaged nerve cells of the spinal cord.

D. All of the above statements are correct.

E. None of the above statements are correct.

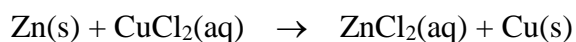17. Consider Figure 5, the graph comparing the effectiveness of different methods of contraception



**Figure 5**

Which of the following statements is correct?

A. The sterilization and douche methods can be considered good methods of avoiding pregnancy.

B. The condom is completely effective in preventing pregnancy.

C. Ninety eight percent of pregnancies can be prevented by using hormone pills.

D. The contraceptive success rate of the rhythm method, where sex is avoided during ovulation is about 35%.
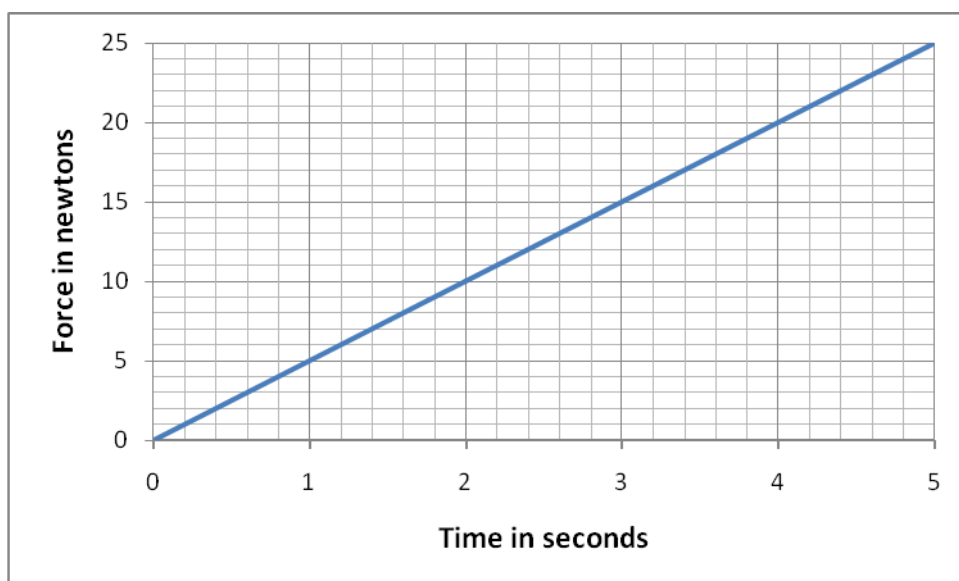
E. All of the above statements are correct.

18. What is the molarity of $ZnCl_2$(aq) that forms when 15.0 g of Zn completely reacts with $CuCl_2$(aq) producing a final volume of 175 mL of solution according to the reaction:

$$Zn(s) + CuCl_2(aq) \rightarrow ZnCl_2(aq) + Cu(s)$$

A. 1.31 M      B. 0.0400 M    C. 0.629 M      D. 0.0857 M    E. 1.05 M

19. Calculate the pH of the resulting solution when 25 mL of a 0.05 M NaOH solution is added to 50 mL of a 0.01 M HCl solution.

A. 2.8      B. 12.5    C. 2.0      D. 12.0    E. Cannot be calculated

20.  A variable force is exerted on a body of constant mass. The body, initially at rest, moves in a straight line. The following graph shows how the force varies with time. All frictional forces are ignored.



If the velocity of the object is 7.0 m s$^{-1}$ after 2.0 s, the velocity after 3.4 s will be approximately equals to

A. 11.9 m s$^{-1}$

B. 17.0 m s$^{-1}$

C. 20.2 m s$^{-1}$

D. 28.9 m s$^{-1}$

E. 30.0 m s$^{-1}$

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