5.95J / 6.982J / 7.59J / 8.395J / 18.094J Teaching College-Level Science and Engineering
Spring 2009

5.95 (Spring 2009)

Homework 3

*Due in class on **Tuesday, 17 March 2009**.*

Here are questions to work on and readings for Lecture 5 (March 17). The only item to bring in is your writeup for **Problem 3**, so that you can trade it with a colleague.

1. **Readings on course design**

   This week's readings are related to course design - the topic of the upcoming lecture:

   a. 'The Eric experiment' from Sheila Tobias (1990), *They're Not Dumb, They're Different: Stalking the Second Tier*, Research Corporation, Tucson, Arizona.

   b. R. David Middlebrook, 'Methods of design-oriented analysis: Low-entropy expressions', *New Approaches to Undergraduate Education IV*, Santa Barbara, 26–31 July 1992.

   c. Selection from Grant Wiggins and Jay McTighe (2005), *Understanding by Design*, ASCD.

   Skim them, then choose your favorite to read more carefully; feel free to choose more than one if you are inspired. Write a question about the reading for yourself (no need to turn it in).

2. **Practice with Bloom's taxonomy**
   Where on Bloom's taxonomy would you categorize the following problems? There is no one right answer, but making the categorizations will give you practice using Bloom's taxonomy.

   a. *[for an intro calculus course]* Construct a function $f(x)$ with all of these characteristics: $f(0) = 0$; $f(x) \approx |x|$ as $|x| \to \infty$; and $f(x) \approx x^2$ as $|x| \to 0$. Sketch $f(x)$ by hand (e.g. without using a graphing calculator).

   b. *[for an introductory calculus course]* Sketch $f(x) = \ln \cosh x$ by hand (e.g. without using a graphing calculator).

   c. *[for an introductory calculus course]* Graph $f(x) = \ln \cosh x$ using a graphing calculator.

   d. *[for a comprehensive exam at the end of a physics undergraduate degree]* In the special-relativity course, you learnt that the speed of light is always c in any reference frame, no matter what. In the electrodynamics course, you learnt that the speed of light in matter is $v = c/n$, where n is the index of refraction. Can these two statements be reconciled?

   e. *[for a freshman-physics course in the hydrostatics unit]* A solid iron sphere is floating in a bath of mercury. You pour water over the sphere and cover it with water. Does the sphere rise, sink, or stay at the same height?

3. Redesigning problems

a. For a course that you are likely to teach or would like to teach, choose a problem from the usual repertoire for that course, and write out the problem. It could be an exam or a homework problem or a problem that you might ask during class.

Then write out a modified version or related problem that is lower in Bloom's taxonomy, and a modified version or related problem that is higher in Bloom's taxonomy.

b. Make up a new problem for this course, at whatever level of Bloom's taxonomy you like.

c. Choose one of the proposed problems in **Problem 2** and make lower- and higher-level versions of it.

Write up your new problems and bring them to class with you on Tuesday in order to trade with a colleague.

You can see examples of my problems under Assignments on the OCW sites for 6.055 and 18.098.