BBM 301 - Programming Languages - Fall 2020 Midterm
December 1, 2020 – Part 1

Name: _____

Student ID number: _____

Please write your name, ID and following honor pledge:
 "**On my honor, I pledge that I have neither given nor received any unauthorized assistance on this exam.** "
and **sign** your answer sheet.

Question 1-2: 23 points, 20 mins.

1- [8 pts] A natural number is either 0 or any positive number consisting of digits 0-9, but that does not start with 0s. That is, the numbers 0, 9, 78, 304, 40105, 20000000 are natural, but 02 and 0034 are not.

   a) Write a BNF for describing natural numbers. Do not use EBNF.

   b) Write a regular expression for describing natural numbers

2- [15 pts] Consider the following grammar, where {S} is the set of non-terminals, and {x; &} is the set of terminals.

```
S -> x
S -> S &
S -> S S
```

   a) Show that this grammar is ambiguous.

   b) Write a BNF for non-ambiguous grammar for the same language, resolving ambiguities as follows:
- Juxtaposition (the production `S -> S S`) associates to the left, & is non-associative
- & has a higher precedence than Juxtaposition.