



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 2 卷二

Time Allowed 限時 40 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	5	5
B 乙	Short Questions 短答題	6 A - F	9
C 丙	Long Questions 長填充題	1 G - J	6
Total 總分			20

- Assume that the size of the `int` data type is 32 bits.
假設 `int` 資料類型的長度為 32 位元。
- 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
5	5

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

C++

```
int main() {  
    char c = '1';  
    c += '1';  
    cout << c;  
}
```

- A 2
B b
C 11
D Compilation error will occur
將出現編譯錯誤

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

C++

```
int main() {  
    int a = 7, b = -3;  
    cout << a / b << ' ' << a % b;  
}
```

- A -3 -1
B -2 -1
C -3 1
D -2 1

3 What is the output of the following program?

以下程序的輸出是什麼？

C++

```
int main() {  
    int x = 0;  
    for (int i = 0; i < 10; ++i)  
        ++x;  
    x *= 2;  
    --x;  
    cout << x;  
}
```

- A 19
- B 20
- C 2045
- D 2046

4 What is the output of the following program?

以下程序的輸出是什麼？

C++

```
int main() {  
    string x = "20", y = "26";  
    if (x + y == "2026") {  
        cout << x + y << " ";  
        string y = "7";  
    } else {  
        y += "7";  
    }  
    cout << y;  
}
```

- A 2026 7
- B 2026 26
- C 33
- D 267

5 What is the output of the following program?

以下程序的輸出是什麼？

C++

```
int main() {  
    int a[5] = {4, 2, 1, 4, 2};  
    queue<int> q;  
    stack<int> s;  
    for (int i = 0; i < 5; ++i) {  
        q.push(a[i]);  
        s.push(a[i]);  
    }  
    for (int i = 0; i < 5; ++i) {  
        if (q.front() < s.top()) {  
            cout << s.top() << " ";  
            s.pop();  
        } else {  
            cout << q.front() << " ";  
            q.pop();  
        }  
    }  
}
```

- A 2 4 2 4 1
- B 2 4 4 2 1
- C 4 2 2 4 1
- D 4 2 4 2 1

Section B 乙部 Short Questions 简答题

# Questions 題目數	Total Marks 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。
- Answers must be in C++.
必須使用 C++ 作答。
- 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？

C++

```
int main() {
    int f[11] = {0, 1};
    for (int i = 2; i < 11; ++i) {
        f[i] = f[max(0, i - 4)] + f[max(0, i - 1)];
    }
    cout << f[10];
}
```

Answer 答案 A 1.5 marks 分

- 2 Complete the following program so that it outputs 4112.
完成以下程序，使其輸出 4112。

C++

```
int f(int x) {
    if (x < 0) return -x;
    return x;
}
int main() {
    int n = -4;
    for (int i = 3; i >= 0; --i) {
        cout << f(n);
                B        ;
    }
}
```

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？

C++

```
int a, b, c;

void f(int &a, int b) {
    c = a * b;
    a = c * b;
    --b;
    return;
}

int main() {
    a = 1; b = 2; c = 3;
    f(b, a);
    cout << a << "," << b << "," << c;
}
```

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？

C++

```
int f(int x);
int g(int x);

int f(int x) {
    if (x <= 0) {
        return 1;
    }
    return g(x - 1) + g(x - 2);
}

int g(int x) {
    if (x <= 0) {
        return 2;
    }
    return f(x - 1) + f(x - 2);
}

int main() {
    cout << f(5) * g(5);
}
```

Answer 答案 D 1.5 marks 分

- 5 Complete the function `b(n)` such that given a positive integer n , the function returns its binary representation.

完成函數 `b(n)`，使得給定正整數 n 時，該函數會傳回其二進制表示法。

For example, `b(13)` should return `1101`.

例如，`b(13)` 應該傳回 `1101`。

C++

```
string b(int n) {
    string s = "";
    while (n) {
        if (n % 2) {
            s += "1";
        } else {
            s += "0";
        }
        _____ E _____;
    }
    reverse(s.begin(), s.end());
    return s;
}
```

Answer 答案 _____ E _____ 1.5 marks 分

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

C++

```
int main() {
    int n = 53, cnt = 0;
    for (int i = 0; i < 6; ++i) {
        if (n & (1 << i)) {
            ++cnt;
        }
    }
    cout << 1 << cnt - 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
1 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。
- Answers must be in C++.
必須使用 C++ 作答。
- 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 $X1, X2, \dots, XN$, it means that marks will only be given when $X1, X2, \dots, XN$ are all correct.
如果空格 X 分為 N 部份 $X1, X2, \dots, XN$ ，那麼 $X1, X2, \dots, XN$ 皆為正確才會給分。

- 1 Complete the function $f(n)$ such that it returns the sum of all positive factors of the positive integer n .
完成函數 $f(n)$ ，使其傳回正整數 n 的所有正因數之和。

C++

