Virginia Instructors of Physics

Summer Edition August '00

VIP's mission is to foster communication among teachers of physics and physical science as well as to provide unique learning experiences for teachers and their students.

Upcoming Meetings!!!!

Sept. 23rd at the Science Museum of Virginia in Richmond

9:00 - 9:30 Hello's
9:30 - 12:00 Behind the scenes at SMV, & other stuff!
12:00 - 1:00 Lunch (You are on your own). **RSVP today!**
1:00 - 3:00 Planning VAST VIP presentations????
IMax movie included! Museum & Movie Free!

November 10th-11th VIP at VAST in Roanoke

VIP will be hosting two sessions this year at the Virginia Association of Science Teachers meeting this fall. We will hold a two hour "meeting" session where we will have our normal sharing of demos, labs, etc. The past couple of years this has been very well attended - standing room only! At our spring meeting it was suggested and decided that we should offer a second session at VAST. This will be a "table top Physics" presentation. Offered science fair style with presenters at each table. I don't have the times for when these meet yet. We still need to do a significant amount of planning and we need PRESENTERS!! Volunteer now & avoid the rush! VAST should be exciting, I hear from Dr. John Kowalski all presentation rooms are full and presenters are being turned away.

If you will be attending the Sept. 23rd meeting, RSVP as soon as possible. Include your name & school or title. If you'd like to present at VAST, please let me know which format you would like and provide a little detail. My e-mail, phone & school address are:

Andy Jackson *ajackson@harrisonburg.k12.va.us or*
Harrisonburg High School Science Dept *asjackson@earthlink.net*
395 South High Street
Harrisonburg, VA 22801 *(540) 434-4923*

As always for VIP, **there are no fees and there are no dues** What makes the group succesful are the contributions of its members, not financially but intelectually. Please consider sending me your favorite labs, demos, or lessons to include in the next newsletter. Also strongly consider presenting at VAST this November.

Directions - a vector excercise

The Science Museum of Virginia is located in mid-town Richmond, Virginia, at 2500 West Broad Street in the historic Broad Street Station designed by renowned architect John Russell Pope. The Science Museum of Virginia is easily reached via Interstate 95 and Interstate 64.

From the north or west:

Take I-95 south or I-64 east to Richmond (I-95 and I-64 run together through Richmond). From I-95, take the Boulevard exit (# 78), bear right onto Boulevard. Take Boulevard to West Broad Street (US 250) (4th traffic light). Turn left onto West Broad Street and go two blocks. The Science Museum is on your left.

From the south or east:

Take I-95 north or I-64 West to Richmond (I-95 and I-64 run together through Richmond). From I-95, take the Boulevard exit (# 78) and bear left onto Hermitage Rd. Take Hermitage south for 1.3 miles to West Broad Street (US 250). Turn right onto West Broad St. and proceed for one half mile. The Science Museum is on your right. There is ample free parking adjacent to the museum.

If you plan to cross the I-95 James River bridge to reach the Science Museum, you may want to check the current status of renovation construction work on the bridge at this VDOT web site:

http://www.95bridge.com/

A note from the President

Hi again! It's hard to believe the summer is gone already. Several interesting things are happening with VIP since our spring meeting at UVA. One of the most exciting is our new list serve! Ron Revere created a group for VIP on e-groups (thanks Ron!). Point your browser to **http://www.egroups.com/group/va-inst-phys** and come join us! It's a work in progress so come help make it be what you need. We have the ability to post messages, conduct polls, keep a calendar of VIP events, chat and more. Correct and creative use of this list serve could be a huge benefit to all of us involved with physics education. This is the nearly instantaneous version of what VIP has been all about these last 14 years or so - fostering communication between teachers of physics and physical sciences.

Another great way to gather up some fabulous ideas is to visit the VIP website. Tony Wayne has been busy moving us from our previous place on VaPen to a new location which is **http://www.geocities.com/vipphysics/**. As Tony continues to work on this location you may also wish to visit us on the VaPen location of **http://www.pen.k12.va.us/Pav/Science/Physics/** where you'll find lots of links and our previous newsletters full of great labs, demos & lesson ideas. Thanks for all the hard work Tony!

