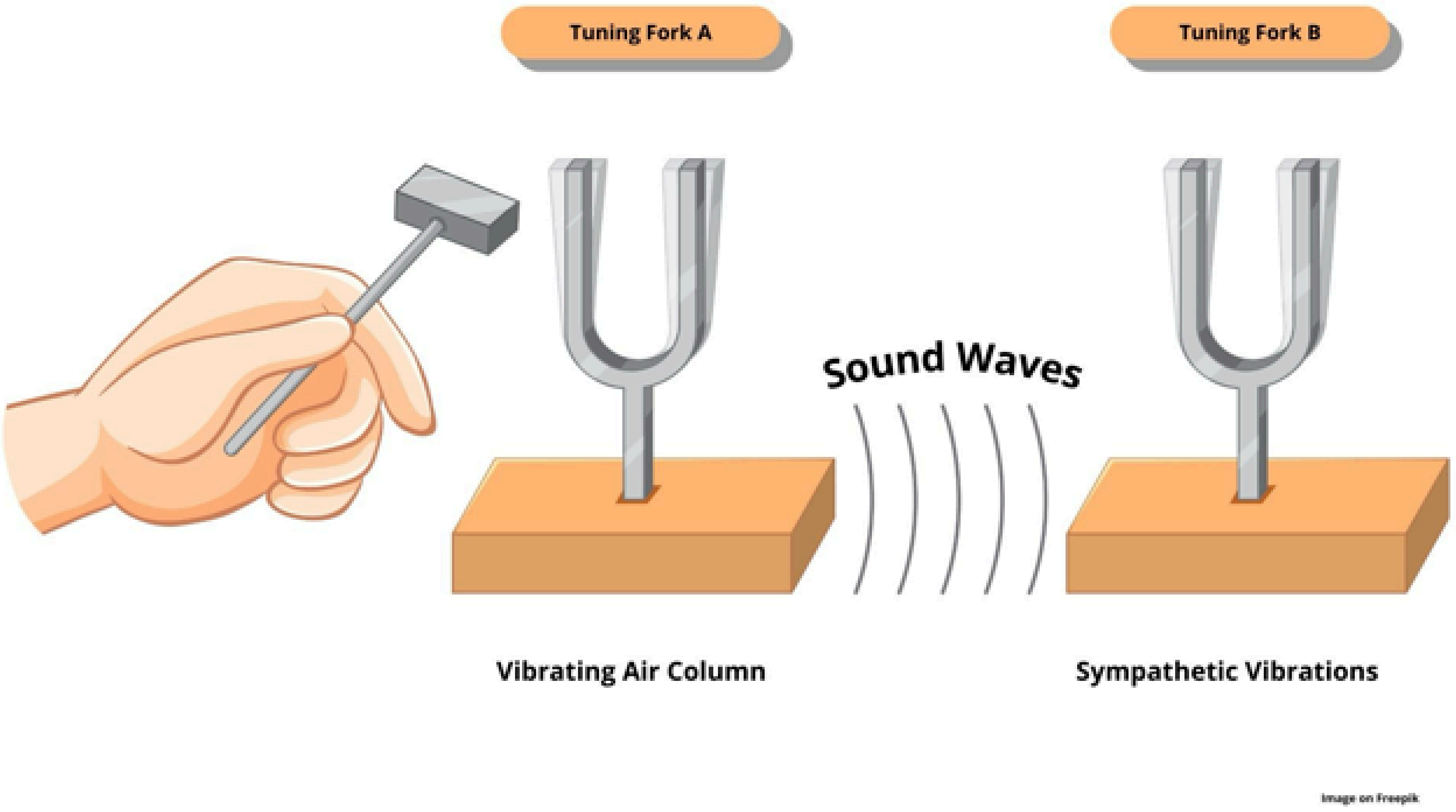
Day 25 - Help Session



HW6 Exercise 1: Morse Potential as an SHO

If the potential has a local minimum, we can often find SHO approximation for that potential near the local minimum.

The Morse potential is a convenient model for the potential energy of a diatomic molecule. The potential is a radial one and thus one-dimensional. It is given by,

$$U(r) = A\left[\left(e^{(R-r)/S} - 1\right)^2 - 1\right]$$

where the distance between the centers of the two atoms is r, and the constants A, R, and S are all positive. Here $S << R$.

- 1a. Sketch (or plot) the potential as a function of r.

HW6 Exercise 1: Morse Potential as an SHO

$$U(r) = A\left[\left(e^{(R-r)/S} - 1\right)^2 - 1\right]$$

- 1b. Find the equilibrium position of the potential, i.e. the position where the potential is at a minimum. We will call this r_e.
- 1c. Rewrite the potential in terms of the displacement from equilibrium, $r = r_e + x$. Expand the potential to second order in x.
- 1d. Find the effective spring constant, k, for the potential near the minimum. What is the frequency of small oscillations about the minimum?

HW6 Exercise 3: Toy Potential

Consider a toy potential of the form,

$$U(r) = U_0 \left(\frac{r}{R} + \lambda^2 \frac{R}{r} \right)$$

where U_0, R, and λ are all positive constants and the domain of the potential is $0 < r < \infty$.

- 3a. Sketch (or plot) the potential as a function of r.

HW6 Exercise 3: Toy Potential

$$U(r) = U_0 \left(\frac{r}{R} + \lambda^2 \frac{R}{r} \right)$$

- 3b. Find the equilibrium position of the potential, i.e. the position where the potential is at a minimum. We will call this r_e.
- 3c. Rewrite the potential in terms of the displacement from equilibrium, $r = r_e + x$. Expand the potential to second order in x. What is the effective spring constant, k, for the potential near the minimum? What is the frequency of small oscillations about the minimum?