PHYSICS 12 **1D/2D Momentum Practice Test** **Name:** _____

Short Answer Questions: SHOW ALL WORK

1) [1D] A 0.0500-kg golf ball acquires a speed of 80.0 m/s when hit with a golf club during an impact time of 0.020s. What was the force of the golf club?

$F_{net}\Delta t = m\Delta v$ $F\cdot(0.02) = 0.05(80)$ **$F = 200\ N$**

2) [1D] A 4.0 kg block resting on a horizontal surface is accelerated from rest with a 35 N force that acts on it for 2.8 s. If the coefficient of friction is 0.30, what is the final momentum of the block?

$F_g = mg = 39.2N = F_N$ $F_f = \mu F_N = 0.3(\ ) = 11.76N$

$F_{net} = F_a - F_f$ $F_{net} = 35N - 11.8$ $F_{net} = 23.24N$

$\Delta P = F_{net}\Delta t$ $P_f - P_i = 23.24(2.8)$ $\therefore$ **$P_f = 65\ kgm/s$** ($P_i = 0$)

3) [1D] A 105 kg man jumps from a height of 1.5 m and lands on firm ground.

a) Calculate the impulse of the men when he hit the ground

$V_i = 0$, $d = -1.5$, $a = -9.8$, $V_f = ?$

$V_f^2 = V_i^2 + 2ad$ $V_f^2 = 2(-9.8)(-1.5)$ $V_f = -5.42\ m/s$

(Just b4) $V_i = -5.42\ m/s$ $V_f = 0$

$\Delta P = P_f - P_i = 0 - 105(-5.42)$ $\Delta P =$ **$569\ kgm/s$**

b) Determine the force exerted on the man if he bent his knees and absorbed the fall over 0.4 s

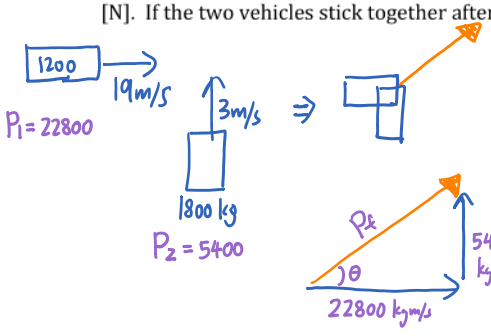
$\Delta P = F\Delta t$ $569 = F(0.4)$ **$F = 1423\ N$**

4) [1D] A freight car of mass 2.0 x 10^4 kg standing at rest is rammed by a moving loaded tank car with mass of 3.0 x 10^4 kg. After the collision, the two cars are locked together and move off at a speed of 0.60 m/s. What was the speed of the tank car before the collision?

3000 → 20000 ⇒ 50000 kg → 0.6 m/s

$m_1v_1 + 0 = m_T v_f$ $3000\ kg\,(v_1) = (5000\ kg)(0.6)$ **$v_1 = 1\ m/s$**

5) **[2D]** The driver of a 1200-kg car travelling at 19.0 m/s [E] is playing with his cell phone and doesn't notice that the light ahead of him has turned red. He hits the side of an 1800-kg truck that is moving at 3.0 m/s [N]. If the two vehicles stick together after the crash, what is their final velocity?



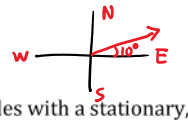
$P_f^2 = 5400^2 + 22800^2$ $P_f = 23431\ kgm/s = M v_f$ (3000 kg)

$v_f = 7.81\ m/s$

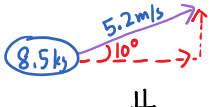
$\tan\theta = \frac{5400}{22800}$ **$\theta = 13.3°$ [N of E]**

6) **[2D]** A 8.5-kg curling stone slides along the ice at 5.2 m/s [E 10° N]. It collides with a stationary, 15-kg bucket of sand, after which the curling stone travels with a velocity of 2.1 m/s [E] Determine the velocity (magnitude and direction) of the sand bucket after the collision.

