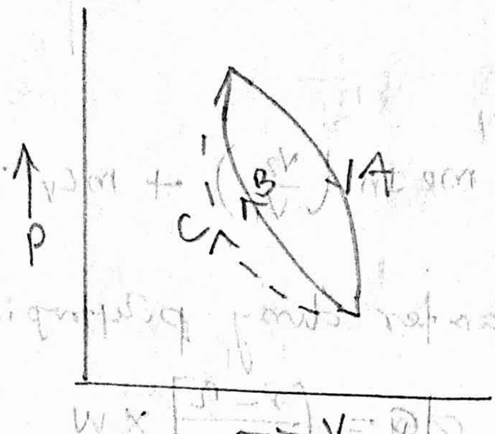
Principle of increase of entropy.

The change of entropy for reversible process is given by $ds = \frac{dQ}{T}$



For a reversible cycle 1-A-2-B-1, the equation

$$\int_{1A}^{2A} \frac{dQ}{T} + \int_{2B}^{1B} \frac{dQ}{T} = 0 \quad \text{--- (1)}$$

For the irreversible cycle 1-A-2-C-1, The Clausius inequality and express it

$$\int_{1A}^{2A} \frac{dQ}{T} + \int_{2C}^{1C} \frac{dQ}{T} \leq 0 \quad \text{--- (2)}$$

Sub (1) from (2)

$$\int_{2C}^{1C} \frac{dQ}{T} - \int_{2B}^{1B} \frac{dQ}{T} \leq 0 \quad \text{--- (3)}$$

On reversing the limit and rearranging eq (3)

$$\int_{1B}^{2B} \frac{dQ}{T} \geq \int_{1C}^{2C} \frac{dQ}{T} \quad \text{--- (4)}$$

Since the process 2-B-1 is reversible, $ds = \frac{dQ}{T}$

Sub in 4

$$\int_1^2 ds \geq \int_{1c}^{2c} \frac{dQ}{T} \quad (or)$$

$$ds \geq \frac{dQ}{T}$$

Principle of increase of entropy states that the entropy of an isolated system never decreases, $ds \geq 0$

$ds = 0$ for reversible process

$ds > 0$ irreversible process

$ds < 0$ impossible process.

problems

1. 1.6 kg of air compressed according to the law $pv^{1.3} = c$ from a pressure of 1.2 bar and temperature of 20°C to a pressure of 17.5 bar. Calculate a) the final volume and temperature (b) work done; (c) heat transferred (d) change in entropy.

Given

$m = 1.6 \, kg$

$pv^{1.3} = c, \quad \therefore n = 1.3$

$P_1 = 1.2 \, bar = 120 \, kN/m^2$

$T_1 = 20°c = 293 K$

$P_2 = 17.5 \, bar = 1750 \, kN/m^2$

To find

(i) $V_2 T_2$ (ii) T_2 (iii) W, (iv) Q (v) Δs