



VICTORIA UNIVERSITY OF
WELLINGTON
TE HERENGA WAKA

EXAMINATIONS – 2026

TRIMESTER 1

END-TERM EXAM

NWEN241

Systems Programming
19/06/2026

Time Allowed: TWO HOURS

CLOSED BOOK

Permitted materials:

- Only silent non-programmable calculators or silent programmable calculators with their memories cleared are permitted in this examination.
- Only paper (non-electronic) foreign to English language dictionaries are allowed.

Instructions:

- Total Marks: 100
- Attempt **ALL** the **50** multiple choice questions.
- Fill in the circle corresponding to your answer on the Answer Sheet.
- The Answer Sheet provides space for 60 questions. **Please fill in only items 1–50 and leave items 51–60 blank.**
- You **MUST** submit this test paper together with the Answer Sheet.

SECTION A System Calls, Process Management and Socket Programming (24 marks)

1. Which system call creates a new process by copying the calling process image?
(2 marks)

- a) `fork()` ✓
- b) `exec()`
- c) `wait()`
- d) `exit()`

2. What does the `wait()` system call allow a parent process to do? (2 marks)

- a) Suspend its execution until one of its child processes terminates and obtain termination information ✓
- b) Replace the current process image with a new program while preserving the same process ID
- c) Create a duplicate child process that executes concurrently with the parent
- d) Pause execution of all running child processes until explicitly resumed

3. In TCP client programming, which function initiates a connection to the server?
(2 marks)

- a) `connect()` ✓
- b) `bind()`
- c) `listen()`
- d) `accept()`

4. Consider the following code segment. (2 marks)

```
1. void display_endianness() {  
2.     int n = 1;  
3.     if(*(char *)&n == 1)  
4.         printf("Little endian\n");  
5.     else  
6.         printf("Big endian\n");  
7. }
```

Which statement correctly explains how the given code determines the byte ordering of the system?

- a) It checks whether the integer value is stored in binary or hexadecimal form
- b) It compares the memory addresses of integer and character variables
- c) It examines the first byte of the integer in memory by treating its address as a character pointer ✓
- d) It converts the integer into network byte order and compares the result

5. Complete the if statement in line 4 below so that it executes only in the child process. **(2 marks)**

```
1. int main() {  
2.     pid_t p = fork();  
3.  
4.     if ( ____ ) {  
5.         /* child process code */  
6.     }  
7. }
```

- a) $p > 0$
- b) $p < 0$
- c) $p == 0$ ✓
- d) $p != -1$

6. Complete the statement below to create a UDP socket. **(2 marks)**

```
socket(AF_INET, _____, 0);
```

- a) SOCK_STREAM
- b) SOCK_PIPE
- c) SOCK_DGRAM ✓
- d) SOCK_RAW

7. In TCP server programming, which system call prepares a socket to accept incoming connection requests? **(2 marks)**

- a) bind()
- b) listen() ✓
- c) connect()
- d) accept()

8. Which command-line utility is commonly used in Linux to trace system calls made by a process? **(2 marks)**

- a) ltrace
- b) strace ✓
- c) ptrace
- d) trace

9. Which of the following is typically stored in a Process Control Block (PCB)?

- a) Program source code

- b) Process state ✓
- c) Process output
- d) Program executable file

10. Determine the output of the following program.

(2 marks)

```
1. #include <stdio.h>
2. #include <unistd.h>
3.
4. int main() {
5.
6.     printf("A\n");
7.     if (fork())
8.         printf("B\n");
9.     else
10.        printf("C\n");
11.
12.     return 0;
13. }
```

- a) A
B
C
- b) A
C
B
- c) Either a) and b) ✓
- d) B
A
C

11. Consider the following code segment:

(2 marks)

```
1. #include <stdio.h>
2. #include <unistd.h>
3.
4. int main() {
5.     if (fork() == 0) {
6.         execl("/bin/cat", "cat", "/etc/passwd", NULL);
7.         printf("Never");
8.     }
9.
10.     return 0;
11. }
```

What happens if `execl()` executes successfully in the child process?

- a) It prints `Never`, then displays `/etc/passwd`
- b) The child process image is replaced by `/bin/cat`, and `printf()` is not executed ✓
- c) Both the parent and child processes execute `cat`
- d) The program terminates with an error

12. Consider the following program. How many processes are running after the loop completes? **(2 marks)**

```
1. #include <unistd.h>
2.
3. int main() {
4.     for (int i = 0; i < 2; i++)
5.         fork();
6.
7.     return 0;
8. }
```

- a) 3
- b) 4 ✓
- c) 6
- d) 8

SECTION B Core C++ Concepts and OOP (24 marks)

