



Tsuen Wan Government Secondary School
Olympiad in Informatics Team
荃灣官立中學 電腦奧林匹克校隊



2026/27
TEAM NOMINATION TEST
校隊提名試
HKOI HEAT MOCK 初賽模擬試

PAPER 1 卷一

Time Allowed 限時 50 minutes 分鐘

Section 部分	Format 類型	# Questions 題目數	Total Marks 佔分
A 甲	Multiple Choice 多項選擇題	10	10
B 乙	Short Questions 短答題	6 A - F	9
C 丙	Long Questions 長填充題	2 G - J	6
Total 總分			25

- The term “arrays” in Paper 1 generally refers to lists in Python.
卷一提及的「陣列」泛指 Python 語言的串列。
- The following code is added to the beginning of all C++ programs.
在所有 C++ 程序的頂部加入以下程式碼：

C++

```
#include <algorithm>
#include <array>
#include <cmath>
#include <cstdlib>
#include <deque>
#include <forward_list>
#include <iostream>
#include <list>
#include <queue>
#include <stack>
#include <string>
#include <utility>
#include <vector>
using namespace std;
```

Section A 甲部 Multiple Choice 多項選擇題

# Questions 題目數	Total Marks 佔分
10	10

- For each question, choose the most appropriate answer and mark the corresponding box (A, B, C, or D) on the answer sheet.
請為下列每題各選一個最適合的答案，然後把答題紙對應的空格（A、B、C、或 D）填滿。
- One mark for each correct answer. No marks will be deducted for wrong answers.
答對得一分，答錯不扣分。

- 1 There is a card on the desk. It is given that if “hoki” is written on one side of the card, nothing will be written on the other side. Which of the following statement(s) can be deduced?
桌上有一張卡片。已知若卡片其中一面寫有「hoki」，則另一面不會寫有任何內容。以下哪些陳述可以由此推導得出？

- i. If there is nothing written on one side, then “hoki” must be written on the other side.
若其中一面沒有寫有任何內容，則另一面必定寫有「hoki」。
- ii. If “sleep” is written on one side, then “hoki” must not be written on the other side.
若其中一面寫有「sleep」，則另一面必定沒有寫有「hoki」。

- A i only
只有 i
- B ii only
只有 ii
- C i and ii
i 和 ii
- D None of them
無

- 2 Given 6 numbers: $-2, -1, 0, 1, 2, 3$. Two numbers are drawn at the same time. What is the probability that their product is non-negative (greater than or equal to 0)?
給定 6 個數字： $-2, -1, 0, 1, 2, 3$ 。現同時抽出兩個數字，它們的乘積為非負數（即大於或等於 0）的概率是多少？

- A $\frac{4}{15}$
- B $\frac{2}{5}$
- C $\frac{3}{5}$
- D $\frac{11}{15}$

- 3 If Hoki gets Influenza A, he will leave early on Friday. If Hoki does not leave early on Friday, he will not see the doctor. If Hoki sees the doctor, he will receive medicine. Given that Hoki did not see the doctor, which of the following statements may be true?

如果 Hoki 患上甲型流感，他便會在星期五提早離開。若 Hoki 沒有在星期五提早離開，他便不會去看醫生。若 Hoki 去看醫生，他便會獲得藥物。已知 Hoki 沒有去看醫生，以下哪些陳述有可能為真？

- i. Hoki has left early on Friday.
Hoki 曾在星期五提早離開。
- ii. Hoki did not get Influenza A.
Hoki 沒有患上甲型流感。
- iii. Hoki has received medicine.
Hoki 曾獲得藥物。

- A i and ii only
只有 i 和 ii
- B i and iii only
只有 i 和 iii
- C ii and iii only
只有 ii 和 iii
- D i, ii and iii
i、ii 和 iii

- 4 Which of the following Boolean expressions are equivalent to $\text{NOT}(A \text{ OR } (B \text{ AND } C))$?
以下哪些布爾表達式等價於 $\text{NOT}(A \text{ OR } (B \text{ AND } C))$?

