Course: Calculus 12 TacoCopter Simulation		Hangzhou International School Mr. Weinberg

Warm Up:

Read the article located at the following link:

http://www.huffingtonpost.com/mobileweb/2012/03/23/tacocopter-startup-delivers-tacos-by-unmanned-drone-helicopter_n_1375842.html

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Mr. Weinberg read this and thinks there's a lot of potential for making this system work in Hangzhou. These quadcopter robots usually contain an electronic <u>accelerometer</u>, which is a sensor that measures acceleration. It is used in phones and tablets to indicate which way the device is being held. This accelerometer can be used to estimate its height above the ground using some integration.

Hmm...integration. That sounds like something you might want to review for your final, no?

While sitting outside on his balcony yesterday, Mr. Weinberg created a simulation of the movement of the TacoCopter using the programming language Python. You won't need to know any programming for this activity, but if you are interested, he can show you how it works. You will create a similar simulation yourself when we work on programming after the AP exam.

Here are some important facts about the simulated TacoCopter.

- The TacoCopter will need to rise from from the ground up to a height of 100 meters above the ground. This will be called its **cruising height,** and will allow the TacoCopter to safely move to its destination while avoiding most obstacles on the ground.

- The TacoCopter will adjust its vertical acceleration automatically according to how far it is from its cruising height, and how fast it is moving. It will calculate this acceleration according to the following equation: $acceleration = b * (\text{cruising height} - \text{current height}) - c * velocity$.

- The simulated acceleration data vs. time has been recorded in the Geogebra spreadsheet. The data is noisy to simulate what data from an actual accelerometer looks like.

- You may assume that the initial height and velocity of the TacoCopter are both zero at the beginning of the simulation.

Your task is to do the following:

1. Use the data table on the next page to calculate the final velocity of the TacoCopter by hand using a rectangular approximation and a trapezoidal approximation for $\int_0^t a(t)dt$.

2. Use a rectangular approximation in the spreadsheet to calculate the change in velocity of the TacoCopter for each interval. Look at the video to get a hint on exactly how to do this.

3. Use your calculated data for velocity vs. time in the spreadsheet to generate a data table for *position* versus time for the TacoCopter.
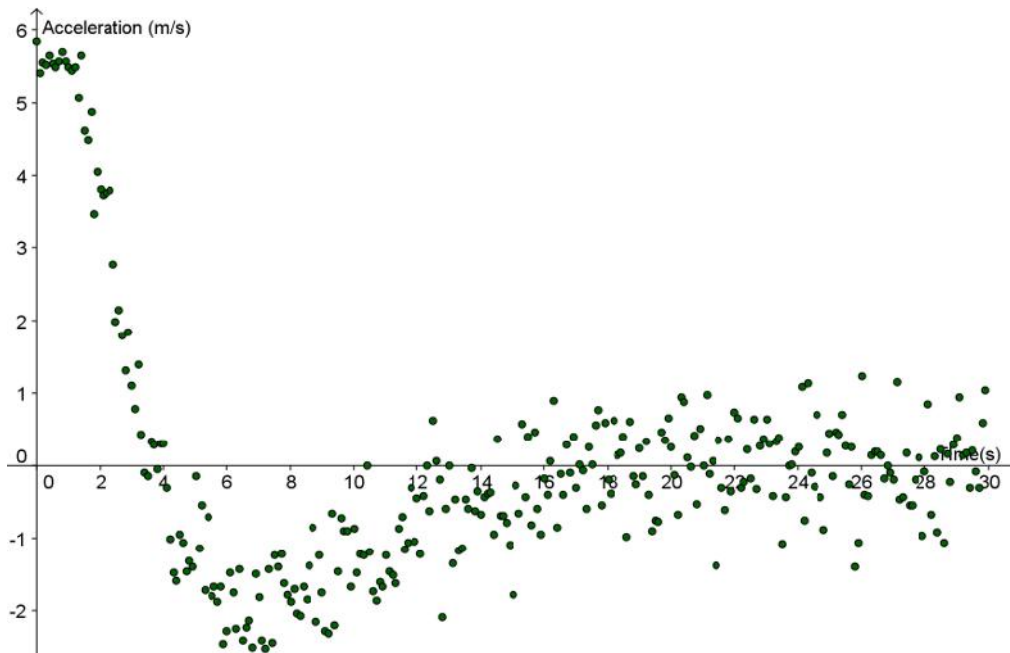
Continue next page!

4. Paste this position vs. time data into Column B of the'TacoCopter Animation.ggb' to see an animation of the TacoCopter moving using your integrated data. If you did it correctly, it should rise and hover around y = 100 meters.

Acceleration data:

Time(seconds)	Acceleration (m/s^2)
0	5.84
1	5.49
2	3.81
3	1.11
4	0.3
5	-0.14
6	-2.27
7	-1.81
8	-1.88
9	-1.74
10	-0.86
11	-1.23
12	-0.45
13	0
14	-0.68
15	-1.78

Acceleration Data graph:

Some other questions to think about:
- How long does it take for the TacoCopter to first arrive at its cruising height? What happens once it gets there?
- What effect does integration have on the 'noisiness' of the data?