

Answer on Question #50475-Physics-Other

A radar station locates a sinking ship at range 17.0 km and bearing 136° clockwise from north. From the same station, a rescue plane is at horizontal range 19.6 km, 156° clockwise from north, with elevation 1.85 km.

(a) Write the displacement vector from plane to ship, letting \hat{i} represent east, \hat{j} north, and \hat{k} up.

(b) How far apart are the plane and ship?

Solution

(a) Converting to CCW from + x axis

$$360 - (136 - 90) = 314$$

$$360 - (153 - 90) = 297$$

Position vector of ship relative to origin:

$$17.0 \cos(314) \hat{i} + 17.0 \sin(314) \hat{j}$$

or

$$\overline{Rs} = 11.81 \hat{i} - 12.23 \hat{j} + 0 \hat{k}$$

Position vector of plane relative to origin "below":

$$19.6 \cos(297) \hat{i} + 19.6 \sin(297) \hat{j} + 1.85 \hat{k}$$

or

$$\overline{Rp} = 8.90 \hat{i} - 17.46 \hat{j} + 1.85 \hat{k}.$$

$$\begin{aligned} \overline{Rsp} &= \overline{Rso} - \overline{Rpo} = (11.81 \hat{i} - 12.23 \hat{j} + 0 \hat{k}) - (8.90 \hat{i} - 17.46 \hat{j} + 1.85 \hat{k}) \\ &= 2.91 \hat{i} + 5.23 \hat{j} - 1.85 \hat{k}. \end{aligned}$$

The plane sees the ship at:

$$\overline{Rsp} = (2.91 \hat{i} + 5.23 \hat{j} - 1.85 \hat{k}) \text{ km.}$$

(b)

$$|\overline{Rsp}| = \sqrt{2.91^2 + 5.23^2 + (-1.85)^2} = 6.26 \text{ km.}$$