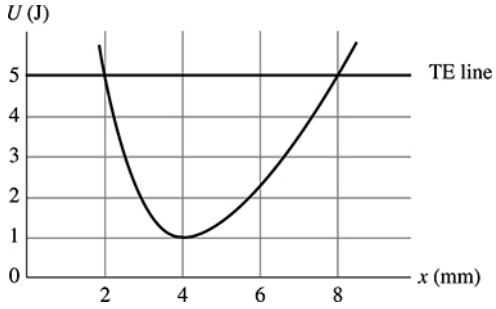
10.31. **Model:** For an energy diagram, the sum of the kinetic and potential energy is a constant.

Visualize:



Since the particle oscillates between $x = 2.0$ mm and $x = 8.0$ mm, the speed of the particle is zero at these points. That is, for these values of x, $E = U = 5.0$ J, which defines the total energy (TE) line. The distance from the potential energy (PE) curve to the TE line is the particle's kinetic energy. These values are transformed as the position changes, but the sum $K + U$ does not change.

Solve: The equation for total energy $E = U + K$ means $K = E - U$, so that K is maximum when U is minimum. We have

$$K_{\max} = \frac{1}{2} m v_{\max}^2 = 5.0 \text{ J} - U_{\min}$$

$$\Rightarrow v_{\max} = \sqrt{2(5.0 \text{ J} - U_{\min})/m} = \sqrt{2(5.0 \text{ J} - 1.0 \text{ J})/0.0020 \text{ kg}} = 63 \text{ m/s}$$