Answer on Question #46316, Physics, Mechanics | Kinematics | Dynamics

A radar station locates a sinking ship at range 15.9 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 2.05 km. (a) Write the displacement vector from plane to ship, letting i hat represent east, j hat north, and k hat bold up.

Solution:

A convenient way to specify the position of an object is with the help of a coordinate system. We choose a fixed point, called the origin and three directed lines, which pass through the origin and are perpendicular to each other. These lines are called the coordinate axes of a three-dimensional rectangular (Cartesian) coordinate system and are labeled the x-, y-, and z-axis. Three numbers with units specify the position of a point P. These numbers are the x-, y-, and z-coordinates of the point P. Here $\hat{\mathbf{i}}$, $\hat{\mathbf{j}}$ and $\hat{\mathbf{k}}$ are unit vectors.

Find the xyz coordinates of each object using:

+x = east

+y = north

+z = altitude.

For ship:

$$x_1 = 15.9 \cdot \cos(136° - 90°) = 15.9 \cdot \cos(46°) = 11.05$$

$$y_1 = -15.9 \cdot \sin(136° - 90°) = -15.9 \cdot \sin(46°) = -11.44$$

$$z_1 = 0$$

For rescue plane:

$$x_2 = 19.6 \cdot \cos(156° - 90°) = 19.6 \cdot \cos(66°) = 7.972$$

$$y_2 = -19.6 \cdot \cos(156° - 90°) = -19.6 \cdot \sin(66°) = -17.91$$

$$z_2 = 2.05$$

The displacement vector d from P_1 to P_2 may be written as

$$\vec{\mathrm{d}} = (x_2 - x_1)\hat{\mathbf{i}} + (y_2 - y_1)\hat{\mathbf{j}} + (z_2 - z_1)\hat{\mathbf{k}}$$

$$\vec{\mathrm{d}} = (7.972 - 11.05)\hat{\mathbf{i}} + (-17.91 + 11.44)\hat{\mathbf{j}} + (2.05 - 0)\hat{\mathbf{k}}$$

$$\vec{\mathrm{d}} = -3.078\hat{\mathbf{i}} - 6.47\hat{\mathbf{j}} + 2.05\hat{\mathbf{k}}$$

Answer: $\vec{\mathrm{d}} = -3.078\hat{\mathbf{i}} - 6.47\hat{\mathbf{j}} + 2.05\hat{\mathbf{k}}$