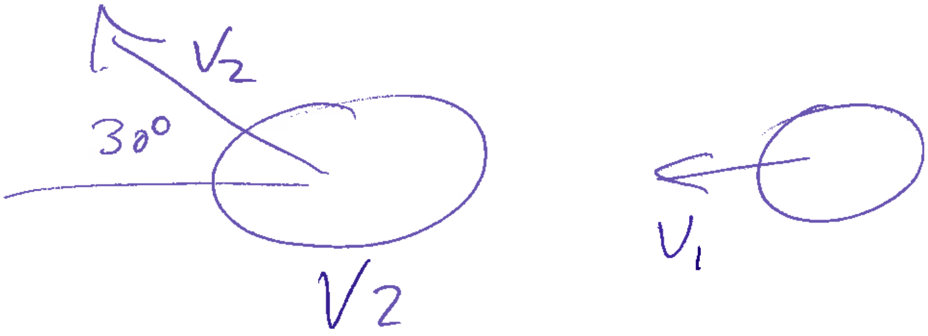
exam2 Practice

1. Superman turns an asteroid.

$V_1 = 20,$~~000~~ Km/s $V_2 = 18,$~~000~~ Km/s



$$W = \Delta K = \frac{1}{2}mV_2^2 - \frac{1}{2}mV_1^2$$

$$W = \frac{1}{2}m(V_2^2 - V_1^2)$$

didn't specify - just leave in if that is the case.

$$W = \frac{1}{2}m((1.8\times10^3 m)^2 - (2.0\times10^3 m)^2)$$

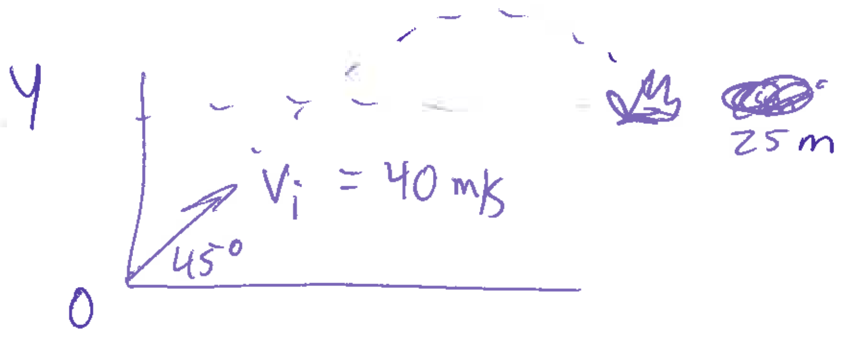
if 10,000 Kg = 10^4 Kg

$$\boxed{W = -380\times10^9 J}$$

Negative - depends on direction of sign.

2. Hulk throws tank pt. 2.

$M_{tank} = 50{,}000\ kg.$



Conservation of Energy here:

$$U_1 + K_1 = U_2 + K_2$$

$$\overset{\parallel}{0} \quad \overset{\parallel}{\tfrac{1}{2}\cancel{m}v_i^2} = \cancel{m}\underset{\overset{\parallel}{10\,m/s^2}}{g}\,(h=25m) \quad \overset{\backslash\backslash}{\tfrac{1}{2}\cancel{m}V_f^2}$$

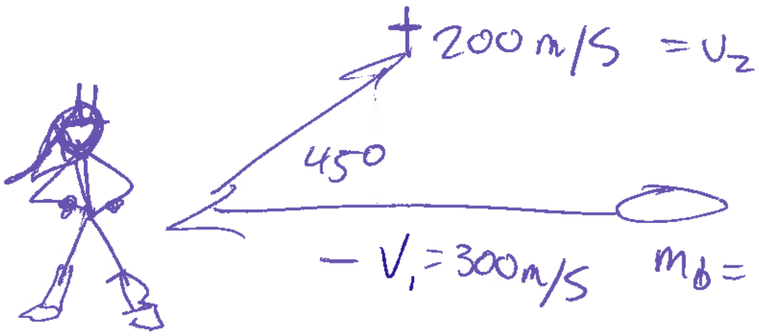
$$\frac{1}{2}(1600) = 250 + \frac{1}{2}V_f^2 \quad [m/s]$$

$$2\times(800-250) = 1100 = V_f^2$$

$$V_f = \sqrt{1100}\ m/s$$

$$\boxed{V_f = 33\ m/s}$$

3. Wonder Woman deflects bullets.



$m_b = 5\,g = 0.005$ kg

$\Delta t = 0.0010$ sec.

