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_{Px} along the x 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.

$$\overrightarrow{r}_{PA} = d_{Px}\widehat{i} - d_{Ay}\widehat{j} + (h_A - h_P)\widehat{k}$$

$$\overrightarrow{r}_{PB} = (d_{Px} - d_{Bx})\widehat{i} + d_{By}\widehat{j} + (h_B - h_P)\widehat{k}$$

$$\overrightarrow{r}_{PC} = (d_{Px} + d_{Cx})\widehat{i} + d_{Cy}\widehat{j} + (h_C - h_P)\widehat{k}$$

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

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

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

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

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

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

Express each force as a cartesian vector.

$$\vec{F}_A = F_A \hat{u}_{PA}$$
$$\Rightarrow \vec{F}_A = F_A \left(\frac{d_{Px}}{\|\vec{r}_{PA}\|} \hat{i} - \frac{d_{Ay}}{\|\vec{r}_{PA}\|} \hat{j} + \frac{h_A - h_P}{\|\vec{r}_{PA}\|} \hat{k} \right)$$

$$\vec{F}_B = F_B \hat{u}_{PB}$$
$$\Rightarrow \vec{F}_B = F_B \left(\frac{d_{Px} - d_{Bx}}{\|\vec{r}_{PB}\|} \hat{i} + \frac{d_{By}}{\|\vec{r}_{PB}\|} \hat{j} + \frac{h_B - h_P}{\|\vec{r}_{PB}\|} \hat{k} \right)$$

$$\vec{F}_C = F_C \hat{u}_{PC}$$
$$\Rightarrow \vec{F}_C = F_C \left(\frac{d_{Px} + d_{Cx}}{\|\vec{r}_{PC}\|} \hat{i} + \frac{d_{Cy}}{\|\vec{r}_{PC}\|} \hat{j} + \frac{h_C - h_P}{\|\vec{r}_{PC}\|} \hat{k} \right)$$