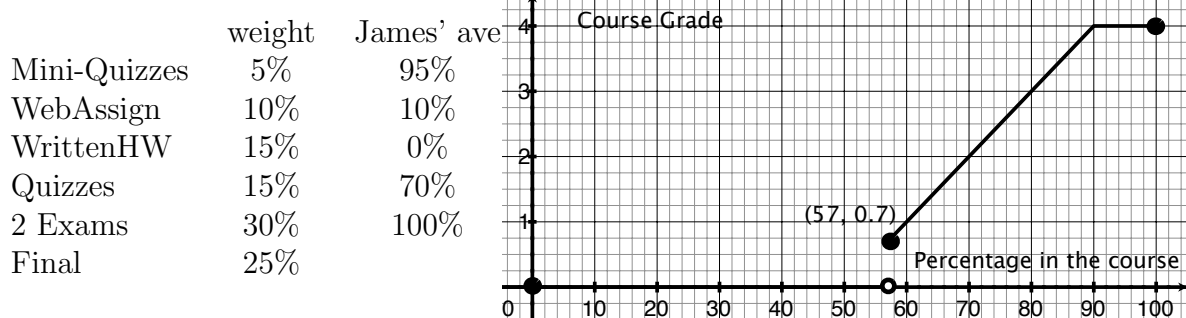


# Some Word Problems

1. A half-full 400,000 gallon reservoir is found to be .075% acidic. Write a function whose output gives the percentage (in decimal form) of acid in the reservoir when  $x$  gallons of water are added to it.
2. A company packages its powdered mixes in containers in the shape of a cylinder. The top and bottom are made of a tin product that costs 5 cents per square inch. The side of the container is made of a cheaper material that costs 1 cent per square inch. If  $x$  is the radius of the base (in inches), find a function that returns the cost of each container, assuming that the capacity of the container is 120 cubic inches.
3. The density of a liquid is .821 g/mL. How many grams of this liquid will fill a test tube that is shaped like a 10 cm long cylinder with a hemisphere on the bottom (that has a radius of 1cm)?
4. Seismic waves travel at about 4km/s but Megan has (a really fast!) carrier pigeon that travels 7km/s. Assume that Megan's first instinct when feeling a quake is to "tweet" the experience and that process (recognizing it's an earthquake, finding her carrier pigeon, attaching a message to the bird's leg, and the message being broadcast) takes 5 minutes. How far does a Megan follower have to be from Megan to know there is an earthquake before feeling it? (inspired by <http://xkcd.com/723>)
5. A salesperson find that her sales average 40 cases per store when she visits 20 stores a week. Each time she visits three additional store per week, the average sales per store decrease by 2 cases. Use methods from this class to figure out how many stores should she visit if she wants to maximize her sales?
6. You have \$5500 in a retirement fund and would like a return of 5% (to do slightly better than the historical trends of inflation). There are 5 year CDs (certificate of deposits) being offered with an annual rate of 3.05% and index funds (a collection of stocks from companies included in measures like the S&P 500) that returned 8.2% since the 1990's (Thomson Reuters, 2010 S&P 500 Composite Index total return for the period 12/31/1989 to 12/31/2009). How much money do you relegate to a CD and how much money do you put in an index fund to get an annual return of 5% for the next five years?
7. Potassium ferrate has been considered for use in batteries but costs \$100 per gram. You have a battery case that is currently *full* with 50 grams of a mixture that is 10% potassium ferrate. You would like to build the battery but you need a higher concentration of the potassium ferrate (40% should do it). What is the minimum amount of potassium ferrate you have to buy and add to the battery case (after you dumped out some of the original mixture to make room) to get the cathode to work?
8. An airplane flew with the wind for 2.5 hours and returned on the same route against the wind in 3.5 hours. If the cruising speed of the plane was a constant 360 mph in air, how fast was the wind blowing?

