Homework Assignment Number One

Problem 1.
Consider sputtering an film with 8 layers that are designated A-rich, A-lean, B-rich, B-lean, C-rich, C-lean, D-rich and D-lean. In how many different ways can the layers be put down
(a) with no restrictions?
(b) if the corresponding rich and lean layers must be adjacent?
(c) if all the rich layers are sputtered first, followed by all the lean layers?

Problem 2.
(a) A preliminary engineering design involves three stages where different solvents are used to perform liquid-liquid extraction. If you are considering 5 different solvents, each of whichwill be used in no more than one extractor, how many different possible designs would you need to investigate?
(b) Now make the assumption that it doesn't matter what order the three extractions are performed in. How many different possible designs would you need to investigate?

Problem 3.
A drug for the relief of arthritis can be purchased from 8 different manufacturers in liquid, tablet, or capsule form, all of which come in 100, 200 and 400 mg doses. How many different ways can a doctor prescribe the drug to a patient suffering from arthritis?

Problem 4.
A group of 500 college freshman are surveyed on the subject of fossil energy, climate change and sustainability. 210 believe sustainability is a legitimate global issue. 258 believe that anthropogenic climate change exists. 216 believe that fossil energy will be exhausted in their lifetime. 122 believe in both sustainability and anthropogenic climate change. 83 believe in both the exhaustion of fossil energy and anthropogenic climate change. 97 believe in both the sustainability and the exhaustion of fossil energy. 52 believe all three statements.

(a) Find the probability of those who believe in sustainability but not in anthropogenic climate change.
(b) Find the probability of those who believe fossil fuel will be exhausted in their lifetimes and in anthropogenic climate change but not in sustainability.
(c) Find the probability of those who believe in neither sustainability nor that fossil energy will be exhausted.

Problem 5. Conditional Probability
In sampling a population for the presence of a disease, the population is of two types: Infected and Uninfected. The results of the test are of two types: Positive and Negative. In rare disease detection, a high probability for detecting a disease can still lead to more false positives than true positives. Consider a case where a disease infects 1 out of every 100,000 individuals. The probability for a positive test result given that the subject is infected is 0.99. The probability for a negative test result given that the subject is uninfected is 0.999.
(a) What is the probability of being uninfected?
(b) What is the probability of being uninfected AND testing negative?
(c) What is the probability of being uninfected AND testing positive?
(d) What is the probability of testing positive?
(e) What is the probability of being uninfected given that the person tested positive? (This is the percentage of erroneous positive tests.)
(Make sure your answers are accurate to five significant figures.)