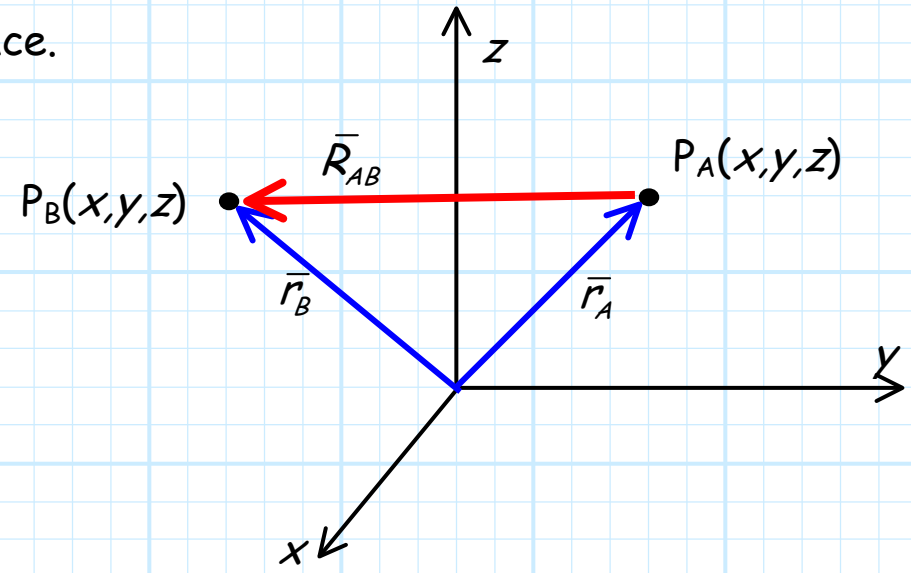
# Applications of the Position Vector

Position vectors are **particularly useful** when we need to determine the directed distance between **two** arbitrary points in space.

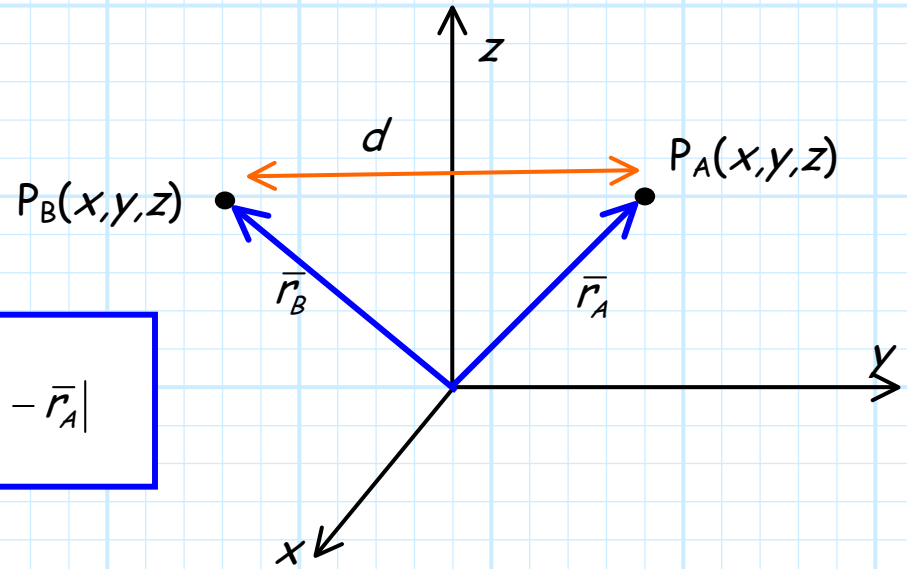



If the location of **point $P_A$** is denoted by position vector $\bar{r}_A$, and the location of **point $P_B$** by position vector $\bar{r}_B$, then the **directed distance** from point $P_A$ to point $P_B$, is:

$$\bar{R}_{AB} = \bar{r}_B - \bar{r}_A$$

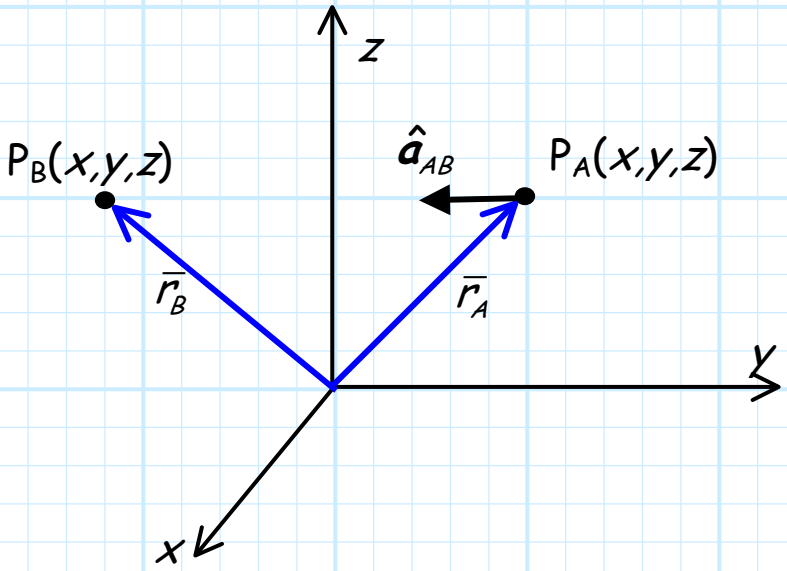
We can use this directed distance $\bar{R}_{AB}$ to describe **much** about the relative locations of point $P_A$ and $P_B$!

For example, the physical **distance** between these two points is simply the magnitude of this directed distance:




$$d = \left|\bar{R}_{AB}\right| = \left|\bar{r}_B - \bar{r}_A\right|$$

Likewise, we can specify the **direction** toward point $P_B$, with **respect** to point $P_A$, by find the **unit vector** $\hat{a}_{AB}$:




$$\hat{a}_{AB} = \frac{\bar{R}_{AB}}{\left|\bar{R}_{AB}\right|} = \frac{\bar{r}_B - \bar{r}_A}{\left|\bar{r}_B - \bar{r}_A\right|}$$