**Name:**

**Advanced Programming in C++**

**Lab Exercise 4/21/2021**

In this lab exercise, you will write several programs that involve solving some very relevant problems that you will encounter in the future.

1. Create a digital computer differentiator. A differentiator is a fancy name for the instantaneous slope of a function. Here is some code that will implement this. Unfortunately, it is written in Dartmouth Basic (a variant of BASIC developed at Dartmouth College in 1964 by Professors Kemeny and Kurtz). Historical Note: The BASIC (Beginners All-purpose Symbolic Instruction Code) was derived from an earlier language DOPE (Dartmouth Oversimplified Programming Experiment).

5 REM BASIC DIFFERENTIATOR

10 DEF FN X(T) = 5 \* T^2

20 INPUT “ENTER VALUE OF T “; T

30 INPUT “ENTER VALUE OF DELTA T “; DELTA

40 X1 = FN X(T)

50 X2 = FN X(T + DELTA)

60 DELTAX = X2 – X1

70 XDOT = DELTAX / DELTA

80 PRINT (“THE DERIVATIVE IS “; XDOT

90 END

1. Create a basic computer integrator. An integrator is a fancy name for calculating the area encompassed by a function. Here is some code that will implement this. Unfortunately it is also written in Dartmouth Basic.

5 REM BASIC INTEGRATOR

10 DEF FN X(T) = 10 \* T^2

20 INPUT (“ENTER VALUE OF UPPER LIMIT “; T2

30 INPUT (“ENTER VALUE OF LOWER LIMIT “; T1

40 INPUT (“ENTER NUMBER OF INTEGRATION STEPS “; N

50 DELTA = (T2 – T1) / N

60 SUM = 0 : T = T1

70 FOR I = 0 TO N

80 SUM = SUM + DELTA \* FN X(T)

90 T = T + DELTA

100 NEXT

110 PRINT “THE VALUE OF THE INTEGRAL IS “; SUM

120 END

1. Triangular numbers (so called because they can be arranged in a triangle are the sum of the n natural numbers from 1 to n. The nth triangular number is given by the formula:



For example, 15 is the 5th triangular number T5 since 1 + 2 + 3 + 4 + 5 = 15.

Write a program that will test a number to see it is triangular. If it is, print the number as a triangular output. For example, since 15 is triangular it should print out as such

X

XX

XXX

XXXX

XXXXX

When you have completed these assignments, submit your source code as well as sample output..