- i. $\text{NOT } A \text{ AND NOT}(B \text{ AND } C)$
- ii. $\text{NOT } A \text{ AND } (\text{NOT } B \text{ OR NOT } C)$

- A i only
只有 i
- B ii only
只有 ii
- C i and ii
i 和 ii
- D None of them
無

- 5 Alice and Bob are playing a candy game. There are x candies in total, where $x > 0$. Alice goes first and Bob goes second. In each round they can take 1 to n candies from the remaining candies. The player who takes the last candy wins the game. Which of the following statements are correct?

愛麗絲和鮑伯正在玩一個糖果遊戲。共有 x 顆糖果，其中 $x > 0$ 。愛麗絲先手，鮑伯後手。每一回合，玩家可以從剩餘的糖果中取走 1 至 n 顆糖果。取走最後一顆糖果的玩家獲勝。以下哪些陳述是正確的？

- i. When $n = 3$, Alice always wins if x is a multiple of 3.
當 $n = 3$ 時，若 x 是 3 的倍數，則愛麗絲必定獲勝。
- ii. When $n = 4$, Bob always wins if x is a multiple of 5.
當 $n = 4$ 時，若 x 是 5 的倍數，則鮑伯必定獲勝。
- iii. Alice always wins if x is not a multiple of $n + 1$.
若 x 不是 $n + 1$ 的倍數，則愛麗絲必定獲勝。

- A i and ii only
只有 i 和 ii
- B i and iii only
只有 i 和 iii
- C ii and iii only
只有 ii 和 iii
- D i, ii and iii
i、ii 和 iii

- 6 What of the following big-O notations best describes the time complexity of the following program?
以下哪個大 O 記號最適合描述以下程序的時間複雜度？

Python

```
n = int(input())
while n:
    if n % 2:
        n -= 1
    n //= 2
```

C++

```
int main() {
    int n;
    cin >> n;
    while (n) {
        if (n % 2)
            --n;
        n /= 2;
    }
}
```

- A $O(\log n)$
- B $O(n)$
- C $O(n \log n)$
- D $O(2^n)$

- 7 For all integers $0 \leq a, b \leq 100$, which of the following expressions always evaluates to the same result as $(a \& b) == 0$?

對於所有滿足 $0 \leq a, b \leq 100$ 的整數，以下哪些表達式的結果必定與 $(a \& b) == 0$ 相同？

- A $(a \wedge b) == 0$
- B $(a + b) == (a | b)$
- C $a != b$
- D None of the other options
其他選項皆非

- 8 Denote A as a sequence such that $A_n - A_{n-1} = (-1)^{n-1}$ for $n > 1$. Which of the following statements must be true?

設 A 為一個數列，當 $n > 1$ 時， $A_n - A_{n-1} = (-1)^{n-1}$ 。以下哪些陳述必定為真？

- i. $A_n = A_{n-2}$ for $n > 2$
對於 $n > 2$ ， $A_n = A_{n-2}$
 - ii. $A_n \times A_{n-2} = (A_{n-1})^2$ for $n > 2$
對於 $n > 2$ ， $A_n \times A_{n-2} = (A_{n-1})^2$
 - iii. $A_{2n} < A_{2n-1}$ for $n > 0$
對於 $n > 0$ ， $A_{2n} < A_{2n-1}$
- A i and ii only
只有 i 和 ii
 - B i and iii only
只有 i 和 iii
 - C ii and iii only
只有 ii 和 iii
 - D i, ii and iii
i、ii 和 iii

- 9 $f()$ is a function which returns a uniformly and independently random integer between 0 and 9 inclusive. Which of the following expression(s) returns a uniformly and independently random integer between 0 and 999 inclusive?

$f()$ 是一個會以相等的概率隨機和獨立地傳回 0 到 9 之間（含）整數的函數。以下哪些表達式能均勻且獨立地傳回 0 到 999 之間（含）的整數？

- A $111 \times f()$
- B $37 \times (f() + f() + f())$
- C $100 \times f() + 10 \times f() + f()$
- D All of the other options
其他選項皆是

- 10 Which of the following input will cause the following program to output 11001?
以下哪一個輸入會使以下程序輸出 11001 ?

