Ideal gas law:

Isothermal Comp. & expan. (Boyle's law)

Controlled variable (V)

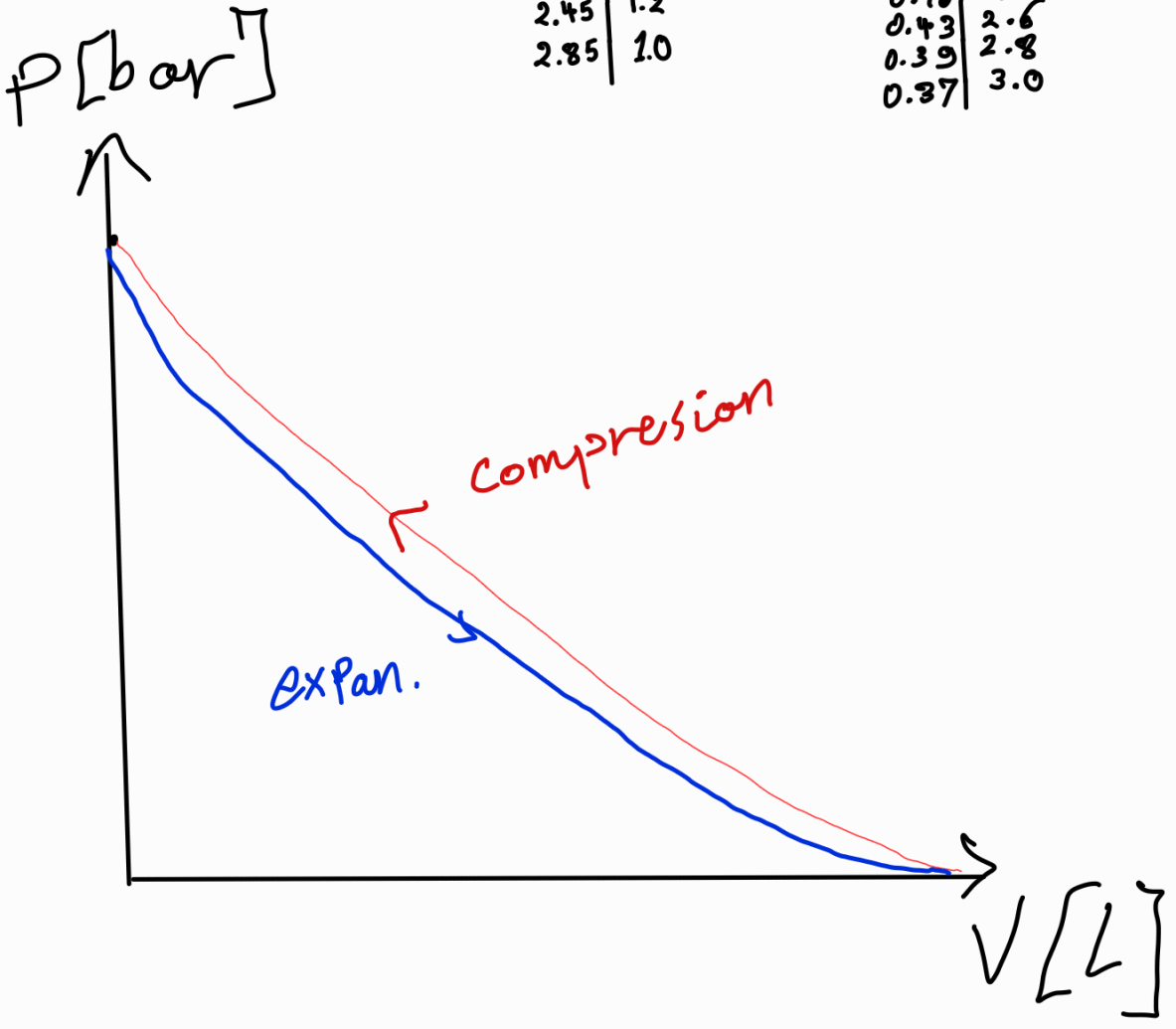
observed variable (P)

Using the compressor, starting at 3L gas in the chamber, fill the chamber with oil thus decreasing the volume of the gas within the chamber to a minimum of 1L. A capacitor is used to determine the exact volume of gas at a given time. Gas pressure is measured by the pressure sensor at the top of the chamber. Once 1L volume has been reached, open the valve at the top of the chamber to equilibrate the gas to atmospheric pressure, and using the compressor, expand the gas back to a volume of 3L. A thermometer is installed to ensure that the gas remains under isothermal conditions.

at $T = 18^{\circ}C = 291\ K$

P[bar]	V[L]
1.01	3.0
1.12	2.8
1.2	2.6
1.33	2.4
1.45	2.2
1.56	2.0
1.73	1.8
1.93	1.6
2.15	1.4
2.45	1.2
2.85	1.0

P[bar]	V[L]
1.02	1
0.86	1.2
0.75	1.4
0.67	1.6
0.6	1.8
0.55	2.0
0.5	2.2
0.46	2.4
0.43	2.6
0.39	2.8
0.37	3.0



Isochoric heating & cooling (Gay-Lussac's Law)

Controlled variable (T)

observed variable (P)

Using the valve at the top of the chamber, ensure that the gas begins at standard pressure and temperature. Using the heater, heat the gas in the chamber to 80 degrees Celcius, monitoring the pressure approximately every ten degrees. Once 80 degrees has been reached, open the valve at the top to return the chamber to atmospheric pressure, turn off the heater and allow the system to cool. Measure the pressure as the system cools to room temperature.

P[bar]	T[C°]
1.01	16.3
1.1	30
1.14	40
1.18	50
1.22	60
1.27	75

Air compressor: $W_{12} = \frac{n}{n-1} R \cdot T_1 \left[\left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} - 1 \right]$

$$T_2 = T_1 \left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}}$$

- What is the inlet temp in [K] & the inlet pressure in [bar]:

$P_1 = 1$ bar , $T = 20°C = 293$ K

- What is the outlet temp. at 1.40 min?

$T_2 = T_1 \left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} = 293\text{K} \left(\frac{5 \cancel{\text{bar}}}{1 \cancel{\text{bar}}} \right)^{\frac{1.3-1}{1.3}} = 425\text{K}$

- At time 1:40 min, how much work $\left(\frac{KJ}{Kg}\right)$ is done by the piston?

$W_{12} = \frac{n}{n-1} R \cdot T_1 \left[\left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} - 1 \right] = 163.98 \text{ KJ/Kg}$

- Input power at 1:40 min?

$P = I \cdot U = (3.3\text{A})(230\text{V}) = 759\text{ W}$

Steam engine:

1- cooling water & lubrication oil

2- turn the Key (connect to power supply)