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Ch 19: The First Law of Thermodynamics

1st Law of Thermodynamics

$$U = Q - W$$

$$dU = dQ - dW$$

What kind of variable is energy?

Work done by changes in state of an ideal gas

$$W = \int_{V1}^{V2} p\, dV$$

$$-p\, dV = -dW$$

$$-dW = -nR\, dT$$

$$dQ = n\, C_p\, dT$$

$$dU = n\, C_p\, dT - nR\, dT$$

so...

$$dU = dQ - dW$$

$$U = Q - W$$

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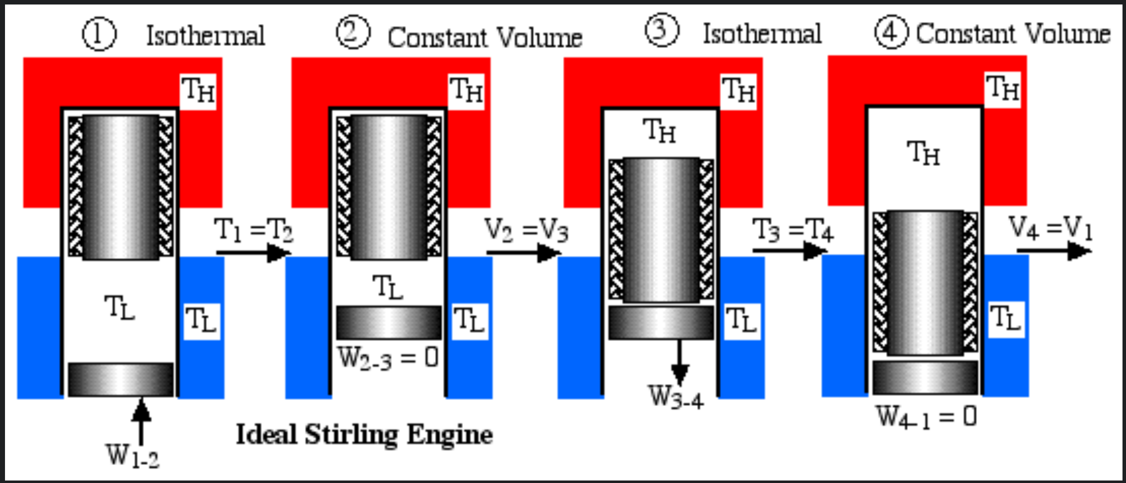
Types of Thermodynamics Processes

- Isothermal
- Isochoric
- Isobaric
- Adiabatic



http://www.ohio.edu/mechanical/thermo/Intro/Chapt.1_6/Second_Law/StirlingEngine.gif

Each process has an isolated value

Why are these processes ideal processes?

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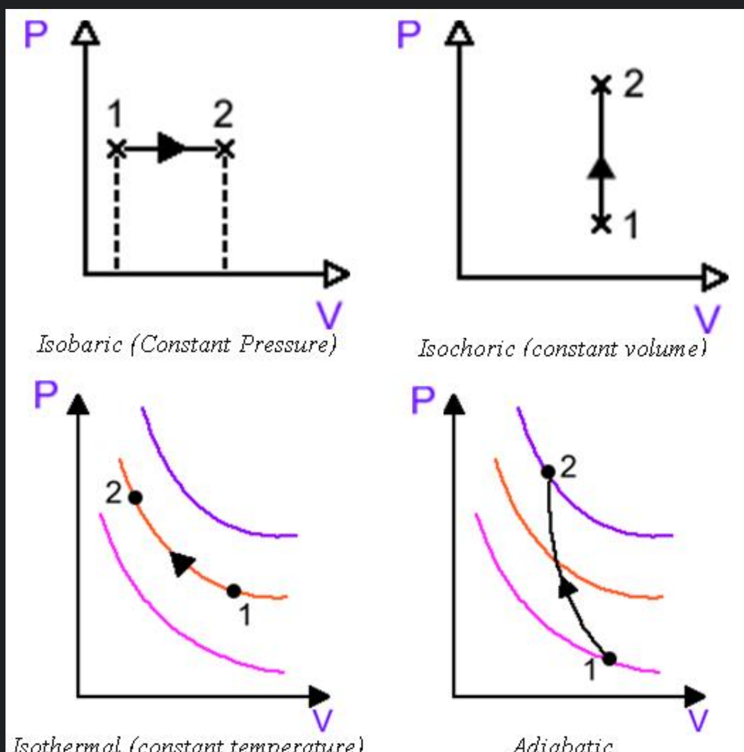
Thermodynamic Work



