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15-83.

The 10-lb collar *B* is at rest, and when it is in the position shown the spring is unstretched. If another 1-lb collar *A* strikes it so that *B* slides 4 ft on the smooth rod before momentarily stopping, determine the velocity of *A* just after impact, and the average force exerted between *A* and *B* during the impact if the impact occurs in 0.002 s. The coefficient of restitution between *A* and *B* is e = 0.5.

SOLUTION

Collar B after impact:

$$T_2 + V_2 = T_3 + V_3$$

$$\frac{1}{2} \left(\frac{10}{32.2}\right) (v_B)_2^2 + 0 = 0 + \frac{1}{2} (20)(5-3)^2$$

$$(v_B)_2 = 16.05 \text{ ft/s}$$

System:

$$(\pm) \qquad \Sigma m_1 v_1 = \Sigma m_1 v_2 \qquad \frac{1}{32.2} (v_A)_1 + 0 = \frac{1}{32.2} (v_A)_2 + \frac{10}{32.2} (16.05) (v_A)_1 - (v_A)_2 = 160.5 (\pm) \qquad e = \frac{(v_B)_2 - (v_A)_2}{(v_A)_I - (v_B)_1} \qquad 0.5 = \frac{16.05 - (v_A)_2}{(v_A)_1 - 0} \qquad 0.5 (v_A)_1 + (v_A)_2 = 16.05$$

Solving:

$$(v_A)_1 = 117.7 \text{ ft/s} = 118 \text{ ft/s} \rightarrow$$

 $(v_A)_2 = -42.8 \text{ ft/s} = 42.8 \text{ ft/s} \leftarrow$

Collar A:

$$(\Rightarrow) \qquad mv_1 + \Sigma \int F \, dt = m \, v_2$$

 $\left(\frac{1}{32.2}\right)(117.7) - F(0.002) = \left(\frac{1}{32.2}\right)(-42.8)$
 $F = 2492.2 \text{ lb} = 2.49 \text{ kip}$



Ans.

Ans.

Ans: $(v_A)_2 = 42.8 \text{ ft/s} \leftarrow F = 2.49 \text{ kip}$