

Exercise 10.1

Hydrogen

1. Explain why heavy water (D_2O) has a higher density than regular water (H_2O).
2. Hydrogen is one of very few elements that readily forms both cations and anions.
 - (a) What is the charge of the hydrogen cation? Write its electron configuration.
 - (b) What is the charge of the hydride anion? Write its electron configuration.
3. Industrial production of hydrogen is primarily done via catalytic steam reformation of hydrocarbons such as methane (CH_4). This is a two-step process.
 - (a) Write a balanced chemical equation for the first step in which methane and water react at 900-1000 °C to produce carbon monoxide and hydrogen.
 - (b) Write a balanced chemical equation for the second step in which the carbon monoxide is reacted with more water at 400-500 °C to produce carbon dioxide and hydrogen.
 - (c) Why does the first step have to be done at a higher temperature than the second step?
4. Identify and describe the three general classes of hydrogen-containing compounds.
Answer in terms of how hydrogen is incorporated in each class of compound (charge, type of bonding, etc.).