Donald P. Shiley School of Engineering
EGR 221 Materials Science
Assignment 12, Fall 2015

1a) If two parts, a big thick part and small thin part, both made from eutectoid composition steel are quickly cooled from being austenite, will they likely have the same microstructure? Explain.
1b) Why may martensite crack upon quick cooling?

For the next few questions, you may use online resource, textbook, etc., and/or the following: http://faculty.up.edu/lulay/egr221/EngineeringMaterials.pdf

2) Answer the following:
   a) Briefly explain the four digits used by AISI to designate steel alloys. What is the difference between AISI 1020, 1040, and 4340 steels?
   b) What is unique about gray cast iron that makes it useful in many heavy machinery applications?
   c) What is stainless steel? What are the alloying elements that make it "stainless" and what are its applications?

3) Answer the following:
   a) What are tool steels? Give one example and very briefly describe its applications.
   b) What are maraging steels? How does their composition differ from other steels? What are their unique properties?
   c) What are refractory metals?

4) Answer the following:
   a) When and by whom was aluminum first extracted in pure form?
   b) For aluminum alloys, what do the following temper designations mean: T6, T3, F
   c) What is meant by "wrought" aluminum alloys?
   d) Aluminum is a fairly active element so why is it corrosion resistant in ambient atmosphere? (the textbook might be a good resource for this – or google).

5) Describe each of the following. What is the molecular structure that distinguishes them from each other (hint, you should include descriptions such as "networked," "cross linked," and/or "linear"). **Sketches are a good idea!** Give one example of each from every-day life.
   a) thermosetting polymer
   b) thermoplastic polymer
   c) elastomers

6) Define the following:
   a) copolymer
   b) polymerization
   c) degree of polymerization
   d) saturated and unsaturated bonds

7) The purpose of this question is to expose students to some very unique materials. As engineers, you never know when one of these may provide the much needed solution to a problem you are working on. I hope you read beyond just enough to answer the questions…but that's up to you. To find the answers to all of these questions, follow the links at the bottom of the course web page.

a) How much stronger are carbon nano-tubes than conventional carbon fiber composites?
b) Name one ceramic that has negative thermal expansion.
c) What are correlated magnets?
d) Name one application of hydrophobic materials.

8) What is the atomic number of each of the following and briefly describe their origin in the universe:

a) hydrogen
b) carbon
c) gold