	Format 類型	**# Questions 題目數**	**Total Marks 佔分**
Section A 甲部	Multiple Choice 多項選擇題	25	25
Section B 乙部	Fill-in-the-blanks 填充題	7 (A - M)	20
Total 總分			**45**

(1) 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。

(2) 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;
```

(3) Assume all programs shall be compiled and executed in Ubuntu 20.04 using the compilers and commands below.
假設所有程序都將在 Ubuntu 20.04 下使用以下編譯器及指令進行編譯，然後執行。

GNU G++ (`g++-11` 11.1.0-1)

```
g++ -std=c++20 program.cpp -o program
./program
```

Section A 甲部 (25 marks 分)

For each question, choose the **most appropriate** answer and mark the corresponding box (A, B, C, or D) on the answer sheet. One mark for each correct answer. No marks will be deducted for wrong answers.
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。
答對得一分，答錯不扣分。

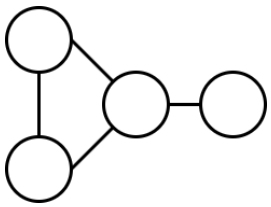
1. What is the output of the following program? 以下程序的輸出是什麼？

C++

```
int main() {
  char one = '1';
  char zero = '0';
  char ten = one + zero;
  cout << ten;
}
```

A. `a`
B. `1`
C. `01`
D. `10`

2. A graph is shown in the figure below. Each vertex can be colored by either red, blue or green. How many ways are there to color all the vertices of the following graph such that no two vertices connected by an edge have the same color?
下圖顯示了一個圖。每一個節點都可以填上紅色，藍色或綠色其中一隻顏色。有多少種方法可以為圖中所有節點都填上顏色使得沒有兩個互相連接的節點有相同的顏色？



A. 6
B. 12
C. 18
D. 81

3. Which of the following **cannot** be used as a variable name in C++?
以下選項，哪個**不能**作爲 C++ 的變量名稱？

A. `hk0i`
B. `next-permutation`
C. `define`
D. `_`

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

C++

```
int main() {
  int cnt = 0;
  for (int i = 0; i <= 10; ++i) {
    for (int j = 0; j < 10; ++j) {
      if (i % 2 == 0 && j % 2 == 0)
        ++cnt;
    }
  }
  cout << cnt;
}
```

A. 25
B. 30
C. 36
D. 110

5. The following operations are performed on a singly linked list of 100,000 numbers. Order the operations from the fastest to the slowest according to the most reasonable approximation of the order of time needed to perform them.
對 100,000 個數字的單向鏈表執行以下操作。根據執行時間的最合理估算，將以下操作從最快到最慢排序。

i. Search whether the number 5 exists in the linked list.
查找數字 5 是否存在於鏈表中。
ii. Insert a number 10 at the front of the linked list.
在鏈表的前面插入一個數字 10。
iii. Sort the linked list in ascending order using bubble sort.
使用冒泡排序對鏈表進行升序排序。

A. i, ii, iii
B. ii, i, iii
C. iii, i, ii
D. iii, ii, i

6. Which of the following expressions is equivalent to `((NOT C) AND (B OR (NOT B))) OR (A AND C)`?
以下哪一表達式與 `((NOT C) AND (B OR (NOT B))) OR (A AND C)` 等價？

A. `NOT C`
B. `(NOT C) OR A`
C. `(NOT C) AND A`
D. `(NOT C) OR (A OR (NOT B))`

7. 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, 1, 3, 2, 0};
  int b[5] = {1, 0, 2, 4, 3};
  int ans = 0;
  for (int i = 0; i < 5; ++i) {
    for (int j = 0; j < 5; ++j) {
      if (a[i] * b[j] >= i * j) {
        ++ans;
      }
    }
  }
  cout << ans;
}
```

