62. The (box)car has velocity $\vec{v}_{c\,g} = v_1\,\hat{\text{i}}$ relative to the ground, and the bullet has velocity

$$\vec{v}_{0\,b\,g} = v_2\cos\theta\,\hat{\text{i}} + v_2\sin\theta\,\hat{\text{j}}$$

relative to the ground before entering the car (we are neglecting the effects of gravity on the bullet). While in the car, its velocity relative to the outside ground is $\vec{v}_{b\,g} = 0.8v_2\cos\theta\,\hat{\text{i}} + 0.8v_2\sin\theta\,\hat{\text{j}}$ (due to the 20% reduction mentioned in the problem). The problem indicates that the velocity of the bullet in the car *relative to the car* is (with v_3 unspecified) $\vec{v}_{b\,c} = v_3\,\hat{\text{j}}$. Now, Eq. 4-42 provides the condition

$$\begin{aligned} \vec{v}_{b\,g} &= \vec{v}_{b\,c} + \vec{v}_{c\,g} \\ 0.8v_2\cos\theta\,\hat{\text{i}} + 0.8v_2\sin\theta\,\hat{\text{j}} &= v_3\,\hat{\text{j}} + v_1\,\hat{\text{i}} \end{aligned}$$

so that equating x components allows us to find θ. If one wished to find v_3 one could also equate the y components, and from this, if the car width were given, one could find the time spent by the bullet in the car, but this information is not asked for (which is why the width is irrelevant). Therefore, examining the x components in SI units leads to

$$\theta = \cos^{-1}\left(\frac{v_1}{0.8v_2}\right) = \cos^{-1}\left(\frac{85\left(\frac{1000}{3600}\right)}{0.8(650)}\right)$$

which yields 87° for the direction of $\vec{v}_{b\,g}$ (measured from $\hat{\text{i}}$, which is the direction of motion of the car). The problem asks, "from what direction was it fired?" – which means the answer is not 87° but rather its supplement 93° (measured from the direction of motion). Stating this more carefully, in the coordinate system we have adopted in our solution, the bullet velocity vector is in the first quadrant, at 87° measured counterclockwise from the $+x$ direction (the direction of train motion), which means that the direction from which the bullet came (where the sniper is) is in the third quadrant, at $-93°$ (that is, 93° measured clockwise from $+x$).