10° [N of E]



B4

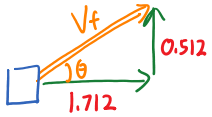


15kg

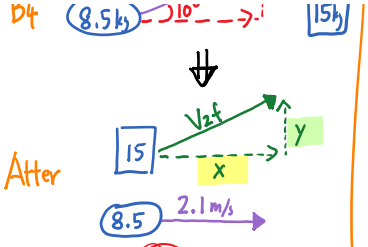
$\Sigma P_{xi} = \Sigma P_{xf}$

$m_1 v_{1x}$: $8.5(5.2\cos 10°) = m_2 v_{2fx}$: $15kg(v_x) + m_1 v_{1fx}$: $8.5kg(2.1m/s)$

$v_x = 1.712\ m/s$



$v_f^2 = 1.712^2 + 0.512^2$

D4 

$m_1 v_{1x} = m_2 v_{2fx} + m_1 v_{1fx}$

$8.5(5.2\cos 10°) = 15_{kg}(V_x) + 8.5_{kg}(2.1_{m/s})$

$V_x = 1.712$ m/s

$\Sigma P_{yi} = \Sigma P_{yf}$

$m_1 v_{1y} = m_2 v_{2fy}$

$8.5_{kg}(5.2\sin 10°) = 15_{kg}(V_y)$

$V_y = 0.512$ m/s

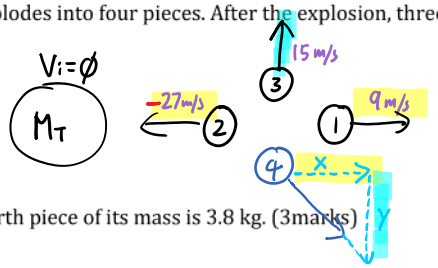
$V_f^2 = 1.712^2 + 0.512^2$

$V_f = 1.79$ m/s

$\theta = \tan^{-1}\left(\frac{0.512}{1.712}\right) = 16.7°$ [N of E]

7) **[2D]** A stationary boulder explodes into four pieces. After the explosion, three of the pieces have masses and velocities as follows:

	Mass	Velocity
⓪	2.5 kg	9.0 m/s [E]
①	3.5 kg	27 m/s [W]
②	2.0 kg	15 m/s [N]



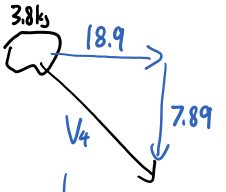
Calculate the speed of the fourth piece of its mass is 3.8 kg. (3marks)

$\Sigma P_{xi} = \Sigma P_{xf}$

$0 = (2.5_{kg})(9_{m/s}) + (3.5)(-27) + (3.8_{kg})(V_x)$ $\quad V_x = 18.9$ m/s

$\Sigma P_{yi} = \Sigma P_{yf}$

$\emptyset = (2.0_{kg})(15) + (3.8_{kg})(V_y)$ $\quad V_y = -7.89$ m/s

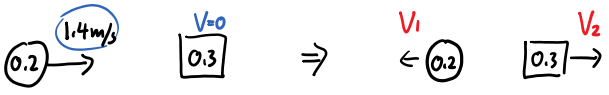


$V_4^2 = 18.9^2 + 7.89^2$

$V_4 = 20.5$ m/s

speed only !!

Extra) A pool ball with mass 0.20 kg is traveling at 1.4 m/s [E]. It collides (completely straight-on) with a stationary pool ball of mass 0.30 kg in a perfectly elastic collision. Determine the final velocity of both balls after the collision. (both momentum and Energy are needed for this one)



$\Sigma P_i = \Sigma P_f$

$m_1 V_{1i} + \emptyset = m_1 V_1 + m_2 V_2$

$0.2(1.4) = 0.2 V_1 + 0.3 V_2$ $\xrightarrow{\times 100}$ ① $28 = 20 V_1 + 30 V_2$ $\rightarrow$ $V_1 = \frac{28 - 30 V_2}{20}$

for nicer looking Eq.

$\Sigma E_{ki} = \Sigma E_{kf}$

$\frac{1}{2} m_1 V_{1i}^2 + \emptyset = \frac{1}{2} m_1 V_1^2 + \frac{1}{2} m_2 V_2^2$

$0.2(1.4)^2 = 0.2 V_1^2 + 0.3 V_2^2$ $\xrightarrow{\times 10}$ ② $3.92 = 2 V_1^2 + 3 V_2^2$

$3.92 = 2\left[\frac{28 - 30 V_2}{20}\right]^2 + 3 V_2^2$

$3.92 = \frac{2}{400}[784 - 1680 V_2 + 900 V_2^2] + 3 V_2^2$

$3.92 = 3.92 - 8.4 V_2 + 4.5 V_2^2 + 3 V_2^2$

$\emptyset = 7.5 V_2^2 - 8.4 V_2$ $\quad (7.5 V_2 - 8.4) = 0$

$\emptyset = V_2[7.5 V_2 - 8.4]$ $\quad V_2 = \emptyset$ or 1.12

logic from diagram !!

$28 = 20 V_1 + 30 V_2$ $\quad 28 = 20 V_1 + 30(1.12)$ $\quad V_1 = -0.28$ m/s