A. 8
B. 10
C. 12
D. 14

8. Which of the following statements about sorting an array is true?
以下哪些對於排序一個陣列的描述是正確的？

i. Counting Sort involves counting the number of occurrences of each value.
計數排序涉及計算每一個數值出現的次數。
ii. Merge Sort involves splitting the array into two parts.
合併排序涉及將陣列分開成兩個部分。
iii. Selection Sort involves selecting all elements smaller than a chosen pivot value.
選擇排序涉及選擇所有比被揀選的基準數值小的元素。

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

C++

```
int main() {
  string s = "\t\\t\\\t\\\\t";
  cout << s.length();
}
```

A. 4
B. 8
C. 10
D. 14

10. If it is raining outside, Alice will bring an umbrella. If it is raining outside and today is a Monday, Bob will be unhappy. Which of the following statements must be true?
如果外面在下雨，愛麗絲就會帶雨傘。如果外面在下雨及今天是星期一，鮑伯就會不高興。以下哪項陳述必須是正確的？

    i. If Alice does not bring an umbrella, it is not raining outside.
    如果愛麗絲沒有帶雨傘，外面就沒有下雨。
    ii. If Bob is not unhappy, it is not raining outside.
    如果鮑伯沒有不高興，外面就沒有下雨。
    iii. If Alice brings an umbrella, Bob will be unhappy.
    如果愛麗絲帶雨傘，鮑伯就會不高興。
    iv. If Bob is unhappy, Alice will bring an umbrella.
    如果鮑伯不高興，愛麗絲就會帶雨傘。

    A. i only 只有 i
    B. ii only 只有 ii
    C. i and iii only 只有 i 和 iii
    D. i and iv only 只有 i 和 iv

11. If the input a is within valid C++ `int` range ($-2^{31} \leq a < 2^{31}$), which of the following expressions must be true right before the main function returns?
如果輸入 a 是在有效的 C++ `int` 範圍內 ($-2^{31} \leq a < 2^{31}$)，以下哪項表達式在主函数返回前必定為真？

C++

```
int main() {
  int a;
  cin >> a;
  int b = a >> 1;
  int c = b << 1;
}
```

    i. `a == c`
    ii. `a > b`
    iii. `b != c`

    A. i only 只有 i
    B. ii only 只有 ii
    C. iii only 只有 iii
    D. None of them 無

12. What is the 55th smallest positive integer that only consists of digits 1, 3 and 7?
請問只用數字 1、3 和 7 組成的第 55 小正整數是？

    A. 1337
    B. 1371
    C. 3317
    D. 7111

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

C++

```
int f(int a, int b) {
  if (a == 0) return b;
  if (b == 0) return a;
  return f(a, b / 2) + f(a / 2, b);
}
int main() {
  cout << f(3, 4);
}
```

A. `13`
B. `14`
C. `16`
D. `17`

14. DeepMind has recently developed an Artificial Intelligence program, AlphaCode, to solve competitive programming tasks in a fully automated manner. Which of the following descriptions about AlphaCode is the most appropriate?
DeepMind 最近研發了一個可以全自動化地解決競賽編程問題的人工智能程式 AlphaCode。以下哪一個有關 AlphaCode 的敘述最恰當？

A. AlphaCode can correctly solve all competitive programming tasks in the world.
AlphaCode 可以正確地解決世界上所有競賽編程問題。
B. AlphaCode learns from previous tasks and programs written by other competitive programmers.
AlphaCode 從過往的題目和其他競賽編程選手的程式碼學習。
C. No training is needed for AlphaCode since it can directly parse the problem statements and translate them into programs.
AlphaCode 不需要經過任何訓練，因為它可以直接解析題目敘述，然後翻譯成程式碼。
D. AlphaCode can only generate programs that does not use recursion.
AlphaCode 只可以生成沒有使用遞歸的程式碼。

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

C++

```
int main() {
  int n = 2023;
  while (n % 4 == 3) {
    n = (n / 2) * 2 - 3;
  }
  cout << n;
}
```