Python

```
n = int(input())
while n:
    print(n % 2, end = "")
    n //= 2
```

C++

```
int main() {
    int n;
    cin >> n;
    while (n) {
        cout << n % 2;
        n /= 2;
    }
}
```

- A 2
B 19
C 25
D 11001

Section B 乙部 Short Questions 短答題

# Questions	Total Marks
題目數	佔分
6	A - F
	9

- The blanks are labeled from A to F. Please fill in the blanks on the answer sheet.
下列各空格分別命名為 A 至 F，請在答題紙上對應的地方填上答案。
- You can write only one character in each box on the answer sheet.
答題紙上每個小格只可填上一個字符。
- Answers must not exceed the designated number of boxes.
答案長度不得多於該題提供的小格數目。

- 1 What is the output of the following program?
以下程序的輸出是什麼？

Python

```
def f():
    print("f", end="")
    return True
def g():
    print("g", end="")
    return False
def h():
    print("h", end="")
    return True
if f() or g() and h():
    print("i", end="")
```

C++

```
bool f() {
    cout << "f";
    return true;
}
bool g() {
    cout << "g";
    return false;
}
bool h() {
    cout << "h";
    return true;
}
int main() {
    if (f() || g() && h()) {
        cout << "i";
    }
}
```

 Answer 答案 A 1.5 marks 分

- 2 Given 7 numbers: $-3, -2, -1, 0, 1, 2, 3$, how many ordered tuples $\{a, b, c\}$ with $a < b < c$ satisfy the equation $a + b + c = a \times b \times c$?
 給定 7 個數字： $-3, -2, -1, 0, 1, 2, 3$ ，有多少個滿足 $a < b < c$ 的有序三元組 $\{a, b, c\}$ 滿足方程式 $a + b + c = a \times b \times c$ ？

 Answer 答案 B 1.5 marks 分

- 3 What is the output of the following program?
 以下程序的輸出是什麼？

Python

```
a = [1, 7, 4, 10]
x = 0
for i in range(2026):
    x = a[x % 4]
print(x % 4)
```

C++

```
int main() {
    int a[4] = {1, 7, 4, 10};
    int x = 0;
    for (int i = 0; i < 2026; ++i) {
        x = a[x % 4];
    }
    cout << x % 4;
}
```

Answer 答案 C 1.5 marks 分

- 4 What is the output of the following program?
 以下程序的輸出是什麼？

Python

```
num = [0, 1, 1, 3, 5, 5, 5, 7, 7, 9]
same, cnt = 0
for i in range(10):
    for j in range(10):
        if i == j:
            if 2 * num[i] == 10:
                same += 1
        else:
            if num[i] + num[j] == 10:
                cnt += 1
print(cnt // 2 + same)
```

C++

```
int main() {
    int num[10] = {
        0, 1, 1, 3, 5, 5, 5, 7, 7, 9
    };
    int same = 0, cnt = 0;
    for (int i = 0; i < 10; ++i) {
        for (int j = 0; j < 10; ++j) {
            if (i == j) {
                if (2 * num[i] == 10) {
                    ++same;
                }
            } else {
                if (num[i] + num[j] == 10) {
                    ++cnt;
                }
            }
        }
    }
    return cnt / 2 + same;
}
```

Answer 答案 D 1.5 marks 分

- 5 Complete the following program so that it outputs 50.

完成以下程序，使其輸出 50。

Python

```
a, b = 0, 0
s = "_____ E _____"
for i in range(len(s)):
    if s[i] == "a":
        a += 1
    if s[i] == "b":
        b += a * a
print(b)
```

C++

```
int main() {
    int a = 0, b = 0;
    string s = "_____ E _____";
    for (int i = 0; i < s.size(); ++i) {
        if (s[i] == 'a') {
            ++a;
        }
        if (s[i] == 'b') {
            b += a * a;
        }
    }
    cout << b;
}
```

Answer 答案 _____ E _____ 1.5 marks 分

- 6 Let a be an array of n integers. Complete the function below, such that a becomes sorted in ascending order after calling $f(a)$.

