1) A car traveling 60.0 km/h is 25.0 m from a barrier when the driver slams on the brakes. The car hits the barrier 2.00 s later. (a) What is the car's constant deceleration before impact? (5 pts) (b) How fast is the car traveling at impact? (5 pts)

\[ a = \frac{2 \times (\Delta x - v_0 t)}{t^2} = -4.17 \text{ m/s}^2 \]

\[ v = v_0 + at = 16.67 \text{ m/s} - 4.17 \text{ m/s}^2 \times 2.5 \]

| \[ = 8.33 \text{ m/s} \] |

You can also use \[ v^2 = v_0^2 + 2a \Delta x \]. Numerically, the above formula is simpler.
2) A ball rolls horizontally off the top of a stairway with a speed of 1.6 m/s. The steps are 20 cm high and 20 cm wide. If one defines the first step to be the first one down, which step does the ball hit first? Show a picture in addition to the calculations.

\[ x = v_0 t \]
\[ y = \frac{1}{2} gt^2 = \frac{1}{2} g \left( \frac{x}{v_0} \right)^2 \]

Let \( y_A = 0.2 \text{ m} \) \( x_A = 0.2 \text{ m} \) \( \downarrow 1^{st} \text{ step} \)

Number of steps: \( n \) an integer

\[ ny_1 = \frac{1}{2} g \left( \frac{nx_1}{v_0} \right)^2 \]

\[ \Rightarrow n = \frac{2y_1 v_0^2}{g x_1^2} = 2.6 \Rightarrow n = 3 \]

Discarding \( n = 0 \)

Another way is to work in increment of height. For example at

\[ y = 0.6 \text{ m} \quad t = 0.35 \text{ s} \quad \Rightarrow x_2 = 0.56 \text{ m} < 0.6 \text{ m} \]

\( \Rightarrow 3^{rd} \text{ step} \).
3) In the Figure shown below, blocks A and B have weights of 44 N and 22 N, respectively. (a) Determine the minimum weight of block C to keep A from sliding if \( \mu_s \) between A and the table is 0.20. (5 pts) (b) Block C suddenly is lifted off A. What is the acceleration of block A if \( \mu_k \) between A and the table is 0.15. (5 pts)

![Diagram of blocks A, B, and C]

q) For B:
\[ T - m_B g = 0 \Rightarrow T = m_B g = 22 N \]

For A+C:
\[ m_C \left( m_A g + m_C g \right) = T = 22 N \]
\[ 0.2 \left( 44 N + m_C g \right) = 22 N \Rightarrow m_C g = 110 N - 44N = 66N \]

b) If C is lifted, we get:

For A:
\[ T - \mu_k \times 44 N = m_A a \]
\[ T = 22 N - \mu_k \times 44 N = (m_A + m_B) a \]

For B:
\[ 22N - T = m_B a \]
\[ a = 2.3 \text{ m/s}^2 \]