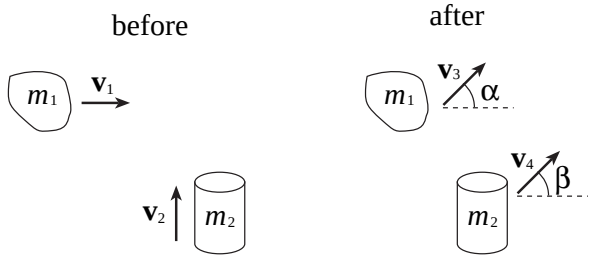
This print-out should have 12 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

**001 (part 1 of 2) 10.0 points**




An $m_2 = 1.4$ kg can of soup is thrown upward with a velocity of $v_2 = 5.9$ m/s. It is immediately struck from the side by an $m_1 = 0.78$ kg rock traveling at $v_1 = 8.4$ m/s. The rock ricochets off at an angle of $\alpha = 54^\circ$ with a velocity of $v_3 = 6$ m/s.

What is the angle of the can's motion after the collision?

Answer in units of °.

**002 (part 2 of 2) 10.0 points**

With what speed does the can move immediately after the collision?

Answer in units of m/s.

**003 10.0 points**

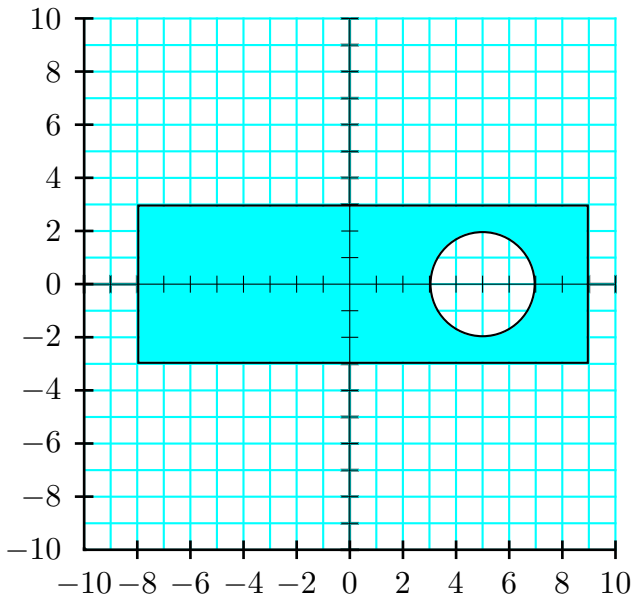
Two ice skaters approach each other at right angles. Skater A has a mass of 77.6 kg and travels in the $+x$ direction at 1.06 m/s. Skater B has a mass of 62.3 kg and is moving in the $+y$ direction at 1.08 m/s. They collide and cling together.

Find the final speed of the couple.

Answer in units of m/s.

**004 10.0 points**

A uniform flat plate of metal with a circular hole is situated in the reference frame shown in the figure below.




Calculate the $x$-coordinate of the center of mass $x_{cm}$ of the metal plate.

**005 (part 1 of 2) 10.0 points**

A 1.26 kg particle has a velocity

$$v_{1.26\ \mathrm{kg}} = a\,\hat{\imath} + b\,\hat{\jmath}\,,$$

where $a = 86.3$ m/s and $b = 1.65$ m/s, and a 1.68 kg particle has a velocity

$$v_{1.68\ \mathrm{kg}} = c\,\hat{\imath} + d\,\hat{\jmath}\,,$$

where $c = 0.603$ m/s and $d = 7.38$ m/s.

Find the speed of the center of mass.

Answer in units of m/s.

**006 (part 2 of 2) 10.0 points**

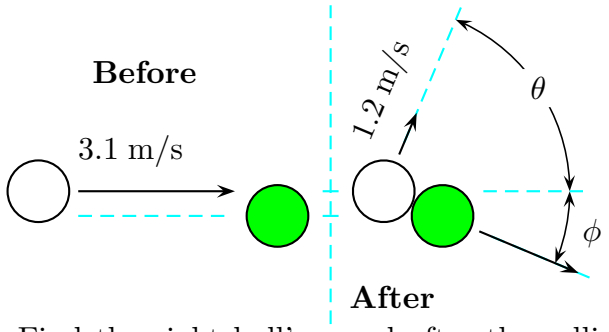
Find the magnitude of the total momentum of the system.

Answer in units of N s.

**007 10.0 points**

*Assume* an elastic collision (ignoring friction and rotational motion).

A queue ball initially moving at 3.1 m/s strikes a stationary eight ball of the same size and mass. After the collision, the queue ball's final speed is 1.2 m/s at an angle of $\theta$ with respect to its original line of motion.




Find the eight ball's speed after the collision.

Answer in units of m/s.

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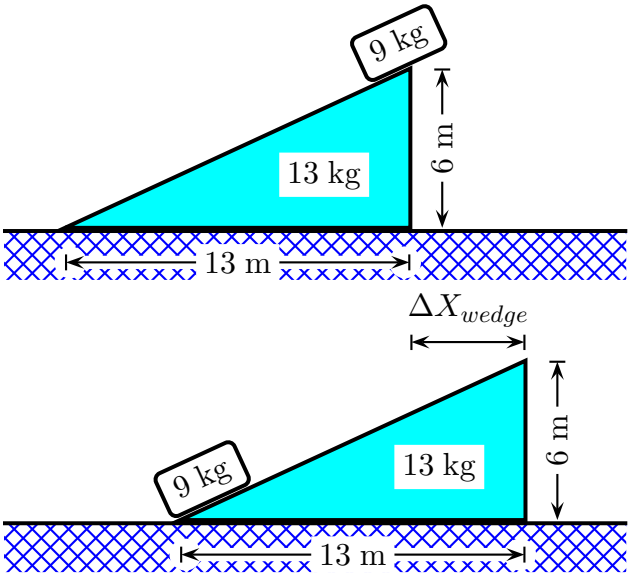
**008 10.0 points**

A triangular wedge 6 m high, 13 m base length, and with a 13 kg mass is placed on a frictionless table. A small block with a 9 kg mass (and negligible size) is placed on top of the wedge as shown in the figure below.




All surfaces are frictionless, so the block slides down the wedge while the wedge slides sidewise on the table. By the time the block slides all the way down to the bottom of the wedge, how far $\Delta X_{wedge}$ does the wedge slide to the right?

Answer in units of m.

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**009 10.0 points**

The mass of a star like our Sun is $4.91 \times 10^5$ Earth masses, and the mean distance from the center of this star to the center of a planet like our Earth is $1.5 \times 10^8$ km.

Treating this planet and star as particles, with each mass concentrated at its respective geometric center, how far from the center of the star is the center of mass of the planet-star system?

Answer in units of km.

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**010 10.0 points**

A 56.4 kg man sits on the stern of a 5.1 m long boat. The prow of the boat touches the pier, but the boat isn't tied. The man notices his mistake, stands up and walks to the boat's prow, but by the time he reaches the prow, it's moved 2.88 m away from the pier.

Assuming no water resistance to the boat's motion, calculate the boat's mass (not counting the man).

Answer in units of kg.

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**011 (part 1 of 2) 10.0 points**

A 2.95 g particle is moving at 3.94 m/s toward a stationary 9.88 g particle.

With what speed does the heavier particle approach the center of mass of the two particles?

Answer in units of m/s.

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**012 (part 2 of 2) 10.0 points**

What is the magnitude of the momentum of the lighter particle, relative to the center of mass?

Answer in units of N s.