53. We use Eq. 4-15 first using velocities relative to the truck (subscript t) and then using velocities relative to the ground (subscript g). We work with SI units, so 20 km/h $\rightarrow$ 5.6 m/s, 30 km/h $\rightarrow$ 8.3 m/s, and 45 km/h $\rightarrow$ 12.5 m/s. We choose east as the $+\hat{\mathrm{i}}$ direction.

(a) The velocity of the cheetah (subscript c) at the end of the 2.0 s interval is (from Eq. 4-42)

$$\vec{v}_{\mathrm{c\,t}} = \vec{v}_{\mathrm{c\,g}} - \vec{v}_{\mathrm{t\,g}} = 12.5\,\hat{\mathrm{i}} - (-5.6\,\hat{\mathrm{i}}) = 18.1\,\hat{\mathrm{i}} \text{ m/s}$$

relative to the truck. The (average) acceleration vector relative to the cameraman (in the truck) is

$$\vec{a}_{\mathrm{avg}} = \frac{18.1\,\hat{\mathrm{i}} - (-8.3\,\hat{\mathrm{i}})}{2.0} = 13\,\hat{\mathrm{i}} \text{ m/s}^2 \ .$$

(b) The velocity of the cheetah at the start of the 2.0 s interval is (from Eq. 4-42)

$$\vec{v}_{0\ \mathrm{c\,g}} = \vec{v}_{0\ \mathrm{c\,t}} + \vec{v}_{0\ \mathrm{t\,g}} = (-8.3\,\hat{\mathrm{i}}) + (-5.6\,\hat{\mathrm{i}}) = -13.9\,\hat{\mathrm{i}} \text{ m/s}$$

relative to the ground. The (average) acceleration vector relative to the crew member (on the ground) is

$$\vec{a}_{\mathrm{avg}} = \frac{12.5\,\hat{\mathrm{i}} - (-13.9\,\hat{\mathrm{i}})}{2.0} = 13\,\hat{\mathrm{i}} \text{ m/s}^2$$

identical to the result of part (a).