CSC 3205: Structure and Interpretation of Computer Programs

Exercise 1

1. Predict the outcome of the following expressions and check your answer.

   a. 75

   b. (+ 10 11 12 13 14)

   c. (* 24 71)

   d. (+ 4 (* 5 1 (/ 20 4)))

   e. (define z 9)

   f.
```
(define y (+  z  1))
```

   g.
```
(if (>   z    y)
    z
    y)
```

   h.
```
(if (>  z   y)
    z)
```

   i.
```
(+ z (if (>=  z  y)
    z
    y))
```

   j.
```
(set! z y)
```

   k.
```
(cond
     ((= z y) (* z y))
     ((< z y) (- z y))
     (else    (+ z y)))
```

   l.
```
(case (+ 13 24)
     ((4) "four")
     ((5) "five")
     ((6 7 8) "six or seven or eight")
     (else    "unknown"))
```

   m.
```
(let
     ((w 11)
      (z 12))
     (+ w z))
```

n. v

o. `(define (double x) (+ x x))`

p. `(double 2)`

q.
```
(define double2 (lambda (x) (+ x x)))
(double2 2)
```

2. Write Scheme expressions for the following

   a. If a person is above 18 years of age, print a message that allows them to vote, otherwise print an error message

   b. A certain university uses the following criteria for grading students:
   if mark is greater than 90, give an A-plus
   if mark is greater than 80, give an A
   If mark is between 65 and 80, give a B
   If mark is between 50 and 65, give a C
   Otherwise, the student has failed.
   Write a Scheme expression to grade students.

3. Procedure definition; write procedures for the following tasks: (Note: extra marks for use of higher-order procedures, let, lambda, conditional expressions, etc, where appropriate.)

   a. A procedure cube that returns the cube of a given number.

   b. A procedure sum-of-cubes that returns the sum of cubes of given numbers.

   c. A procedure to convert a given temperature from

      i. Celsius to Fahrenheit

      ii. Fahrenheit to Celsius

   d. A procedure, leap-year?, that tells whether a given year say 2021 is a leap year or not.

   e. A procedure minimum, which when given 3 values, finds the smallest value.

   f. A procedure maximum, which when given 3 values, finds the biggest value.

   g. A procedure divisible?, which when given 2 values a and b, is able to tell whether a is divisible by b, otherwise, it returns the remainder.

   h. A procedure simple-calc, which takes as arguments a sign(+, -, /, *) and 2 values, and returns the result of applying the sign to the 2 given values.

4. Recursion and Iteration. (Note: extra marks will be given for use of higher-order procedures, let, lambda, conditional expressions, etc, where appropriate.)

a. Write a recursive procedure (count-down n count b), that counts down from a given number n to another b by the value *count*. For instance (count-down 100 10 0) counts down from 100 to 0 by reducing by 10.

b. Define a procedure double that takes a procedure of one argument as argument and returns a procedure that applies the original procedure twice. For example, if inc is a procedure that adds 1 to its argument, then (double inc) should be a procedure that adds 2.

c. Write a recursive procedure that returns the sum of cubes of integers between 1 and 10. Rewrite the same procedure as an iterative process.