13. What is the default access specifier for members of a C++ class? (2 marks)

- a) public
- b) private ✓
- c) protected
- d) static

14. Consider the following program. Which statement about the use of the `inline` keyword is correct? (2 marks)

```
1. #include <iostream>
2. using namespace std;
3. class Test {
4. public:
5.     inline void display() {
6.         cout << "Hello\n";
7.     }
8. };
9.
10. int main() {
11.     Test t;
12.     t.display();
13.     return 0;
14. }
```

- a) The compiler is required to replace every call to `display()` with the function body
- b) Declaring a function as `inline` guarantees that no function call overhead will occur
- c) The `inline` keyword is a request to the compiler, which the compiler may ignore ✓
- d) Inline functions cannot be defined inside a class declaration

15. When is a class constructor automatically invoked in C++? (2 marks)

- a) When the program starts
- b) When an object is created ✓
- c) When a member function is called
- d) Never automatically

16. Complete the constructor declaration for the class Time.

(2 marks)

```
class Time {  
public:  
    -----();  
};
```

- a) constructor
- b) void Time
- c) Time ✓
- d) class Time

17. What is the output of the following C++ program?

(2 marks)

```
1.  #include <iostream>  
2.  using namespace std;  
3.  
4.  class Test {  
5.  public:  
6.      static int x;  
7.  
8.      Test() {  
9.          x++;  
10.     }  
11. };  
12.  
13. int Test::x = 5;  
14.  
15. int main() {  
16.     Test t1;  
17.     Test t2;  
18.  
19.     cout << t1.x << " ";  
20.     cout << t2.x << endl;  
21.  
22.     return 0;  
23. }
```

- a) 5 5
- b) 6 6
- c) 6 7
- d) 7 7 ✓

18. Given a class `Counter` with a static data member `count`, which option correctly accesses the static member outside the class? **(2 marks)**

- a) `Counter.count`
- b) `Counter::count` ✓
- c) `static Counter::count`
- d) `count::Counter`

19. What is the output of the following C++ program? **(2 marks)**

```
1. #include <iostream>
2. using namespace std;
3.
4. void change(int &x, int y) {
5.     x = x + y;
6.     y = x + y;
7. }
8.
9. int main() {
10.    int a = 4;
11.    int b = 6;
12.
13.    change(a, b);
14.    change(b, a);
15.
16.    cout << a << " " << b << endl;
17.    return 0;
18. }
```

- a) 10 16 ✓
- b) 10 20
- c) 16 26
- d) 4 6

20. Which of the following situations does **not** typically invoke a copy constructor in C++? **(2 marks)**

- a) Passing an object by value to a function
- b) Returning an object by value from a function
- c) Initialising an object using another object of the same class
- d) Passing an object by reference to a function ✓

21. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. using namespace std;
3.
4. class Test {
5. public:
6.     Test() {
7.         cout << "A";
8.     }
9.
10.    ~Test() {
11.        cout << "B";
12.    }
13. };
14.
15. int main() {
16.     Test t1;
17.
18.     return 0;
19. }
```

- a) A
- b) B
- c) AB ✓
- d) BA

22. Which statement about the `this` pointer in C++ is correct?

(2 marks)

- a) The `this` pointer can be used inside static member functions
- b) The `this` pointer refers to the current object that invoked the member function ✓
- c) The `this` pointer can be reassigned to refer to another object
- d) Every class contains only one shared `this` pointer for all objects

23. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. using namespace std;
3.
4. class Counter {
5. private:
6.     int count;
7.
8. public:
9.     Counter() {
10.         count = 0;
11.     }
12.
13.     void increment() const {
14.         count++;
15.     }
16. };
17.
18. int main() {
19.     Counter c;
20.     c.increment();
21.
22.     return 0;
23. }
```

- a) 0
- b) 1
- c) Compilation error ✓
- d) Runtime error

24. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. using namespace std;
3.
4. class Test {
5. private:
6.     int x;
7.     int y;
8.
9. public:
10.     Test(int a) : y(a), x(y) { }
11.
12.     void display() {
13.         cout << x << " " << y;
14.     }
15. };
16.
17. int main() {
18.     Test t(5);
19.     t.display();
20.
21.     return 0;
22. }
```

- a) 5 5
- b) 0 5
- c) A garbage (indeterminate) value followed by 5 ✓
- d) Compilation error

SECTION C Inheritance, Containers and Templates (24 marks)

25. Which access specifier allows derived classes to access inherited members while restricting direct external access? **(2 marks)**

- a) private
- b) protected ✓
- c) public
- d) static

26. What is the default inheritance mode when a C++ class inherits from another class without specifying an access mode? **(2 marks)**

- a) public
- b) protected
- c) private ✓
- d) static

27. What is the output of the following C++ program? **(2 marks)**

