

# Momentum

AT Momentum (16)

Solve the following problems showing ALL work and CIRCLING your answers. Each is worth 5 points.

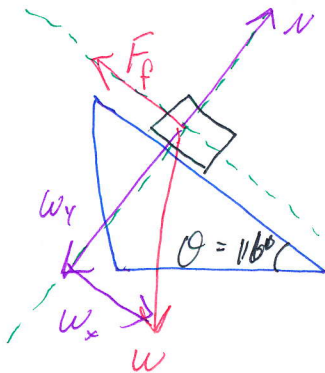
1) Determine the momentum of a person (mass 72kg) running at 8 m/s. The wind is blowing at 2 m/s and it is 64°F outside.

$$p = mv = (72 \text{ kg})(8 \text{ m/s}) = 576 \text{ kg m/s}$$

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2) A 12 kg box is on a downward sloping ramp which slopes downward at 16 degrees. The coefficient of friction between the ramp and the box is 0.04. Determine the change in momentum of the box if it takes 3 seconds for the box to slide down the incline.



$$\Sigma F_y = N - W_y = 0$$

$$N = W_y$$

$$N = mg \cos \theta$$

$$\Sigma F_x = W_x - F_p = \frac{\Delta p}{t}$$

$$mg \sin \theta - \mu N = \frac{\Delta p}{t}$$

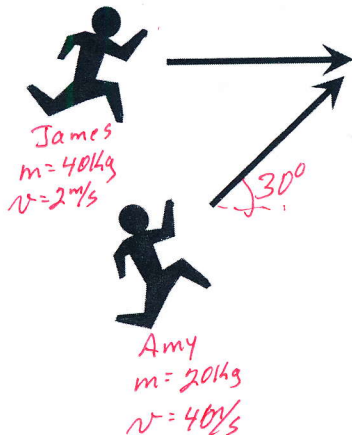
$$mg \sin \theta - \mu mg \cos \theta = \frac{\Delta p}{t}$$

$$t mg (\sin \theta - \mu \cos \theta) = \Delta p$$

$$(3s)(12.1kg)(9.8m/s^2)(\sin(16^\circ) - (0.04)\cos(16^\circ)) = \Delta p = 83.7 \text{ kg m/s}$$

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3) Two kids, James and Amy, are playing on ice. James has a mass of 40 kg and Amy has a mass of 20 kg. James runs due east and slides at a speed of 2 m/s. Amy runs and slides on the ice at a speed of 4 m/s and at 30 degrees north of east. The two will collide in a totally inelastic collision. Determine the speed of the two after the collision.



Total Initial x-momentum

$$\text{James} = (40\text{kg})(2\text{m/s}) = 80\text{kg m/s}$$

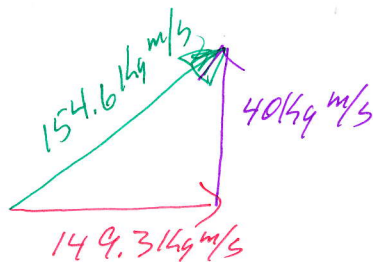
$$\text{Amy} = (20\text{kg})(4\text{m/s})(\cos 30^\circ) = 69.31\text{kg m/s}$$

$$\Rightarrow 149.31\text{kg m/s}$$

Total Initial y-momentum

$$\text{Amy} \Rightarrow (20\text{kg})(4\text{m/s})(\sin 30^\circ) = 40\text{kg m/s}$$

Final momentum



$$p = mv = (60\text{kg})(v) = 154.6\text{kg m/s}$$

$$v = 2.58\text{m/s}$$

Speed Is Not  
 A Vector Quantity..

(Use the information below to respond to problems 4-7. Each question is worth 2 points. Incorrect responses will carry, so "Double Jeopardy" is in effect. Use what you know to "fix" any potential issues)

A red bumper car (At an amusement park) has a mass of 185kg and is moving to the right at 2 m/s. The car collides in a totally elastic one dimensional collision with a blue bumper car of mass 192kg that was moving at 3 m/s to the left. The collision takes place in a time of 0.3s.

4) Determine the final velocity of the red car after the collision

$-3.09 \text{ m/s}$

5) Determine the final velocity of the blue car after the collision

$1.91 \text{ m/s}$

6) Determine the force that acts on the red car.

$+3140 \text{ N}$

7) Determine the force that acts on the blue car.

$3140 \text{ N}$

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8) A 0.035kg ball flies toward a wall at 18 m/s, then bounces off the wall at 15 m/s. Determine the change in momentum of the ball.

$$\frac{\Delta p}{t} = \frac{m(\Delta v)}{t} = \frac{m(v - v_0)}{t}$$

$$\Delta p = m(v - v_0) = (0.035\text{kg})(-15\text{m/s} - 18\text{m/s})$$

$$\Delta p = 1.155\text{kg m/s}$$