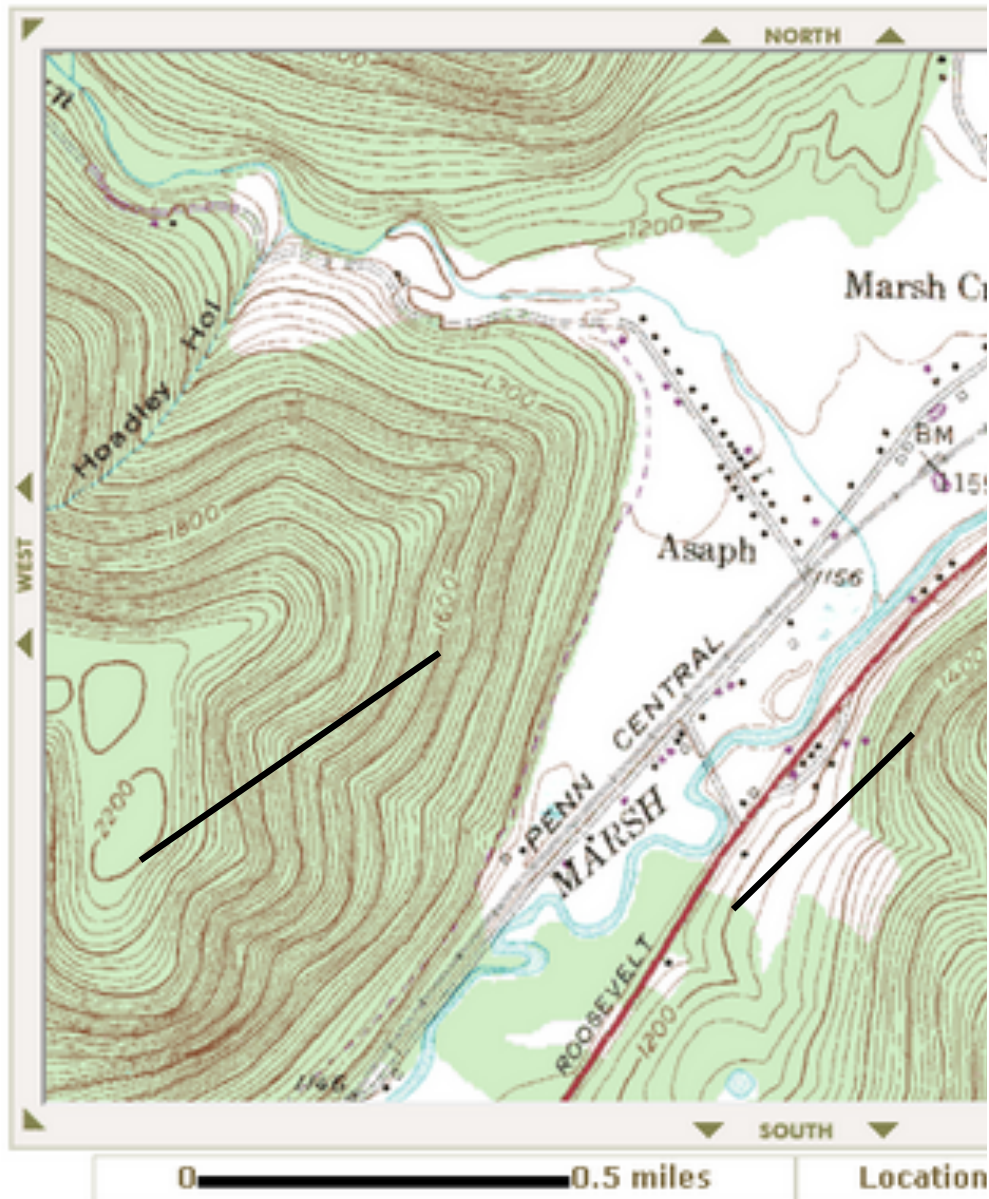
9. James T. Kirk is in this course and would like to know if it is still possible to earn a 2.5 now that he's taken two exams. He has looked at the gradebook on WebAssign and has computed the averages listed below.

