Homework #3
Solution

1. Ideal Rectifiers

Circuit One is a full-wave rectifier. Its output waveform can be seen on page 71 of Gingrich. The output waveform on the lower right looks like the correct one because there is a signal in every half cycle.

Circuit Two is a half-wave rectifier. Its output waveform can be seen on page 70 of Gingrich. The output waveform on the upper right looks like the correct one because there is a signal only every other half cycle.

For the full-wave rectifier there is always a path for the current to flow through the load resistor, while for the half-wave, the current only flows when the source voltage is positive.

2. PSpice Simulations of Real Diode Rectifiers

The figure on the left is for a full-wave rectifier while the one on the right is for a half-wave rectifier. There are two obvious differences between these two figures and the ideal outputs. Both are due to the fact that the diode must be forward biased a small amount before it turns on. Thus, there is a region near the zero-crossing of the input where there is no output (the voltage is zero). Also, the output voltage does not reach the same level as the input, since some of the input voltage is across the junction to keep the diode on. Once the diode is on, one can think of it as a battery. In this case the voltage is about 0.7 volt. For the plot on the next page (half-wave rectifier case), note that the cursors show a difference of about this much between the peak input and peak output voltages. For the full-wave rectifier, the difference between the input and output is twice this value, since there are now two diodes that must be turned on.

3. Smoothing

If we want to add smoothing, we add a capacitor across the output resistor. In the two circuits, add a capacitor C in parallel with R_L in each case. You may recall that adding such a capacitor in Experiment 6 produced an output voltage something like the second figure on the next page. The reason to add smoothing is to produce a more regular DC average.