# Some Word Problems

A word about presentations:

Next week there will be a chance to earn extra credit for the exam. Groups of three can choose one of the numbered problems below and present its solution to the class. Each group can earn up to 4% extra credit for the next exam where each earned point comes from the criteria following:
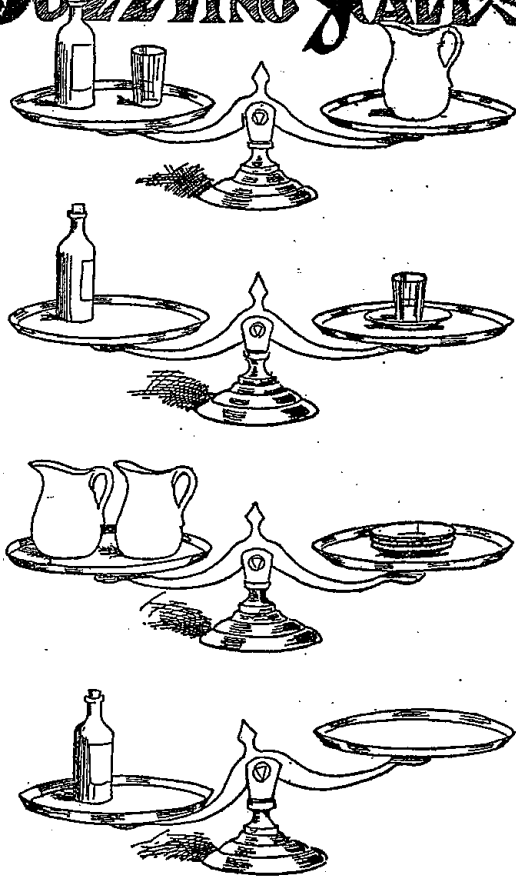
- Mastery of the problem: Do you understand the problem? All of the steps in solving the problem? Could you solve a related but slightly different question?
- Presentation of the problem: You are presenting material to your classmates that will be on their exam next week. Your peers need this time to be *taught* the material (not merely shown a solution). Be sure to *explain* your steps and *why* you take them. Multiple approaches or those using materials from outside the course are encouraged!
- Presentation: Do you interact with your audience or do you just stare at the board? Is it clear that all the members made significant contributions to the solution (consider citing each other!)? Did the group act supportive of each other?
- Fielding questions: Can you understand someone's question about the material and formulate a cohesive answer?

1. 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 conainer is 120 cubic inches.

2. 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)?

3. 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)

4. A salesperson find that her sales average 42 cases per store when she visits 20 stores a week. Each time he visits five additional store per week, the average sales per store decrease by 2 cases. Use methods from this class to figure out how many stores he should visit if he wants to maximize her sales?

5. 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?

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. The water level in a reservoir must be lowered by 3 ft. Opening spillway A lowers the water 1ft in 4 hours whereas a smaller spillway B lowers the water 1 ft in 6 hours. If both spillways are open, how long will it take the water level to lower 3ft?

9. An airplane flew with the wind for 2.5 hours and returned on the same route against the wind in 3 hours. If the cruising speed of the plane was a constant 360 mph in air, how fast was the wind blowing?