Assuming James' work does not drastically change in the remaining 3 weeks and his averages remain about the same, find what grade he needs to get on the final to receive a 2.0 in the course. In case you don't remember, the weights specified in the syllabus and the graph of the function  $f$  that takes your class percentage  $x$  and returns your score on a 4. scale are also provided.



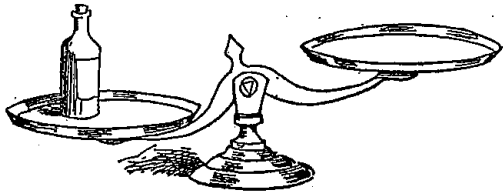
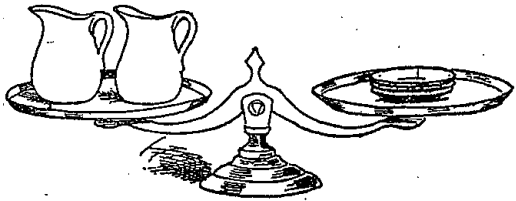
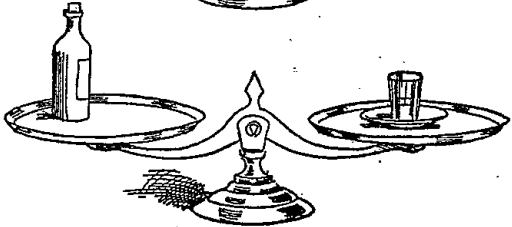
10. The Athenians when suffering from the great plague of eruptive typhoid fever in 430BC consulted the oracle at Delos as to how they could stop it. Apollo replied that they must *double the size* of his alter which was in the form of a *cube*. The Athenians constructed a new alter where the *edges* were double that of the old. Apollo made the pestilence worse than before.
- By what factor did the Athenians increase the size of Apollo's alter?
  - Give new directions for the construction of Apollo's alter to guarantee Apollo's request that the new alter is twice the volume of his first.
11. Rutabaga Riddle: 100 lbs of rutabaga consist of 99 percent water (since they are purely mathematical rutabagas) . The rutabagas are left outside overnight so that they consist of 98 percent water the next day. What is their new weight?
12. You are standing on the top of a 300 ft tower and toss a penny *up* at a velocity of 10ft/sec. At time  $t$  seconds after the toss the velocity of the penny is  $v(t) = -32t + 10$  and the distance from the sidewalk is given by  $p(x) = -16t^2 + 10t + 300$ .
- When is the penny at its highest point? What is that maximum height?
  - How long is the penny in the air? How fast is it going when it hits the ground?
13. Solve the problems pictured on page 4.

14. The topographical map below has two paths (that follow straight lines) drawn on it.
- Find how steep the ascent (slope/average rate of change) is for each of the paths.
  - Which of the two paths is more steep?



15. An explosion occurred in a remote location-and one person was seriously injured. You are asked to question the only other person within any distance to know anything about it. During your interrogation, you determine that Billy Bob was working for a drilling company, and was using the drilling equipment to create an irrigation well for a farmer in the area. The drill moved at 6.66 in/min, and Billy Bob worked from 8am to 3pm with a 45 min. lunch break in the middle. When finished, you walk to the hole which was drilled and drop a coin, Precisely 1 second after you drop it, you hear the sound of the splash. Is there a problem with his story? Make sure you show the mathematics behind your conclusions.

# PUZZLING SCALES



**How many glasses will balance with the bottle?**

# THE INSPECTOR'S PROBLEM

THREE PYRAMIDS BALANCED WITH EIGHT CUBES ON THESE DISHONEST SCALES



HE MADE ANOTHER BALANCE LIKE THIS. THEN HOW MANY PYRAMIDS WOULD BALANCE WITH EIGHT CUBES UPON HONEST SCALES?



**How much does a cube weigh?**