PHYSICS 2: FLUID MECHANICS AND THERMODYNAMICS

Phan Hiền Vũ

Department of Physics - IU VNU-HCM

Office: A1.503

Email: phvu@hcmiu.edu.vn

Midterm Review

Chapter 1: Fluid Mechanics

density: $$\rho = \frac{m}{V}$$

pressure: $$p = \frac{F}{A}$$

fluids at rest: $$p = p_0 + \rho g h$$

absolute pressure

atmosphere pressure

gauge pressure

Pascal's law:

$$\frac{F_i}{A_i} = \frac{F_0}{A_0}$$

Archimede's principal:

$$F_b = \rho_{fluid} gV \text{ : buoyant force}$$

Equation of continuity:

$$A_1 v_1 = A_2 v_2 = \text{constant}$$

Bernoulli's equation:

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2 = \text{constant}$$

Chapter 2: Heat, Temperature and the First Law of Thermodynamics

Temperature:

$$T(K) = T(C^0) + 273.15$$

Thermal expansion:

- Linear expansion: (solids)

$$\Delta L = L\alpha\Delta T$$

- Area expansion: (solids)

$$\Delta A = A\alpha_A\Delta T; \alpha_A = 2\alpha$$

- Volume expansion: (solids and liquids)

$$\Delta V = V\beta\Delta T;\ \beta = 3\alpha$$

Heat capacity:

$$Q = C\,\Delta T = C\,(T_f - T_i)$$

Specific capacity:

$$Q = cm\,\Delta T = cm\,(T_f - T_i)$$

Latent heat:

$$Q = Lm$$

The first law of thermodynamics:

$$\Delta E_{int} = E_{int,f} - E_{int,i} = Q - W$$

Three special cases:

1. Adiabatic processes:

$$Q = 0 \Rightarrow \Delta E_{int} = -W$$

2. Constant-volume (isochoric) processes:

$$W = 0 \Rightarrow \Delta E_{int} = Q$$

3. Cyclical processes:

$$\Delta E_{int} = 0 \Rightarrow Q = W$$

- Work done by the gas:

  -Expansion: $W > 0$

  -Compression: $W < 0$

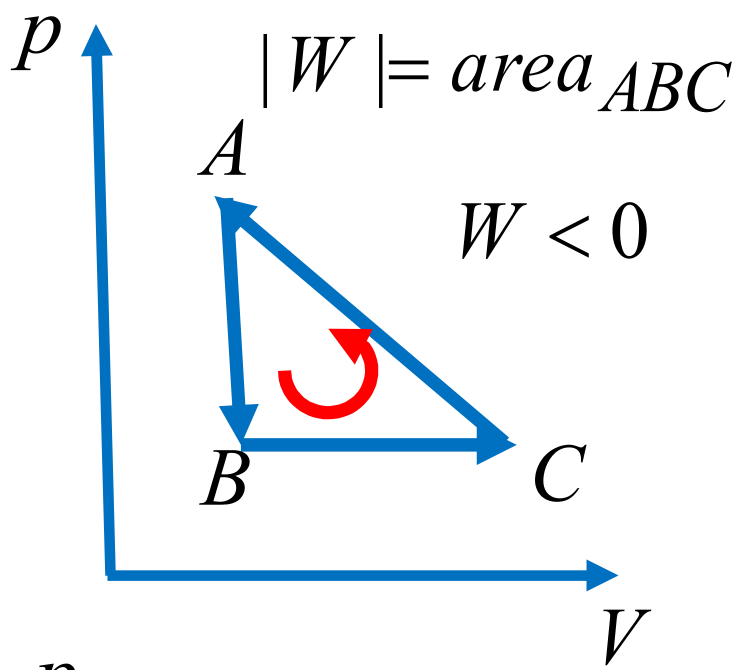
- Energy transferred as heat Q:

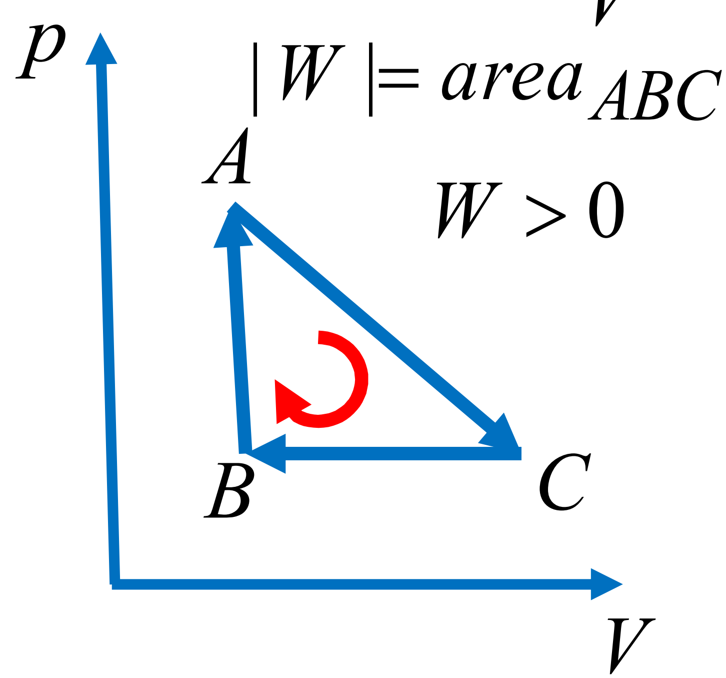
  -Heat transferred to the gas (receiving energy as heat):

  $$Q > 0$$

  -Heat transferred from the gas (releasing energy as heat):

  $$Q < 0$$





Heat Transfer Mechanisms:

Conduction:

$$P_{cond} = \frac{Q}{t} = kA\frac{T_H - T_C}{L}$$

(Unit: W = J/s)

Steady-state:

$$P_{cond} = \frac{k_2 A(T_H - T_X)}{L_2} = \frac{k_1 A(T_X - T_C)}{L_1}$$

If the slab consists of n materials:

$$P_{cond} = \frac{A(T_H - T_C)}{\sum_{i=1}^{n}(L_i/k_i)}$$