CSC465/2104       Test 1      2021 March 1
1 page, 3 questions, 42 marks, 50 minutes
Aids allowed: one letter-sized page, both sides
list of laws, 14 pages

Cheating is a serious offense.
The consequence ranges from zero on the test
to failure on the course to expulsion from the university.

The value of each question is indicated in square brackets.
A blank answer is worth about one-third of the marks;
to that, marks will be added for readable and relevant and correct information,
and marks will be subtracted for unreadable or irrelevant or incorrect information.

Please position the camera so that your hands and face are visible.
Please write your name and student number on each answer page.
If you are in doubt about the meaning of a question,
state what meaning you assume as part of your answer.

0[12] Let \( x \) and \( y \) be binary variables. Simplify
\[
\begin{align*}
x &: = x \oplus y, \\
y &: = x \oplus y, \\
x &: = x \oplus y
\end{align*}
\]

1 Let \( n \) be a natural variable, and let \( b \) be a binary variable. Using the notations and methods of this course, write a program to determine whether \( 3 \) is a factor of \( n \)
(whether \( 3 \) divides evenly into \( n \) with no remainder), reporting the answer as the final value of \( b \).
Your program can use addition, subtraction, comparison, and binary operators, but not multiplication, division, \( \text{div} \), or \( \text{mod} \).
(Your non-program specifications can use anything.)
(a)[6] Write a formal specification.
(b)[9] Refine your specification to obtain a program. You do not need to prove the refinements.

2[15] Let \( n \) and \( d \) be \textit{nat} variables. Prove that \( n' = n + d \times (d-1)/2 \) is refined by
\[
\textbf{while } d > 0 \textbf{ do } d := d - 1. \quad n := n + d \textbf{ od}
\]

end of test