

NATIONAL UNIVERSITY OF SINGAPORE
CS1101S — PROGRAMMING METHODOLOGY

(AY2021/2022 SEMESTER 1)

READING ASSESSMENT 1

Time Allowed: **45 Minutes**

INSTRUCTIONS

1. This assessment contains **18 Multiple-Choice Questions** in **4 Sections**.
2. Each question has one correct answer. **1 mark** is awarded for each correct answer and there is no penalty for a wrong answer.
3. The full score of this assessment is **18 marks**.
4. Answer **all questions**.
5. This is a **Closed-Book** assessment, but you are allowed one double-sided **A4 / foolscap / letter-sized sheet** of handwritten or printed **notes**.
6. You are allowed to use up to **4 sheets** of **blank A4 / foolscap / letter-sized** paper as **scratch paper**.
7. **Follow the instructions of your invigilator or the module coordinator to submit your answers.**

Section A

(1) What is the result of evaluating the following Source program?

```
const a = 3;
function fun(a) {
    const b = 20;
    return a + b + c;
}
const b = 5;
const c = 10;
fun(a + b);
```

- A. 18
- B. 33
- C. 23
- D. 38
- E. Error: one or more names is/are redeclared
- F. Error: one or more names is/are not declared before being used

(2) What is the result of evaluating the following Source program?

```
const x = 3;
function fun(x) {
    if (x % 2 === 0) {
        const z = 20;
    } else {
        const z = 30;
    }
    return x + y + z;
}
const y = 5;
const z = 10;
fun(x + y);
```

- A. 23
- B. 33
- C. 43
- D. 18
- E. 28
- F. 38
- G. Error: one or more names is/are redeclared
- H. Error: one or more names is/are not declared before being used

(3) What is the result of evaluating the following Source program?

```
const x = 1;  
(x => (x => (x => 2 * x)(x + 3))(3 * x + 1))(x + 4);
```

- A. 2
- B. 10
- C. 16
- D. 20
- E. 38
- F. 40

(4) What is the result of evaluating the following Source program?

```
function w(w, x) {  
    return x <= 1 ? x : w(w, x - 1);  
}  
w((w, x) => 2 * x + 1, 5);
```

- A. 1
- B. 9
- C. 19
- D. 39
- E. 79
- F. 159
- G. Error: one or more names is/are redeclared
- H. Error: wrong kind of arguments(s) or wrong number of argument(s)

(5) What is the result of evaluating the following Source program?

```
function h(f, x) {  
    function h(g, x) {  
        return x <= 1 ? 1 : 3 * g(f, x - 1);  
    }  
    return x <= 1 ? 1 : 2 * f(h, x - 1);  
}  
h(h, 5);
```

- A. 16
- B. 24
- C. 32
- D. 36
- E. 54
- F. 81
- G. Error: one or more names is/are redeclared
- H. Error: wrong kind of arguments(s) or wrong number of argument(s)

Section B

In some of the following questions, the pre-declared `display` function is used in the Source programs. The `display` function displays/prints the value of its input argument in the REPL, *and* returns the value of its input argument. For example, `display(2 * 5)` prints `10` and returns `10`; and `display(1 > 2)` prints `false` and returns `false`.

- (6) What is the sequence of values printed by the `display` function when the following program is evaluated?

```
function fun(x) {  
    if (x === 0) {  
        display(x);  
        return 0;  
    } else {  
        display(fun(x - 1));  
        return x;  
    }  
}  
fun(5);
```

- A. 3 2 1 0
- B. 4 3 2 1 0
- C. 4 3 2 1 0 0
- D. 0 1 2 3
- E. 0 1 2 3 4
- F. 0 0 1 2 3 4
- G. None of the other options is the correct answer

- (7) What is the sequence of values printed by the `display` function when the following program is evaluated?

```
function fun(x) {  
    if (x <= 1) {  
        return 1;  
    } else {  
        display(x);  
        return fun(x - 1) + fun(x - 2);  
    }  
}  
fun(5);
```

- A. 5 4 3 2 2 3 2
- B. 5 3 2 4 2 3 2
- C. 5 4 3 3 2 2 2
- D. 5 3 4 2 2 3 2
- E. 5 4 3 2 4 3 2
- F. None of the other options is the correct answer

- (8) What is the sequence of values printed by the `display` function when the following program is evaluated?

```
function fun(x) {  
    display(x);  
    return x <= 1 ? x : fun(fun(x - 1));  
}  
fun(5);
```

- A. 5 4 3 2 1
- B. 5 4 3 2 1 1
- C. 5 4 3 2 1 1 1 1 1
- D. 5 4 3 2 1 4 3 2 1
- E. 5 4 4 3 3 2 2 1 1
- F. None of the other options is the correct answer

- (9) What is the sequence of values printed by the `display` function when the following program is evaluated? Note that the value returned by `math_floor(x)` is the largest integer value that is less than or equal to `x`.

```
function fun(f, a, b) {
  display(a);
  display(b);

  const x = math_floor((a + b) / 2);
  const fx = f(x);

  return a > b
    ? false
    : fx === 0
    ? x
    : fx < 0
    ? fun(f, a, x - 1)
    : fun(f, x + 1, b);
}

fun(x => 2 * x - 26, 1, 20);
```

