HW 4-

a) Whatever we guess, our answer must be consistent with $F_{\text{net}} = 0$ for either mass! So the guess of $2F_1$ is wrong!

b), c), d) We cover all three choices below, to cover your choices:

Solving with any two of the above gives a above and (notice how adding the last two gives the first).
Continued on next page

\[ T = F_1 + m_1 \frac{F_2 - F_1}{m_1 + m_2} = \frac{F_1 (m_1 + m_2) + m_1 (F_2 - F_1)}{m_1 + m_2} \]

\[ \Rightarrow T = \frac{m_2 F_1 + m_1 F_2}{m_1 + m_2} \]

\[ T - F = 0 \text{ for each } m_1, m_2 \Rightarrow T = F \]

\[ F_{\text{net}} \text{ (piece of rope)} = T - T = \begin{cases} 0 & \text{massless} \\ \text{m} & \text{given} \end{cases} \]
HW 4.3

a) \( F = ma = 1500(-8) = -12,000 \text{ N} \) points opposite to the motion (so F is the component \( F \) here).

b) \( K_f - K_i = 0 - \frac{1}{2} \frac{mv_i^2}{1500 (90/3.6)^2} = -4.69 \times 10^5 \text{ J} \)

c) From the work-energy relation, (b) tells us \( W_{\text{braking force on m}} = -4.69 \times 10^5 \text{ J} < 0 \) which means that the work is actually done ON the brakes (they heat up!).

d) On the other hand, we know \( W_{\text{braking force on m}} = F \cdot x \) with \( F = F \) from (a) and \( W_{\text{braking force on m}} \) from (c), and \( x \) the distance along the x-axis so:

\[
x = -4.69 \times 10^5 / (-12,000) = 39 \text{ m}
\]

An alternative derivation for (d) is from the old constant-acceleration formula

\[
\frac{v_f^2 - v_i^2}{2a} = d \Rightarrow d = \frac{(v_f^2 - v_i^2)}{2a} = 31 \text{ m}
\]

Either derivation gets full credit, but the work formula is the new and faster way to do this particular calculation, since we've already done the "work." 

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HW 4.8

\[
K_i + U_i = K_f + U_f \quad \text{conservation of energy}
\]

\[
\frac{1}{2}mv_i^2 + \frac{1}{2}mV_i^2 = \frac{1}{2}mV_f^2 + \frac{1}{2}mV_f^2 \quad \text{for } U = m g y_f
\]

\[
\frac{u^2 - v_i^2}{2a} = \frac{15^2}{2 \times 9.81} = 11.5 \text{ m}
\]

Exactly the same argument:

\[
\frac{v_i^2 - v_f^2}{2a} = \frac{-15^2}{2 \times 9.81} = 11.5 \text{ m}
\]