29. If we write (for the general case) $\vec{r} = x\hat{\text{i}} + y\hat{\text{j}} + z\hat{\text{k}}$, then (using Eq. 3-30) we find $\vec{r} \times \vec{v}$ is equal to

$$(yv_z - zv_y)\,\hat{\text{i}} + (zv_x - xv_z)\,\hat{\text{j}} + (xv_y - yv_x)\,\hat{\text{k}}\ .$$

(a) The angular momentum is given by the vector product $\vec{\ell} = m\vec{r} \times \vec{v}$, where $\vec{r}$ is the position vector of the particle, $\vec{v}$ is its velocity, and $m = 3.0$ kg is its mass. Substituting (with SI units understood) $x = 3$, $y = 8$, $z = 0$, $v_x = 5$, $v_y = -6$ and $v_z = 0$ into the above expression, we obtain

$$\vec{\ell} = (3.0)\,((3)(-6) - (8.0)(5.0))\,\hat{\text{k}} = -1.7 \times 10^2\,\hat{\text{k}}\ \text{kg}\cdot\text{m}^2/\text{s}\ .$$

(b) The torque is given by Eq. 12-14, $\vec{\tau} = \vec{r} \times \vec{F}$. We write $\vec{r} = x\hat{\text{i}} + y\hat{\text{j}}$ and $\vec{F} = F_x\,\hat{\text{i}}$ and obtain

$$\vec{\tau} = \left(x\,\hat{\text{i}} + y\,\hat{\text{j}}\right) \times \left(F_x\,\hat{\text{i}}\right) = -yF_x\,\hat{\text{k}}$$

since $\hat{\text{i}} \times \hat{\text{i}} = 0$ and $\hat{\text{j}} \times \hat{\text{i}} = -\hat{\text{k}}$. Thus, we find $\vec{\tau} = -(8.0\,\text{m})(-7.0\,\text{N})\,\hat{\text{k}} = 56\,\hat{\text{k}}\ \text{N}\cdot\text{m}$.

(c) According to Newton's second law $\vec{\tau} = d\vec{\ell}/dt$, so the rate of change of the angular momentum is $56\,\text{kg}\cdot\text{m}^2/\text{s}^2$, in the positive z direction.