Two other new things for VIP you saw on page one. We are being hosted at the Science Museum of Virginia. I wanted a chance for us to get together a little earlier in the year for a Kick-of-the-Year-Right kind of meeting. Jeff Liverman from SMV and I are working out the details. I hope it will be an energizing visit to a great State resource and the forging of a new partnership for VIP. Thanks Jeff for all you are doing for us. The second new twist on VIP will be at the VAST meeting. At the Spring VIP meeting it was agreed upon (unanimously as always - we're such an agreeable bunch!) that in addition to our regular 2 hour session at VAST, we would also present a one hour "table top physics" session, where the audience could just come in, look, learn and leave as they wish. It will make for an exciting format and it will require many presenters and a bit of planning. Come to Richmond with some thoughts of what you may like to present.

I hope your school year starts off great whether it's your first time at the front of the class or your 31st! I look forward to seeing you in Richmond. It should be a great meeting and a great opportunity for a behind the scenes look at the museum. PLUS the Imax film "Amazing Journeys" to boot!

With best regards,

Andy

The exercise below serves two purposes. In my class the students make frequent use of Vernier's Graphical Analysis. This exercise provides an introduction to the software. It gives the students hands on practice inputting numbers, titling the columns, and fitting best fit curves and lines. They can then use the printed & electronic versions of this exercise through the year when trying to understand "directly proportional", "inverse square" and those other foreign terms we physics types use. This is ungraded and I provide as much help as needed to ensure each student can do everything correctly. - Andy Jackson

A quick reference to graph types and variable relationships

Open the program "Graphical Analysis"

In the "X" column enter the numbers from 1 to 10.

Change the name of this column to "Independent"

A. In the next column to the right enter the numbers that would be equal to the x column times 3.5. In other words the first number is 3.5 then 7 . . . and so on.

B. In the next column to the right enter the numbers that would be equal to the X column times 2 + 4. Speaking math $Y = 2X + 4$ is the new column.

C. In the next column over enter the numbers that would be equal to the x column squared.

D. In the next column over enter the numbers that would be equal to 1 divided by the x column. In other words 1, 0.5, 0.333 . . . and so on. Put in three decimal places.

E. In the next column over enter the numbers that would be equal to 1 divided by the numbers in the x column squared. In other words 1, 0.25, . . .Put in three decimal places.

A through E represent some common relationships we will see through the course. Create the 5 different graphs using "independent" as the x axis and each of the different columns as the Y axis in turn.

For each graph have the computer fit a best fit curve or line to the numbers.

In the text window describe what relationship Y had to X to get this graph.

In the text window explain the "meaning" of each constant in the auto curve fit equation.

Create a folder Named "Graph Examples" and save each graph under an appropriately descriptive name. (like directly proportional or inverse square)

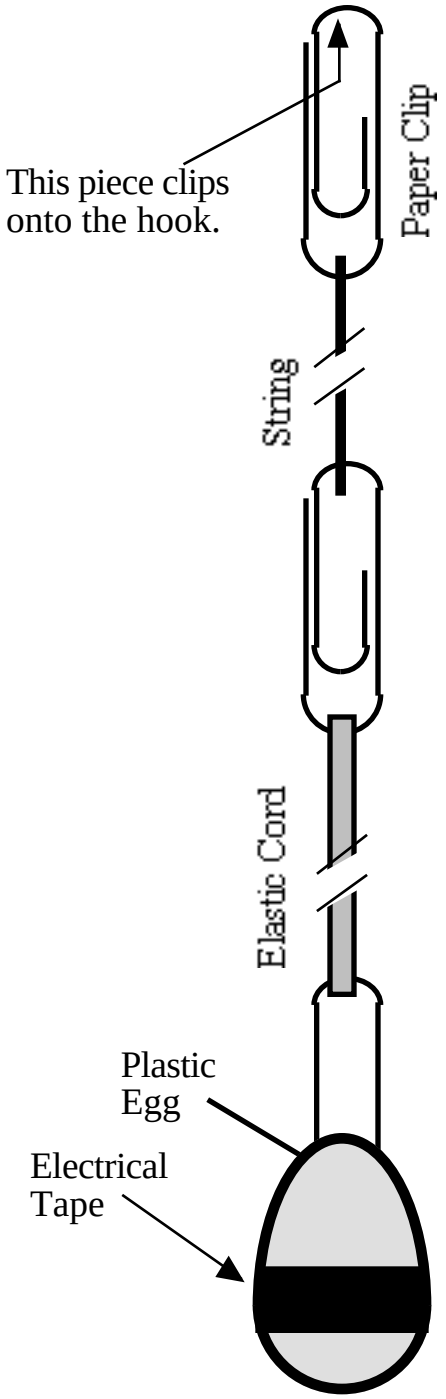
Refer to these graphs when working with data to determine what relationships you may be examining.

