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Date: 3/20/17

NV College Physics Practice Quiz - Momentum

Answer all the questions below, show your work and circle or box your answer!

Short answer

1) A bullet with a mass of 40g has a velocity of 650m/s east. What is its momentum?

$$m = 40g = .04 \text{ kg} \quad \vec{p} = m\vec{v} = (.04)(650) = \boxed{26 \text{ kg}\cdot\text{m/s East}}$$

$$\vec{v} = 650 \text{ m/s East}$$

2) A 400g snowball has a momentum of 5.2kg·m/s. What is the magnitude of its velocity?

$$m = .4 \text{ kg} \quad \vec{p} = m\vec{v}$$

$$\vec{p} = 5.2 \text{ kg}\cdot\text{m/s} \quad |\vec{v}| = \frac{|\vec{p}|}{m} = \frac{5.2}{.4} = \boxed{13 \text{ m/s}}$$

3) A rocket engine applies a force of 1200N to a satellite with a mass of 800kg for a period of 5s. What is the magnitude of the impulse delivered to the satellite?

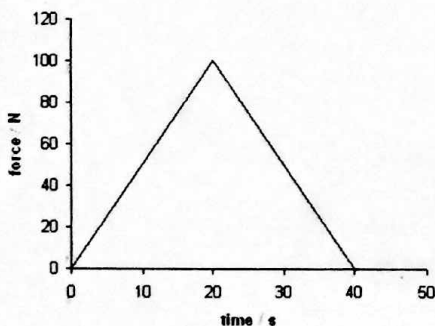
$$|\vec{J}| = |\vec{F}|(\Delta t) = (1200)(5) = \boxed{6000 \text{ N}\cdot\text{s}}$$

4) A baseball with a mass of .15 kg is pitched due south with a velocity of 40m/s. If the batter hits it back to the north at 60 m/s, what is the total change in momentum of the baseball?

$$0 \xrightarrow{40 \text{ m/s}} \vec{p}_0 = (.15)(40) = 6 \quad \Delta\vec{p} = \vec{p} - \vec{p}_0 = -9 - 6 = \boxed{-15 \text{ kg}\cdot\text{m/s}}$$

$$\xleftarrow{60 \text{ m/s}} 0 \quad \vec{p} = (.15)(-60) = -9 \quad \text{or } +15 \text{ kg}\cdot\text{m/s if directions are reversed!}$$

5) A force is applied over an interval of time as shown below. What is the impulse delivered by the force? directions are reversed!



$$\vec{J} = \int_{t_1}^{t_2} F dt = \text{Area under graph}$$

$$\text{Area} = \frac{1}{2}(\text{base})(\text{height}) = \frac{1}{2}(40)(100) = \boxed{2000 \text{ N}\cdot\text{s}}$$

6) Two bumper cars are about to collide. One has a mass of 90kg and is heading east at 2m/s. The other has a mass of 100kg and is heading west at 1.5 m/s. What is the total momentum of the system of 2 cars before the collision?

$$\boxed{90 \text{ kg}} \xrightarrow{p_1 = 180 \text{ kg}\cdot\text{m/s}} \quad \xleftarrow{p_2 = -150 \text{ kg}\cdot\text{m/s}} \boxed{100 \text{ kg}}$$

$$p_{\text{total}} = p_1 + p_2 = 180 + (-150)$$

$$\boxed{p_{\text{total}} = 30 \text{ kg}\cdot\text{m/s}}$$

7) A cannonball has a momentum of 1440 kg·m/s south and 172800J of kinetic energy. What is its velocity?

$$K = \frac{1}{2}mv^2$$

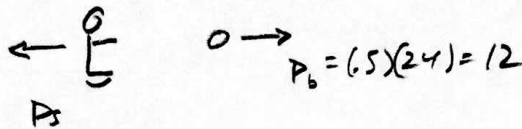
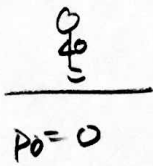
$$p = mv$$

$$\frac{K}{p} = \frac{\frac{1}{2}mv^2}{mv} = \frac{v}{2} = \frac{172800}{1440}$$

$$\frac{v}{2} = 120, \quad \boxed{\vec{v} = 240 \text{ m/s South}}$$

Problem solving

8) An ice-skater standing in the middle of a frozen lake throws a snowball to the north with a speed of 24m/s. If the mass of the snowball is .5kg and the mass of the skater is 60kg, what is the final velocity of the skater?



$$0 = P_s + 12$$

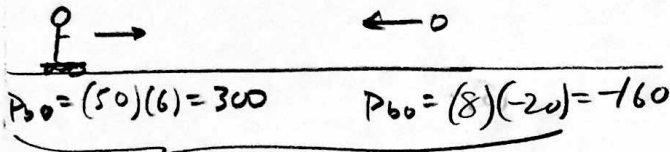
$$P_s = -12$$

$$m_s v_s = -12$$

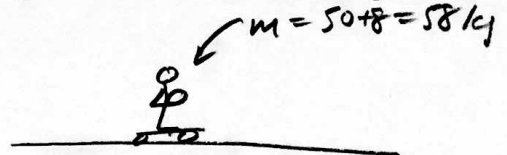
$$(60) v_s = -12$$

$$v_s = -.2 \text{ m/s or } \boxed{.2 \text{ m/s South}}$$

9) A boy is riding his skateboard to the east with a velocity of 6m/s. He catches a ball that is thrown to him with a velocity of 20m/s west. The mass of the boy and the skateboard is 50kg. The mass of the ball is 8kg. What is the final velocity of the boy?



initial $P_{total} = 140 \text{ kg} \cdot \text{m/s}$

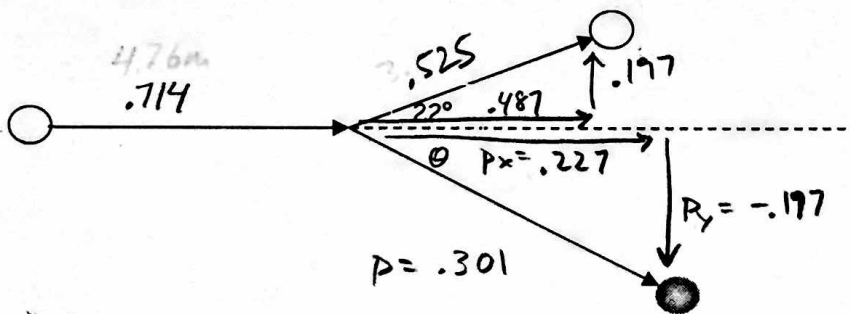


initial $P_{TOTAL} = \text{final } P_{TOTAL}$

$$140 = (50+8) v$$

$$v = \frac{140}{58} = \boxed{2.41 \text{ m/s}}$$

10) In a game of pool, a cue ball strikes a colored ball (initially at rest) in a glancing collision as shown below. The initial velocity of the cue ball (white one) is 4.76m/s and after the collision it is 3.5m/s at the angle shown. Find the velocity of the colored ball after the collision. $m = .15 \text{ kg}$



$$P = mV = .301$$

$$(.15) v = .301$$

$$v = 2.01 \text{ m/s}$$

$$\theta = \tan^{-1} \left(\frac{.197}{.227} \right) = 41.0^\circ$$

X-DIR

total P_x initial = total P_x final

$$.714 = .487 + P_x$$

$$P_x = .227$$

X-DIR

total P_y initial = total P_y final

$$0 = .197 + P_y$$

$$P_y = -.197$$