http://ibphysicsstuff.wdfiles.com/local--files/processes/PVdiagrams.jpg

	Formulas
Isochoric	$W=0$ $V_1=V_2$
Isobaric	$W=p(v2-v1)$ $p_1=p_2$
Isothermal	$W=nRT\ \ln(v2/v1)$ $T_1=T_2$
Adiabatic	$-W=\Delta U$ $Q=0$

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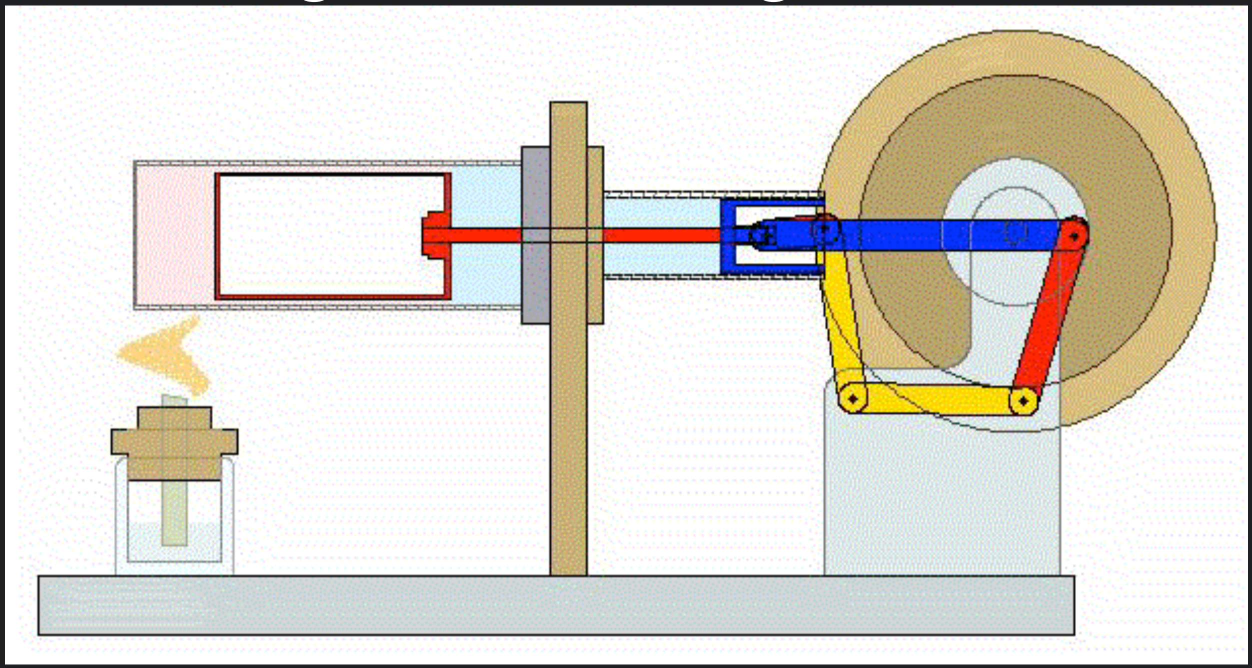
Heat Engines & Refrigerators



http://www.et.byu.edu/~vps/ME321/engine.gif

What is the energy exchange in this animation?

