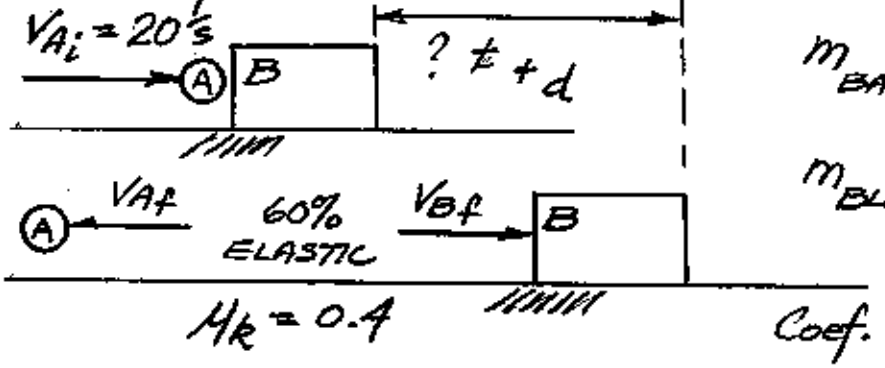
HIBBELER

# IMPACT

15-61
15-62




$m_{BALL_A} = 1\ lbm$

$m_{BLOCK_B} = 10\ lbm$

$e = 0.6$ Coef. of Restitution

CONSERVATION OF MOMENTUM $\quad \Sigma (mV)_i = \Sigma (mV)_f$

$(1\ lbm)(20\ ft/s) + (10\ lbm)(0) = (1\ lbm) V_{Af} + (10\ lbm) V_{Bf}$

$20 = V_{Af} + 10 V_{Bf}$ all same units

Use $\quad e = 0.6 = \dfrac{V_{Bf} - V_{Af}}{V_{Ai} - V_{Bi}} = \dfrac{V_{Bf} - V_{Af}}{20 - 0}$

$\therefore \boxed{V_{Bf} - V_{Af} = 12}$ OR $\boxed{V_{Bf} = 12 + V_{Af}}$ SUB.

$20 = V_{Af} + 10[12 + V_{Af}] = V_{Af} + 120 + 10 V_{Af}$

$-100 = 11 V_{Af} \quad \therefore V_{Af} = -9.09\ ft/s \leftarrow$

$\therefore V_{Bf} = 2.91\ ft/s \rightarrow$

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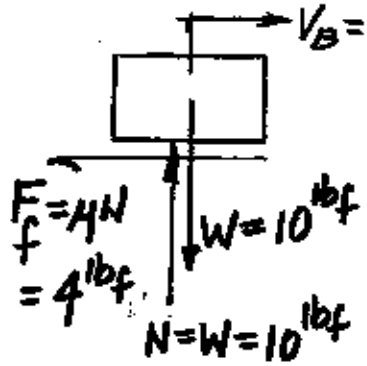
BLOCK B SLIDES UNTIL IT STOPS




CONSIDERING $lb_m = lb_f$

$\Sigma F_x = m\vec{a}_x = m \dfrac{dV}{dt}$

$\int_0^t \Sigma F\, dt = \int_{V_B}^{0} m\, dV$

$-F_f t = 0 - m V_B$

WATCH UNITS ON THIS ONE!

$-4\ lbf\,(t) = -\dfrac{10\ lbf}{32.2\ ft/s^2}(2.91\ ft/s)$

$\boxed{t = 0.226\ s}$

TIME TO STOP SLIDING, SO IT DECELERATES.

WHAT IS THE DISTANCE BEFORE IT STOPS?

ARE YOU TEMPTED TO USE

$$S = S_0 + V_0 t + at^2 \quad \text{where } a = \frac{dV}{dt}$$

This is for a kinematic analysis that does not consider any forces affecting the mass. You HAVE FRICTION!

MOMENTUM is no longer CONSERVED when a FORCE acts on the mass.

So ... consider CONSERVATION of ENERGY.

$$PE_i + KE_i = PE_f + KE_f$$

$$\underbrace{PE_i - PE_f}_{\text{WORK}} = KE_f - KE_i \quad \left.\right\} \text{HORIZ. PATH}$$

$$\text{WORK} = \Delta KE$$

$$(-4^{lb_f})(d) = \tfrac{1}{2} m \cancel{V_{B_{STOP}}^{\,0}} - \tfrac{1}{2} m V_{B_f}^2$$

15-61 #62 CONT'D.

WATCH UNITS AGAIN: USING $lb_f$ on FBD

$$-4^{lb_f}\, d = -\frac{1}{2}\left(\frac{10^{lb_f}}{32.2\,ft/s^2}\right)\left(2.91\,\frac{ft}{s}\right)^2$$

$$\boxed{d = 0.329'}$$

NOTE: MOTION IN X-DIR.

FORCES IN X-DIR. $= F_f = 4^{lb_f}$