CS46, Swarthmore College, Spring 2014
Homework 9 – due 2 May
Your Name(s) Here

1. Suppose $A \leq_p B$ for all $A, B \in$ NP. This implies, amongst other things that if $A \leq_p B$ then $B \leq_p A$ for any $A, B \in$ NP. Show if the first statement is true, then P=NP.

2. From Kleinberg and Tardos 8.4: A computer operating system manages a set of n processes and access to a set of m limited shared resources. Examples of shared resources might be the disk, the network, the monitor, and the keyboard. Assume for this problem that the each process requests the set of resources it needs to use, but each resource can only be used by a single process at any given time. If a process can acquire all the resources it needs, it is active, otherwise it is blocked. Given the set of processes, their resource requests and the set of resources, we would like to maximize the number of active processes. Consider a decision version of this problem where we ask if it is possible to schedule k processes for some given k. The following problems are either in P or are NP-Complete. If the problem is in P give an algorithm that solves the problem. If the problem is NP-Complete give both a certificate to show the problem is in NP and a reduction from a known NP-Complete problem (4-pts each)

   (a) The general problem as described above

   (b) The case when $k = 2$

   (c) The case when each resource is requested by at most two processes

   (d) The case where there are two types of resources, e.g., CPUs and Disks, and each process requires at most one resource of each type. For example, process 1 may requests CPU 2 and Disk 3, while process 2 requests CPU 2 and Disk 1.