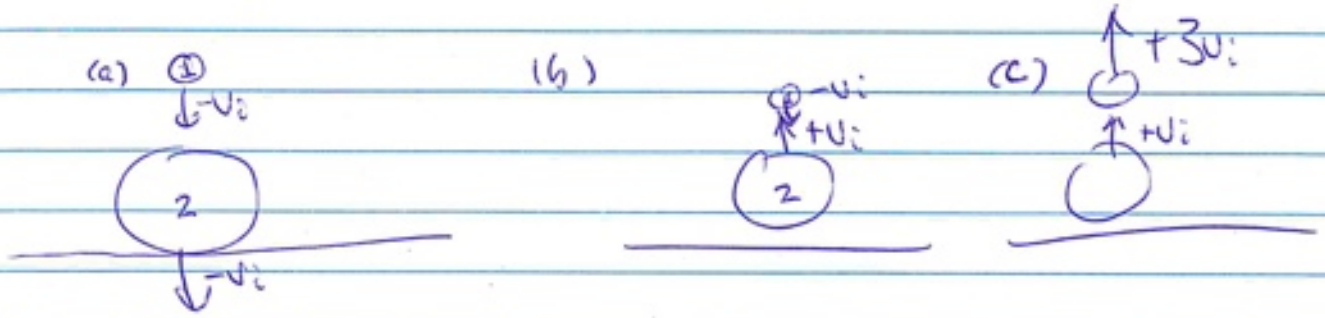
(a) Basketball and smaller ball reach ground with velocity $-V_i$ (downward)



(b) Basketball collides elastically with ground and switches directions (almost instantaneously) to $+V_i$

(c) Relative velocity $V_{rel} = 2V_i$

$\therefore \Delta V_i = 2V_{rel} = 4V_i$

is change in velocity of smaller ball.

$\therefore V_{i} = -V_i$

$V_{f} = +3V_i$

$\Rightarrow$ kinetic energy increases by a factor of 9!

$\Rightarrow$ rises to 9 × original height.

By equations,

$$V_{1f} = \frac{m_1 - m_2}{m_1 + m_2} V_{1i} + \frac{2m_2}{m_1 + m_2} V_{2i}$$

Here $m_1 << m_2$ and $V_{1i} = -V_i$

$V_{2i} = +V_i$

$\therefore V_{1f} \approx -V_{1i} + 2V_{2i}$

$= V_i + 2V_i = 3V_i$

$\frac{1}{2} m_1 v_{1i}^2 = m_1 g h_1$

$$\boxed{v_{1i}^2 = 2 g h_1}$$

$v_{1i} = 1.25 \text{ m/s}$ (horizontal at bottom of arc.)

v_{1i}

⊙→○ elastic collision ($v_{2i} = 0$)

$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i}$$

$$= \frac{30 - 75}{30 + 75} \left(1.25 \frac{m}{s}\right) = -0.54 \frac{m}{s}$$

As above, $v_{1f}^2 = 2 g h_{1f}$ $\therefore h_{1f} = \frac{v_{1f}^2}{2g} = 1.5 \text{ cm}.$

$$v_{2f} = \frac{2 m_1}{m_1 + m_2} v_{1i} = \frac{2 \times 30}{30 + 75} \left(1.25 \frac{m}{s}\right)$$

$$= 0.72 \frac{m}{s}$$

As above $v_{2f}^2 = 2 g h_{2f}$ $\therefore h_{2f} = 2.6 \text{ cm}.$

before after

$m_1 = 2\,kg$ $V_{1i} = 10\,m/s$

$m_2 = 5\,kg$ $V_{2i} = 3\,m/s$

$$m_1 V_{1i} + m_2 V_{2i} = (m_1 + m_2) V_f$$

$$\therefore V_f = 5\,m/s$$

$E_i = K_i = \frac{1}{2} m_1 V_{1i}^2 + \frac{1}{2} m_2 V_{2i}^2$ (kinetic energy before (potential energy is 0))

$E_f = K_f + \frac{1}{2} k d^2$ ← total energy after

$= \frac{1}{2}(m_1 + m_2) V_f^2 + \frac{1}{2} k d^2$

d : compressi of spring

$\Rightarrow d = 0.25\,m = 25\,cm.$

$E_i = E_f$

Ok use

$\Delta K = -\Delta U = -\frac{1}{2} k d^2$

$\Delta K = \frac{1}{2}(m_1 + m_2) V_f^2 - \frac{1}{2} m_1 V_{1i}^2 - \frac{1}{2} m_2 V_{2i}^2$

$= 87.5\,J - 122.5\,J$

$= -35\,J$

$\therefore d^2 = \frac{2 \times 35\,J}{1120\,N/m} = 0.0625\,m^2$ $\therefore d = 0.25\,m$