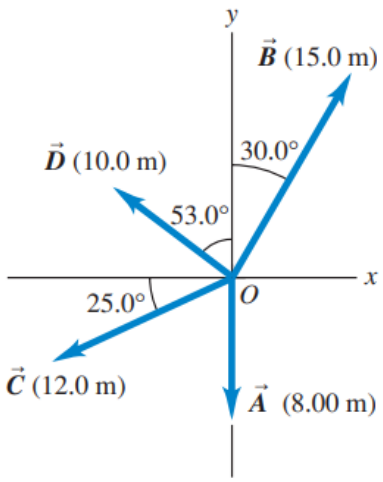
Exercise 1.45

For the vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$ in Fig. E1.28, find the scalar products (a) $\vec{A} \cdot \vec{B}$; (b) $\vec{B} \cdot \vec{C}$; (c) $\vec{A} \cdot \vec{C}$.

Solution

Figure **E1.28**



Each of the vectors are

$$\mathbf{A} = \langle A_x, A_y \rangle = \langle 0, -8.00 \rangle = (-8.00 \text{ m})\hat{\boldsymbol{j}}$$
$$\mathbf{B} = \langle B_x, B_y \rangle = \langle 15.0 \sin 30°, 15.0 \cos 30° \rangle \approx \langle 7.50, 13.0 \rangle = (7.50 \text{ m})\hat{\boldsymbol{i}} + (13.0 \text{ m})\hat{\boldsymbol{j}}$$
$$\mathbf{C} = \langle C_x, C_y \rangle = \langle -12.0 \cos 25°, -12.0 \sin 25° \rangle \approx \langle -10.9, -5.07 \rangle = (-10.9 \text{ m})\hat{\boldsymbol{i}} + (-5.07 \text{ m})\hat{\boldsymbol{j}}$$
$$\mathbf{D} = \langle D_x, D_y \rangle = \langle -10.0 \sin 53°, 10.0 \cos 53° \rangle \approx \langle -7.99, 6.02 \rangle = (-7.99 \text{ m})\hat{\boldsymbol{i}} + (6.02 \text{ m})\hat{\boldsymbol{j}}.$$

Now calculate the desired dot products.

$$\begin{aligned} \mathbf{A} \cdot \mathbf{B} &= A_x B_x + A_y B_y \\ &= (0 \text{ m})(15.0 \sin 30° \text{ m}) + (-8.00 \text{ m})(15.0 \cos 30° \text{ m}) \\ &\approx -104 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \mathbf{B} \cdot \mathbf{C} &= B_x C_x + B_y C_y \\ &= (15.0 \sin 30° \text{ m})(-12.0 \cos 25° \text{ m}) + (15.0 \cos 30° \text{ m})(-12.0 \sin 25° \text{ m}) \\ &\approx -147 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \mathbf{A} \cdot \mathbf{C} &= A_x C_x + A_y C_y \\ &= (0 \text{ m})(-12.0 \cos 25° \text{ m}) + (-8.00 \text{ m})(-12.0 \sin 25° \text{ m}) \\ &\approx 40.6 \text{ m}^2 \end{aligned}$$