

# Conservation of Momentum!

Physics 432

Name: \_\_\_\_\_  
1 2 3 4 5 6 7 8

## Part I

MacGyver has gotten himself into a pinch! Use your superior physics knowledge to help him craft his escape! Sitting in a room tied to a chair, and armed with only his pocketknife, he attempts his escape.

- 1) Simulating the call of an attractive woman, MacGyver lures his guard into his holding cell. Thinking fast, MacGyver decides that he needs to know the mass of the guard. If the guard walks at a pace of  $0.75 \text{ m/s}$  and has a momentum of  $82 \text{ kg}\cdot\text{m/s}$ , what is the mass of the guard?

Picture



- 2) Coming to a stop in front of him, the guard threatens MacGyver. MacGyver responds by kicking the guard in the chest, sending him out of the cell at a rate of  $8.4 \text{ m/s}$ . If MacGyver moves backward at a rate of  $8.4 \text{ m/s}$  as well, what is MacGyver's momentum? (use mass of guard found in #1)

Before Picture

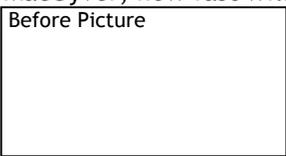


After Picture

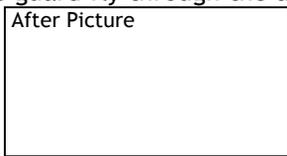


- 3) Untying himself with his pocketknife, MacGyver dresses in the guard's clothes and sneaks out of the cell. Using toothpaste and a coffee cup, he makes a skateboard to ride to his freedom. MacGyver moves with a momentum of  $300 \text{ kg}\cdot\text{m/s}$ , and collides with a different guard ( $m=100\text{kg}$ ) who was standing checking his watch. If the collision stops MacGyver, how fast will the guard fly through the air?

Before Picture

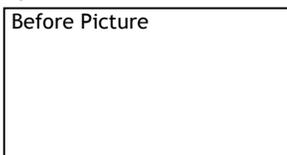


After Picture

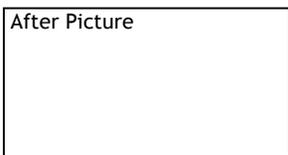


4) Suddenly aware, the guards begin to converge on MacGyver's position. The swift MacGyver quickly jumps into a Jeep waiting outside and hotwires the car using telepathic skills. Driving at 15 m/s, MacGyver's 800 kg Jeep is rear ended by a 1200 kg Hummer. If the cars stick together and move at a new speed of 18 m/s, what was the Hummer's original speed?

Before Picture

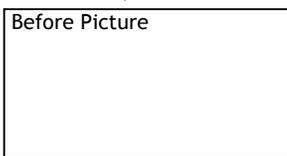


After Picture

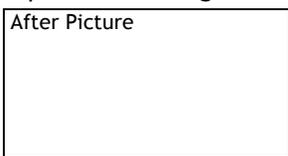


5) The Hummer manages to stop both vehicles while they are still stuck together. Seeking to separate the cars, MacGyver places an explosive between the cars. After the explosion the Hummer is forced backwards with a velocity of 22 m/s, how fast is the jeep now traveling?

Before Picture



After Picture



6) Jumping out of his wrecked jeep, MacGyver(100 kg) is back on his skateboard moving at 8m/s. MacGyver suddenly hears "Nuts!" and a very sweaty squirrel lands on the road in front of him (he probably fell out of a tree). MacGyver collides with the squirrel and they both travel together at 7m/s, what is the "nutty" squirrel's mass?

picture



## Part II -- Relationships

MacGyver is traveling on his makeshift skateboard with a momentum of 100 kg-m/s. Indicate how his momentum will be change for the following scenarios:

10) MacGyver changes his speed to 2x his original speed?

Factor changed	New Momentum
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11) MacGyver changes his mass to  $\frac{1}{2}$  his original mass and  $\frac{1}{4}$  his original speed?

Factor changed	New Momentum
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12) MacGyver changes his speed to 12 times the original, and  $\frac{1}{2}$  the original mass?

Factor changed	New Momentum
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