9. (a) The initial momentum of the car is $\vec{p}_i = m\vec{v}_i = (1400\,\text{kg})(5.3\,\text{m/s})\,\hat{\text{j}} = (7400\,\text{kg}\cdot\text{m/s})\,\hat{\text{j}}$ and the final momentum is $\vec{p}_f = (7400\,\text{kg}\cdot\text{m/s})\,\hat{\text{i}}$. The impulse on it equals the change in its momentum:

$$\vec{J} = \vec{p}_f - \vec{p}_i = (7400\,\text{N}\cdot\text{s})(\hat{\text{i}} - \hat{\text{j}}) \ .$$

(b) The initial momentum of the car is $\vec{p}_i = (7400\,\text{kg}\cdot\text{m/s})\,\hat{\text{i}}$ and the final momentum is $\vec{p}_f = 0$. The impulse acting on it is

$$\vec{J} = \vec{p}_f - \vec{p}_i = -7400\,\hat{\text{i}} \ \ \text{N}\cdot\text{s} \ .$$

(c) The average force on the car is

$$\vec{F}_{\text{avg}} = \frac{\Delta\vec{p}}{\Delta t} = \frac{\vec{J}}{\Delta t} = \frac{(7400\,\text{kg}\cdot\text{m/s})(\hat{\text{i}} - \hat{\text{j}})}{4.6\,\text{s}} = (1600\,\text{N})(\hat{\text{i}} - \hat{\text{j}})$$

and its magnitude is $F_{\text{avg}} = (1600\,\text{N})\sqrt{2} = 2300\,\text{N}$.

(d) The average force is

$$\vec{F}_{\text{avg}} = \frac{\vec{J}}{\Delta t} = \frac{(-7400\,\text{kg}\cdot\text{m/s})\,\hat{\text{i}}}{350\times10^{-3}\,\text{s}} = (-2.1\times10^4\,\text{N})\,\hat{\text{i}}$$

and its magnitude is $F_{\text{avg}} = 2.1\times10^4\,\text{N}$.

(e) The average force is given above in unit vector notation. Its x and y components have equal magnitudes. The x component is positive and the y component is negative, so the force is 45° below the positive x axis.