

Answer on Question #55385 - Chemistry - General chemistry

Question:

Determine standard entropy of formation at 298K for each of the following:

H₂(g)

H₂O(g)

NH₃(g)

O₃(g)

I₂(g)

Please explain to me how you got your answer for each element.

Solution:

To get the standard entropy of simple substances we have to use standard entropy reference data

$$S^0(H_2) = 130.6 \frac{J}{mol \times K};$$

$$S^0(O_3) = 238.0 \frac{J}{mol \times K};$$

$$S^0(I_2) = 260.6 \frac{J}{mol \times K};$$

To get the standard entropy of other substances formation we have to use standard entropy reference data and the following formula:

$$\Delta S^0(\text{reaction}) = \sum S^0(\text{products}) - \sum S^0(\text{reactants})$$

Reaction of water formation $H_2 + \frac{1}{2} O_2 = H_2O$

$$\Delta S^0(\text{formation}) = S^0(H_2O) - S^0(H_2) - 0.5S^0(O_2) = 188.7 - 115 - 205/2 = -28.8 \frac{J}{mol \times K};$$

Reaction of ammonia formation

$\frac{1}{2}N_2 + \frac{3}{2}H_2 = NH_3$

$$\Delta S^0(\text{formation}) = S^0(NH_3) - 1.5S^0(H_2) - 0.5S^0(N_2) = 193 - 1.5 \times 115 - 0.5 \times 192 = -75.5 \frac{J}{mol \times K}$$

Answer:

$$S^0(H_2) = 130.6 \frac{J}{mol \times K};$$

$$S^0(O_3) = 238.0 \frac{J}{mol \times K};$$

$$S^0(I_2) = 260.6 \frac{J}{mol \times K};$$

$$\Delta S^0(\text{formation}, H_2O) = -28.8 \frac{J}{mol \times K}$$

$$\Delta S^0(\text{formation}, NH_3) = -75.5 \frac{J}{mol \times K}$$