MOMENTUM

AT Momentum (13)

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/sand it is 64°F outside .

The Wind Really Doesn't matter...

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

2) Two kids, James and Amy, are playing on ice. James has a mass of 55 kg and Amy has a mass of 40kg. James runs due east and slides at a speed of 5 m/s. Amy runs and slides on the ice at a speed of 6 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.

James
$m_J = 55 kg$
$v_J = 5 \frac{m}{s}$

θ

$\theta = 30°$

Amy
$m_A = 40 kg$
$v_A = 6 \frac{m}{s}$
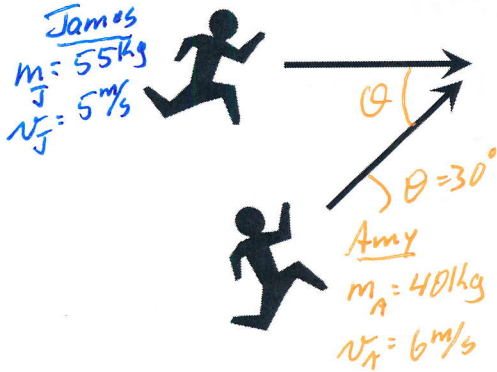
Total x-momentum

$$P_{J_{0_x}} + P_{A_{0_x}} = P_{AJ_x}$$

$$(55 kg)(5 \tfrac{m}{s}) + (40 kg)(6 \tfrac{m}{s})(\cos 30°) = (95 kg) v_{AJ_x}$$

$$5.1 \tfrac{m}{s} = v_{AJ_x}$$

Total y-momentum

$$P_{A_{0y}} = P_{AJ_y}$$

$$(40 kg)(6 \tfrac{m}{s})(\sin 30°) = (95 kg) v_{AJ_y}$$

$$v_{AJ_y} = 1.21 \tfrac{m}{s}$$

$$\boxed{v_{AJ} = 5.2 \tfrac{m}{s}}$$

"Speed" Is Requested, So Angle Is Not Needed.

5.2 m/s   1.26 m/s

5.1 m/s
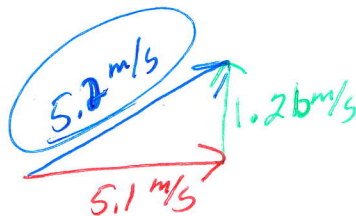
Level I Key Pd 1

(Use the information below to respond to problems 3-6)

A red bumper car (At an amusement park) has a mass of 85kg and is moving to the right at 4 m/s. The car collides in a totally elastic collision with a blue bumper car of mass 92kg that was moving at 4.5 m/s to the left. The collision takes place in a time of 0.08s.

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

Red $m_A = 85kg$
$v_{A_0} = 4 m/s$

$$v_{Red} = -4.84 \, m/s$$

Blue $m_B = 92kg$
$v_{B_0} = -4.5 m/s$

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

$$v_{Blue} = 3.66 \, m/s$$

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

$$-9390 \, N$$

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

$$9390 \, N$$

7) A 0.05kg ball flies toward a wall at 18 m/s, then bounces off the wall at 9 m/s. Determine the change in momentum of the ball.
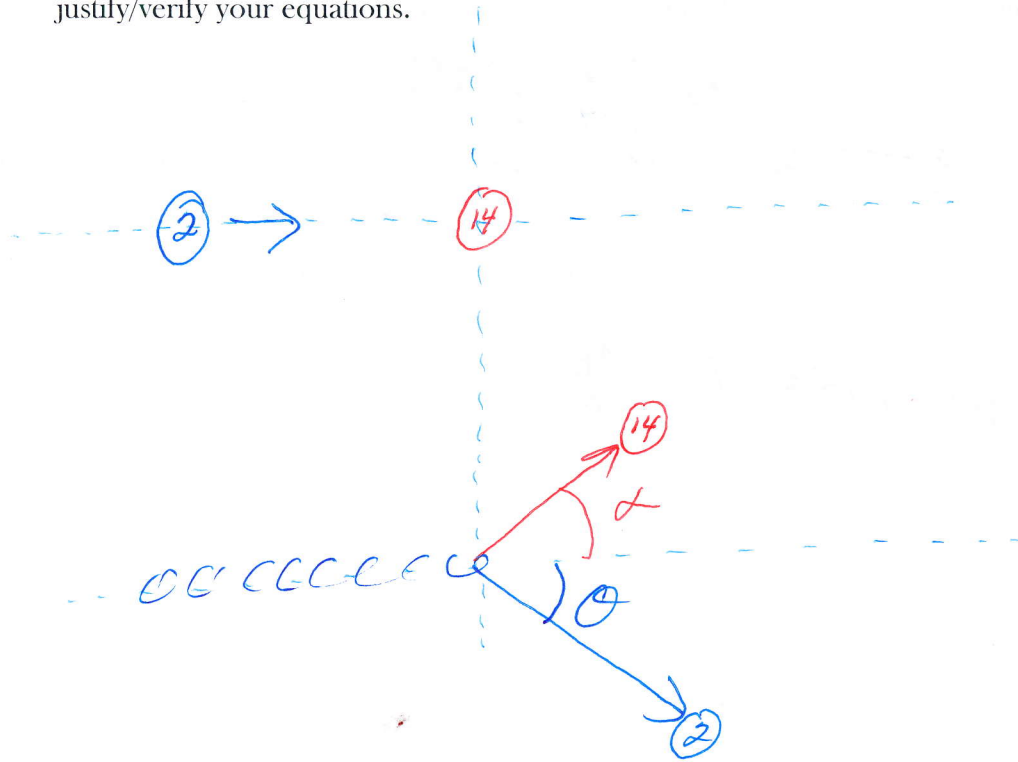
$$\Delta p = p - p_o$$

$$\Delta p = mv - mv_o$$

$$\Delta p = (.05 \, kg)(-9 \, m/s - 18 \, m/s)$$

$$\Delta p = \boxed{1.35 \, kg \, m/s}$$

8) On a billiard table, the 2 ball is moving toward the 14 ball. The two balls collide in a 2 D elastic collision. Write equations involving energy and momentum (Including trig functions) to describe the collision. Include a diagram to justify/verify your equations.
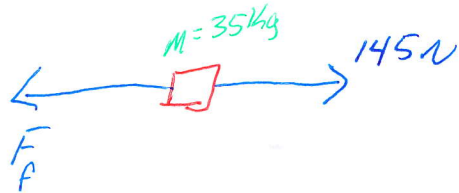
$$v_{2_0}^2 = v_2^2 + v_{14}^2$$

$$v_{2_0} = v_2 \cos\theta + v_{14} \cos\alpha$$

$$0 = -v_2 \sin\theta + v_{14} \sin\alpha$$

9) Write a MOMENTUM equation for the following situation involving a BOX. A 145 N force acts to the right on a BOX. The BOX has a mass of 35 kg. The coefficient of friction between the box and the floor is 0.3. (Yeah, this should look like a Sum of force problem....but how can we incorporate momentum?)

$M = 35 kg$

$145 N$

$\overline{F}_f$

$$\Sigma F_x = 145 N - F_f = \frac{\Delta p}{t}$$