Q => KE

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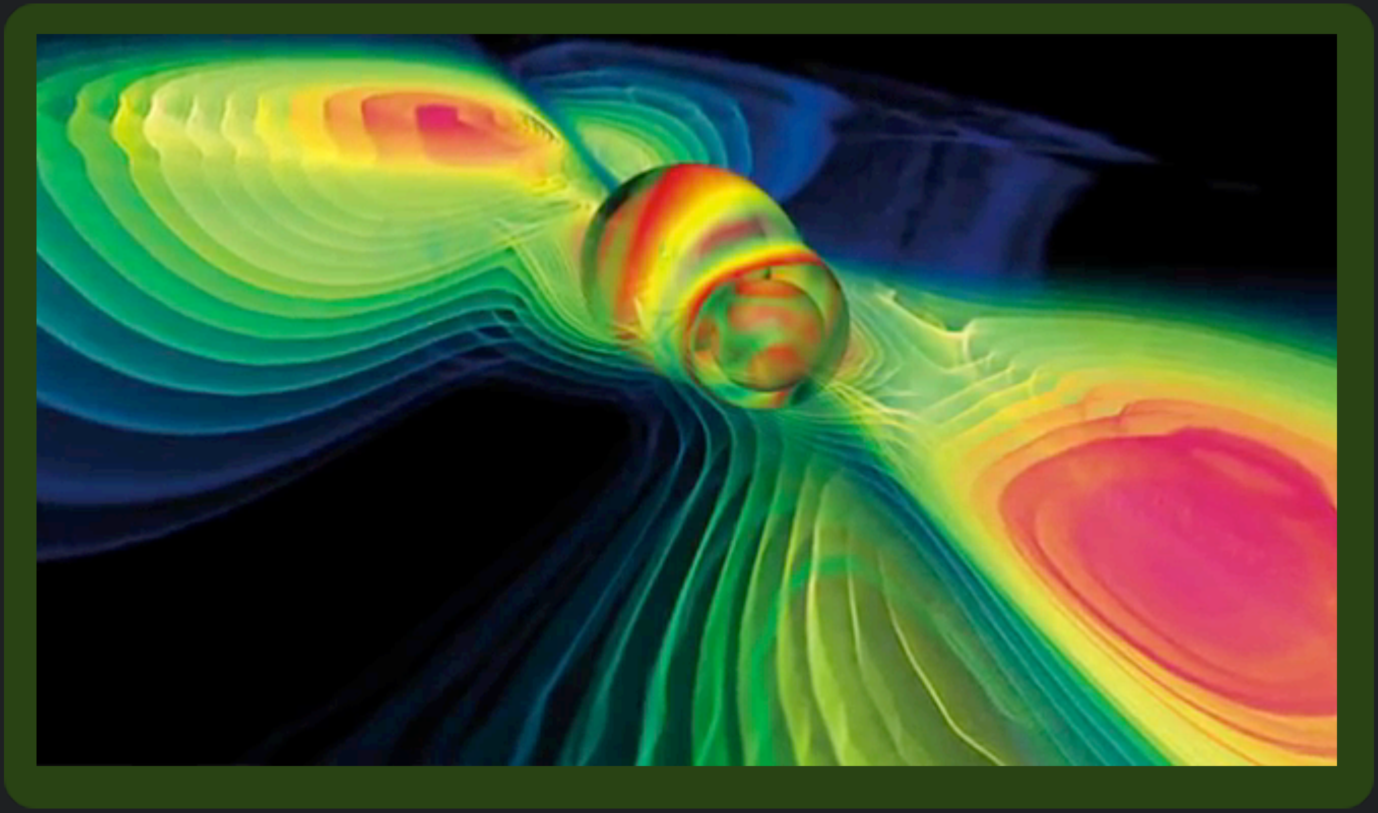

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Thermodynamic Efficiency

Based only on the work done and the heat used

- 100% is not possible
- Related to entropy
- Related to the 0th Law

Thermal energy must be deposited at a lower temperature to cause Kinetic motion

Why?

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Summary

★Thermodynamic Processes
★Thermodynamic Work
★Heat Engines & Refrigerators
★Thermodynamic Efficiency

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Citation

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