

1. Not all *quasistatic* processes are *reversible*! Give an example of a process that illustrates this. (Would it look right if played backwards?)

1. Anything with friction.



Gradual free expansion through a small hole. Many others!

Are all reversible processes quasistatic?

Yes!

2. The Carnot cycle is as follows. Take  $n$  moles of gas in a cylinder, and do the following to it, reversibly:

Start at  $p_1, V_1, T_1$ .

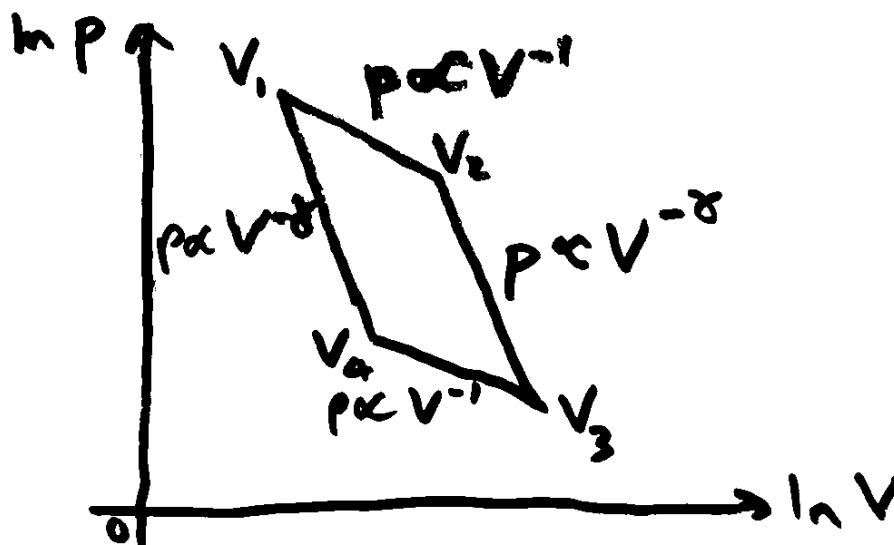
Expand isothermally to  $p_2, V_2, T_2$ .

Expand adiabatically to  $p_3, V_3, T_3$ .

Compress isothermally to  $p_4, V_4, T_4$ .

Compress adiabatically back to  $p_1, V_1, T_1$ .

Sketch the Carnot cycle on a diagram of  $\ln P$  vs  $\ln V$ , instead of the usual  $P$  vs  $V$ . Show from this diagram that  $V_3/V_4 = V_2/V_1$ .



It's a parallelogram

$$\ln V_2 - \ln V_1 = \ln V_3 - \ln V_4$$

$$\text{so } V_2/V_1 = V_3/V_4$$