A. `-3`
B. `-1`
C. `2020`
D. The program will not terminate 該程序不會終止

16. The contents of array `arr` is initially `[3, 2, 6, 4, 1, 5]`. Define a swap as choosing two **adjacent** elements, then swapping their values. Which of the following are true?
數組 `arr` 最初是 `[3, 2, 6, 4, 1, 5]`。定義一次交換為選擇兩個**相鄰**的元素，然後交換它們的值。以下哪些描述是正確的？

    i. It is possible to make `arr` sorted in ascending order using exactly 2022 swaps.
    可以使用恰好 2022 次交換使 `arr` 按升序排序。
    ii. It is possible to make `arr` sorted in ascending order using exactly 2023 swaps.
    可以使用恰好 2023 次交換使 `arr` 按升序排序。
    iii. It is possible to make `arr` sorted in descending order using exactly 2022 swaps.
    可以使用恰好 2022 次交換使 `arr` 按降序排序。

    A. i only 只有 i
    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

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

C++

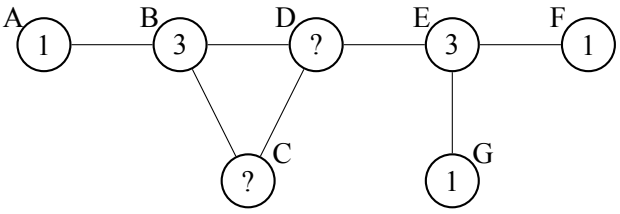
```
int i, j;
int main() {
  j = 8;
  int c = 0;
  for (i = 1; i <= 10; i += 2)
    for (i = 4; i <= j; ++i)
      c = c + 1;
  cout << c;
}
```

    A. `5`
    B. `10`
    C. `25`
    D. The program will not terminate 該程序不會終止

18. Alice selects the sequence “Heads, Heads, Tails” while Bob selects the sequence “Tails, Heads, Heads”. A fair coin is tossed until either Alice’s or Bob’s sequence appears as a consecutive subsequence of the coin toss outcomes. The player whose sequence appears first wins. What is the probability that Bob wins?
愛麗絲選擇序列「正面，正面，反面」，而鮑伯選擇序列「反面，正面，正面」。反復投擲一枚公平的硬幣，直到愛麗絲或鮑伯的序列作為投幣結果的連續子序列出現。序列首先出現的玩家獲勝。鮑伯獲勝的概率是多少？

    A. $\frac{1}{4}$
    B. $\frac{1}{2}$
    C. $\frac{2}{3}$
    D. $\frac{3}{4}$

19. The following figure shows an undirected graph, where each node is labelled with a letter. Some of the nodes are *safe nodes* while the other nodes are *unsafe nodes*. Given a number on some of the nodes that shows the number of safe nodes within distance 1 from that node (possibly including the node itself). Which of the followings **must** be true?
下圖顯示一個無向圖，圖中每個節點都以一個字母標示。有些節點是*安全節點*而其他節點是*不安全節點*。部分節點上給定一個數字，代表距離該節點不大於 1 的安全節點數量（可以包括該節點自身）。以下哪項**必定**為真？



i. Node A is safe. 節點 A 是安全的。
ii. Node C is safe. 節點 C 是安全的。
iii. Node E is safe. 節點 E 是安全的。

A. ii only 只有 ii
B. iii only 只有 iii
C. i and ii only 只有 i 和 ii
D. i and iii only 只有 i 和 iii

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

C++

```
int x;
void f() {
  if (x < 0)
    return;
  if (x % 2 == 1) {
    x -= 3;
    f();
  }
  if (x % 2 == 0) {
    x -= 2;
    f();
  }
}
int main() {
  x = 15;
  f();
  cout << x;
}
```

