





Penguina's dogs are feeling rowdy and start tugging on their leashes with forces F_A , F_B , and F_C . For each dog, express the exerted force as a cartesian vector. Let the distance between Penguina's hand and the z axis be d_{Py} along the y axis. Assume that the dogs exert their forces away from Penguina as shown above.

Find the unit vector of each force as a cartesian vector.

$$\vec{r}_{PA} = -d_{Ax}\hat{i} + d_{Py}\hat{j} + (h_A - h_P)\hat{k}$$

$$\vec{r}_{PB} = d_{Bx}\hat{i} + (d_{Py} - d_{By})\hat{j} + (h_B - h_P)\hat{k}$$

$$\vec{r}_{PC} = d_{Cx}\hat{i} + (d_{Py} + d_{Cy})\hat{j} + (h_C - h_P)\hat{k}$$

$$||\vec{r}_{PA}|| = \sqrt{d_{Ax}^2 + d_{Py}^2 + (h_A - h_P)^2}$$

$$||\vec{r}_{PB}|| = \sqrt{d_{Bx}^2 + (d_{Py} - d_{By})^2 + (h_B - h_P)^2}$$

$$||\vec{r}_{PC}|| = \sqrt{d_{Cx}^2 + (d_{Py} + d_{Cy})^2 + (h_C - h_P)^2}$$

$$\hat{u}_{PA} = \frac{\vec{r}_{PA}}{||\vec{r}_{PA}||}$$

$$\hat{u}_{PB} = \frac{\vec{r}_{PB}}{||\vec{r}_{PB}||}$$

$$\hat{u}_{PC} = \frac{\vec{r}_{PC}}{||\vec{r}_{PC}||}$$

Express each force as a cartesian vector.

$$\begin{aligned}\vec{F}_A &= F_A \hat{u}_{PA} \\ \Rightarrow \vec{F}_A &= \frac{F_A}{||\vec{r}_{PA}||} (-d_{Ax} \hat{i} + d_{Py} \hat{j} + (h_A - h_P) \hat{k})\end{aligned}$$

$$\begin{aligned}\vec{F}_B &= F_B \hat{u}_{PB} \\ \Rightarrow \vec{F}_B &= \frac{F_B}{||\vec{r}_{PB}||} (d_{Bx} \hat{i} + (d_{Py} - d_{By}) \hat{j} + (h_B - h_P) \hat{k})\end{aligned}$$

$$\begin{aligned}\vec{F}_C &= F_C \hat{u}_{PC} \\ \Rightarrow \vec{F}_C &= \frac{F_C}{||\vec{r}_{PC}||} (d_{Cx} \hat{i} + (d_{Py} + d_{Cy}) \hat{j} + (h_C - h_P) \hat{k})\end{aligned}$$