Physics 105
Quiz 6

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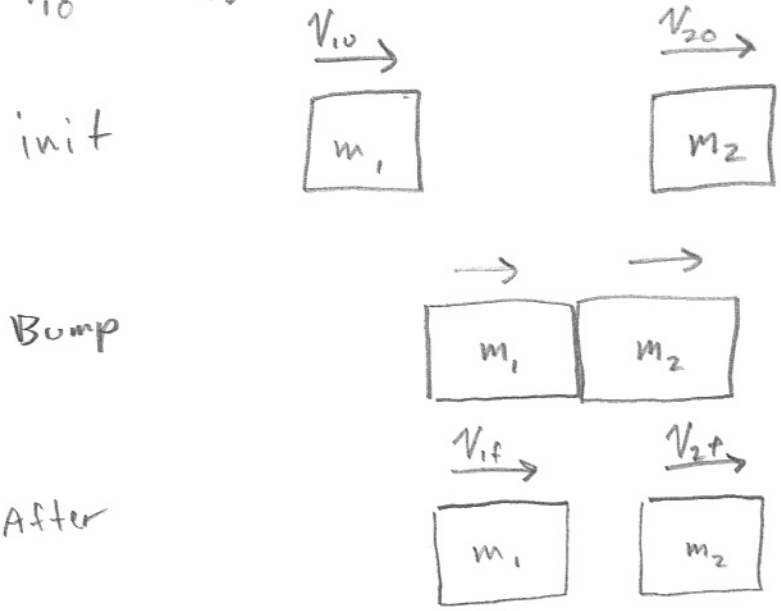
Directions: Use g = 9.80 m/s^2 and assume all numbers are accurate to 3 significant figures unless otherwise indicated..

This is a general elastic collision problem. You will not be asked to do one like this on the exam because, as you shall see, it is more algebra than physics. The only type of elastic collision problem you will be responsible on Test 2 will be when the masses of the objects are the same.

Two objects are sliding on a horizontal, frictionless surface along the x axis. Object 1 has a mass of 1 kg and is moving toward the right with a speed of 2 m/s. Object 2, initially located to the right of object 1, has a mass of 2 kg and is moving to the right with a speed of 1 m/s. They have a "head-on" collision (meaning they continue to travel along the x-axis after the collision). What are the velocities (both magnitude and direction) of both objects after the collision?

$m_1 = 1\ kg$
$v_{10} = 2\ m/s$

$m_2 = 2\ kg$
$v_{20} = 1\ m/s$



2 equations

$$m_1 v_{10} + m_2 v_{20} = m_1 v_{1f} + m_2 v_{2f}$$ and

$$\frac{1}{2} m_1 v_{10}^2 + \frac{1}{2} m_2 v_{20}^2 = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2$$

$m_1 = 1\,kg$ $\quad v_{10} = 2\,m/s$

$m_2 = 2kg$ $\quad v_{20} = 1\,m/s$

① $1kg(2\,m/s) + 2kg(1\,m/s) = 1kg\,v_{1f} + 2kg\,v_{2f}$

$4\,m/s = v_{1f} + 2v_{2f}$

$v_{1f} = 4\,m/s - 2v_{2f}$

② $1kg(2\,m/s)^2 + 2kg(1\,m/s)^2 = 1kg\,v_{1f}^2 + 2kg\,v_{2f}^2$

$4\,m^2/s^2 + 2\,m^2/s^2 = v_{1f}^2 + 2v_{2f}^2$

$0 = v_{1f}^2 + 2v_{2f}^2 - 6\,m^2/s^2$

plug in v_{1f}:

$0 = (4\,m/s - 2v_{2f})^2 + 2v_{2f}^2 - 6\,m^2/s^2$

$0 = 16\,m^2/s^2 - 16v_{2f} + 4v_{2f}^2 + 2v_{2f}^2 - 6\,m^2/s^2$

$0 = 6v_{2f}^2 - 16v_{2f} + 10\,m^2/s^2$

$0 = 3v_{2f}^2 - 8v_{2f} + 5\,m^2/s^2$

$$v_{2f} = \frac{8 \pm \sqrt{8^2 - 4(3)(5)}}{2(3)}$$

$\boxed{v_{2f} = 1.67\,m/s}$, 1 ← original speed

$v_{1f} = 4\,m/s - 2(1.67\,m/s)$

$\boxed{v_{1f} = 0.66\,m/s}$