I will provide you with a printed version of the graphs, equations, and tables.

Bungie Jumping Energy Activity

For the teacher **by Tony Wayne**

- Put between 100 and 200 grams of clay in the bottom of each egg
- Wrap electrical tape around the middle of the the egg to hold it closed during the lab.
- Heat up a nail in a candle flame and poke it horizontally through the top of the egg. this is where a paper clip will go to attach the elastic cord to.'
- Each lab group uses an elastic cord about 1 meter long. The elastic cord should be either 1/8" flat or 1/16 " round. The elastic cord can be purchased at a fabric supply store or the craft/fabric departments of some stores.
- Make an example of how to connect string and elastic cord using 20 cm long pieces of string and elastic. Hang this on the chalk board or somewhere prominent for students to see.



Solution: $mgh = \frac{1}{2}kx^2$

m: egg mass in kg

g: 9.80 m/s^2

h: drop height from the bottom of the egg when it next to the ceiling to the lowest point targeted in the motion.

k: force constant of the elastic cord (Usually between 1 and 8 N/m.) Found from prior experiment.

x: distance the elastic cord will stretch from the elastic's equilibrium. Equilibrium distance is without attaching the egg. The unknown is usually "x."

Bungie Jumping Energy Activity

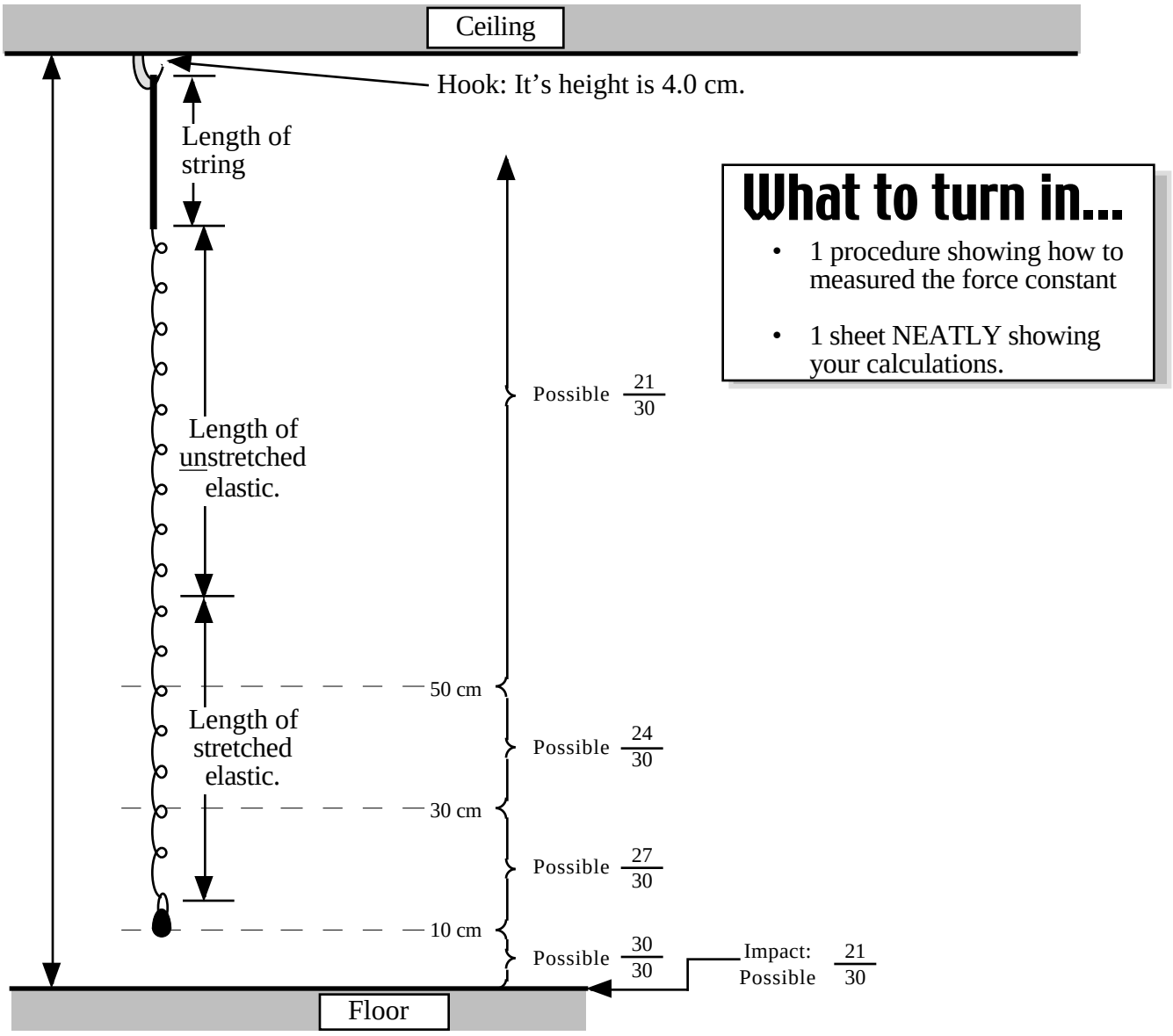
30 possible points

Bungie jumping is a sport enjoyed by some daring individuals. It consists of a person hurling him or herself from a perfectly stable bridge, balloon, or platform with only an elastic cord to impede the otherwise inevitable impact with ground or riverbed. The person must possess the faith that the elastic material will be able to absorb the potential energy of the fall without breaking, and that the point at which the material absorbs this energy is at a positive vertical value (i.e. above the ground).