```
int f(int n) {
    int sum = 0;
    for (int i = 1; i <= n; ++i) {
        if ( _____ G _____ ) {
            sum += i;
        }
    }
    return sum;
}
```

Answer 答案 _____ G _____ 1.5 marks 分

 Suppose $f(n)$ is correctly implemented, what is the return value of $f(28)$?

 假設 $f(n)$ 已被正確地實現， $f(28)$ 的傳回值是什麼？

Answer 答案 _____ H _____ 1 mark 分

x is a prime factor of n if and only if n is divisible by x and x is a prime number. Complete the function `prime_factor(n)` such that it returns an array of type `vector<int>` containing all distinct prime factors n .

當且僅當 n 能被 x 整除且 x 為質數時， x 才是 n 的質因數。完成函數 `prime_factor(n)`，使其傳回一個類型為 `vector<int>`，包含全部 n 的質因數的陣列，陣列中不可有重複元素。

C++

```
vector<int> prime_factor(int n) {  
    vector<int> pf;  
    bool check[n + 1] = {};  
    for (int i = 2; i <= n; ++i) {  
        if (check[i]) {  
            continue;  
        }  
        if (n % i == 0) {  
            pf.push_back(i);  
        }  
        for (int j = 2 * i; j <= n; _____ I _____) {  
            check[j] = true;  
        }  
    }  
    return pf;  
}
```

Answer 答案 _____ I _____ 1.5 marks 分

The sum of all positive factors of a positive integer n can also be computed using a product formula derived from its prime factorisation. Let $n = p_1^{e_1} \times p_2^{e_2} \times \cdots \times p_k^{e_k}$ be the prime factorisation of n , where

$p_1, p_2, \dots, p_k$ are distinct prime numbers and $e_1, e_2, \dots, e_k$ are positive integers. The sum of all positive factors of n is $(1 + p_1 + p_1^2 + \cdots + p_1^{e_1}) \times (1 + p_2 + p_2^2 + \cdots + p_2^{e_2}) \times \cdots \times (1 + p_k + p_k^2 + \cdots + p_k^{e_k})$.

正整數 n 的所有正因數之和亦可以利用其質因數分解所導出的乘積公式來計算。設

$n = p_1^{e_1} \times p_2^{e_2} \times \cdots \times p_k^{e_k}$ 為 n 的質因數分解，其中 $p_1, p_2, \dots, p_k$ 為不重複的質數，而 $e_1, e_2, \dots, e_k$ 為正整數。 n 的所有正因數之和為

$$(1 + p_1 + p_1^2 + \cdots + p_1^{e_1}) \times (1 + p_2 + p_2^2 + \cdots + p_2^{e_2}) \times \cdots \times (1 + p_k + p_k^2 + \cdots + p_k^{e_k})。$$

For example, if $n = 18 = 2^1 \times 3^2$, then the sum of all positive factors of n is $(1 + 2^1) \times (1 + 3^1 + 3^2) = 39$.

If $n = 1400 = 2^3 \times 5^2 \times 7^1$, then the sum of all positive factors of n is

$$(1 + 2^1 + 2^2 + 2^3) \times (1 + 5^1 + 5^2) \times (1 + 7^1) = 3720.$$

例如，若 $n = 18 = 2^1 \times 3^2$ ，則 n 的所有正因數之和為 $(1 + 2^1) \times (1 + 3^1 + 3^2) = 39$ ；若

$n = 1400 = 2^3 \times 5^2 \times 7^1$ ，則 n 的所有正因數之和為

$$(1 + 2^1 + 2^2 + 2^3) \times (1 + 5^1 + 5^2) \times (1 + 7^1) = 3720。$$

Given array pf storing all distinct prime factors of n . Complete the function `g(n, pf)` such that it returns the same value as `f(n)`, the sum of all positive factors of n .

給定陣列 pf 存儲 n 的所有質因數，且當中沒有重複元素。完成函數 `g(n, pf)`，使其與 `f(n)` 一樣，傳回 n 的所有正因數之和。

C++

```
int g(int n, vector<int> pf) {
    int sum = 1;
    for (int i = 0; i < pf.size(); ++i) {
        int cur = 1, tem = 0;
        while (n % cur == 0) {
            tem += cur;
            J1;
        }
        J2;
    }
    return sum;
}
```

Answer 答案 J1 J2 2 marks 分