20. We use the notation $\vec{r}\,'$ to indicate the vector pointing from the axis of rotation directly to the position of the particle. If we write $\vec{r}\,' = x'\,\hat{\mathrm{i}} + y'\,\hat{\mathrm{j}} + z'\,\hat{\mathrm{k}}$, then (using Eq. 3-30) we find $\vec{r}\,' \times \vec{F}$ is equal to

$$(y'F_z - z'F_y)\,\hat{\mathrm{i}} + (z'F_x - x'F_z)\,\hat{\mathrm{j}} + (x'F_y - y'F_x)\,\hat{\mathrm{k}} \ .$$

(a) Here, $\vec{r}\,' = \vec{r}$. Dropping the primes in the above expression, we set (with SI units understood) $x = 0$, $y = 0.5$, $z = -2.0$, $F_x = 2$, $F_y = 0$ and $F_z = -3$. Then we obtain $\vec{\tau} = \vec{r} \times \vec{F} = \left(-1.5\,\hat{\mathrm{i}} - 4\,\hat{\mathrm{j}} - \hat{\mathrm{k}}\right)$ N·m.

(b) Now $\vec{r}\,' = \vec{r} - \vec{r}_{\mathrm{o}}$ where $\vec{r}_{\mathrm{o}} = 2\,\hat{\mathrm{i}} - 3\,\hat{\mathrm{k}}$. Therefore, in the above expression, we set $x' = -2.0$, $y' = 0.5$, $z' = 1.0$, $F_x = 2$, $F_y = 0$ and $F_z = -3$. Thus, we obtain $\vec{\tau} = \vec{r}\,' \times \vec{F} = \left(-1.5\,\hat{\mathrm{i}} - 4\,\hat{\mathrm{j}} - \hat{\mathrm{k}}\right)$ N·m.