The design of such a thrill involves calculating the point at which the gravitational potential energy lost during the jumper's fall will equal the elastic potential energy (similar to a spring) gained by the elastic cord. To ensure maximum thrill this point is designed to be as close to the ground as safely possible.

Your task is to provide a cheep thrill for some plastic eggs using an elastic cord, a plastic egg, and a length of string. You must calculate the length of string that will give the maximum enjoyment. (If your elastic cord is too long, you may reduce the weight of your egg. To assist in your design task you may also use a meter stick, a spring scale, and a mass balance. Also the following diagram summarizing the task may be of assistance. Prior to the jump, you must provide assurance to the jump master that your calculations and subsequent design will provide a safe trip for your client.

The string is attached to the hook in the ceiling. The bungie cord is attached to the string. The *top of the paper clip* at the egg's top will touch the ceiling when dropped. Grades will be based on how close you come to the floor without touching the floor. See the diagram below. The rest of your score comes from how well you do and show your calculations. Your jump will be at the end of the period. You can take up to 2 jumps. The best score will be yours



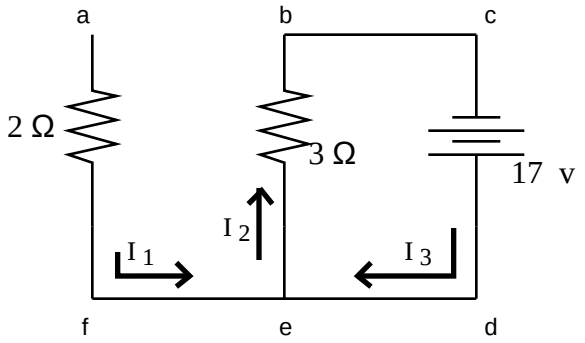
What to turn in...

- 1 procedure showing how to measured the force constant
- 1 sheet NEATLY showing your calculations.

USING A TI-83 GRAPHING CALCULATOR TO SOLVE SIMULTANEOUS EQUATIONS

Submitted by Tony Wayne

Question: Calculate the current through each branch of the circuit below.



