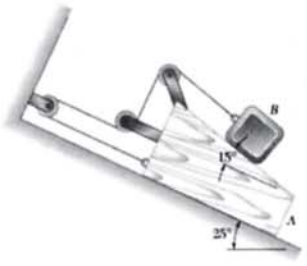


PROBLEM 11.190

Knowing that at the instant shown block A has a velocity of 8 in./s and an acceleration of 6 in./s^2 both directed down the incline, determine (*a*) the velocity of block B, (*b*) the acceleration of block B.

SOLUTION

Constraint: $2x_A + x_{B/A} = \text{constant}, \qquad 2v_A + v_{B/A} = 0, \; 2a_A + a_{B/A} = 0$

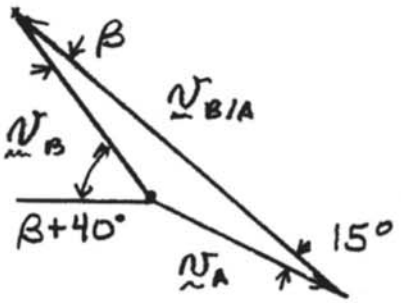
Then, $v_{B/A} = -2v_A = -(2)(8) = -16 \text{ in./s}$

$a_{B/A} = -2a_A = -(2)(6) = -12 \text{ in./s}^2$

(*a*) The velocity vectors are as follows:

$\mathbf{v}_A = 8 \text{ in./s} \measuredangle 25°, \quad \mathbf{v}_{B/A} = 16 \text{ in./s} \measuredangle 40°$

$\mathbf{v}_B = \mathbf{v}_A + \mathbf{v}_{B/A}$



Sketch the vector addition as shown.

Law of cosines:

$$v_B^2 = v_A^2 + v_{B/A}^2 - 2v_A v_B \cos 15°$$
$$= 8^2 + 16^2 - (2)(8)(16)\cos 15°$$
$$v_B = 8.53 \text{ in./s}$$

Law of sines: $\dfrac{\sin\beta}{v_A} = \dfrac{\sin 15°}{v_B}$

$$\sin\beta = \frac{v_A \sin 15°}{v_B} = \frac{8\sin 15°}{8.53} = 0.24280, \quad \beta = 14.1°$$

$\beta + 40° = 54.1°,$ $\qquad \mathbf{v}_B = 8.53 \text{ in./s} \measuredangle 54.1°$ ◀

(*b*) The acceleration vectors are as follows:

$\mathbf{a}_A = 6 \text{ in./s}^2 \measuredangle 25°, \quad \mathbf{a}_{B/A} = 12 \text{ in./s}^2 \measuredangle 40°$

Using a vector addition diagram like that used for velocity.

$$a_B^2 = a_A^2 + a_{B/A}^2 - 2a_A a_{B/A}\cos 15° = 6^2 + 12^2 - (2)(6)(12)\cos 15°$$
$$a_B = 6.40 \text{ in./s}^2$$

$$\sin\beta = \frac{a_A \sin 15°}{a_B} = \frac{6\sin 15°}{6.40} = 0.24280, \quad \beta = 14.1°$$

$\beta + 40° = 54.1°$ $\qquad \mathbf{a}_B = 6.40 \text{ in./s}^2 \measuredangle 54.1°$ ◀