10. Solve the problems pictured on page 4.

11. The topographical map below has two paths (that follow straight lines) drawn on it.

    (a) Find how steep the assent (slope/average rate of change) is for each of the paths.
    (b) Which of the two paths is more steep?
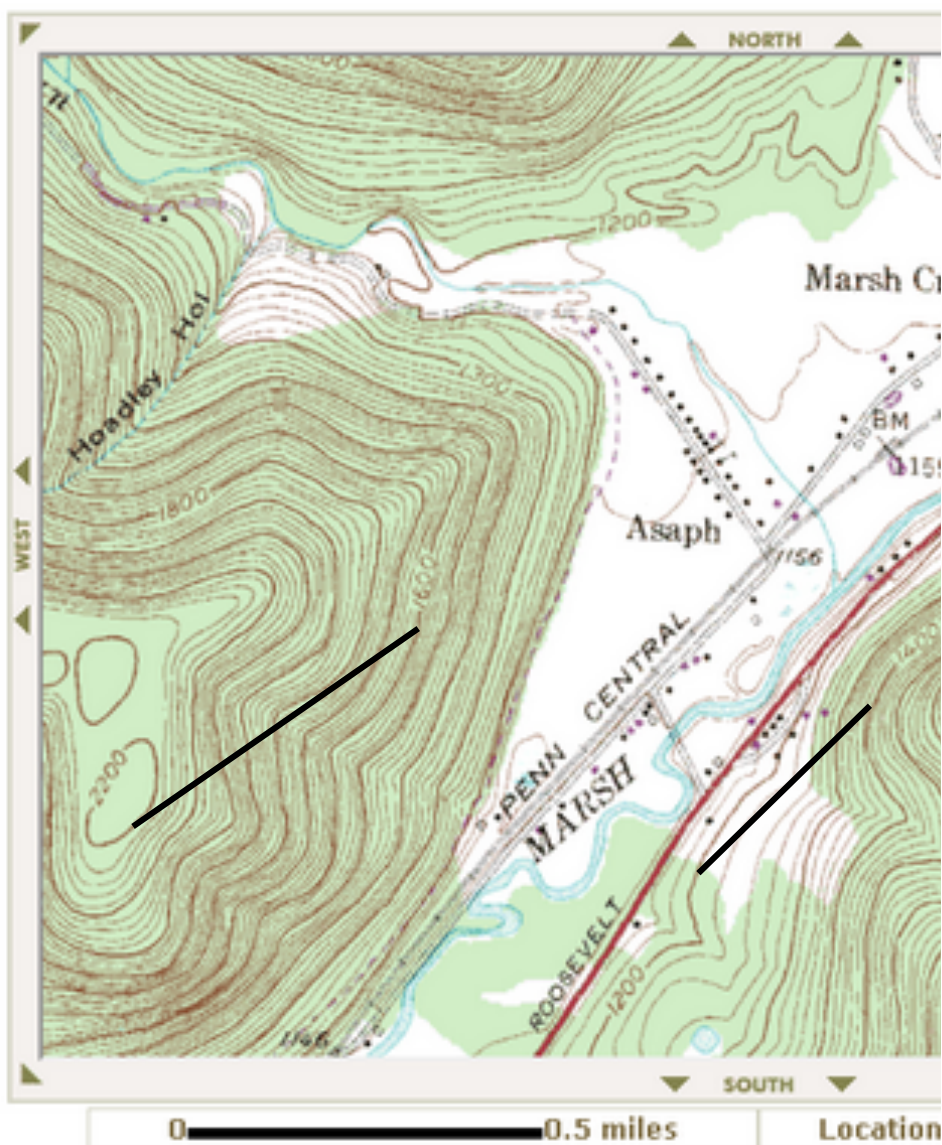
12. Ammonia NH_3 reacts with water H_2O to form NH_4^+ and OH^-. The solution finds an equilibrium between the concentration of these four components whose ratio of products has been measured to be $1.8 \cdot 10^{-5}$, more specifically, $1.8 \cdot 10^{-5} = \frac{[NH_4][OH^-]}{[H_2O][NH_3]}$. Recall that brackets indicate concentrations in moles per liter. Assume 10 moles of NH_3 are dropped in 1 Liter of H_2O. Find the concentration of OH^- at equilibrium.

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?

13. Let $P(x)$ return the probability that a person with ability x answers a question correctly. Let $x = 0$ denote the ability of an average person and $x > 0$ denote the ability of a highly skilled person.

   - Interpret what $P(0) = .25$ means.
   - What would you think $P(0)$ would be for a True/False question?

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