A 1.50 kg block is released from rest and allowed to slide down a frictionless surface and into a spring. The far end of the spring is attached to a wall, as shown below. The initial height of the block is 0.550 m above the lower part of the slide and the spring constant is 450.0 N/m. (a) What is the block’s speed when it is at a height of 0.25 m above the base of the slide? (b) How far is the spring compressed?

\[
\text{non-conservative} \rightarrow \text{any force other than gravity + elastic force}
\]

\[
W_{nc} = 0 \quad \Rightarrow \quad E_f = E_o
\]

\[
KE_f + PE_f = KE_o + PE_o
\]

\[
\frac{1}{2} mv_f^2 + mgh_f + \frac{1}{2} kx_f^2 = \frac{1}{2} mv_0^2 + mgh_o + \frac{1}{2} kx_0^2
\]

(a) \( v_0 = 0 \text{ m/s} \)

\( h_o = 0.550 \text{ m} \)

\( v_f = ? \)

\( h_f = 0.25 \text{ m} \)

\( x_f = x_o = 0 \text{ m} \)

\[
\frac{1}{2} mv_f^2 + mgh_f + \frac{1}{2} kx_f^2 = \frac{1}{2} mv_0^2 + mgh_o + \frac{1}{2} kx_0^2
\]

\[
\frac{1}{2} mv_f^2 = mg(h_o - h_f)
\]

\[
\frac{1}{2} mv_f^2 = mg(h_o - h_f) \Rightarrow v_f = \sqrt{2g(h_o - h_f)}
\]
\[ V_f = \sqrt{2g(h_0-h_f)} = \sqrt{2 \times (9.8 \text{ m/s}^2) (0.550 \text{ m} - 0.250 \text{ m})} \]

\[ V_f = 2.42 \text{ m/s} \]

(b) \[ V_o = 0 \text{ m/s} \]
\[ h_o = 0.550 \text{ m} \]
\[ x_o = 0 \text{ m} \]
\[ V_f = 0 \text{ m/s} \]
\[ h_f = 0 \text{ m} \]
\[ x_f = ? \]

\[ \frac{1}{2} m V_f^2 + mg h_f + \frac{1}{2} K x_f^2 = \frac{1}{2} m V_o^2 + mg h_o + \frac{1}{2} K x_o^2 \]

\[ \implies 0 = 0 \]

\[ \frac{1}{2} K x_f^2 = mg h_o \]

\[ x_f = \sqrt{\frac{2mg h_o}{K}} = \sqrt{2(1.50 \text{ Kg})(9.8 \text{ m/s}^2)(0.550 \text{ m})} \]

\[ x_f = 0.190 \text{ m} \]