Worksheet 9 – Answers to Critical Thinking Questions

The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

Model 1: Stars and the Stefan-Boltzmann Law

1. q_{out} is the total energy radiated per unit surface area per unit time. It has units of J m^{-2} s^{-1}.

   T is the absolute temperature. It has units of K.

2. $q_{out} = 3.85 \times 10^{26}$ J s^{-1}.

3. $q_{in} = 1.75 \times 10^{17}$ J s^{-1}

4. 279 K.

5. If 28% is reflected back, then only 72% of q_{in} is absorbed: $q_{in}' = 1.3 \times 10^{17}$ J m^{-2} s^{-1}

6. 260 K.

7. The polar ice caps are white and reflect sunlight. Melting of the polar ice caps would cause less of the sunlight to be reflected. This would cause a temperature increase which would, in turn, lead to more melting.

8. Molecules in the atmosphere absorb the radiation. This is known as the Greenhouse Effect.

Model 2: Enthalpy of Atomization ($\Delta_{atom}H$) and Enthalpy of Atom Combination ($\Delta_{ac}H$)

1. $\Delta_{atom}H = -\Delta_{ac}H$

2. $\Delta H = 0$

Model 3: Enthalpy of Reaction using $\Delta_{atom}H$ and $\Delta_{ac}H$

1. It involves bond breaking only, which requires energy.

2. It involves bond making only, which releases energy.

3. $\Delta H = (239 + 435)$ kJ mol^{-1} + (2×-431) kJ mol^{-1} = -188 kJ mol^{-1}

4. $\Delta_{rxn}H = \Delta_{ac}H$ (products) – $\Delta_{ac}H$ (reactants)

5. $\Delta_{rxn}H = \Delta_{atom}H$ (reactants) - $\Delta_{atom}H$ (products)

6. $\Delta_{rxn}H$ will be positive. If the bonds that need to be broken in the reactants are stronger than those formed in the products, the reaction is endothermic.

Model 3: Enthalpy of Reaction using $\Delta_f H$

1. $\Delta_f H°$ (O_2(g)) refers to the formation of O_2(g) from the element in its standard state (i.e. O_2(g)):

   $O_2(g) \rightarrow O_2(g)$

   $\Delta_f H°$ (H_2(g)) refers to the formation of H_2(g) from the element in its standard state (i.e. H_2(g)):

   $H_2(g) \rightarrow H_2(g)$

   Both processes involve no change and so $\Delta H° = 0$.

2. $\Delta_{rxn} H° = -882$ kJ mol^{-1}

3. $\Delta_{rxn} H° = ((-1096) – (-602 + -394))$ kJ mol^{-1} = -100 kJ mol^{-1}