

# PhyzJob: Conservation of Momentum Number Puzzles

## PART 2: SPEED



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

### 1. A Stationary Bomb Explodes.



DON'T THINK:	$p = p'$
	$p_1 + p_2 = p_1' + p_2'$
	$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$
THINK:	$v_1 = v_2 = v = 0$
APPLY:	$0 = m_1v_1' + m_2v_2'$

SOLVE:  $0 = m_1v_1' + m_2v_2'$

$m_2v_2' = -m_1v_1'$

$v_2' = -m_1v_1'/m_2$

$v_2' = -7.0 \text{ kg} \cdot -1.43 \text{ m/s} / 3.0 \text{ kg}$

$v_2' = 3.3 \text{ m/s}$

### 2. A Blob of Clay Collides With a Stationary Blob of Clay.



DON'T THINK:	$p = p'$
	$p_1 + p_2 = p_1' + p_2'$
	$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$
THINK:	$v_2 = 0, v_1' = v_2' = v'$
APPLY:	$m_1v_1 = m_1v' + m_2v'$

$m_1v_1 = m_1v' + m_2v'$

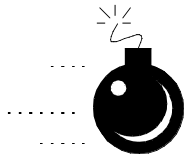
$m_1v_1 = v'(m_1 + m_2)$

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

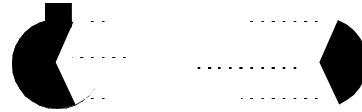
$v' = 5 \text{ kg} \cdot 8 \text{ m/s} / (5 \text{ kg} + 3 \text{ kg})$

$v_2' = 5.0 \text{ m/s}$

3. A Moving Bomb Explodes.



**BOOM!**



$m_1 = 6.0 \text{ kg}$     $m_2 = 4.0 \text{ kg}$     $v = +9.0 \text{ m/s}$

$v_1' = -7.5 \text{ m/s}$

$v_2' = ?$

DON'T THINK:

$p = p'$

$p_1 + p_2 = p_1' + p_2'$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

THINK:

$v_1 = v_2 = v$

APPLY:  $m_1v + m_2v = m_1v_1' + m_2v_2'$

$m_1v + m_2v = m_1v_1' + m_2v_2'$

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

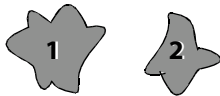
$v(m_1 + m_2) - m_1v_1' = m_2v_2'$

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

$v_2' = [9.0\text{m/s}(6.0\text{kg} + 4.0\text{kg}) - 6.0\text{kg}(-7.5\text{m/s})] / 4.0\text{kg}$

$v_2' = 34 \text{ m/s}$

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



**sklitch**



$m_1 = 8.0 \text{ kg}$     $m_2 = 5.0 \text{ kg}$   
 $v_1 = +4.0 \text{ m/s}$     $v_2 = -2.0 \text{ m/s}$

$v' = ?$

$p = p'$

$p_1 + p_2 = p_1' + p_2'$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$v_1' = v_2' = v'$

$m_1v_1 + m_2v_2 = m_1v' + m_2v'$

$m_1v_1 + m_2v_2 = m_1v' + m_2v'$

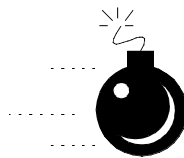
$m_1v_1 + m_2v_2 = (m_1 + m_2)v'$

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

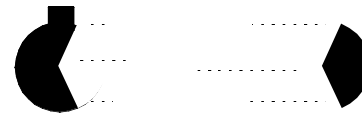
$v' = (8.0\text{kg}\cdot 4.0\text{m/s} + 5.0\text{kg}\cdot -2.0\text{m/s}) / (8.0\text{kg} + 5.0\text{kg})$

$v' = +1.7 \text{ m/s}$

5. A Moving Bomb Explodes.



**BOOM!**



$m_1 = 4.0 \text{ kg}$     $m_2 = 3.0 \text{ kg}$   
 $v = ?$

$v_1' = -5.0 \text{ m/s}$     $v_2' = +12 \text{ m/s}$

$p = p'$

$p_1 + p_2 = p_1' + p_2'$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$v_1 = v_2 = v$

$m_1v + m_2v = m_1v_1' + m_2v_2'$

$m_1v + m_2v = m_1v_1' + m_2v_2'$

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

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

$v = (4.0\text{kg}\cdot -5.0\text{m/s}' + 3.0\text{kg}\cdot 12\text{m/s}) / (4.0\text{kg} + 3.0\text{kg})$

$v = 3.2 \text{ m/s}$

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