```
1. #include <iostream>
2. using namespace std;
3.
4. template <class T>
5. void swapValues(T a, T b) {
6.     T temp = a;
7.     a = b;
8.     b = temp;
9. }
10.
11. int main() {
12.     int x = 5;
13.     int y = 10;
14.
15.     swapValues(x, y);
16.
17.     cout << x << " " << y;
18.     return 0;
19. }
```

- a) 10 5
- b) 5 10 ✓
- c) 10 10
- d) Compilation error

28. Which statement correctly declares a class template in C++?

(2 marks)

- a) `template<class T> class A {};` ✓
- b) `class<T> A {};`
- c) `<class T> template {};`
- d) `template <T> class A {};`

29. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. using namespace std;
3.
4. class Base1 {
5. public:
6.     Base1() {
7.         cout << "X";
8.     }
9. };
10.
11. class Base2 {
12. public:
13.     Base2() {
14.         cout << "Y";
15.     }
16. };
17.
18. class Derived : public Base1, public Base2 {
19. public:
20.     Derived() {
21.         cout << "Z";
22.     }
23. };
24.
25. int main() {
26.     Derived d;
27.
28.     return 0;
29. }
```

- a) XYZ ✓
- b) ZYX
- c) YXZ
- d) XZY

30. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. using namespace std;
3.
4. class A {
5. public:
6.     void display() {
7.         cout << "A";
8.     }
9. };
10.
11. class B : private A {
12. };
13.
14. class C : public B {
15. };
16.
17. int main() {
18.     C obj;
19.     obj.display();
20.
21.     return 0;
22. }
```

- a) A
- b) C
- c) Compilation error ✓
- d) Runtime error

31. A program stores a large sequence of elements that are mostly accessed by position. Insertions and deletions occur rarely after the initial data is loaded. Which STL container is most suitable? (2 marks)

- a) vector ✓
- b) list
- c) set
- d) queue

32. Which STL container does **not** support direct access using the subscript operator [] ? (2 marks)

- a) vector
- b) array
- c) deque
- d) list ✓

33. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. #include <vector>
3. using namespace std;
4.
5. int main() {
6.     vector<int> v(3);
7.     cout << v.size() << " " << v[0];
8.     return 0;
9. }
```

- a) 0 0
- b) 3 0 ✓
- c) 3 Garbage value
- d) Compilation error

34. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. #include <list>
3. using namespace std;
4. int main() {
5.     list<int> nums = {1, 2, 3, 4};
6.     for (auto it = nums.begin(); it != nums.end(); ++it) {
7.         if (*it < 3)
8.             nums.push_front(*it);
9.     }
10.    for (int n : nums)
11.        cout << n << " ";
12.    return 0;
13. }
```

- a) 1 2 3 4
- b) 2 1 1 2 3 4 ✓
- c) 1 1 2 2 3 4
- d) Compilation error

35. What is the output of the following C++ program?

(2 marks)

```
1.  #include <iostream>
2.  using namespace std;
3.
4.  class Base {
5.  public:
6.      Base() {
7.          cout << "B";
8.      }
9.
10.     virtual void show() {
11.         cout << "Base";
12.     }
13.
14.     ~Base() {
15.         cout << "b";
16.     }
17. };
18.
19. class Derived : public Base {
20. public:
21.     Derived() {
22.         cout << "D";
23.     }
24.
25.     void show() {
26.         cout << "Derived";
27.     }
28.
29.     ~Derived() {
30.         cout << "d";
31.     }
32. };
33.
34. int main() {
35.     Base* ptr = new Derived();
36.
37.     ptr->show();
38.     delete ptr;
39.     return 0;
40. }
```

- a) BDDeriveddb
- b) BDDerivedb ✓
- c) BBaseb
- d) BDDerivedbd

36. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. using namespace std;
3.
4. template <class T>
5. class Box {
6. private:
7.     T value;
8.
9. public:
10.     Box(T v) : value(v) { }
11.
12.     void show() {
13.         cout << value;
14.     }
15. };
16.
17. int main() {
18.     Box<char> b1('A');
19.     Box<int> b2('A');
20.
21.     b1.show();
22.     cout << " ";
23.     b2.show();
24. }
```

- a) A A
- b) A 65 ✓
- c) 65 A
- d) Compilation error

SECTION D Strings, Structures and Friend Functions (18 marks)

37. What is one major advantage of `std::string` over C-style character arrays in C++?
(2 marks)

- a) `std::string` always uses fixed-size memory allocation
- b) `std::string` automatically manages memory and can resize dynamically ✓
- c) `std::string` stores characters in non-contiguous memory locations
- d) `std::string` cannot be modified after creation

38. Which statement correctly describes a key difference between `struct` and `class` in C++?
(2 marks)

- a) Structs cannot have member functions
- b) The default access specifier is different: members of a `struct` are public by default, whereas members of a `class` are private by default ✓
- c) Structures are intended solely for storing data
- d) There are no syntactic or semantic differences between `struct` and `class` in C++