Impulse?

$$J_x = \Delta p_x$$

$$J_y = \Delta p_y$$

$$V_{1x} = -300\ m/s \qquad V_{1y} = 0$$

$$V_{2x} = (+200\ m/s)\underset{0.707}{\cos 45^\circ} = 141\ m/s$$

$$V_{2y} = (+200\ m/s)\sin 45^\circ = 141\ m/s$$

$$J_x = mV_{2x} - mV_{1x} = 0.005\ kg\,(+141\ m/s + 300\ m/s)$$

$$= 2.2\ kg \cdot m/s$$

$$J_y = mV_{2y} - mV_{1y} = 0.005\ kg\,(141\ m/s) = 0.70\ kg \cdot m/s$$

$$|J| = \sqrt{J_x^2 + J_y^2} = \sqrt{0.5 + 4.8} = \sqrt{5.3} = \boxed{2.3\ kg \cdot m/s}$$

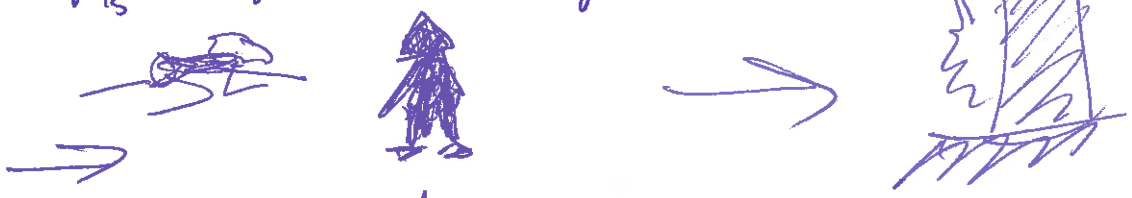
$$\theta = \arctan \frac{J_y}{J_x} = \boxed{0.3\ rad} = (18^\circ)$$

$$F_{AVE} = \frac{J}{\Delta t}$$, same angle but × 1000 ⇒ N

$$\boxed{2300\ N}$$

4. Supergirl Tackles Darkseid

$m_S = 60\,kg$ $M_D = 200\,kg$



$V_S = 1000\,m/s$ $V_D = 0$

Conservation of Momentum:

$$P_S + P_D = P_{pair}$$

$$\underset{60{,}000\ kg\cdot m/s}{m_S V_S} + \underset{0}{m_D V_D} = \underset{260\ kg\ V_{pair}}{(m_S + m_D) V_{pair}}$$

$$V_{pair} = \left(\frac{60{,}000}{260}\right) m/s = \boxed{231\, m/s}$$

$P_{final} = (260)(231) = 60000\ kg\,m/s$ = same.

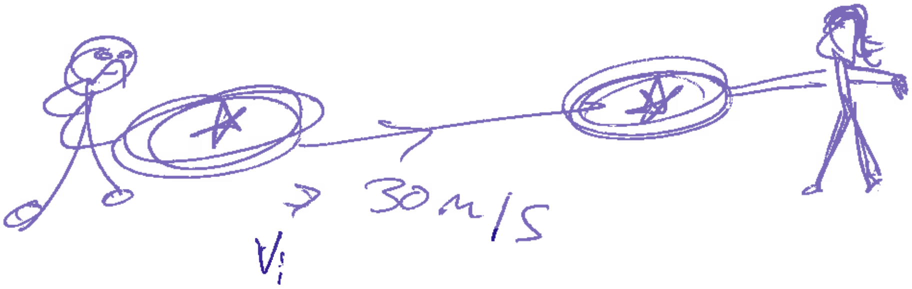
$P_{initial}/_{final} = 1.$

K.E. $K_1 = \frac{1}{2} m_S V_S^2$ $K_2 = \frac{1}{2}(m_S + m_D) V_{pair}^2$

$$\frac{K_1}{K_2} = \frac{m_S V_S^2}{(m_S + m_D) V_{pair}^2} = \frac{(60\,kg)(1000\,m/s)^2}{(260\,kg)(231)^2} = \frac{6 \times 10^6}{139\,000}$$

$$= \underline{\underline{43}}$$

5. Capt. America Throws Shield



$\omega = 10$ rad/s

$m = 10$ kg. $r_S = 0.40$ m.

$I = \frac{1}{2} m R^2$

$K = \frac{1}{2} m v_2^2 + \frac{1}{2} I \omega^2 = \ldots$

$p = mv = \ldots$

$L = I\omega = \ldots$

Plug & Chug w/ the given information.

6. Quicksilver in Hamster wheel.

$I = M R^2$ for hollow cylinder

$R = 2\,m$

$m = 300\,kg$.

$t_{final} = 10\,sec$

$\omega_f = 100\,rad/s$

V_{linear}?

α_{const} ?

$K_{wheel} =$?

Work?

$Work = K_{wheel}$.

$K_{wheel} = \frac{1}{2} \underset{\checkmark}{I} \underset{\checkmark}{\omega^2}$ all given.

$V = \underset{\checkmark}{R}\underset{\checkmark}{\omega}$ – all given.

α_{const}? :

$$\omega_z = \overset{0}{\omega_{0z}} + \alpha_z \overset{10\,sec}{t}$$

$$\alpha_z = \frac{\omega_z}{10\,sec.} = 10\,rad/s.$$

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