A baseball of mass 2 kg is at rest and acquires velocity of 10 m/s after being struck. If the ball and bat were in contact for 100 ms, what has been the average collision force exerted on the baseball ?

$$\text{Force} = \Delta p/\Delta t$$

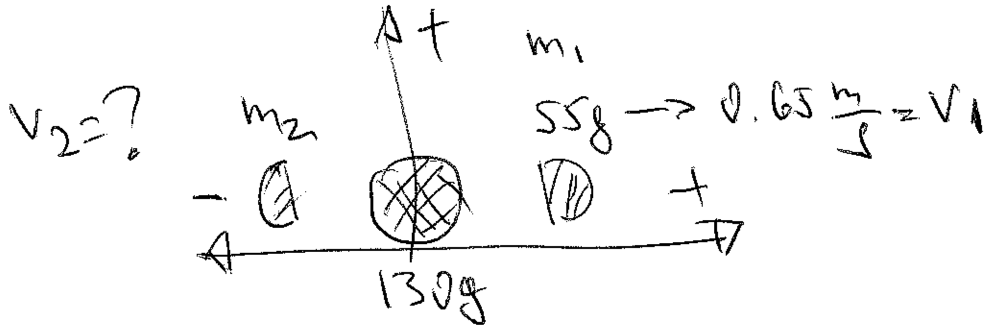
$$\Delta p = p_f - p_i$$

$$p_i = 0$$

$$p_f = 2\text{kg}.10\text{m/s}$$

$$\text{Force} = (2\text{kg}.10\text{m/s})/(100\ \text{x}10^{-3}\ \text{s})$$

$$= 200\ \text{N}$$



55. **ORGANIZE AND PLAN** The two pieces of the meteoroid will move in opposite directions. We must calculate the mass of the second piece. We'll use conservation of momentum where the initial momentum of the system is zero, $m_1v_1 = -m_2v_2$. Subscripts 1 and 2 refer to the two pieces of the meteoroid.

Known: $m_{\text{total}} = 130.\text{g}$; $m_1 = 55$ g; $v_1 = 0.65$ m/s.

SOLVE First, convert mass to kilograms:

$$m_{\text{total}} = 130.\text{g}\left(\frac{1\text{ kg}}{1000\text{ g}}\right) = 0.130\text{ kg}$$

Likewise,

$$m_1 = 55\text{ g} = 0.055\text{ kg}$$

Then we find the mass of the second piece,

$$m_2 = m_{\text{total}} - m_1 = 0.130.\text{kg} - 0.055\text{ kg} = 0.075\text{ kg}$$

Now,

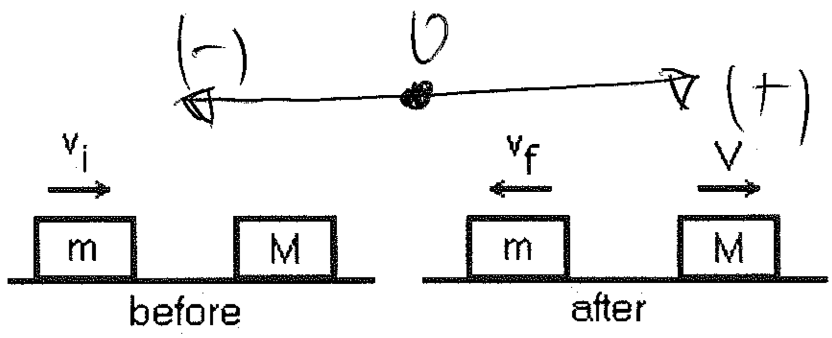
$$\boxed{\vec{P}_i = 0 = \vec{P}_1 + \vec{P}_2} = \vec{P}_f$$

$$m_1v_1 = -m_2v_2$$

$$\vec{P}_1 = -\vec{P}_2$$

$$v_2 = \frac{-m_1v_1}{m_2} = \frac{-(0.055\text{ kg})(0.65\text{ m/s})}{0.075} = -0.48\text{ m/s}$$

REFLECT Since the meteoroid is initially at rest, the two pieces must move in opposite directions to conserve momentum. We notice that in this particular problem we would not have had to convert mass to kilograms since we are only using the ratio of masses. It's good practice to do so, to minimize errors in other types of calculations.