A. `-4`
B. `-2`
C. `0`
D. `15`

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

C++

```
int main() {
  int a = 5;
  int b = 3;
  int ans = 1;
  for (int i = 1; i <= a; ++i) {
    int tmp = 0;
    for (int j = 1; j <= b; ++j) {
      tmp += ans;
    }
    ans += tmp;
  }
  cout << ans;
}
```

A. 16
B. 125
C. 243
D. 1024

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

C++

```
int main() {
  int n = 10;
  int x = 0;
  int a[n] = {9, 23, 5, 12, 1, 29, 16, 15, 28, 6};
  for (int i = n; i >= 0; --i) {
    int j = 1 << i;
    if (j > n) {
      continue;
    }
    x += j;
    int y = 0;
    for (int k = 0; k < x; ++k) {
      y += a[k];
    }
    if (y >= 79) {
      x -= j;
    }
  }
  cout << a[x];
}
```

A. 5
B. 6
C. 16
D. 29

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

C++

```
int f(int& a, int b) {
  a += b + 2;
  b = 3;
  return a;
}
int main() {
  int a = 1;
  int b = 2;
  a = f(b, a) + a;
  b += a;
  cout << b;
}
```

A. 8
B. 11
C. 12
D. 13

24. Consider the following function: 考慮以下函數：

C++

```
int f(int l, int r) {
  int mid = (l + r) / 2;
  int n = r - l + 1;
  int sum = n * n;
  if (l < r) {
    sum += f(l, mid) + f(mid + 1, r);
  }
  return sum;
}
```

What is the return value of `f(1,16)`?
請問 `f(1,16)` 的傳回值是什麼？

A. 341
B. 496
C. 511
D. 512

25. A subsequence of a given sequence is a sequence that can be derived by deleting zero or more elements without changing the order of the remaining elements.
Consider a non-empty subsequence consisting of only digits as a numerical value (e.g. subsequence `{1,2,3}` will be considered as 123). How many different non-empty subsequences in `{1,1,1,2,2,2,3}` is divisible by 2 but not 3? Two subsequences are different if and only if they have their deleted elements at different positions.
一個子序列能夠從最初序列通過去除零個或更多個元素，而又不改變餘下元素的相對位置中形成。
現把只包含數字的非空子序列當成數值處理（如子序列 `{1,2,3}` 可當作數值 123）。請問在序列 `{1,1,1,2,2,2,3}` 中，有多少個不同的非空子序列為 2 的倍數，但不是 3 的倍數？兩個子序列為不同當且僅當它們去除了不同位置的元素。

A. 36
B. 39
C. 42
D. 56

END OF SECTION A 甲部完

Section B 乙部 (20 marks 分)

The blanks are labeled from A to M. Please fill in the blanks on the answer sheet.
下列各空格分別命名為 A 至 M，請在答題紙上對應的地方填上答案。

Note 注意：

(1) Answers must be in C++. Completed programs shall be compiled and executed according to the procedure specified on Page 1.
您必須使用 C++ 作答。完成的程序將以第一頁之步驟進行編繹及執行。

(2) 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。

(3) 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。

(4) Write legibly. Unrecognizable answers will be regarded as incorrect.
字體須端正清楚，無法辨別之答案當錯誤論。

(5) If blank X is divided into N parts X1, X2, ..., XN, it means that marks will only be given when X1, X2, ..., XN are all correct.
如果空格 X 分為 N 部份 X1、X2、...、XN，那麼 X1、X2、...、XN 皆為正確才會給分。

