Concept to remember:

Chemical Thermodynamics-II:

Internal Energy: Total energy posses by a system, this includes all kind of energy a system may possess.

Internal energy may change:

i)   Heat comes into or out of the system
ii)   Work is done on or by the system
iii)   Matter enters or leaves the system

Sign Convention:

Work done on the system: + (positive)

Work done by the system: - (negative)

Heat added to the system: + (positive)

Heat extracted from system: - (negative)

First law of Thermodynamics: $\Delta U = q + w$ … This is law of energy conversion

Work done on a gas: $W = -\int_{V_i}^{V_f} P_{ex} dV$

P_{ex} is external pressure and expressed as $P_{in} \pm dp$ and P_{in} is pressure of the gas. As dp is very small, we can write $W = -\int_{V_i}^{V_f} P_{in} dV$

For n mol ideal gas $P_{in} = P$, $P = nRT/V$; so, $W = -\int_{V_i}^{V_f} (nRT/V) dV = -nRT \ln\frac{V_f}{V_i}$

Free expansion: expansion in vacuum, $P_{ex} = 0$