وزارة التعليم العالي والبحث العلمي
جامعة الموصل
كلية العلوم البيئية
قسم تقانات البيئة

Thermodynamics

ا.م.د.ايمان عبد المنعم الجوادي
كلية العلوم البيئية

الاشارات الدالة ل Q
Sign Conventions for Q

$Q > 0$: heat added to system

$Q < 0$: heat removed from system

- Consistent with sign of ΔT from earlier:

$$Q = mc\,\Delta T \quad \text{or} \quad Q = nC\,\Delta T$$

Heat Q:

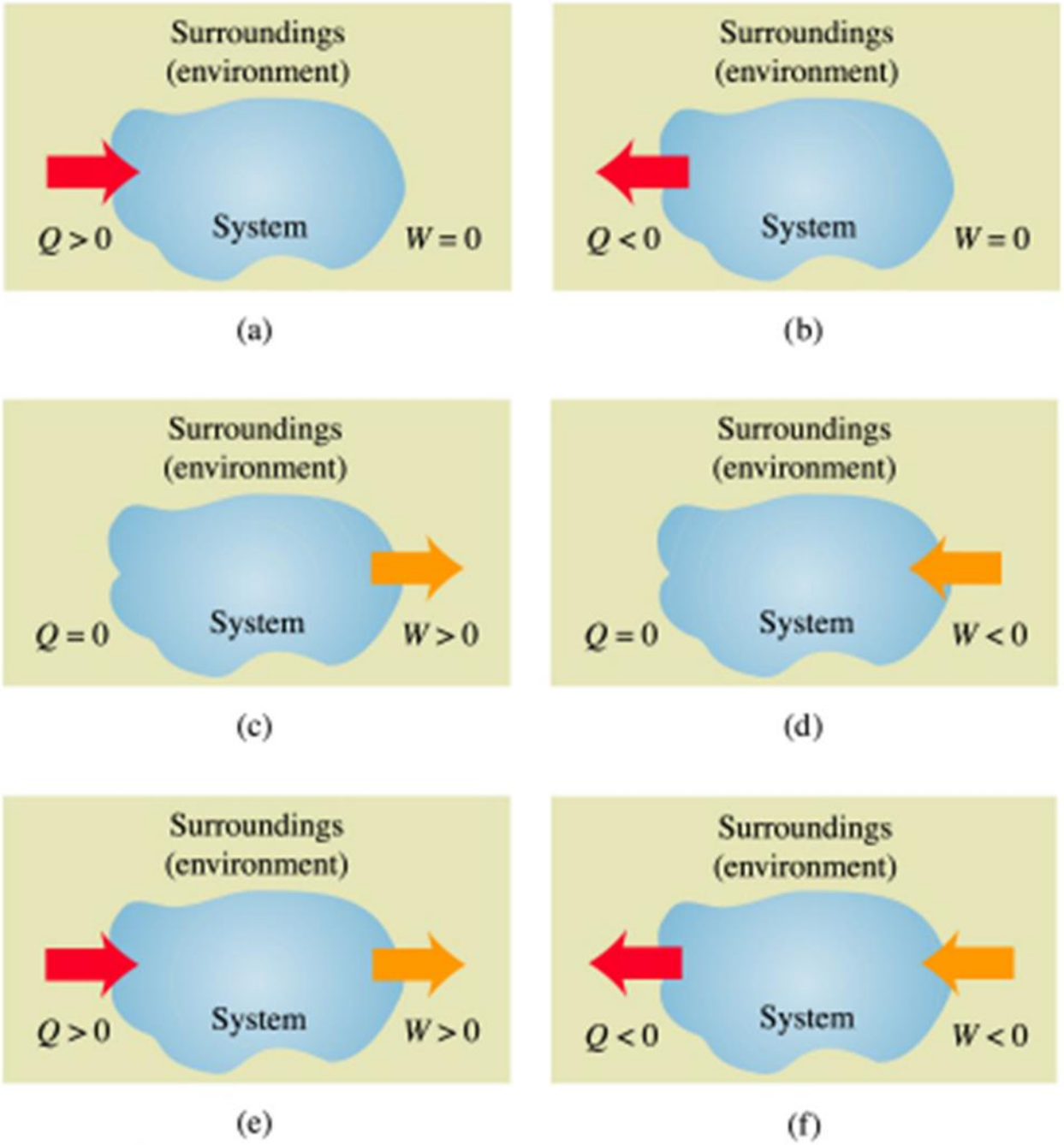
can leave or enter system

$Q > 0$:

