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`?

```
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 ———