Answer on Question #81061 - Physics - Mechanics, Relativity

Obtain expressions in component form for the position vectors having the following polar coordinates.
(a) 12.6 m, 140° counterclockwise from the +x axis

(b) 4.00 cm, 50.0° counterclockwise from the +x axis

(c) 20.0 in., 220° counterclockwise from the +x axis

Solution.

We denote the length of the vector $\vec{R}$ by R and the angle between the positive direction of x-axis and the vector $\vec{R}$ by θ. Let $\vec{\imath}$ and $\vec{\jmath}$ be the unit vectors directed along the x-axis and y-axis respectively.

The projections of the vector $\vec{R}$ on the axis:

$$R_x = R\cos\theta$$

$$R_y = R\sin\theta$$

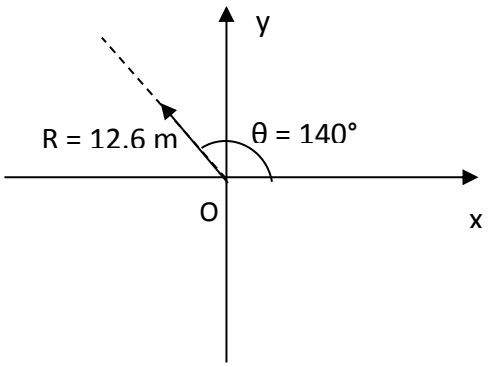
Vector in the component notation:

$$\vec{R} = (R_x, R_y) = \vec{\imath}R_x + \vec{\jmath}R_y$$

$$\vec{R} = (R\cos\theta\,, R\sin\theta) = \vec{\imath}R\cos\theta + \vec{\jmath}R\sin\theta$$

(a).

R = 12.6 m; θ = 140°



$$R\cos\theta = 12.6\times\cos 140° \approx -9.7\ \text{m}$$

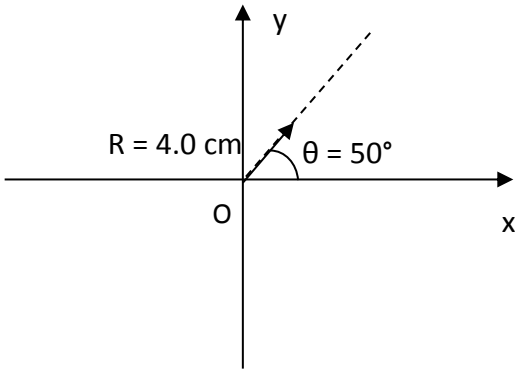
$$R\sin\theta = 12.6\times\sin 140° \approx 8.1\ \text{m}$$

$$\vec{R} = (-9.7\ \text{m},\ \ 8.1\ \text{m}) = -\vec{\imath}\times(9.7\ \text{m}) + \vec{\jmath}\times(8.1\ \text{m})$$

Answer: $\vec{R} = (-9.7\ \text{m},\ \ 8.1\ \text{m}) = -\vec{\imath}\times(9.7\ \text{m}) + \vec{\jmath}\times(8.1\ \text{m})$

(b).

R = 4.00 cm; θ = 50°



$$R\cos\theta = 4.00 \times \cos 50° \approx -2.57 \text{ cm}$$

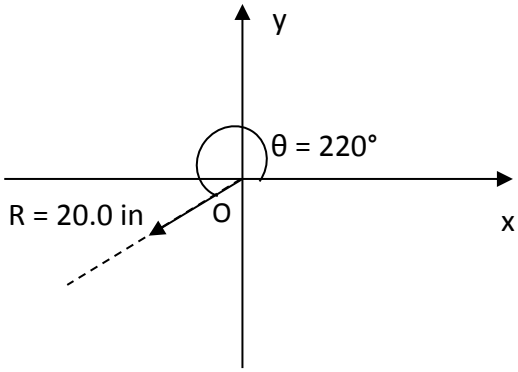
$$R\sin\theta = 4.00 \times \sin 50° \approx 3.06 \text{ cm}$$

$$\vec{R} = (-2.57 \text{ cm},\ \ 3.06 \text{ cm}) = -\vec{\imath} \times (2.57 \text{ cm}) + \vec{\jmath} \times (3.06 \text{ cm})$$

Answer: $\vec{R} = (-2.57 \text{ cm},\ \ 3.06 \text{ cm}) = -\vec{\imath} \times (2.57 \text{ cm}) + \vec{\jmath} \times (3.06 \text{ cm})$

(c).

R = 20.0 in; θ = 220°



$$R\cos\theta = 20.0 \times \cos 220° \approx -15.3 \text{ in}$$

$$R\sin\theta = 20.0 \times \sin 220° \approx -12.9 \text{ in}$$

$$\vec{R} = (-15.3 \text{ in},\ \ -12.9 \text{ in}) = -\vec{\imath} \times (15.3 \text{ in}) - \vec{\jmath} \times (12.9 \text{ in})$$

Answer: $\vec{R} = (-15.3 \text{ in},\ \ -12.9 \text{ in}) = -\vec{\imath} \times (15.3 \text{ in}) - \vec{\jmath} \times (12.9 \text{ in})$