heat added to system

$Q < 0$:

heat removed from system



الدلالة لاشارة الشغل
Sign Conventions for W

$W > 0$: system does work on surroundings

$W < 0$: surroundings does work on system

- (the ‘opposite perspective’ as in mechanics)

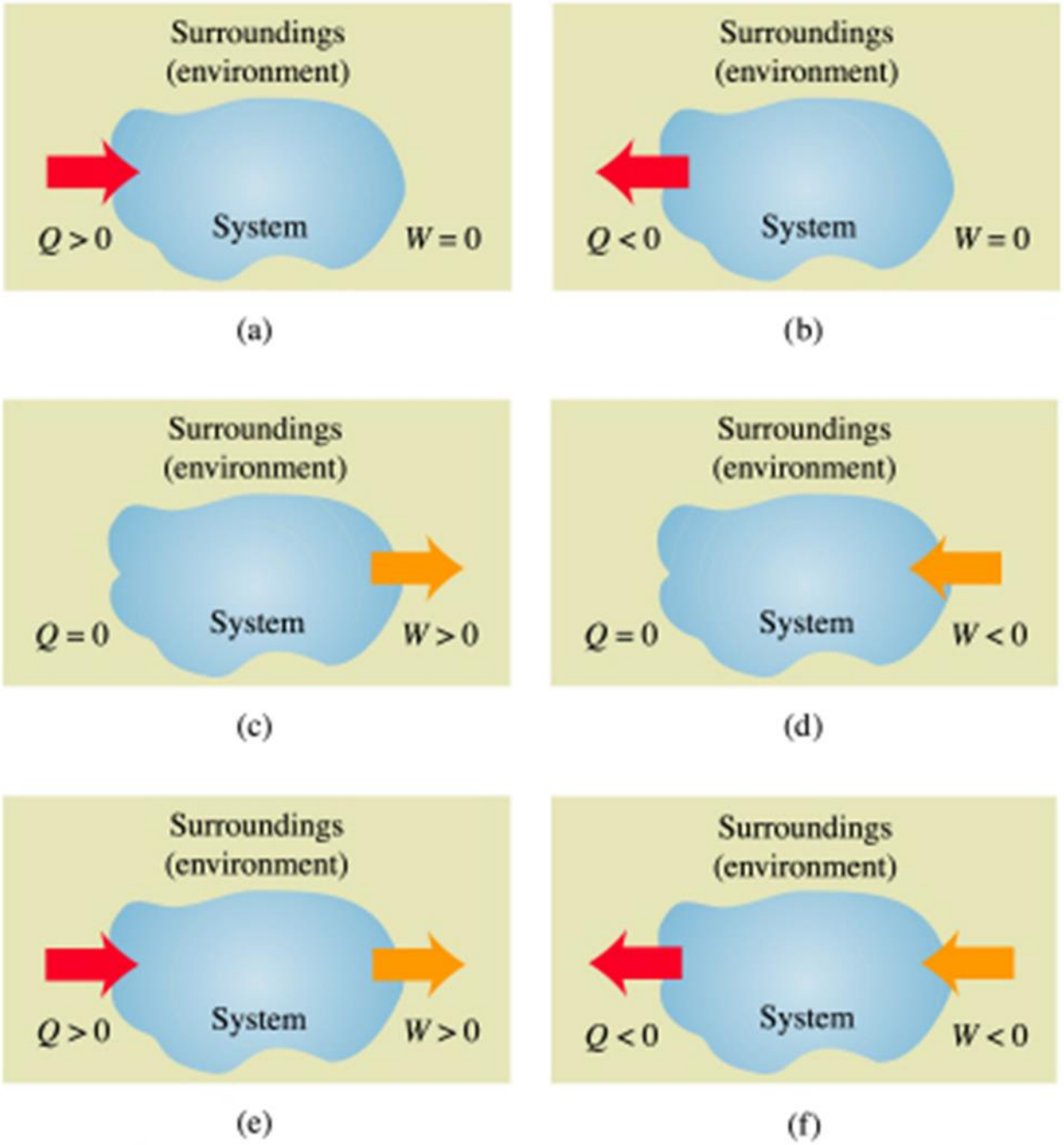
Work *W*:

