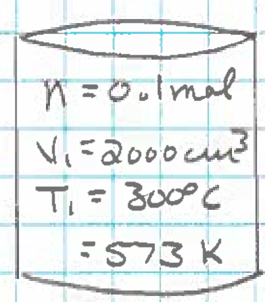
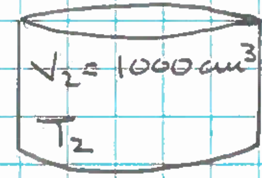
State 1

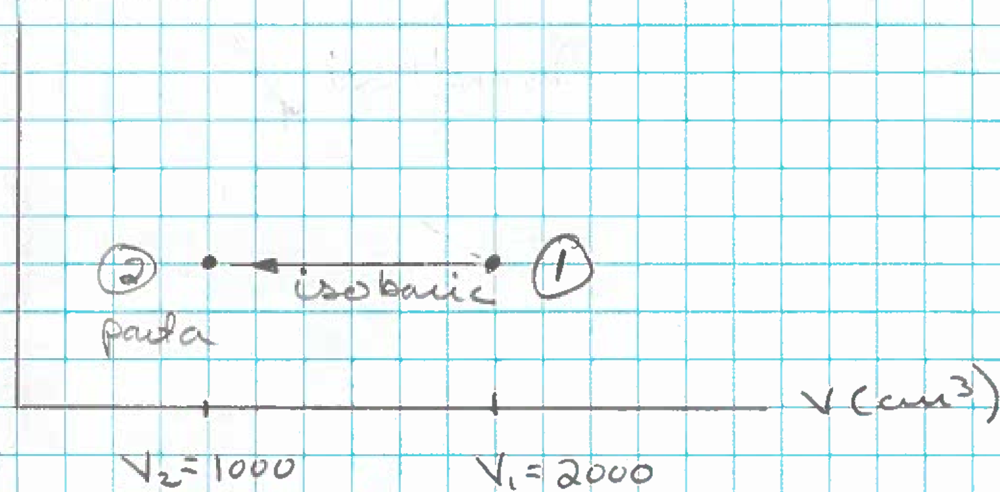


State 2



First, show processes on a PV diagram:

a.) Isobaric



b.) Isobaric, $P_2 = P_1$

$$W_{1\to 2} = -\int_{V_1}^{V_2} p\,dV = -(\text{area under isobaric path.})$$

$$= -P_1 \int_{V_1}^{V_2} dV = -P_1 V\Big|_{V_1}^{V_2} = -P_1(V_2 - V_1) = -P_1 \Delta V$$

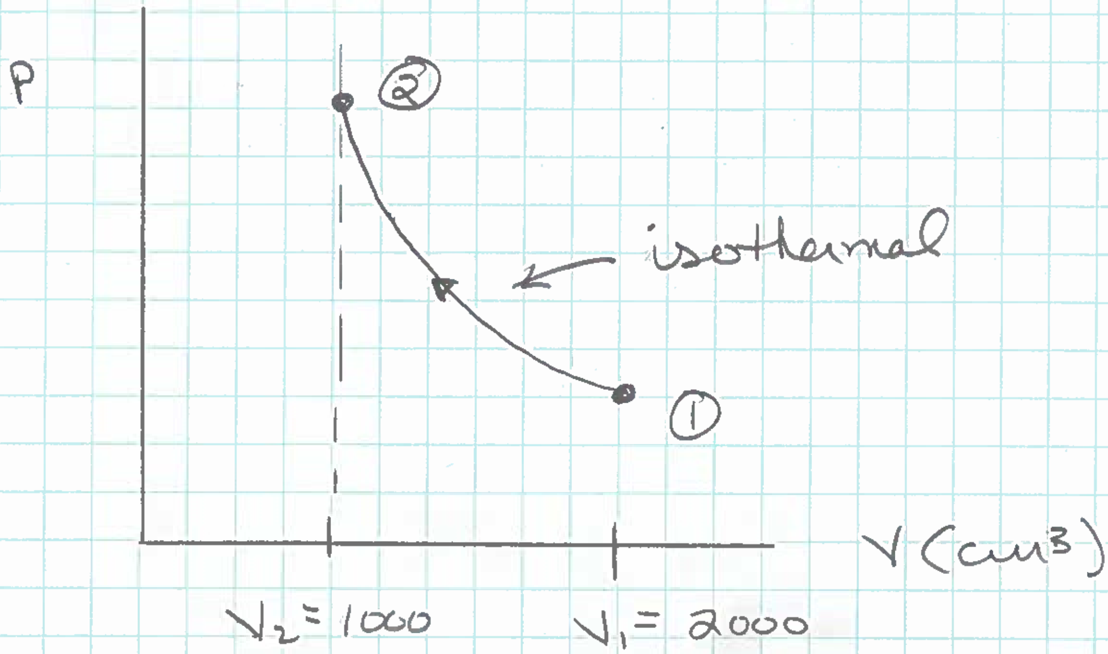
Now, $PV = nRT \Rightarrow P_1 = \dfrac{nRT_1}{V_1}$

$\therefore$

$$\boxed{W_{1\to 2} = -nRT_1\left(\frac{V_2 - V_1}{V_1}\right) = +238 \text{ J}}$$

Isothermal

c.)



d.) <u>Isothermal</u>, $T_2 = T_1$

$$W_{1\to 2} = -\int_{V_1}^{V_2} p\,dV = -(\text{area under isothermal path.})$$

- Can p come outside the integral?
  No, we need p as a function of V:

$$PV = nRT \Rightarrow P = \frac{nRT}{V}$$

So, integral is:

$$W_{1\to 2} = -\int_{V_1}^{V_2} p\,dV = -\int_{V_1}^{V_2} \frac{nRT}{V}\,dV = -nRT_1 \int_{V_1}^{V_2} \frac{dV}{V}$$

So,

$$W_{1\to 2} = -nRT_1 \ln V \Big|_{V_1}^{V_2} = -nRT_1(\ln V_2 - \ln V_1)$$

$$\therefore \boxed{W_{1\to 2} = -nRT \ln\left(\frac{V_2}{V_1}\right) = +330\text{ J}}$$

In the future, when we need to calculate the work for an isothermal process, we'll just use this equation. But, you should go through the integration at least once.