

AP Physics - Thermodynamics - PV Diagrams

Note Title

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Thermodynamics - Study of energy transferred as heat and work.

Heat - Transfer of energy because of difference in Temperature.

Work - Transfer of energy not because of a difference in Temperature.

System - Set of objects.

Closed System - No mass enters or leaves (but energy can)

Open System - Mass can enter or leave

Isolated System - Closed system and no energy can pass through a system boundary.

Internal Energy - Energy that exists in a system by virtue of its objects having a temperature greater than absolute zero.

$$U = N \cdot \overline{KE} \leftarrow \text{avg KE of each molecule}$$

↑
of molecules

$$U = N \overline{KE}$$

$$U = N \left(\frac{3}{2} k_B T \right)$$

$$U = N \cdot \frac{3}{2} \cdot \frac{R}{N_A} \cdot T$$

$$U = \frac{3}{2} \cdot n \cdot R \cdot T$$

$$U = \frac{3}{2} nRT$$

First Law of Thermodynamics

If you transfer heat in or do work on a system, you increase its internal energy.

$$\Delta U = Q_{in} - W_{by}$$

or

$$\Delta U = Q_{in} + W_{on}$$

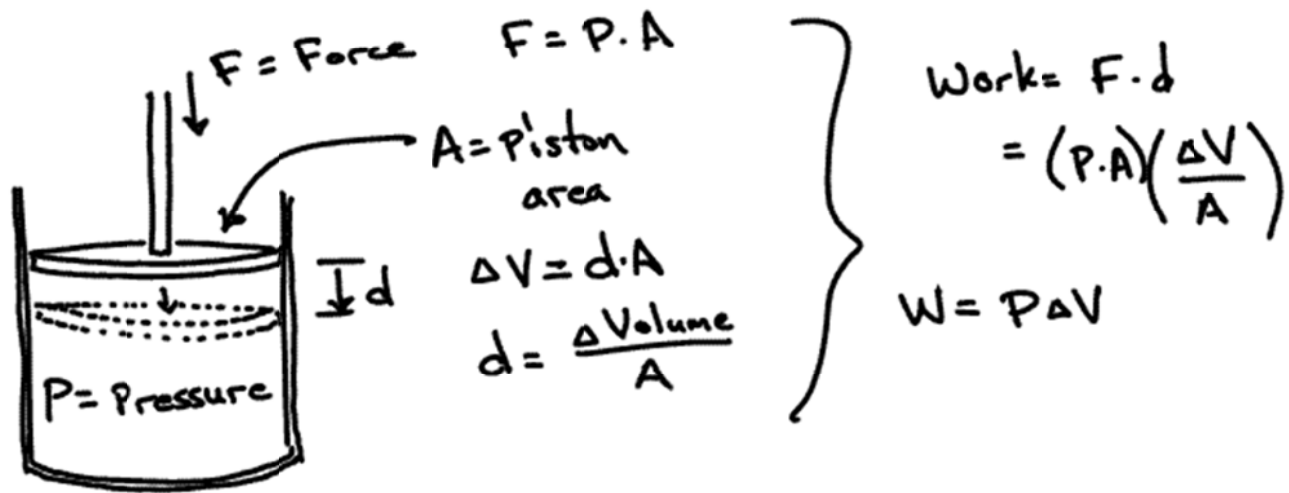
} Add Heat $Q_{in} \rightarrow U \uparrow$
Lose Heat $Q_{out} \rightarrow U \downarrow$
Work on system $W_{on} \rightarrow U \uparrow$
Work by system $W_{by} \rightarrow U \downarrow$

Internal energy (U) is a system property (Like $P, T, \rho, V, n, \text{etc.}$)

Heat (Q) and work (W) are not system properties.

Calculating work on a closed system

Consider an enclosed cylinder containing a gas with a piston:



\therefore Work done on a closed system (assuming negligible change in temperature)

$$W = P \Delta V$$