

**3.22** Convert the coordinates of the following points from cylindrical to Cartesian coordinates:

(a)  $P_1 = (2, \pi/4, -4),$

(b)  $P_2 = (3, 0, -4),$

(c)  $P_3 = (4, \pi, 4).$

**Solution:**

(a)

$$\begin{aligned} P_1 = (x, y, z) &= (r \cos \phi, r \sin \phi, z) = \left( 2 \cos \frac{\pi}{4}, 2 \sin \frac{\pi}{4}, -4 \right) \\ &= (1.41, 1.41, -4). \end{aligned}$$

(b)  $P_2 = (x, y, z) = (3 \cos 0, 3 \sin 0, -2) = (3, 0, -4).$

(c)  $P_3 = (x, y, z) = (4 \cos \pi, 4 \sin \pi, 5) = (-4, 0, 4).$

---