19. 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

$$(yF_z - zF_y)\,\hat{\mathrm{i}} + (zF_x - xF_z)\,\hat{\mathrm{j}} + (xF_y - yF_x)\,\hat{\mathrm{k}}\ .$$

(a) In the above expression, we set (with SI units understood) $x = 0$, $y = -4$, $z = 3$, $F_x = 2$, $F_y = 0$ and $F_z = 0$. Then we obtain $\vec{\tau} = \vec{r} \times \vec{F} = \left(6\,\hat{\mathrm{j}} + 8\,\hat{\mathrm{k}}\right)$ N·m. This has magnitude $\sqrt{6^2 + 8^2} = 10$ N·m and is seen to be parallel to the yz plane. Its angle (measured counterclockwise from the $+y$ direction) is $\tan^{-1}(8/6) = 53°$.

(b) In the above expression, we set $x = 0$, $y = -4$, $z = 3$, $F_x = 0$, $F_y = 2$ and $F_z = 4$. Then we obtain $\vec{\tau} = \vec{r} \times \vec{F} = -22\,\hat{\mathrm{i}}$ N·m. This has magnitude 22 N·m and points in the $-x$ direction.