A block of mass m = 3.3 kg moving with a speed v_i = 10 m/s collides elastically with a block of mass M at rest. After the collision, the 3.3 kg block recoils with a speed of v_f = 1.1 m/s. Find mass M:

$V_{mf} = (m-M) .V_{mi} / (m+M)$

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

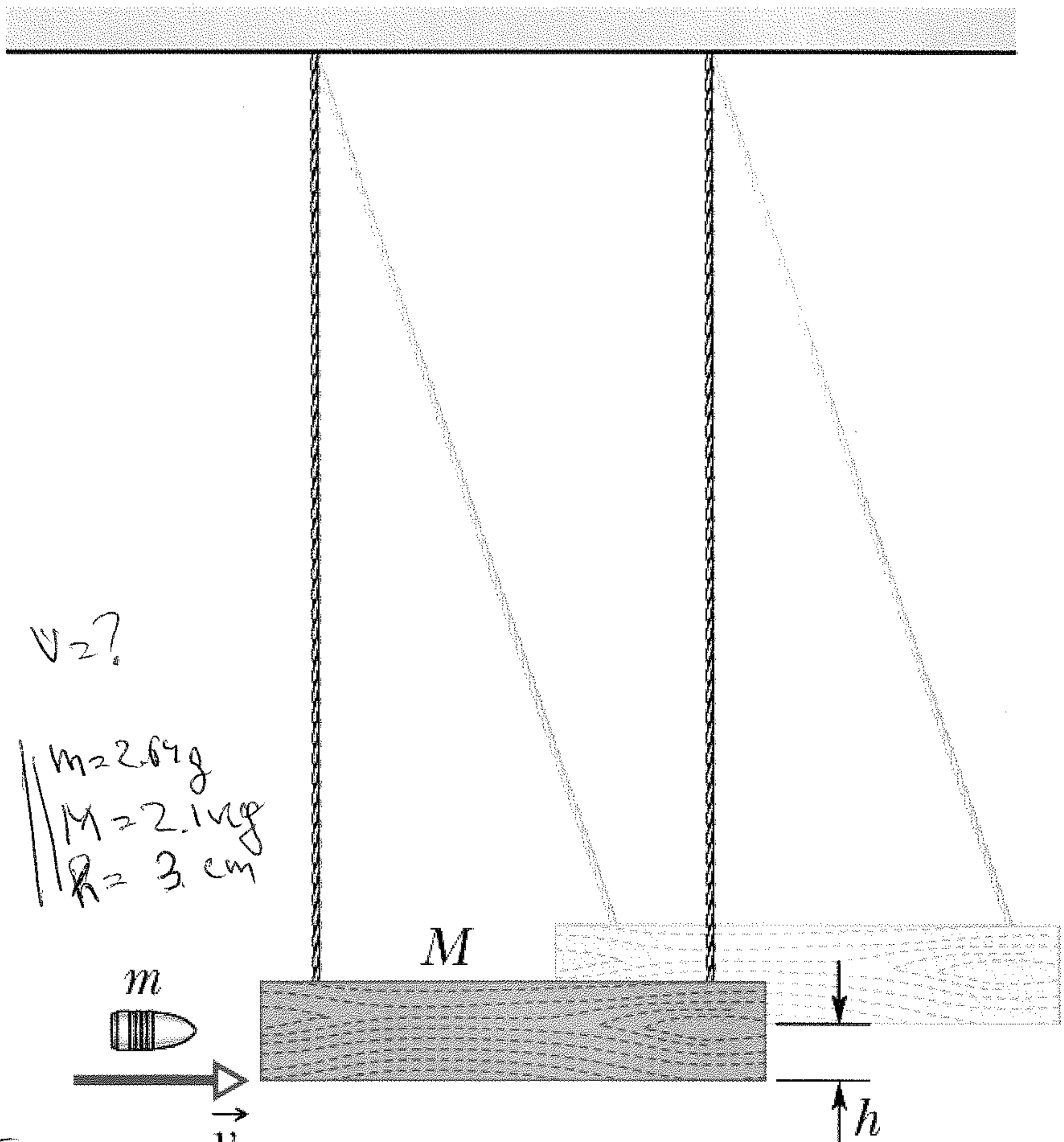
-1.1 m/s = (3.3 kg – M).10m/s/(3.3kg +M)

-1.1m/s.(3.3kg +M) = 3.3kg.10m/s – M.10m/s

-3.63 kg.m/s – 1.1m/s.M = 33kg.m/s – M.10m/s

8.9m/s.M= 36.3kg.m/s

M = 4.07 kg ~ 4.1 kg



$V = ?$

$m = 2.64\,g$
$M = 2.1\,kg$
$h = 3\,cm$

Inelastic; isolated system

$mv = (M+m)V, \rightarrow V = \frac{m}{M+m} v$

$P_i = P_f$

or $v = \left(\frac{M+m}{m}\right) V$

Energy after collision

$\frac{1}{2}\cancel{(m+M)}V^2 = \cancel{(m+M)}gh$

$V = \sqrt{2gh}$

$v = \left(\frac{M+m}{m}\right)\sqrt{2gh} \approx 708\ m/s$