– KEY –

Physics 12 Unit 4 – Momentum Worksheet #2.5

Additional 2-D Problems for review

Name: _____ Date: _____

Momentum is a vector quantity

$P_{CAR} = 53,333\ NS$ $44.4\ m/s$ $P_{TRUCK} = 44,444\ NS$

1. A 1200 kg car traveling north at 160 km/r collides with and sticks to a 1600 kg truck travelling 20 degrees North of West at 100 km/hr. Find the velocity (magnitude and direction) of the wreck.

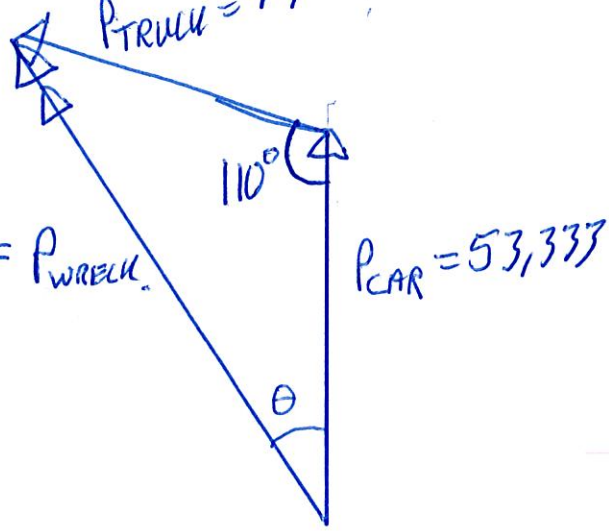
$27.7\ m/s$

① Use cosine law $c^2 = a^2 + b^2 - 2ab\cos\theta$

$P_w^2 = 53,333^2 + 44,444^2 - (2)(53,333)(44,444)\cos 110°$

$P_w^2 = 6441080505 \longrightarrow P_w = 80,256\ NS$

② $V = \frac{P}{m} = \frac{80,256}{2,800} = 28.7\ m/s$



③ $\frac{\sin\theta}{44,444} = \frac{\sin 110}{80,256}$

$\sin\theta = 0.5203$

$\theta = 31.4$

$\theta = 31°$ W of N

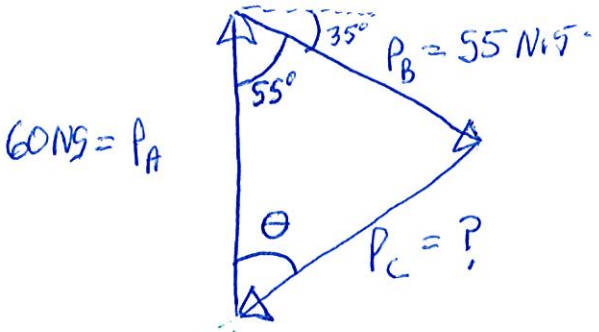
$P_i = 0$ ∴ $P_f = 0$

2. A 12 kg rock initially at rest explodes into three pieces.

Piece A is 4 kg and is travelling at 15 m/s directly North ↑

Piece B is 5 kg and is travelling 11 m/s 35 degrees South of East ↘

Find the velocity (magnitude and direction) of piece C



Resultant = 0

$P_f = 0$

Use cosine law $c^2 = a^2 + b^2 - 2ab\cos\theta$

$= 60^2 + 55^2 - 2(60)(55)\cos 55°$

$c^2 = 2839$

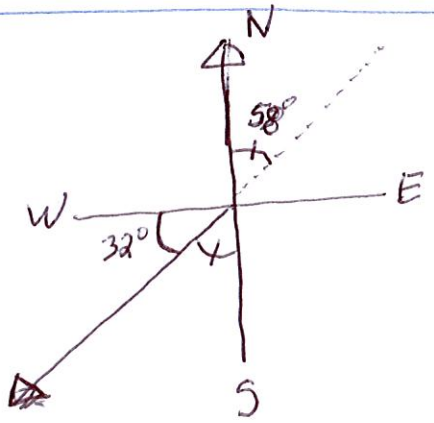
$P_C = 53.285$

$V = \frac{P_c}{m} = \frac{53.285}{3} = 17.8\ m/s$

$\frac{\sin\theta}{55} = \frac{\sin 55°}{53.28}$

$\sin\theta = 0.845$

$\theta = 57.7 = 58°$



32° S of W

277.7 m/s

3. A two piece rocket with a mass of 3000 kg is travelling at 1000 km/hr. The engine separates from the main capsule with a small thruster.

