PhyzJob: Conservation of Momentum Number Puzzles

PART 3: MORE PUZZLES

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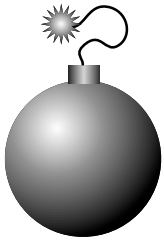
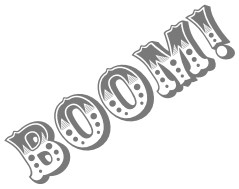
INSTRUCTIONS: In each of the scenarios below, some information regarding the system (or elements within the system) is given. Determine the missing quantity based on what you know about conservation of momentum.

1. A Stationary Bomb Explodes.

BEFORE





AFTER

$v = 0$ m/s

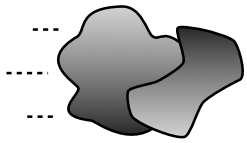
$m_1 = 9.3$ kg
$v_1' = -2.7$ m/s

$m_2 = ?$
$v_2' = +4.8$ m/s

DON'T THINK:	$p = p'$	SOLVE: $0 = m_1v_1' + m_2v_2'$
	$p_1 + p_2 = p_1' + p_2'$	$m_2v_2' = -m_1v_1'$
	$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$	$m_2 = -m_1v_1'/v_2'$
THINK:	$v_1 = v_2 = v = 0$	$v_2' = -9.3$ kg · (−2.7 m/s) / 4.8m/s
APPLY:	$0 = m_1v_1' + m_2v_2'$	$m_2 = 5.2$ kg

2. Moving Blobs of Clay Collide.

sketch



$m_1 = 7.8$ kg
$v_1 = ?$

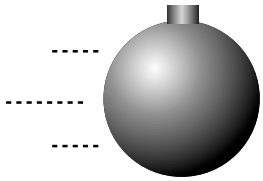
$m_2 = 4.7$ kg
$v_2 = 0$ m/s

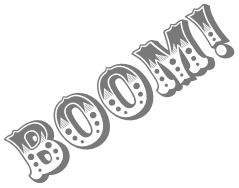
$v' = 3.5$ m/s

DON'T THINK:	$p = p'$	$m_1v_1 = m_1v' + m_2v'$
	$p_1 + p_2 = p_1' + p_2'$	$m_1v_1 = v'(m_1 + m_2)$
	$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$	$v_1 = v'(m_1 + m_2)/ m_1$
THINK:	$v_2 = 0$, $v_1' = v_2' = v'$	$v_1 = 3.5$ m/s · (7.8 kg + 4.7 kg) / 7.8 kg
APPLY:	$m_1v_1 = m_1v' + m_2v'$	$v_1 = 5.6$ m/s

5.6 m/s 7.8 kg 4.7 kg

3. A Moving Bomb Explodes.





$m_1 = 8.1$ kg $m_2 = ?$ $v = +5.2$ m/s $v_1' = -3.7$ m/s $v_2' = +17.4$ m

$p = p'$

$p_1 + p_2 = p_1' + p_2'$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$v_1 = v_2 = v$

$m_1v + m_2v = m_1v_1' + m_2v_2'$

$m_2v - m_2v_2' = m_1v_1' - m_1v$

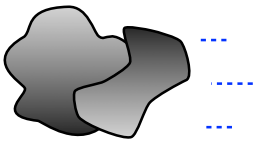
$m_2(v - v_2') = m_1(v_1' - v)$

$m_2 = m_1(v_1' - v) / (v - v_2')$

$m_2 = 8.1\text{ kg}(-3.7\text{ m/s} - 5.2\text{ m/s}) / (5.2\text{ m/s} - 17.4\text{ m/s})$

$m_2 = 5.9\text{ kg}$

4. Moving Blobs of Clay Collide. (YOU draw the "speed lines.")



$m_1 = 6.0$ kg $m_2 = 4.0$ kg
$v_1 = +7.0$ m/s $v_2 = ?$

$v' = -2.2$ m/s

$p = p'$

$p_1 + p_2 = p_1' + p_2'$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$v_1' = v_2' = v'$

$m_1v_1 + m_2v_2 = m_1v' + m_2v'$

$m_1v_1 + m_2v_2 = m_1v' + m_2v'$

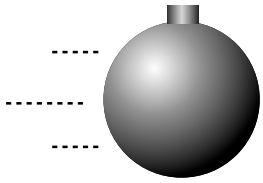
$m_2v_2 = (m_1 + m_2)v' - m_1v_1$

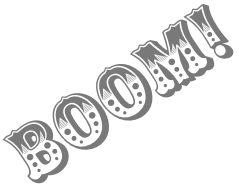
$v_2 = [(m_1 + m_2)v' - m_1v_1] / m_2$

$v_2 = [(6\text{kg} + 4\text{kg})(-2.2\text{kg}) - 6\text{kg}\cdot 7\text{m/s}] / 4\text{kg}$

$v_2 = -16$ kg

5. A Moving Bomb Explodes.





$m_1 = 8.0$ kg $m_2 = 5.0$ kg
$v = 3.9$ m/s

$v_1' = -3.0$ m/s $v_2' = ?$

$p = p'$

$p_1 + p_2 = p_1' + p_2'$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$v_1 = v_2 = v$

$m_1v + m_2v = m_1v_1' + m_2v_2'$

$m_1v + m_2v = m_1v_1' + m_2v_2'$

$v(m_1 + m_2) - m_1v_1' = m_2v_2'$

$v_2' = v(m_1 + m_2) - m_1v_1' / m_2$

$v_2' = 3.9\text{m/s}(8.0\text{kg} + 5.0\text{kg}) - 8.0\text{kg}\cdot -3.0\text{m/s} / 5.0\text{kg}$

$v = 15$ m/s

3. 2.9 kg 4. −10 m/s 2. 12 m/s

db