Glossary of Thermodynamic Terms—C.E. Mungan, Fall 1998

Temperature: Macroscopic definition—The property of an object which determines how much heat it will exchange with another object when brought into thermal contact with it. Microscopic definition—A measure of the average molecular kinetic energy of an ideal gas. Symbol T.

Ideal Gas: A material whose equation of state is $PV = nRT$.

Work: Energy transferred out of a body as a result of a macroscopic increase in its volume which is opposed by an external pressure. Symbol W.

Heat: Energy transferred into a body from another body of higher temperature due either to random molecular collisions between the portions of the objects in physical contact (i.e., by conduction or convection) or to thermal radiation exchanged between them. Symbol Q.

Internal Energy: The energy of a material excluding any external mechanical energy it may have due either to its collective rotational and translational motion (KE) or to the position of its center of mass (PE). Internal energy includes random molecular translational, rotational, and vibrational kinetic energy, chemical energy associated with bonding within and between molecules, and the binding energy of the electrons and of the nuclei. Symbol U.

Entropy: Thermodynamic definition—The change in entropy of a body is given by $\Delta S = \int d\!Q_R / T$ in which the total heat is split into small portions transferred by hypothetical reversible processes at temperature T. For the universe as a whole, $\Delta S > 0$ for irreversible processes (i.e., any macroscopic event) and $\Delta S = 0$ for reversible processes (i.e., any microscopic event). Statistical mechanics definition—S is determined by the number of possible microscopic arrangements which give rise to that macroscopic state of the system, and hence increases with the "degree of disorder" of the system.

Types of Processes:
    isobaric—at constant pressure P
    isochoric—at constant volume V
    isothermal—at constant temperature T
    adiabatic—without exchange of heat with the surroundings (i.e., $Q = 0$ or insulated)

Types of Machines:
    engine—thermal efficiency $e = \dfrac{W}{Q_H}$ with $e_c = \dfrac{T_H - T_C}{T_H}$

    refrigerator—coefficient of performance $\text{COP} = \dfrac{Q_C}{W}$ with $\text{COP}_c = \dfrac{T_C}{T_H - T_C}$

    heat pump—coefficient of performance $\text{COP} = \dfrac{Q_H}{W}$ with $\text{COP}_c = \dfrac{T_H}{T_H - T_C}$

Here the subscript "c" designates Carnot, which gives the maximum possible value. In all three cases, $W = Q_H - Q_C$ by energy conservation.