Consider the following gas process, which cycles through a rectangle on a pV diagram.

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Figure 1: Gas engine path

Make a table, like the one below, and find W_{net}.

Time period	Description (in words)	Work done by gas in this time period
0-10s		
10-20s		
20-30s		
30-40s		

Solution We can begin with the first step. Since the volume did not change, no work was done. The pressure is changing while the volume is being held fixed. The only way this could be happening (witout changing the number of molecules in the gas) would be for the temperature of the gas to be changing. To raise the pressure of the gas, the temperature must be increasing.

In the second step, the pressure is constant, so we can find the work from

$$W = -\int p dV \tag{1}$$

$$= -p\int dV \tag{2}$$

$$= -p\Delta V \tag{3}$$

$$= -(2\text{ atm})(0.5\text{ L}) \tag{4}$$

$$= \text{FIXME unit conversions} \tag{5}$$

FIXME, expand this to show the rest of the work

Time period	Description (in words)	Work done by gas in this time period
0-10s	gas is heated at fixed volume	0, no volume change
10-20s	gas expands at fixed pressure	-100 J
20-30s	gas is cooled at fixed volume	0, no volume change
30-40s	gas is compressed at fixed pressure	50 J

The net work done is

$$W_{\text{net}} = -100\text{ J} + 50\text{ J} = 50\text{ J} \tag{6}$$

Since we compress the gas at lower pressure than when it expands, it's easier to compress, and we can get net work out of the gas.