CHEM 1004
Homework #1
Spring 2011
Buckley

This homework is due on Thursday, January 13, at class time. The assignment will be accepted up until the start of class on Tuesday, January 18, with a 20% penalty. Assignments turned in after class that day will receive no credit, though I will look through them if you want me to.

1. (4 points) Label each of the following as Applied Research or Basic Research.
   a. **BR** A chemist is studying a series of compounds made using the same element and discovers a new compound.
   b. **AR** A tire manufacturer is experiencing difficulty with tire failures. A chemist is assigned the task of identifying and correcting the problem.
   c. **BR** A physicist studies the interaction between coupled spinning particles at a distance.
   d. **AR** A company assigns a materials scientist the task of determining why laboratory bench tops when cured warp a little bit.

2. (4 points) Identify each of the following as either a testable (use a “T” if you want) or untestable (use a “U” if you want) hypothesis.
   a. **T** People born under the astrological sign of Gemini are statistically taller than those born under other signs.
   b. **U** People born under the astrological sign of Gemini are nicer than those born under other signs.
   c. **T** A sugar cube will not burn if placed in a flame. However, if it is first dipped in cigarette ashes it will burn.
   d. **T** An automobile body may be prevented from rusting by connecting the negative pole of its battery to the car body.
3. (6 points) Carry out the risk-benefit analyses requested in Problem 15 on page 35 of the textbook. State whether the DQ is high or low and explain your reasoning in each of the three cases requested in the problem. Use the back of the page if necessary.

(The problem is: X-rays are used in medicine to diagnose injuries and illnesses, in industry to detect unseen flaws in metal equipment, in airport security to detect hidden weapons, in science to determine the structure of crystals, and in many other ways. X-rays can cause cancer, but for exposures from ordinary medical procedures, the risk is quite low. What is the DQ for the use of X-rays in (a) the detection of flaws in the structural steel of a bridge, (b) detecting cancerous growth in the brain, and (c) determining the fit of a pair of new shoes?)

a. **Benefits:** helps maintain the structural integrity of a bridge to avoid catastrophic failures, such as in Minnesota a couple of years ago.
   **Risks:** There may be risks to workers using the X-ray machines in close quarters. However, these could be minimized by appropriate protective gear and safety procedures.
   **DQ:** Probably fairly high because the benefits far outweigh the risks.

b. **Benefits:** Provides insight into the growth of a cancer as well as its response to various treatments. Can help guide future treatments for a patient.
   **Risks:** The patient is exposed to radiation and could suffer some ill effects from the increased radiation – the use in this case would certainly be more frequent than typical X-ray use with patients.
   **DQ:** Would probably depend to a large extent on the severity of the cancer and the prognosis. For someone in the early stages of cancer this may not be as beneficial as to someone in the late stages, because the long term exposure benefits may not outweigh the risks. However, for someone in the latter stages of cancer, the risk of increased exposure may be able to provide enough information to help try to reverse the cancer’s growth.

c. **Benefits:** Not many. There are other ways to fit shoes that are a lot less risky.
   **Risks:** Increased exposure to X-rays could potentially cause cancer.
   **DQ:** This use would have an incredibly low DQ – no benefit, moderate risk.