Brief Answers to Critical Thinking Questions from Lecture 5

Model 1

1. (a) Low reduced mass of bonds involving H.
   (b) Force constant increases with strength / stiffness of bond: \( k_{C-O} < k_{C=O} < k_{C≡O} \)

2. (a) \( \mu(H_2) = \frac{1}{2} \) (b) \( \mu(D_2) = 1 \)  
   In general, \( \mu(X_2) = m_X / 2 \)

3. \( \mu(D_2) / \mu(H_2) = 2. \)

4. \( \nu(D_2) / \nu(H_2) = 1/\sqrt{2} \)

5. \( \mu(HX) \rightarrow m_H \) for large \( m_X \).

When Q4 and Q5 are combined, the useful result emerges that \( \nu(DX) / \nu(HX) \sim 1/\sqrt{2} \).

Model 2

1. \( \varepsilon_0 = 1/2h \nu \)

2. \( \varepsilon_1 = 3/2h \nu \)

2. \( \Delta \varepsilon = \varepsilon_1 - \varepsilon_0 = h \nu \)

The transition energy is equal to the energy of the classical harmonic oscillator!