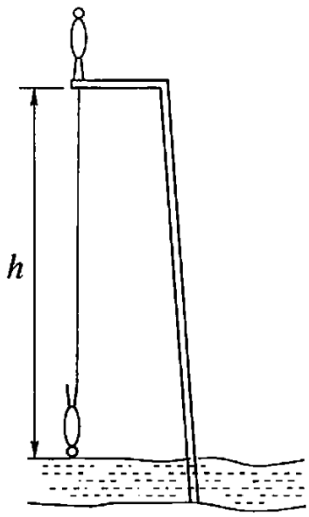
CSUC Spring Term 2020 Physics 204A Portfolio Problem for Week 11:
Due Monday, April 13 by Noon on our class Blackboard site: 202-PHYS204A-05-4569

Dear Class: This is the third (and Week11) Portfolio Problem. This is an energy problem. Draw lots of pictures! Don't rush! The answer is surprising – and you will have learned a ton about problem solving. This is an open book and unlimited time exercise.

Bungee Jumping!

You're an engineer … but you're also a dare-devil outdoors person. The task at hand is to design the proper bungee cord for a thrill experience so that the excitement is maximized. However, you're also something of an entrepreneur and you want to market the device if you're, indeed, successful. That means you may have to choose your bungee cord to fit the customer. You model the likely customer as 2 meters tall but of unknown mass **m**. The jump is to be into a lake off a platform 25m high. One end of the elastic bungee cord (treat it as a long spring) is tied to the participant's foot and the other end to the top of the platform. The start is from rest in a vertical position. Your goal for the task at hand is to choose the spring constant and rest length of the bungee cord so that the speed will have been reduced to zero *just at the instant* that one's head touches the water's surface. Ultimately, the jumper is to be hanging from the cord, at rest, with his/her head 8 meters above the water.



I. Choose your coordinate system as you like, but use the jumper's "center" as the appropriate reference point for computing the gravitational potential energy. You don't know the person's mass …but you will find that this is a soluble problem! The spring constant **k** will be known, at the end, only in relation to the jumper's mass. This makes sense, since a more massive person will need a stiffer spring. Then, when you are done ***below***, you are to draw a careful ***potential energy curve*** of the system potential energy versus the distance *x* the jumper has fallen. You will need to "actually" graph:

$$\frac{U_{tot}}{mg \cdot 1meter} \; vs. \; x/1meter$$

Make sure to identify on the graph just where the "bounce point" and the "hanging point" are to be found.

II. You are to find:

a) The necessary un-stretched length of the bungee cord.
b) The maximum speed and acceleration achieved during the jump.
c) The spring constant of the bungee cord in relation to the jumper's mass.