- A. 1 20 11 20 11 14 13 14
- B. 1 20 11 20 11 14 12 13 13 13
- C. 1 20 10 20 10 15 12 15
- D. 1 20 1 9 1 4 1 1 1 0
- E. 1 20 11 20 16 20 19 20 20 20 21 20
- F. None of the other options is the correct answer

- (10) Given that, in Source, the left operand of a binary operation is evaluated before the right operand, what is the sequence of values printed by the `display` function when the following program is evaluated?

```
function D(m, x) {  
    display(m);  
    return x;  
}  
  
function fun(x) {  
    return x * x;  
}  
  
D( "fun",  
  fun( D( "*",  
        D("2", 2) * D("3", 3)  
      )  
    )  
);
```

- A. "2" "*" "3" "fun"
- B. "2" "3" "*" "fun"
- C. "*" "2" "3" "fun"
- D. "fun" "2" "*" "3"
- E. "fun" "2" "3" "*"
- F. "fun" "*" "2" "3"
- G. None of the other options is the correct answer

- (11) What is the sequence of values printed by the `display` function when the following program is evaluated?

```
function D(m, x) {  
    display(m);  
    return x;  
}  
  
const f = D(2, () => D(1, 1));  
D(3, f());
```

- A. 1 2 1 2 3
- B. 2 1 3 2 1
- C. 2 1 2 3
- D. 1 2 1 3
- E. 2 1 3
- F. None of the other options is the correct answer

Section C

- (12) What kind of process does the following function give rise to for any *integer* argument $n > 0$?

```
function f(n) {  
    return n <= 1  
        ? false  
        : f(n - 1)  
        ? false  
        : true;  
}
```

- A. An iterative process
- B. A recursive process
- C. A process that is neither iterative nor recursive
- D. A substitution process
- E. An infinite process

- (13) What kind of process does the following function give rise to for any *integer* argument $n > 0$?

```
function f(n) {  
    return n <= 1 ? 1 : f(f(n - 1));  
}
```

- A. An iterative process
- B. A recursive process
- C. A process that is neither iterative nor recursive
- D. A substitution process
- E. An infinite process

(14) What kind of process does the following function give rise to for any *integer* argument $n > 0$?

```
function f(n) {  
    return n <= 1 ? 1 : (x => x)(f(n - 1));  
}
```

- A. An iterative process
- B. A recursive process
- C. A process that is neither iterative nor recursive
- D. A substitution process
- E. An infinite process

(15) What kind of process does the following function give rise to for any *integer* argument $n > 5$? (This question has been voided.)

```
function f(n) {  
    return n <= 1  
        ? 1  
        : n <= 5  
        ? 2 * f(n - 1)  
        : f(n - 2);  
}
```

- A. An iterative process
- B. A recursive process
- C. A process that is both iterative and recursive
- D. A substitution process
- E. An infinite process

Section D

- (16) We specify that the function q , when applied to any two *integer* arguments x and y , should return true if x is equal to y , or if x or y is equal to zero, and return false otherwise. Consider the following implementation:

```
function q(x, y) {  
    return x === y  
        ? true  
        : x === 0  
        ? true  
        : false;  
}
```

Which one of the following statements is correct?

- A. The function q meets the specification.
- B. The function q does not meet the specification because it can be applied to non-integer arguments.
- C. The function q does not meet the specification because the arguments x and y must always be larger than zero.
- D. The function q does not meet the specification because it does not check whether the arguments are valid inputs.
- E. The function q does not meet the specification because it does not work correctly for some valid arguments.

- (17) We specify that the function A, when applied to any non-negative integer argument n, should return n modulo 2. Consider the following implementation:

```
function A(n) {  
  function helper(x, n) {  
    return n === 0  
      ? 0  
      : x + helper(-x, n - 1);  
  }  
  return helper(1, n);  
}
```

Which one of the following statements is correct?

- A. The function A meets the specification.
- B. The function A does not meet the specification because it can be applied to non-integer arguments.
- C. The function A does not meet the specification because the nested helper function does not check if the argument n is greater than 0.
- D. The function A does not meet the specification because it is an inefficient way to compute n modulo 2.
- E. The function A does not meet the specification because it does not work correctly for some valid arguments.

- (18) We specify that the function C, when applied to any number argument, should return the cube of the argument. Consider the following implementation:

```
function z(g, x) {  
  return g(g(x));  
}  
  
const C = x => z(x => x * x, x);
```

Which one of the following statements is correct?

- A. The function C meets the specification.
- B. The function C does not meet the specification because it can be applied to non-integer arguments.
- C. The function C does not meet the specification because one of the lambda expressions cannot be evaluated.
- D. The function C does not meet the specification because it is an inefficient way to compute the cube of a number.
- E. The function C does not meet the specification because it does not work correctly for valid inputs.

————— END OF QUESTIONS —————