**Problem 1**

1.

a) In this problem, one must move three items from one location, or categorization, to another while keeping the items, each of which is volatile to one of the other two, from harming another.

b) This problem has been around for quite some time. It was created to encourage critical thinking and problem-solving skills. There is really only one way to begin that meets all of the requirements.

c) The overall goal is to arrive on the other side of the river with all three items, without putting any of them at risk.

2.

a) The constraints of this problem are that we can’t have the cat and parrot, or the parrot and seeds, together in the same location (or category) unattended.

b) The sub-goals would be to get each of the items over to the other side individually, adhering to the constraints. In other words, moving the cat to the other side, moving the parrot to the other side, and moving the bag of seed to the other side.

3.

a) At first glance, there are nine different possible solutions to this problem; however, not all of these solutions are guaranteed to meet the constraints. If we set variable names for each item (i.e. cat=c, parrot=p, and seed=s), and we write the solution as the order of the variables that we bring over, then the potential solutions would appear to be: cps, csp, pcs, psc, scp, and spc. However, it quickly becomes clear that, in order to meet the constraints, an item will have to be brought back. This adds a great deal to the number of possible solutions.

4.

a) None of the solutions specifically mentioned in #3 meets all of the goals; however, the idea of bringing an item back to it’s original location is mentioned, and if done correctly, it will work as a full solution.

b) No solution will work for all cases.

5.

a) There are two solutions that would meet all goals. Both solutions follow the same principle, and either is just as effective and efficient. The first solution is as follows:

Take p over to the destination first. Go back to the original location and take c. When putting c at the destination, take p. Bring p back to the original location. Leave p and take s. Bring s to the destination. Return to the original location and take p. Bring p to the destination, ending with all three at the destination and unharmed.

The other solution is in the same order, but instead of taking c second, take s.

Both solutions can be thought of as one in the same, as they are along the same train of thought.

b) As I had already known the solution to this problem, I didn’t have any test cases; however, it is obvious that if one would have started with any other item, or had failed to bring back the parrot after dropping either of the other two objects at the destination, one of the constraints would have been broken.

**Problem 2**

1.

a) You have 20 objects. These objects belong in pairs. Of these 20, you have 3 classifications. There are 5 pairs of the first class, three pairs of the second class, and two pairs of the third class. You are unable to discern between the classes while taking the objects. Keeping this in mind, what is the least number you must take in order to ensure you have:

At least one pair from the same class.

At least one pair from each class.

b) This problem is also one that has been around for some time. However, it is often told with different amounts of each classification. It is apparent that this is a simple probability problem, in which one must minimize the objective function, while adhering to the constraints.

c) The overall goal is to come up with the minimum amount of objects you must take in order to ENSURE that you have enough to reach the goal. In other words, one must assume that the “worst-case scenario” will happen, and should pull as much as necessary to make sure that the constraints are still fulfilled.

2.

a) The constraints are that we acquire all the objects required to ensure objective completion, without foreknowledge. One must acquire this while taking the least amount of objects, while still fulfilling the first constraint. So, the first constraint is to take a number of socks that ensures you reach the objective. The second constraint is to take the minimum amount of socks possible.

b) The sub-goals are that you take a number of socks. This is, of course, very simple, but if you were to add the constraints that the number of socks be a certain combination, then you would have the overall objective.

3.

a) There only seems to be one solution that matches the constraints for both objectives. However, on might attempt to take a certain number of socks that has a high likelihood of achieving the desired result, rather than one that would ensure it.

4.

a) This strategy, though possibly being likely to result in the objective, doesn’t ensure it absolutely. Therefore, it doesn’t meet the goals.

b) The only solutions that would work for all cases would be the one below.

5.

a) The only solution for the first objective (acquiring at least one matching pair) would be to take four socks. As there are only three classes (or colors) of socks, then even if you took one of each class in the first three pulls, the fourth would be one of those three colors, matching the one already taken and fulfilling the constraint that we take the minimum amount, while ensuring we reach the objective. For the second objective, the only solution would be to take 18 socks. Though unlikely, it is possible that the first 16 socks taken could be black and brown. Therefore, you would still have to take two of the remaining to absolutely reach the objective. This is the minimum you can pull to remain certain you’ve taken the amount necessary.

b) As this is a simple probability problem, I did no test cases; however, one can be certain that these answers are sound, and that there are no other options.

**Problem 3**

1.

a) One counts with a system that repeats itself. Starting at the origin, the count continues across four other classes, before returning in four back to the origin.

b) I believe this problem to be a simple one, as the little girl is using her digits to actually count by eights.

c) The overall goal is to determine what class, or finger, the little girl will end her count on.

2.

a) The constraints are that the girl is counting by eights, and therefore ends each count on a multiple of eight.

b) The sub-goals are to determine what pattern the girl counts with, and then to determine at what point that pattern ends.

3.

a) One possible solution would be to count on one’s hand until the ending destination is reached.

First finger

Little finger

Thumb