$loop_{abef} = -6 + I_2(3) + I_1(2) = 0$

$loop_{bcde} = 17 - I_2(3) = 0$

$loop_{acdf} = -6 + 17 + I_1(2) = 0$

$junction_e\ I_1 - I_2 + I_3 = 0$

Solution:

Rearrange three equations so that the variables are in the same columns.

$$6 = I_1(2) + I_2(3) + I_3(0)$$
$$17 = I_1(0) + I_2(3) + I_3(0)$$
$$0 = I_1 - I_2 + I_3$$

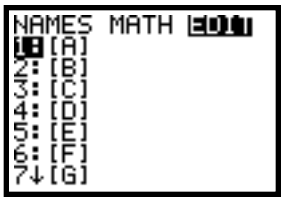
This yields 2 matrices. One of the coefficients and one of the answers.

$$\begin{bmatrix} 2 & 3 & 0 \\ 0 & 3 & 0 \\ 1 & -1 & 1 \end{bmatrix} \quad \begin{bmatrix} 6 \\ 17 \\ 0 \end{bmatrix}$$

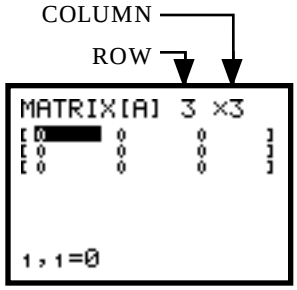
I_1 I_2 I_3 ANSWERS

Now for the calculator...

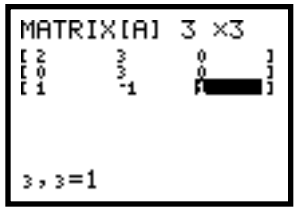
Find the matrix button. Press it and use the arrow keys to move the highlight at the top of the screen to "EDIT."



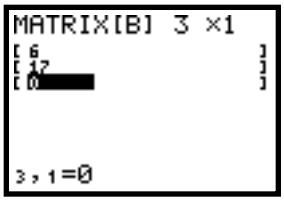
Enter the coefficients matrix first. Select the [A] matrix and type "3" "ENTER" 3 "ENTER." Your screen will look like this.



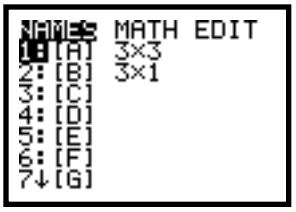
Enter the values in the coefficient matrix. Use the arrow keys to move around the matrices rows and column.



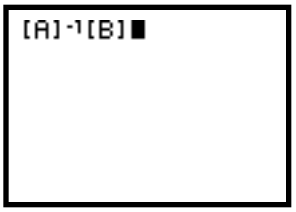
Press the "MATRIX" key again and create a 3 X 1 matrix in the "[B]" slot. Enter the answers into the matrix.



Go back to the command screen. To do math with the matrices use the matrix key to call up a list of matrices. Use the arrow keys to highlight the matrix you want and press "ENTER."

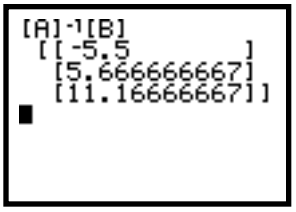


Type Matrix [A] Inverse Matrix [B] and press the "ENTER" key.



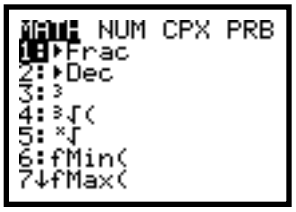
The first row is the variable in the 1st column, the second row is the variable in the 2nd column and the third row is the variable in the 3rd column. Therefore

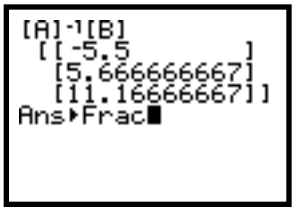
I_1 = -5.5, I_2 = 5.7 and I_3 = 11.2 .

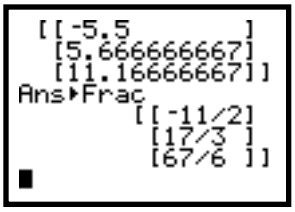


If the calculator says there is an error when trying to find the answer; either the numbers are enters wrong; the [A] and [B] matrices are backwards or the original equations are incorrect.

Note: The values can be converted into fractions using the "Frac" command from the "MATH" menu key.