1. Alice has N gift points and she plans to use them to redeem gifts. There are two types of redeemable gifts: gift A and gift B. Gift A costs pA gift points and has value vA. Gift B costs pB gift points and has value vB.
Alice wants to redeem some gifts, so that their total value is maximized. For each type of gift, she may redeem zero, one, or more of it. The total number of gift points used must not exceed N.
愛麗絲有 N 點積分，她打算將積分用於兌換禮物。可兌換的禮物有兩種：禮物 A 和禮物 B。禮物 A 花費 pA 積分，價值 vA。禮物 B 花費 pB 積分，價值 vB。
愛麗絲想兌換禮物使得禮物的總價值最大。每種禮物可以兌換零個、一個或更多。總共使用的積分不可超過 N。
(a) Complete the function `FindMaxValue(N, pA, vA, pB, vB)`, so that it returns the maximum total value of the redeemed gifts. Assume that N, pA, vA, pB, vB are integers between 1 and 10000 inclusive.
完成函數 `FindMaxValue(N, pA, vA, pB, vB)`，使其返回兌換禮物的最大總值。
假設 N, pA, vA, pB, vB 是 1 至 10000（含）的整數。

C++

```
int FindMaxValue(int N, int pA, int vA, int pB, int vB) {
  int ans = 0;
  for (int xA = 0; xA * pA <= N; ++xA) {
    for (int xB = 0; xB * pB <= N; ++xB) {
      if (_____A1_____) {
        ans = max(ans, _____A2_____);
      }
    }
  }
  return ans;
}
```

Answer 答案: _____A1_____ _____A2_____ (1 mark 分)

(b) Complete the function `FindMaxValueFaster(N, pA, vA, pB, vB)`, so that it also returns the maximum total value of the redeemed gifts. You **may not** call `FindMaxValue` in your answer. Assume that N, pA, vA, pB, vB are integers between 1 and 10000 inclusive.
完成函數 `FindMaxValueFaster(N, pA, vA, pB, vB)`，使其同樣返回兌換禮物的最大總值。**不可**在答案呼告 `FindMaxValue`。假設 N, pA, vA, pB, vB 是 1 至 10000（含）的整數。

C++

```
int FindMaxValueFaster(int N, int pA, int vA, int pB, int vB) {
  int ans = 0;
  for (int xA = 0; xA * pA <= N; ++xA) {
    ans = max(ans, _______B_______);
  }
  return ans;
}
```

Answer 答案: _____B_____ (1.5 marks 分)

(c) Suppose now that there is a third type of gift, gift C, which costs pC gift points and has value vC. Complete the function `FindMaxValueABC(N, pA, vA, pB, vB, pC, vC)`, so that it returns the maximum total value of the redeemed gifts. You may call `FindMaxValue` or `FindMaxValueFaster` in the answer. Assume that they have been correctly implemented.
Assume that all parameters are integers between 1 and 10000 inclusive.
現在假設有第三種禮物 C，它花費 pC 積分兌換，價值為 vC。完成函數 `FindMaxValueABC(N, pA, vA, pB, vB, pC, vC)`，使其返回兌換禮物的最大總值。可以在答案呼告 `FindMaxValue` 或者 `FindMaxValueFaster`。假設它們已經正確實現。
假設所有參數均是 1 至 10000（含）的整數。

C++

```
int FindMaxValueABC(int N, int pA, int vA, int pB, int vB,
                    int pC, int vC) {
  int ans = 0;
  for (int xA = 0; xA * pA <= N; ++xA) {
    ans = max(ans, _______C_______);
  }
  return ans;
}
```

Answer 答案: _____C_____ (1.5 marks 分)

2. The following program tries to compute the checksum of a string S (variable `s`) of length 4 consisting of only uppercase alphabets.
In the calculation, `A` is regarded as 1, `B` is regarded as 2, etc, up until `Z` which is 26. Let S_i be the i-th character of the string S. The checksum of a string S is calculated as $(S_1)^4 + (S_2)^3 + (S_3)^2 + S_4$.
For example, the checksum of the string `ABCD` is $1^4 + 2^3 + 3^2 + 4 = 22$.
以下程序嘗試計算只由大寫英文字母組成且長度為 4 的字符串 S（變量 `s`）的校驗和。
在計算中，`A` 被視為 1，`B` 被視為 2, 如此類推直至 `Z` 被視為 26。設 S_i 為字符串 S 的第 i 個字符。S 的校驗和的值為 $(S_1)^4 + (S_2)^3 + (S_3)^2 + S_4$。
例如，`ABCD` 的校驗和是 $1^4 + 2^3 + 3^2 + 4 = 22$。