The 1800 kg engine is now travelling at 900 km/hr. 250 m/s

What is the final velocity of the main capsule after separation?

$p_i = mv = (3000)(277.7) = 833,333 \text{ NS}$

$p_i = p_f$

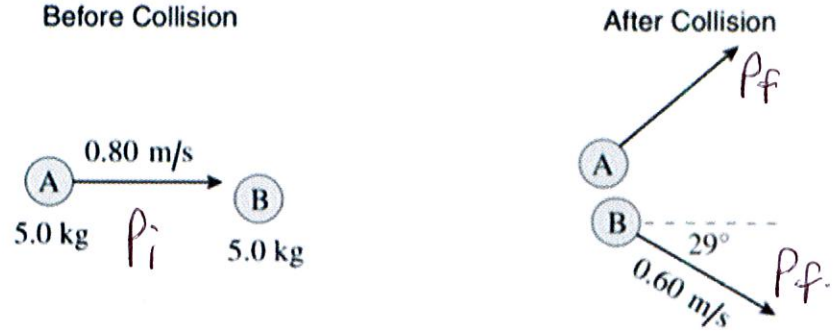
$833,333 = (1800)(250) + (1200)(v)$

v of main capsule.

$V = 319 \text{ m/s}$

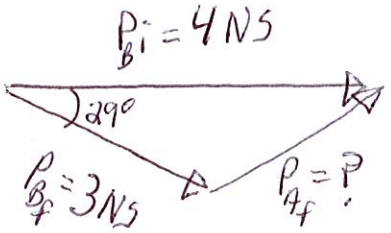
4. Find the magnitude of the moment of Puck A after rate collision.

A 5.0 kg puck (A) moving at 0.80 m/s to the right collides obliquely with an identical stationary puck (B). Puck B then moves at 0.60 m/s as shown.



What is the magnitude of the momentum of puck A after the collision?

A. 1.0 kg · m/s
B. 2.0 kg · m/s
C. 3.0 kg · m/s
D. 5.0 kg · m/s



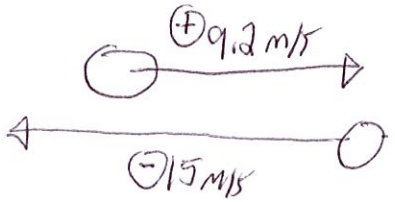
Use cosine law

$p_A^2 = 3^2 + 4^2 - (2)(3)(4)\cos 29°$

$p_A = 2.0$ NS

5. A 0.45 kg ball rolls at a soccer player at 9.2 m/s. The player kicks the ball straight back in the direction is came from at 15 m/s.

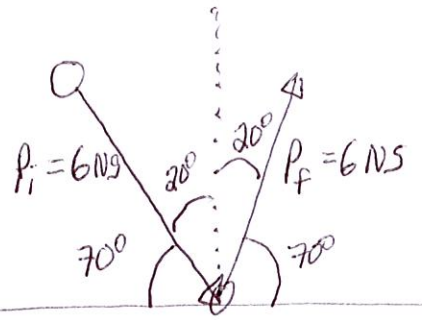
If the collision lasted 0.1 second what was the average force during the collision?



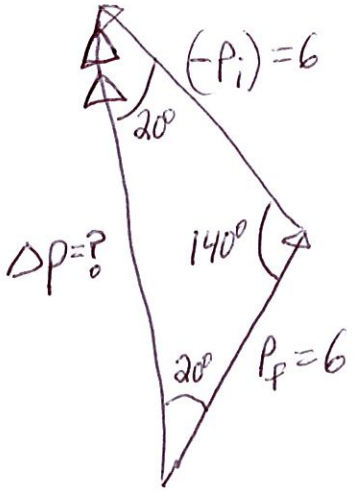
$$\Delta V = V_f - V_i$$
$$= -15 - 9.2$$
$$\Delta V = 24.2$$

$$\vec{F} = \Delta p = F \cdot t = m \Delta v$$
$$F = \frac{m \Delta v}{t} = \frac{(0.45)(24.2)}{0.1}$$
$$F = 108.9\ N$$

6. A 0.4 kg ball travelling at 15 m.s is redirected by a soccer player as shown below. What was the average force on the ball during the 0.08 second impact?



$\Delta p = P_f + (-P_i)$



Use either sin or cos law

$$\frac{\Delta p}{\sin 140} = \frac{6}{\sin 20}$$

$\Delta p = 11.3$ NS.

$\Delta p = F \Delta t$

$$F = \frac{\Delta p}{\Delta t} = \frac{11.3}{0.08} = 140.9 \approx 141 \text{ N}$$