Discussion questions

1. Does the equipotential distribution depend on the absolute or relative K values for the background and the inclusion? How would you use the model to test your answer?

   The equipotential distribution depends on the relative K values for the background and the inclusion. The large the difference between the K values the move water will flow to the high K value. To test this hypothesis, I would have the background K for the model equal to 1 and the test K values ranging from 0.001 – 100 in order to see how the equipotential lines changed.

2. Discuss what it means to say that, for steady state flow, there are equivalent Type I and Type II boundary conditions. How might this be useful in practice?

   Steady state flow mean that q_in = q_out which can be created for Type II and Type I boundary conditions depending on head or flux values. This means that we can achieve a model with steady state flow through adding either Type I or Type II boundary conditions. This is important to know because it allows us to ensure our model is mass balanced under both conditions (ie we have a Type I and Type II boundary condition that yields the same flux). If we were not able to find equivalent boundary conditions then that may mean water is being stored or lost somewhere in the model and mass balance does not necessarily hold.

3. What would you find if you altered your model to consider unconfined conditions??

   If we changed the model to look at unconfined conditions we shouldn't see any change in the system. We should still see water moving more quickly through the high K value area and trying to avoid the low K area. That is assuming we keep everything the same and just shift the value from unconfined (uncf) to a value greater than 0.

Glossary questions:

1. What is FloPy? How is it different from MODFLOW and how does it interact with MODFLOW? What are some advantages (easy) and disadvantages (harder) of using FloPy rather than building MODFLOW models manually?

   Flopy is a python packages that was created to interface and run the fortran compiled code, Modflow. It interacts with Modflow using a set of packages that create the different Modflow input files in the directory so that we can run Modflow. It also easily interfaces with matplotlib and other python packages to calculate and graph the outputs.

   Pros: much less time consuming and can run code iteratively, easy to process outputs graphically and allows for manual adjustment of colors and design

Cons; uses a coding language and is a lot harder than simply using a GUI to interact with Modflow

2. Given that the distribution of K is always heterogeneous at the small scale, what does it mean to provide one K value per grid cell? What are the implications for the K values we use in models in general? How does this change if we are modeling with different spatial resolutions (i.e. grid cell sizes)?

   This means that we assume that K is uniform for one grid cell (ie that our grid cell is homogeneous) and the intricacies of the variations in K don't matter. Since K is not easily measured in the field, this means that we are at any point in time simply estimating what we think the K value should be. IN large scale modelling this means that our models are never exactly perfect as we are assuming that each grid cell is only defined by that one K value. If our resolution size is 1 km for a grid cell we lose a lot of the resolution regarding what is happening in the grid cell. That said, when looking at larger spatial bounds (ie global systems) that smaller resolution may not directly affect our analysis.

3. What does it mean for a groundwater model to be confined? How does this simplify calculations of groundwater flux? How do we specify this with cell types in MODFLOW?

   A groundwater model is confined means that no water is coming in or out of the model boundaries. Therefore, we are simply looking at the what is happening within the boundaries to better understand water movement in this area. This simplifies groundwater flux as we can just say that water is not leaving or entering and we have the same amount of water moving through the domain (ie flux is equal to 0 on the bounds and the system will eventually reach a steady state). We turn off cell types in Modflow to not allow flow to pass through those boundaries (I think that's the right answer).