設 a 為一個包含 n 個整數的陣列。完成以下函數，使得呼叫 $f(a)$ 後陣列 a 中的元素按遞增排序。

Python

```
def f(a):
    n = len(a)
    for i in range(n):
        for j in range(_____ F _____):
            if a[j] > a[j + 1]:
                (a[j], a[j + 1])
                = a[j + 1], a[j])
```

C++

```
void f(vector<int> a) {
    int n = a.size();
    for (int i = 0; i < n; ++i) {
        for (int j = 0;
            j < _____ F _____;
            ++j) {
            if (a[j] > a[j + 1]) {
                swap(a[j], a[j + 1]);
            }
        }
    }
}
```

Answer 答案 _____ F _____ 1.5 marks 分

Section C 丙部 Long Questions 長填充題

# Questions 題目數	Total Marks 佔分
2 G - J	6

- The blanks are labeled from G to J. Please fill in the blanks on the answer sheet.
下列各空格分別命名為 G 至 J，請在答題紙上對應的地方填上答案。
- You can write only one character in each box on the answer sheet.
答題紙上每個小格只可填上一個字符。
- Answers must not exceed the designated number of boxes.
答案長度不得多於該題提供的小格數目。
- If blank X is divided into N parts $X_1, X_2, \dots, X_N$, it means that marks will only be given when $X_1, X_2, \dots, X_N$ are all correct.
如果空格 X 分為 N 部份 $X_1, X_2, \dots, X_N$ ，那麼 $X_1, X_2, \dots, X_N$ 皆為正確才會給分。

- 1 Consider the following function:
考慮以下函數：

Python

```
def f(a):
    cnt = 0
    for i in range(8):
        if gcd(a[i], a[i + 1]) == 1:
            cnt += 1
    return cnt
```

C++

```
int f(vector<int> a) {
    int cnt = 0;
    for (int i = 0; i < 8; ++i) {
        if (gcd(a[i], a[i + 1]) == 1) {
            ++cnt;
        }
    }
    return cnt;
}
```

Given that $\text{gcd}(x, y)$ returns the greatest common divisor of positive integers x and y . For example, $\text{gcd}(4, 6)$ returns 2 and $\text{gcd}(7, 1)$ returns 1.

已知 $\text{gcd}(x, y)$ 會傳回正整數 x 和 y 的最大公因數。例如， $\text{gcd}(4, 6)$ 傳回 2， $\text{gcd}(7, 1)$ 傳回 1。

Assuming that the array a has size 9 and represents a permutation of the set $\{1, 2, \dots, 9\}$, where each integer between 1 and 9 inclusive appears exactly once in a .

假設陣列 a 的大小為 9，且代表集合 $\{1, 2, \dots, 9\}$ 的一個排列，即 1 到 9 之間（含）的每個整數在 a 中均恰好出現一次。

What is the maximum possible return value of $f(a)$?

$f(a)$ 可能的最大傳回值是多少？

Answer 答案 G 1.5 marks 分

What is the minimum possible return value of $f(a)$?

$f(a)$ 可能的最小傳回值是多少？

Answer 答案 H 1.5 marks 分

- 2 A Zimin sequence Z is a sequence of strings defined recursively. Given a reference string x of length l , whose characters are $x_0, x_1, x_2, \dots, x_{l-1}$. $Z_0 = x_0$; and $Z_n = Z_{n-1} + x_n + Z_{n-1}$ for $1 \leq n \leq l-1$, where $+$ represents string concatenation.

Zimin 序列 Z 是一個以遞歸方式定義的字串序列。給定一個長度為 l 的參考字串 x ，其字符為 $x_0, x_1, x_2, \dots, x_{l-1}$ 。且對於 $1 \leq n \leq l-1$ ， $Z_n = Z_{n-1} + x_n + Z_{n-1}$ ，其中 $+$ 代表字串串接。

For example, if $x = \text{abc}$, then $Z_0 = \text{a}$, $Z_1 = \text{aba}$, $Z_2 = \text{abacaba}$.

例如，若 $x = \text{abc}$ ，則 $Z_0 = \text{a}$ 、 $Z_1 = \text{aba}$ 、 $Z_2 = \text{abacaba}$ 。

If $x = \text{abcdef}$, what is the string length of Z_5 ?

若 $x = \text{abcdef}$ ， Z_5 的字串長度是多少？

Answer 答案 I 1 mark 分

Complete the function `rec(x, n)` such that it returns the value of Z_n .

完成函數 `rec(x, n)`，使其傳回 Z_n 的值。

Python

```
def rec(x, n):
    if n == 0:
        return x[0]
    u = rec(x,         J1        )
    return         J2        
```

C++

```
string rec(string x, int n) {
    if (n == 0) {
        return string("") + x[0];
    }
    string u = rec(x,         J1        );
    return         J2        ;
}
```

Answer 答案 J1 J2 2 marks 分