Complete the program so that it calculates and outputs the above checksum.
`mypow(b, p)` is a function that returns the value of b^p.
完成以下程序使得其計算並輸出以上的校驗和。
函數 `mypow(b, p)` 會回傳 b^p 的值。

C++

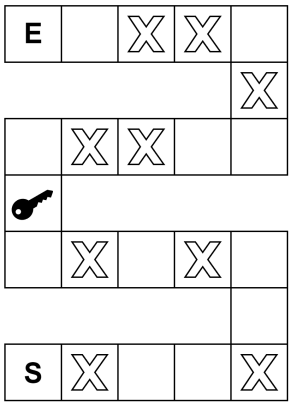
```
int main() {
  string s;
  cin >> s;
  int checksum = 0;
  for (int i = 0; i < 4; ++i) {
    checksum += mypow(_____D1_____, _____D2_____);
  }
  cout << checksum << endl;
}
```

Answer 答案: _____D1_____ _____D2_____ (1.5 marks 分)

Find another string of length 4 and consists of only uppercase alphabets other than the string `PAGE` and have the same checksum as the string `PAGE`
找出另一個除了 `PAGE` 以外只由大寫英文字母組成且長度為 4，且與 `PAGE` 有相同校驗和的字符串。

Answer 答案: _____E_____ (1.5 marks 分)

3. Alice is playing a computer game, and it takes place in the following map with 23 cells: Alice can only walk from S towards E by zigzagging. By walking few steps each time, Alice will skip the cells in the middle and land at the cell according to how many steps she walks. To win the game, Alice has to walk from cell S, get the key and arrive cell E. Notice that Alice cannot land at the cells marked with an X and she has to land exactly at the cell with the key in order to get it.
愛麗絲正在玩一個電腦遊戲，遊戲在右面有 23 格的地圖中進行：愛麗絲只能以之字形從 S 走向 E。每一次走幾步的時候，愛麗絲會跳過中間的格子，根據她走的步數停在該格子上。為了贏得遊戲，愛麗絲必須從 S 格步行，拿到鑰匙並到達 E 格。請注意，愛麗絲不能停在標有 X 的格上，而且她必須停在有鑰匙的格才能得到它。



If Alice can only walk 6 times and the sequence of number of steps she walks has to be a permutation of {2, 2, 3, 4, 5, 6}, please output one possible sequence of Alice winning the game.
如果愛麗絲只能走 6 次，並且她走的步數必須是以 {2, 2, 3, 4, 5, 6} 組成的排列，請寫出其中一種愛麗絲可以贏得遊戲的排列。

Answer 答案: _____F_____ (1.5 marks 分)

If Alice can walk 1 to 6 (inclusive) steps each time, how many different ways can Alice win the game?
如果愛麗絲每次可以走 1 至 6 步（含），那麼愛麗絲可以通過多少種不同的方式贏得遊戲？

Answer 答案: _____G_____ (2 marks 分)

4. Consider implementing a linked list using array, where `-1` is used to represent the null pointer, `h` is the head pointer, `a[]` stores the values of every linked list node and `p[]` stores the next pointers of every linked list node. Complete the following program so that `f(x)` can delete the first `x` found in a singly linked list. The linked list remains unchanged if `x` is not found.
考慮以數組實現一個鏈表，其中 `-1` 代表空指針，`h` 是頭指針，`a[]` 儲存了每一個鏈表節點的數值，`p[]` 儲存了每一個鏈表節點指向下個節點的指針。
完成以下程序，使得 `f(x)` 可以刪除單向鏈表中第一個找到的 `x`。如果找不到 `x`，則鏈表維持不變。

