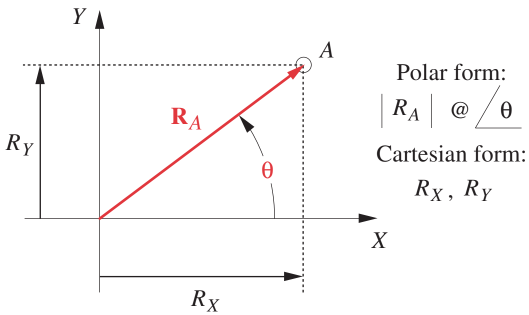
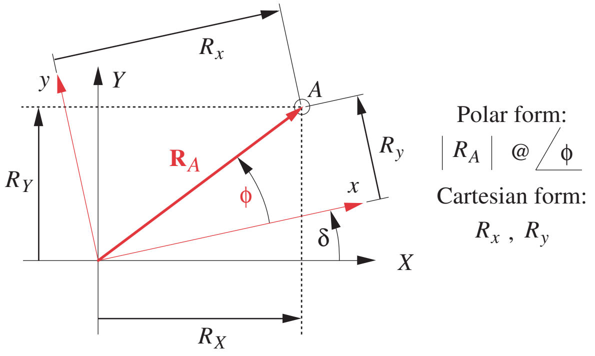


(a) Global coordinate system XY



(b) Local coordinate system xy

FIGURE 4-1

A position vector in the plane - expressed in both global and local coordinates

magnitude and the angle of the vector. The **cartesian form** provides the *X* and *Y* components of the vector. Each form is directly convertible into the other by*

the Pythagorean theorem:

$$R_A = \sqrt{R_X^2 + R_Y^2}$$

and trigonometry: (4.0a)

$$\theta = \arctan\left(\frac{R_Y}{R_X}\right)$$

Equations 4.0a are shown in global coordinates but could as well be expressed in local coordinates.

Coordinate Transformation

It is often necessary to transform the coordinates of a point defined in one system to coordinates in another. If the system's origins are coincident as shown in Figure 4-1b and the required transformation is a rotation, it can be expressed in terms of the original coordinates and the signed angle δ between the coordinate systems. If the position of point *A* in Figure 4-1b is expressed in the local *xy* system as R_x, R_y, and it is desired to transform its coordinates to R_X, R_Y in the global *XY* system, the equations are:

$$\begin{aligned} R_X &= R_x \cos\delta - R_y \sin\delta \\ R_Y &= R_x \sin\delta + R_y \cos\delta \end{aligned} \qquad (4.0b)$$

Displacement

Displacement of a point is the change in its position and can be defined as *the straight-line distance between the initial and final position of a point which has moved in the reference frame*. Note that displacement is not necessarily the same as the path length which the point may have traveled to get from its initial to final position. Figure 4-2a shows a