# ALGONQUIN COLLEGE

DAT8921 Lab 6

Scientists have designed a special rocket whose purpose is to make wind measurements during times of extreme weather. Before the rocket is actually built, computer simulations are conducted so that scientists can predict how their rocket will behave. A simulation using a rocket length of 5 meters launched with an initial velocity of 100 m/s was conducted and the data obtained was used to generate the graph above, which projects the rocket's trajectory. The rocket was launched at t = 0.0 seconds, reached a maximum height of 515.2 m at t = 10.2 seconds, and landed back on earth approximately 21 seconds later.

Figure 1:

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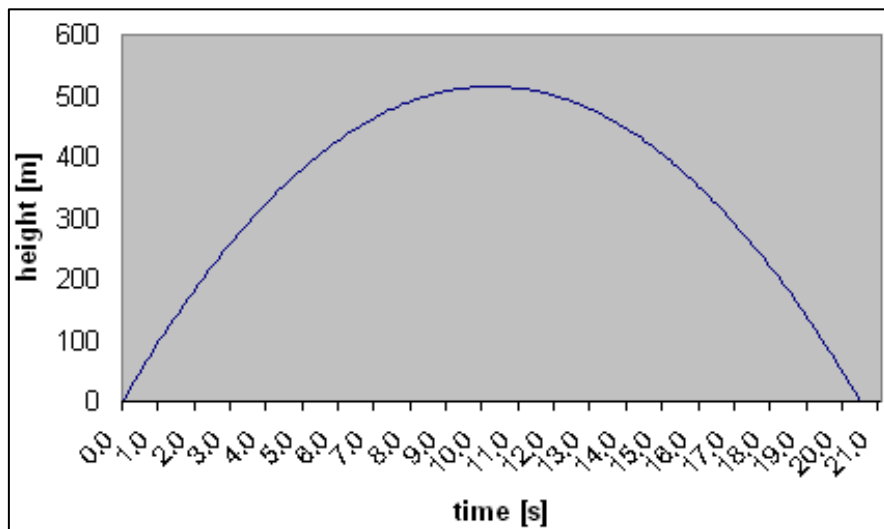
Assignment:

Design a program that resembles the output below. The table should continue to print out the time and height until the rocket completes the flight (i.e. until the rocket crashes).
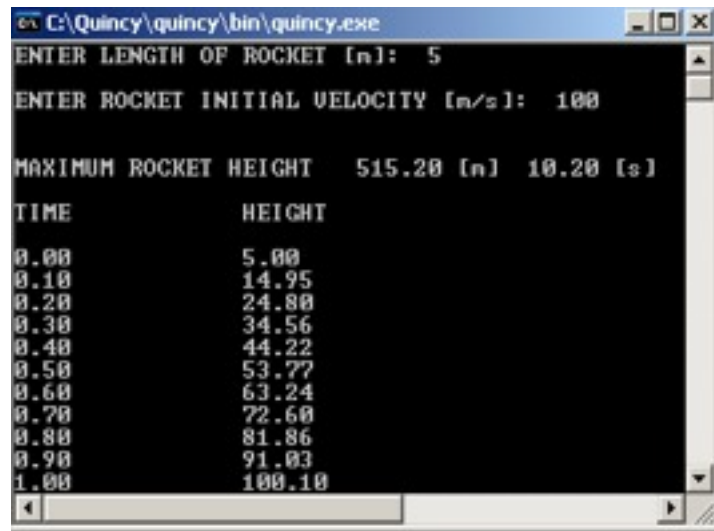
The outputs should resemble the following:

```
C:\Quincy\quincy\bin\quincy.exe                    _ □ X
ENTER LENGTH OF ROCKET [m]:   5

ENTER ROCKET INITIAL VELOCITY [m/s]:   100


MAXIMUM ROCKET HEIGHT    515.20 [m]  10.20 [s]

TIME                HEIGHT

0.00                5.00
0.10                14.95
0.20                24.80
0.30                34.56
0.40                44.22
0.50                53.77
0.60                63.24
0.70                72.60
0.80                81.86
0.90                91.03
1.00                100.10
```

Figure 2: rockets height v.s time

```
C:\Quincy\quincy\bin\quincy.exe                    _ □ X
19.20               118.66
19.30               109.80
19.40               100.84
19.50               91.77
19.60               82.62
19.70               73.36
19.80               64.00
19.90               54.55
20.00               45.00
20.10               35.35
20.20               25.60
20.30               15.76
20.40               5.82
20.50               -4.23

Press Enter to return to Quincy..._
```
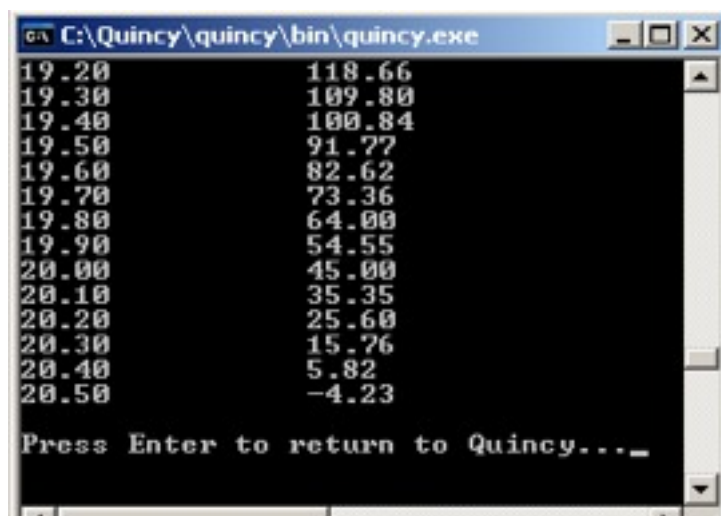
Figure 3: rockets height v.s time (continued)

Prompt the user for the rocket's length in meters and the rocket's initial velocity in meters/second. Calculate the time at which the rocket acquires maximum height using equation [1]. Then use this result to solve for maximum rocket height.

[1].

$$t\_max\_height = v_o / gravity$$

Calculate the rocket's total flight time. This can be accomplished using the quadratic equation but for simplicity, just the following formula will be used:

[2]

$$total\_flight\_time = \frac{-v_o - \sqrt{v_o^2 - 4*(-4.9)*rocket\_length}}{2*(-4.9)}$$

Generate a table of values by using the repetition structure of your choice. Start at t = 0.0 seconds and increment in steps of 0.1 second. Use [3] to calculate the rocket height.

[3]

$$rocket\_height = rocket\_length + v_o*t - \frac{1}{2}*g*t^2$$

where v_o = initial velocity of the rocket, g = gravity (9.8 m/s^2) and t = time.

Advice:

Try writing out a solution for heights at: .1, .2, .3, seconds. How would you teach someone else to solve this problem by hand? Write out the program in pseudocode to begin with, then attempt programming in C.