Name:_____

Physics 117
Quiz 2 (2/19/2003)

A) A ball is hit with a horizontal speed of 15 m/s and a vertical speed of 18 m/s upward.
   Q-A1: *What are these speeds 1 second later?*
   (Consider the gravitational acceleration g=10 m/s^2 and ignore the air resistance)

A-A1: We can separate the horizontal and vertical motions.

$$\text{In general } v(t) = v_{init} + at \quad \text{where } a \text{ is the acceleration in the direction of the motion}$$

$$\text{So} \quad \begin{cases} {}^{horiz}v = {}^{horiz}v_{init} \\ {}^{vert}v = {}^{vert}v_{init} - gt \end{cases}$$

$$\text{where} \quad {}^{horiz}v_{init} = 15 \ m/s, \quad {}^{vert}v_{init} = 18 \ m/s$$

For *t=1 s* one gets

$$\begin{cases} {}^{horiz}v = 15 \ m/s \\ {}^{vert}v = 18 \ m/s - 10 \ m/s^2 \cdot 1 \ s = 8 \ m/s \end{cases}$$

B) A car turns a corner with a radius 25 m at a speed of 15 m/s.
   Q-B1: *What is the car's acceleration?*
   Q-B2: *If the car has a mass of 1000 Kg, what is the force that causes the car to turn?*

A-B1: The acceleration to which the car is subject when it turns is the centripetal one:

$$a_c = \frac{v^2}{r} = \frac{(15 \ m/s)^2}{25 \ m} = \frac{225}{25} \ m/s^2 = 9 \ m/s^2$$

A-B2: The force is simply given by Newton's second law F=ma:

$$F = ma_c = m\frac{v^2}{r} = 1000Kg \cdot 9 \ \frac{m}{s^2} = 9000 \ N$$

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C) Two children with masses of 27 and 36 Kg are sitting on a balanced seesaw.
Q-C1: *If the lighter child is sitting at 4 m from the center, where is the heaver child sitting?*

A-C1: If the seesaw is in equilibrium then the torques, $\tau = F\, r$, on the two sides are equal.

$$\tau_1 = W_1 \cdot r_1 = m \cdot g \cdot r_1 = 27\ Kg \cdot 10\frac{m}{s^2} \cdot 4\ m = 1080\ N \cdot m$$

$$\tau_2 = W_2 \cdot r_2 = m \cdot g \cdot r_2 = 36\ Kg \cdot 10\frac{m}{s^2} \cdot r_2 = 360\ N \cdot r_2$$

$$\text{At equilibrium}:\ \tau_1 = \tau_2\ \text{ hence }\ r_2 = \frac{1080}{360}m = 3\ m$$

Note that it is not necessary to know the exact value of g in order to answer the question (in the above calculations you can leave it unspecified and in the final ratio it will drop out).