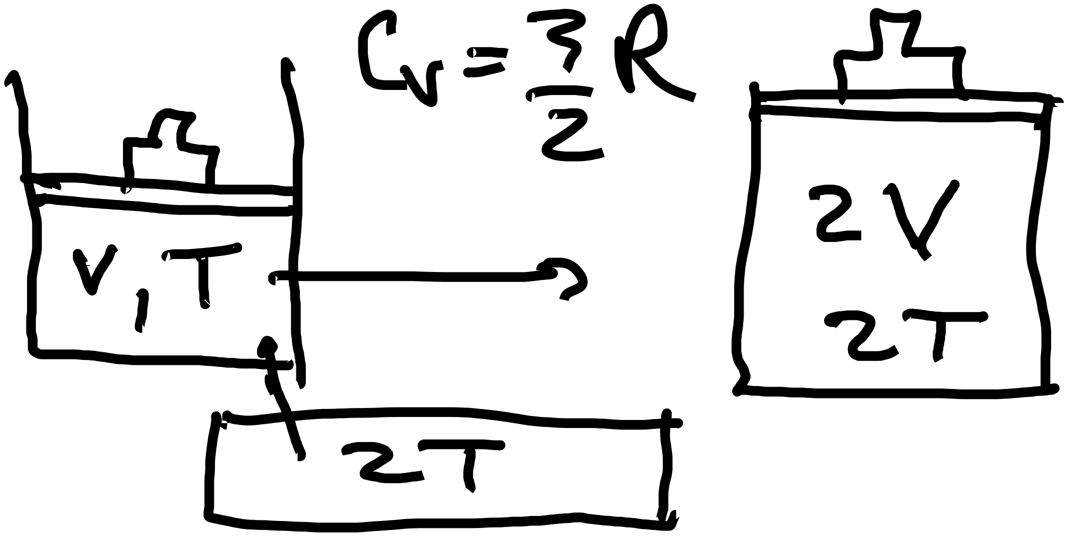
$C_v = \frac{3}{2}R$



$PV = nRT$

$\Delta S_{univ} > 0$

$$\Delta S_{gas} = \int_i^f \frac{dQ}{T}$$

$$dQ = dE_{int} + dW$$

$$dQ = nC_v\,dT + \frac{nRT}{V}\,dV$$

$$\Delta S_{gas} = nC_v \ln 2 + nR \ln 2 = \underbrace{\frac{5}{2} nR \ln 2}$$

$$\Delta S_{env} = -\frac{Q}{2T}$$

$$Q = nC_v \cdot T + nRT \ln 2$$
$$= \frac{3}{2} nRT + nRT \ln 2$$

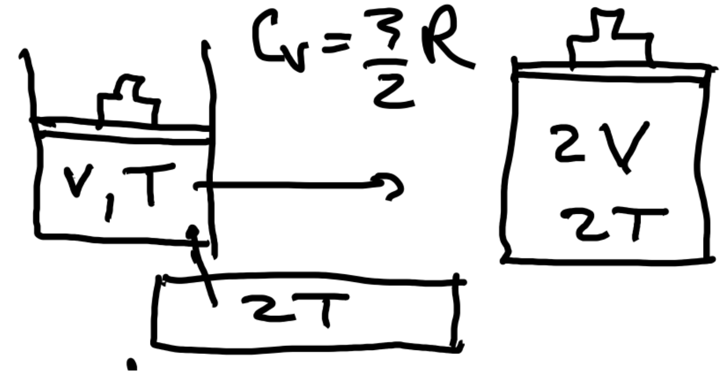
$$\Delta S_{env} = -\frac{3}{4} nR - \frac{nR}{2} \ln 2 \; ; \; \Delta S_{univ} = 2nR\underline{\ln 2} - \frac{3}{4} nR$$

<u>Correction on previous slide</u>

$$dQ = dE_{int} + dW$$

$$dQ = nC_v\,dT + \frac{nRT}{V}\,dV$$

$$Q = nC_v \cdot T + nRT\ln 2$$



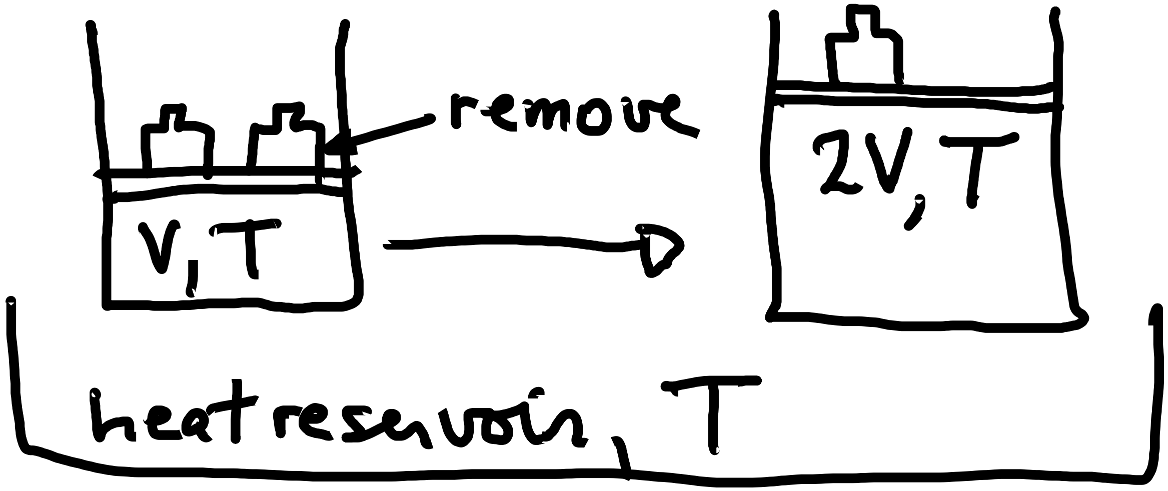
2^{nd} term in the Q expression above is wrong, this is not a isothermal process

It is a process at constant P, where V and T are changing. So the work is:

$$W = P\Delta V,\ P = \frac{nRT}{V},\ \ \Delta V = (2V - V) ==> W = nRT$$

$$\Delta S_{env} = -\frac{3}{4}nR - \frac{1}{2}nR = -\frac{5}{4}nR$$

$$\Delta S_{univ} = \frac{5}{2}nR\ln 2 - \frac{5}{4}nR = \frac{5}{4}nR(2\ln 2 - 1) = 0.48nR$$



initially: $PV = nRT$. then, $P' = P/2$

Work done by gas: $W = \frac{P}{2}\Delta V = nRT/2$

Heat absorbed: $\Delta E_{int} = Q - W = 0 \Rightarrow Q = W$

So $\Delta S_{env} = -\frac{Q}{T} = -\frac{nRT}{2T} = -\frac{nR}{2}$

$\Delta S_{gas} = nR \ln \frac{V_f}{V_i} = nR \ln 2$

$\Delta S_{univ} = nR\left(\ln 2 - \frac{1}{2}\right) = 0.19\, nR$

A statistical view of entropy

Learning Objectives

- **20.21** Explain what is meant by the configurations of a system of molecules.
- **20.22** Calculate the multiplicity of a given configuration.
- **20.23** Identify that all microstates are equally probable but the configurations with more microstates are more probable than the other configurations.
- **20.24** Apply Boltzmann's entropy equation to calculate the entropy associated with a multiplicity.