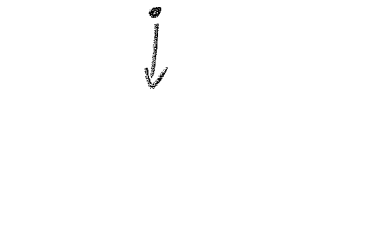
Quiz #6A

Clearly indicate (with a box) your answers to the following questions. SHOW ALL WORK.

1. A 35-kg child jumping on a trampoline reaches a maximum height 1.5 meters above the surface. Upon landing on the surface of the trampoline, the trampoline fabric stretches, allowing the child to come to a step within 12 centimeters. What is the average upward force exerted on the child by the surface of the trampoline?



Falling

$\Delta y = 1.5\ m$

$v_{0y} = 0$

$v_y = ?$

$a_y = 9.8\ m/s^2$

$t = ?$

$v_y^2 = v_{0y}^2 + 2a_y \Delta y$

$v_y = \sqrt{2a_y \Delta y} = \sqrt{(2)(9.8)(1.5)} = 5.43\ m/s$

Trampoline

$v_0 = 5.43\ m/s$

$v = 0$

$\Delta y = 0.12\ m$

$a_y = ?$

$t = ?$

$\Delta y = \frac{1}{2}(v_0 + v)t$

$.12 = \frac{1}{2}(5.43 + 0)t$

$t = .0442\ s$

$P_i = mv_0 = (35)(5.43)$

$= 190\ kg \cdot m/s$

$P = 0$

$\frac{\Delta p}{\Delta t} = \bar{F} = \frac{0 - 190}{.0442} = -4300\ N$

4300 N, upwards

2. A 12-gram bullet is fired into a stationary 1.5-kg wooden block and emerges from the block with a speed of 48 m/s. After the bullet strikes the block, the block slides along a rough surface for 2.1 meters before coming to a stop. The coefficient of kinetic friction between the block and surface is 0.33. What was the initial speed of the bullet?

Collision

$m_1 = .012\ kg$

$m_2 = 1.5\ kg$

$V_{1i} = ?$

$V_{2i} = 0$

$V_{1f} = 48\ m/s$

$V_{2f} = ?\ 3.69\ m/s$

$m_1 V_{1i} + 0 = m_1 V_{1f} + m_2 V_{2f}$

$V_{1i} = \dfrac{(.012)(48) + (1.5)(3.69)}{.012}$

$= \boxed{510\ m/s}$

Sliding

$\Sigma W_F = W_{KF} = 0 - \frac{1}{2} m V_0^2$

$-\mu_K m g \Delta s = -\frac{1}{2} m V_0^2$

$V_0 = \sqrt{\mu_K 2 g \Delta s}$

$= \sqrt{(.33)(2)(9.8)(2.1)} = 3.69\ m/s$

3. Two cars of equal mass collide at an intersection, and the subsequent wreckage moves as one object. The speed of car A is 41 m/s in a direction 65° North of East, and the speed of car B is 47 m/s due East. What is the magnitude and direction of the velocity of the wreckage immediately after the collision.

$$V_{A,x} = 41 \cos 65^\circ = 17.3 \text{ m/s}$$

$$V_{A,y} = 41 \sin 65^\circ = 37.2 \text{ m/s}$$

$$V_{Bi,x} = 47$$

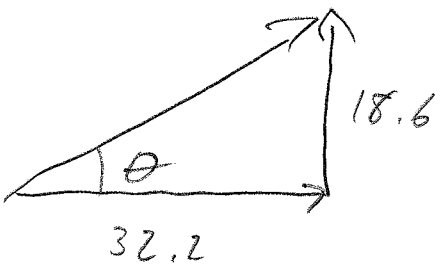
$$V_{Bi,y} = 0$$

$$m V_{Ai,x} + m V_{Bi,x} = 2m V_{f,x}$$

$$17.3 + 47 = 2V_{f,x} \qquad V_{f,x} = 32.2 \text{ m/s}$$

$$m V_{Ai,y} + m V_{Bi,y} = 2m V_{f,y}$$

$$37.2 + 0 = 2V_{f,y} \qquad V_{f,y} = 18.6 \text{ m/s}$$



$$V_f = \sqrt{32.2^2 + 18.6^2}$$

$$= \boxed{37 \text{ m/s}}$$

$$\theta = \tan^{-1}\left(\frac{18.6}{32.2}\right) = \boxed{30^\circ \text{ N of E}}$$