1. (25%)
   (a) What is the normal (Gaussian) distribution?
   (b) Why is it important in the theory of probability and statistics?

2. (25%) In semiconductor manufacturing, the probability is 0.1 that a chip subjected to high level of contamination causes a product failure; the probability is 0.01 that a chip subjected to medium level of contamination causes a product failure, the probability is 0.001 that a chip subjected to low level of contamination causes a product failure. In a production run, 20% of the chips are subjected to high level of contamination, 30% to medium level, and 50% to low level.
   (a) What is the probability that a product using one of these chips fails?
   (b) If a product fails, what is the probability that the chip was exposed to high level of contamination?

3. (25%) Suppose that a random sample of n observations x_i, i=1~n is taken from a normal population with mean μ and variance σ^2.
   (a) What is the sampling distribution of the mean $\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$?
   (b) Find the mean and the variance of the above sampling distribution in terms of μ and variance σ^2.
   (c) Derive the (1-α)% confidence interval for estimating μ from a given sample mean $\overline{x}$, assuming that the population variance σ^2 is known.

4. (25%)
   (a) What are the type-I and type-II errors in testing a statistical hypothesis?
   (b) A random sample of 100 recorded deaths in an area showed an average life span of 71.8 years. Assuming a population standard deviation of 8.9 years, does this indicates at the 0.05 level of significance that the mean life span is greater than 70 years? (Hint: the critical value $z_{0.05}$=1.645)