39. Which declaration correctly makes the function `connect()` a friend of the class `Server`?
(2 marks)

```
class Server {  
private:  
    int port;  
  
public:  
    ----- connect(Server& s);  
};  
  
void connect(Server& s) { /* can access s.port*/  
}
```

- a) friend class
- b) friend void ✓
- c) void friend
- d) class friend

40. A friend function in C++ can access which members of the class that declares it as a friend? **(2 marks)**

- a) Public members only
- b) Protected members only
- c) Public, protected, and private members of the class ✓
- d) No class members

41. What is the output of the following C++ code segment? **(2 marks)**

```
string s = "ABC";  
cout << s.length();
```

- a) 2
- b) 3 ✓
- c) 4
- d) Compilation error

42. What is the output of the following C++ program? **(2 marks)**

```
1. #include <iostream>  
2. using namespace std;  
3.  
4. struct Data {  
5.     int a;  
6.     int b;  
7. };  
8.  
9. void process(Data d) {  
10.     d.a = d.a + d.b;  
11.     d.b = d.a + d.b;  
12. }  
13.  
14. int main() {  
15.     Data x = {2, 3};  
16.  
17.     process(x);  
18.  
19.     cout << x.a << " " << x.b;  
20.  
21.     return 0;  
22. }
```

- a) 5 8
- b) 2 3 ✓
- c) 5 3
- d) Compilation error

43. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. #include <string>
3. using namespace std;
4.
5. struct Record {
6.     private:
7.         string text;
8.
9.     public:
10.        Record(string t) : text(t) { }
11.
12.        friend void update(Record r);
13. };
14.
15. void update(Record r) {
16.     r.text += " C++";
17. }
18.
19. int main() {
20.     Record r("Hello");
21.
22.     update(r);
23.
24.     cout << r.text;
25.
26.     return 0;
27. }
```

- a) Hello
- b) Hello C++
- c) C++
- d) Compilation error ✓

44. Which statement about friend functions in C++ is correct?

(2 marks)

- a) Friend functions are inherited automatically by derived classes
- b) Declaring a function as a friend violates access control only for the specified class ✓
- c) Friend functions can only access protected members of a class
- d) A friend function must be called using an object of the class

45. What is the output of the following C++ program?

(2 marks)

```
1. #include <iostream>
2. #include <string>
3. using namespace std;
4.
5. struct Package {
6.     string name = "Default";
7.     int version = 1;
8. };
9.
10. int main() {
11.     Package p1 = {"App", 2};
12.     Package p2 = {"App", 3};
13.
14.     cout << (p1.name == p2.name ? "Y" : "N");
15.
16.     return 0;
17. }
```

- a) Y ✓
- b) N
- c) 1
- d) Compilation error

SECTION E File Handling and Dynamic Memory Allocation (10 marks)

46. Which statement about dynamic memory allocation in C++ is correct? (2 marks)

- a) Memory allocated using `new[]` should be released using `delete`
- b) Memory allocated using `new` should be released using `delete[]`
- c) Memory allocated using `new[]` should be released using `delete[]` ✓
- d) Memory allocated using `new` does not need to be manually released

47. Which statement correctly describes the effect of the file open modes used in the following C++ code? (2 marks)

- a) `ios::trunc` clears existing file contents, while `ios::app` writes data at the end of the file ✓
- b) `ios::app` clears the file before writing, while `ios::trunc` preserves existing contents
- c) Both `ios::trunc` and `ios::app` overwrite the file from the beginning
- d) `ios::app` can only be used when reading from a file

48. What will be the output of the following C++ program if the user enters ABC DEF? (2 marks)

```
1. #include <iostream>
2. using namespace std;
3.
4. int main() {
5.     char word[20];
6.     char line[20];
7.
8.     cin.get(word, 20);
9.     cin.getline(line, 20);
10.
11.     cout << "[" << word << "];"
12.     cout << "[" << line << "];"
13.
14.     return 0;
15. }
```

- a) [ABC DEF] [] ✓
- b) [ABC] [DEF]
- c) [ABC DEF] [DEF]
- d) Compilation error

49. What is the output of the following C++ code segment?

(2 marks)

```
int *p = new int(5);
int *q = p;

*q = 10;

cout << *p << " " << *q;

delete p;
```

- a) 5 5
- b) 10 10 ✓
- c) 5 10
- d) Undefined behaviour

50. Assume the file `example.txt` contains the following data on a single line. (2 marks)

1 A Sam P

What is the output of the C++ code segment below?

```
int id;
char grade;
string name;

ifstream fs("example.txt");

fs >> id >> grade >> name;

cout << id << " " << grade << " " << name;
```

- a) 1 A Sam P
- b) 1ASam
- c) 1 A Sam ✓
- d) Compilation error
