(1)

Entropy Change for Vander Waals Gas

$$Tds = C_v dT + P dV$$

from approximate Vander Waals Gas eqn

$$P(V-b) = RT$$

[neglecting a/V^2 as $a \ll V^2$]

$$P = \frac{RT}{V-b}$$

$$\frac{P}{T} = \frac{R}{V-b}$$

So $$ds = C_v \frac{dT}{T} + \frac{P}{T} dV$$

or $$ds = C_v \frac{dT}{T} + R \frac{dV}{V-b}$$

$$S_2 - S_1 = C_v \int_{T_1}^{T_2} \frac{dT}{T} + R \int_{V_1}^{V_2} \frac{dV}{V-b}$$

or $$\boxed{S_2 - S_1 = C_v \ln \frac{T_2}{T_1} + R \ln \frac{V_2 - b}{V_1 - b}}$$

→ Entropy change for Vander Waals gas

(2) Entropy of Steam formation :

To get the value of Steam let us imagine that 1 gram ice at T_i temperature is converted into steam at temperature T_s.

The whole process can be divided into following processes

(1) — Ice at T_i changes into water at T_i
(2) — Water at T_i is heated upto temperature T_s
(3) — Water at temperature T_s is converted into Steam at temperature T_s

For Step (1)

$$dS = \int_{T_i}^{T_i} \frac{d\theta}{T} \text{ or } \boxed{S_1 = \frac{L_i}{T_i}}$$

[L_i = Latent heat of ice]

For Step (2) $dS = \int_{T_i}^{T_s} \frac{d\theta}{T} = \int_{T_i}^{T_s} ms\frac{dT}{T}$

or $\boxed{S_2 = c \ln \frac{T_s}{T_i}}$

[c = Sp heat of water]

$m = 1$ gm

For step (3)

$$dS = \int_{T_s}^{T_s} \frac{dQ}{T} \quad \text{or} \quad \boxed{S_3 = \frac{L_s}{T_s}}$$

L_s = latent heat of steam

$dQ = L_s$

So total entropy change

$S_1 + S_2 + S_3$

$$\boxed{\Delta S = \frac{L_i}{T_i} + C \ln \frac{T_s}{T_2} + \frac{L_s}{T_s}}$$