Chapter 02

1a $d = 275\ m$

$\vec{v}_{is} = +25.0\ m/s$ $\quad$ $\vec{v}_{iL} = -30.0\ m/s$

$a_L = 1.20\, a_s$ $\quad$ $a_L = ?$ $\quad$ $a_s = ?$

$\vec{v}_{fs} = 0\ m/s$ $\quad$ $\vec{v}_{fL} = 0\ m/s$

$\vec{x}_{fs} = \vec{x}_{fL}$ $\quad$ $\Delta t_s = \Delta t_L$

1b Assumptions and Simplifications

1-D motion (ignore the other two dimensions)

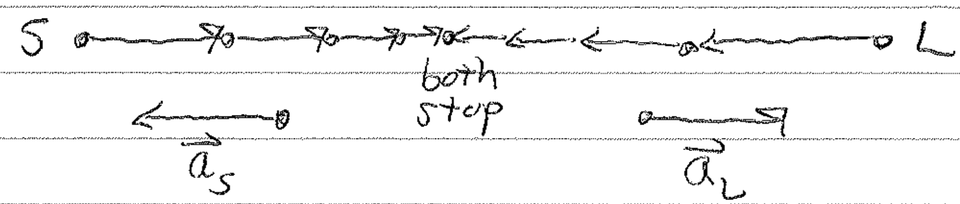
Treat the cars as particles.

Assume constant acceleration.

Concepts and Laws

Kinematics in 1-D for constant acceleration

2a Motion Diagrams $\quad$ $- \longleftrightarrow +$



2b Mathematical Representations

$$\vec{x}_f = \vec{x}_i + \vec{v}_i \Delta t + \frac{1}{2}\vec{a}(\Delta t)^2$$

3a Solve

$$\vec{x}_{fs} = 0 + \vec{v}_{is} \Delta t_s + \frac{1}{2}\vec{a}_s(\Delta t_s)^2$$

$$\vec{x}_{fL} = d + \vec{v}_{iL} \Delta t_L + \frac{1}{2}\vec{a}_L(\Delta t_L)^2$$

$$25\Delta t + \frac{1}{2} a_s (\Delta t)^2 = 275 - 30\Delta t + \frac{1}{2} a_L (\Delta t)^2$$

$$a_L = 1.20\, a_s$$

$$25\Delta t - \frac{1}{2} a_s (\Delta t)^2 = 275 - 30\Delta t + \frac{1}{2}(1.20 a_s)(\Delta t)^2$$

$$1.10 a_s (\Delta t)^2 - 55\Delta t + 275 = 0$$ (two unknowns)

Need another equation: $\vec{v}_{fs} = \vec{v}_{is} + \vec{a}_s \Delta t_s$

$$0 = 25 - a_s \Delta t \qquad \Delta t = \frac{25}{a_s}$$ (substitute)

$$1.1\, a_s \left(\frac{25}{a_s}\right)^2 - 55\left(\frac{25}{a_s}\right) + 275 = 0$$

$$\frac{1.1(625)}{a_s} - \frac{(55)(25)}{a_s} + 275 = 0$$ (solve for a_s)

$$(1.1)(625) - (55)(25) + 275\, a_s = 0$$

$$a_s = \frac{(55)(25) - (1.1)(625)}{275} = \frac{1375 - 687.5}{275}$$

$$a_s = 2.50 \text{ m/s}^2 \qquad a_L = 1.20\, a_s = 3.00 \text{ m/s}^2$$

4a The units balance. The answers are reasonable since they are both less than $g = 9.80 \text{ m/s}^2$.