$W > 0$:

system does work on its surroundings

$W < 0$:

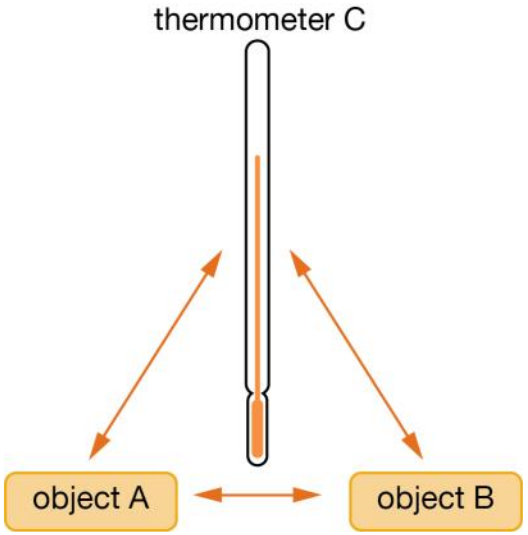
surroundings does work on the system



Zeroth law

If A is in thermal equilibrium with B, and B is in thermal equilibrium with C, then C will be in thermal equilibrium with A.

In other words, all three systems have the same ‘temperature’.



Rigid walls that permit a system to change its state (by thermal transfer) are called ‘diathermic’.
Saucepans are diathermic vessels.

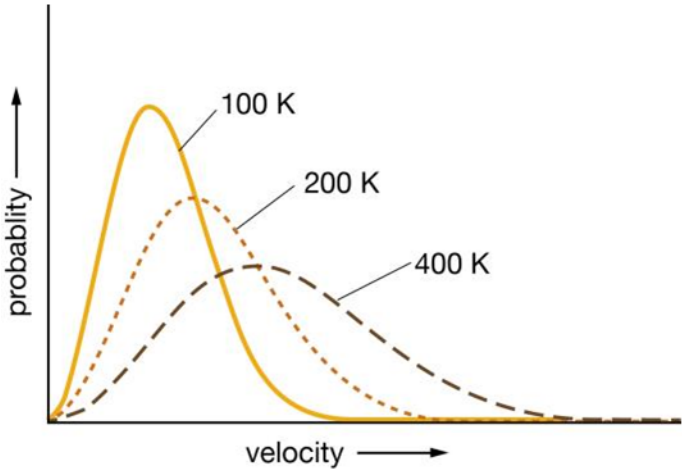
Walls that do NOT permit such changes (by thermal transfer) are called ‘adiabatic’.
A vacuum flask is adiabatic.

Temperature scales: Fahrenheit, Celsius, Kelvin.

Zeroth law - particle level

Statistical thermodynamics, developed by Ludwig Boltzmann (1844-1906), describes what happens at atomic or molecular level.

Molecules in a gas have quantised energy levels. In equilibrium, molecules are distributed over a range of allowed states.



Average E_k of a molecule $= \frac{3}{2}kT$

Boltzmann constant,

$k = 1.38 \times 10^{-23}\ \mathrm{JK}^{-1}$

smaller mass => *v* larger