A lioness is loping along at 1.50 m/s in some deep grass when a gazelle races past at a constant 15.0 m/s. It takes the lion's brain 2.00 s to register the notion that dinner just went by. At that moment the lioness takes off after the gazelle with a constant acceleration of 2.24 m/s². Assume both the lion and gazelle run in a straight line.

A. [8 pts.] At the instant the lioness begins accelerating, how far is the gazelle from the lioness?

\[ \Delta x = (15.0 \text{ m/s} - 1.5 \text{ m/s})(2 \text{ s}) \]

\[ \Delta x = 27.0 \text{ m} \]

B. [20 pts.] Take the initial instant \( t_0 = 0 \) as the moment the lioness begins her acceleration, and the origin of your 1-D coordinate system as the location of the lioness at \( t_0 \). How long does it take the lioness to reach the gazelle?

\[ x_{0L} = 0 \]
\[ x_{0G} = 37.0 \text{ m} \]
\[ v_{0L} = 1.5 \text{ m/s} \]
\[ v_{0G} = 15.0 \text{ m/s} \]
\[ a_L = 2.24 \text{ m/s}^2 \]

\[ x_L = x_G \]
\[ x_G = x_G \]
\[ v_{0L} = v_{0G} = 15.0 \text{ m/s} \]

\[ x_G = x_G \]
\[ v_{0L} = v_{0G} = 15.0 \text{ m/s} \]
\[ a_L = 2.24 \text{ m/s}^2 \]

\[ \begin{align*}
\frac{1}{2} a_L t^2 &= (15.0 \text{ m/s}) t + (1.12 \text{ m/s}^2) t^2 \\
0 &= 1.12 t^2 - 13.5 t - 27
\end{align*} \]

\[ t = 13.85 \text{ s}, -1.74 \text{ s} \]

\[ t = 13.85 \text{ s} \]

C. [7 pts.] How far does the lioness run from the origin until it reaches the gazelle?

\[ x_L = x_{0L} t + \frac{1}{2} a_L t^2 \]
\[ x_L = (1.5 \text{ m/s})(13.85 \text{ s}) + (1.12 \text{ m/s}^2)(13.85 \text{ s})^2 \]

\[ x_L = 234 \text{ m} \]