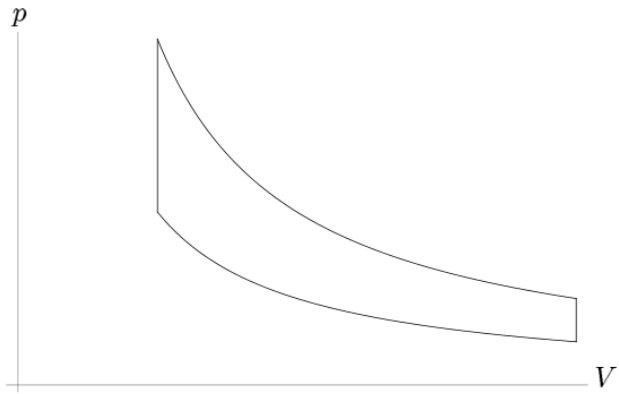
**Problem 2. Thermodynamic cycle *(5 points)***




It is possible to realise the described process as a reversible cycle between two reservoirs at $T_1$ and $T_2$ (in this case it is called the Stirling cycle). A thermodynamic process is reversible if and only if there is never any heat flux between regions having non-infinitesimally different temperatures. During either isotherm we may keep the system in contact with a reservoir. The isochores can be connected with a heat exchanger in such a way that the heat emitted at any specific temperature on one isochore is later reused at the same temperature on the other isochore. A corollary of Carnot's theorem (which says that the Carnot cycle is the most efficient one possible between to reservoirs) is that any reversible cycle between two reservoirs has the same efficiency as Carnot's. Assuming $T_1 > T_2$, the efficiency is $(T_1 - T_2)/T_1$.

Alternatively: for an isotherm, $p \propto T/V$, therefore the work done during compression from $V_1$ to $V_2$ is $Q_{12}(T) = \int_{V_1}^{V_2} p\,dV \propto T\int_{V_1}^{V_2} \frac{dV}{V} = T\int_{V_1}^{V_2} d\ln V = T\ln\frac{V_2}{V_1}$. During isochores there is no displacement and thus no work done. The efficiency $\eta = \frac{Q_{12}(T_2)-Q_{12}(T_1)}{Q_{12}(T_2)} = \frac{T_2-T_1}{T_2}$.