C++

```
int h, a[], p[];
void f(int x) {
  if (h != -1 && a[h] == x) {
    h = p[h];
    return;
  }
  for (int i = h; i != -1; i = p[i]) {
    if (_____H1_____ && (_____H2_____ == x)) {
      _____H3_____;
      return;
    }
  }
}
```

Answer 答案: _____H1_____ _____H2_____ _____H3_____ (2 marks 分)

5. Complete the function `f` such that the program outputs `210`.
完成函數 `f` 使程式輸出 `210`.

C++

```
int f(int a) {
  return a ______I______;
}
int main() {
  int ans = 0;
  for (int i = 1; i <= 70; ++i) {
    ans += f(i);
  }
  cout << ans;
}
```

Answer 答案: _____I_____ (1.5 marks 分)

6. Consider the following function: 考慮以下函數：

C++

```
int f(int n) {
  int sum = 0;
  for (int i = 1; i <= n; ++i)
    sum += i & -i;
  return sum;
}
```

Write down the return value of `f(64)`.
寫下 `f(64)` 的傳回值。

Answer 答案: _____J_____ (1 mark 分)

Without calling the function `f`, complete the following function `g`, so that `g(n)` has the same return value as `f(n)` for $1 \leq n \leq 10000$.
在不使用函數 `f` 的情況下完成下列函數 `g`，使得對於 $1 \leq n \leq 10000$，`g(n)` 和 `f(n)` 的傳回值相同。

C++

```
int g(int n) {
  int i = 2;
  int sum = _____K1_____;
  while (i <= n) {
    sum += _____K2_____;
    i *= 2;
  }
  return sum;
}
```

Answer 答案: _____K1_____ _____K2_____ (2 marks 分)

7. Alice is asked to write a program to calculate the sum of differences of adjacent elements in an array. The program should first read an integer n, indicating the number of elements in the array, then n integers, which are the elements in the array. The program should output only one integer, which is the required sum. For example, when the input is `3 1 3 4`, the program should calculate $|1-3|+|3-4|$, and output `3`.
愛麗絲被要求寫一個程序去計算一個數組裡相鄰兩個元素之間的差的總和。程序一開始需要輸入一個整數 n ，表示數組元素的數量，然後再輸入 n 個整數，表示數組的元素。程序只需要輸出一個整數，表示要求計算的總和。例如，當輸入是 `3 1 3 4` 時，程序應該計算 $|1-3|+|3-4|$ ，並輸出答案 `3` 。
Alice tries to write the following program to solve the problem:
愛麗絲嘗試寫下以下程序去解決這個問題：

C++

```
11 int main() {
12   int n;
13   cin >> n;
14   vector<int> a(n);
15   for (int i = 0;
16        i < a.size();
17        ++i)
18     cin >> a[i];
19   int sum = 0;
20   for (int i = 0;
21        i < a.size() - 1;
22        ++i)
23     sum += abs(a[i] - a[i + 1]);
24   cout << sum;
25 }
```

However, the program contains a bug. When the input is `0`, runtime error occurs. Please indicate which line when the above program executes, runtime error occurs.
然而，這個程序存在一個錯誤。當輸入是 `0` 時，程序會出現運行錯誤。請指出以上程序在運行哪一行時會出現運行錯誤。

Answer 答案: _____L_____ (1 mark 分)

The bug can be fixed by changing exactly one line. Find the line and correct it so the program can output correctly for all the following cases:
此錯誤只需更改一行便能修正，請找出那一行並將其改正，使得對於所有以下情況，程序都能輸出正確答案。

Input 輸入	Output 輸出
`0`	`0`
`1 5`	`0`
`3 1 3 4`	`3`
`5 2 0 2 2 3`	`5`

Line number 行數: __M1__
Correction 改正: _____M2_____ (2 marks 分)

END OF PAPER 全卷完