1. The following table gives the steps necessary to complete a task. For each task it lists the time (in hours) to complete the task and the immediately preceeding tasks.

Task	Time	Preceeding steps
A	2	none
B	4	none
C	3	A, B
D	6	C
E	7	C
F	3	E
G	4	D, E
H	1	G, F

   (a) Draw the PERT diagram for this problem.

   (b) What is the critical path?

   (c) What would the critical path be if the time for task E was reduced to 4 hours?

2. Counting problems (From Section 1.2 - forgot to list that).

   (a) From the standard 26 letter alphabet, how many different 3 letter initial sets could be made? (For instance my initials are JBS)

   (b) How many of the above use no letter more than once?

   (c) If $S = \{1, 2, 3, 4\}$, then how many permutaions of three elements of the set are possible?

3. Let $U = \{1, 2, 3, 4, 5, 6, 7, 8\}$ be the universal set, and consider the following subsets: $A = \{2, 4, 5, 7\}$, $B = \{1, 2, 3, 4\}$, $C = \{1, 4, 6, 7, 8\}$. Find the following subsets.

   (a) $\bar{A}$

   (b) $A \cup B$

   (c) $(A \cap B) \cup C$

   (d) $(A \cup B) \cap C$

4. Draw a Venn diagram for the set $(\bar{A} \cap B) \cup (A \cap \bar{B})$, where A and B are subets of a universal set U. This set is sometimes called the *symmetric difference* of the sets A and B.

5. When can you be sure that $A \cap B = A$?

6. If X has 5 elements and Y has 7 elements, then how many elements does $X \times Y$ have?

7. Define the following for a set X:
   (a) A relation $\mathcal{R}$ on X,
   (b) the following properties that a relation $\mathcal{R}$ may or may not have.
      i. the relation $\mathcal{R}$ is reflexive.
      ii. the relation $\mathcal{R}$ is symmetric.
      iii. the relation $\mathcal{R}$ is antisymmetric.
      iv. the relation $\mathcal{R}$ is transitive.
   (c) Define: $\mathcal{R}$ is an eqivalence relation. (Which of the properties does it have?)
   (d) Define: $\mathcal{R}$ is a partial order. (Which of the properties does it have?)
8. Define the relation $\sim$ on Z, the set of integers, by $x \sim y$ if and only if 7 divides $x - y$.
   (a) First, give a useful definition of "7 divids the integer n".
   (b) Now prove that $\sim$ is an equivalence relation on Z.
9. Let $S = \{2, 3, 4, 6, 8, 9, 12, 16, 18\}$, and define the relation $\preceq$ on S by $x \preceq y$ ifa and only if $y = x \cdot 2^k$ for some integer $k = 0, 1, 2, 3, \ldots$.
   (a) Prove that $\preceq$ is a partial order on the positive integers. (we are condiering it for a subset of the integers S, but prove it in general.)
   (b) Draw a Hasse diagram for the resulting partially ordered set.
   (c) identify, specifically, any maximum, maximal, mininimum or minimal elements.
10. Functions.
    (a) Define $f : X \to Y$ is a function.
    (b) the function f is one-to-one.
    (c) f is an onto function.
11. Let $X = \{1, 2, 3\}$ and $Y = \{a, b, c, d\}$
    (a) draw a diagram (or use ordered pair notation) for each of the following.
       i. A function from X to Y (any one will do)
       ii. a relation that is not a function from X to Y.
       iii. a one-to one function from X to Y.
    (b) Is it possible for there to be an onto function from X to Y? How about Y to X?