This lab uses several different stations to introduce the student to the concepts of inertia and friction. The equipment I use are several embroidery hoops, pennies, florence flasks, pool balls, tennis balls, a few quarters, a battery operated toy hovercraft (air track would work too), and Ken and a homemade Ken doll car. I'll bring them to VAST for the table top session. The students get caught up in the fun and it lays a great foundation for the concept of inertia. - Andy

Hoop! Hoop! Hooray!

Time for a little physics fun. A break from the equations. (Not to say they aren't fun!) The game is simple (in principle). Carefully balance an embroidery hoop vertically on the mouth of a florence flask. Stack pennies on the top of the hoop. The idea is to remove the hoop in a manner that allows the pennies to fall into the flask. See how successful you can be. The HHS record is 52!

POINTS TO PONDER

1-What technique is most successful? There are two "secrets" to success.

2- What physical property helps you in this game?

3- What physical property is a hindrance? How does the most successful method avoid this hindrance?

An Old Carnival Game

Stand at the end of the table opposite the paper with the circle on it. Balance the coin on the top of the pool ball in the center of the circle. Roll the other pool ball so that it strikes the ball in the circle and causes the coin to fall out of the circle.

4-What method is the most successful?

5-What physical property helps you to succeed?

6- What physical property makes this game difficult to win?

7- Try the game with two tennis balls. Is it easier or harder? Why?

TOYS R PHYSICS

Slide the hovercraft across the counter. Notice how quickly it comes to a stop. Turn it on and give it a very slight push.

8-Why does its motion change so much from when it turned off to when its turned on?

9-How far would it slide if nothing got in its way?

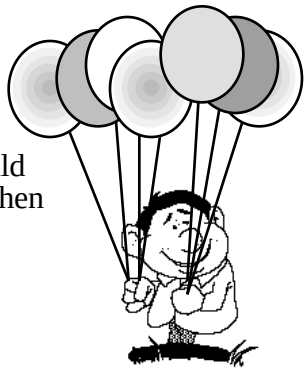
A Crash Course in Physics

Put the "Ken" on the cart and allow the cart to wreck into the barrier at the end of the table.

10-What happens when the cart comes to an abrupt stop? Why?

11- Now buckle-up and observe the wreck. Get the picture?

The Misadventures of Ima Senurslaker by Andrew Jackson



Ima has decided he would like to do some aerial photography of his house. He has devised the following plan. He will tie 100 helium balloons each with a lift of 7.0 N to his lawn chair. He and the lawn chair have a combined mass of 65.0 kg. He plans to anchor the chair to the ground and then climb in holding his 20.0 kg physics binder. He will then release the anchor and when he's ready to go, toss the binder overboard. He would like to take some pictures from 100 m above his house. He wants to get up to 100 m and then pop enough balloons so that he will have an acceleration towards the ground. Answer the following questions concerning Ima's plan.

1. Is the binder heavy enough to keep them on the ground?

2. When he tosses the binder, what will his acceleration be?

3. How long will it take Ima to reach an altitude of 100 m?

4. When he reaches 100 m , how many balloons does he need to pop so that he will have the smallest acceleration possible back to the ground?

5. What will his velocity be at this point? (100 m) (include direction)

6. What will his acceleration be now? (100 m) (include direction)

7. How high will he be when he reaches his highest point of the trip?

8. How long will his total trip take from take-off to landing?

9. How fast will he be going when he lands?

10. **For 5 points extra credit!** On your own (pledged work) devise a method for Ima to reach an altitude of 100 ± 10 m and return to the ground safely ($V_{landing} \leq 5$ m/s)

Show all work in great detail so I can follow it with ease.

Note: No 100 m ropes or other "easy" solutions allowed. You must work with the equipment given.)

I allow my general physics classes to work in groups to solve this set of problems. This problem set reinforces the concepts that acceleration and velocity do **not** have to be in the same direction, but net force and acceleration do. The extra credit question has been most interesting. Students come up with a variety of ingenious ways to solve the problem. In recent years the students tell me a man attempting such a feat died - so make sure you give the "don't try this at home" speech. By the way, the source of the student's information about the death was the "Darwin Awards" so. . . - Andy Jackson