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) $\Delta x = v_0 t + \frac{1}{2} a t^2$ $\qquad v_0 = 60 \frac{km}{h} = 16.67 m/s$

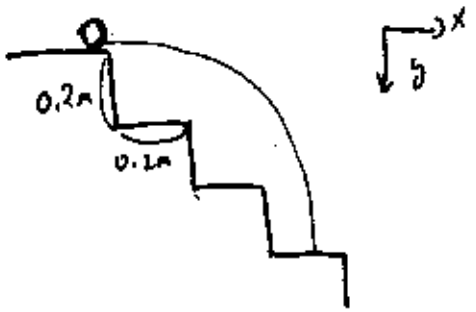
$\Rightarrow a = 2 \times \frac{(\Delta x - v_0 t)}{t^2} = -4.17 m/s^2$

b) $v = v_0 + at = 16.67 m/s - 4.17 m/s^2 \times 2s$

$= 8.33 m/s$

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.



$$x = v_0 t$$

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

let $y_1 = 0.2\,m$ $\quad x_1 = 0.2\,m \leftarrow 1^{st}$ step

Number of steps: n an integer

$$n y_1 = \frac{1}{2} g \left(\frac{n x_1}{v_0}\right)^2$$

e.g. $1 < n < 2$
$\Rightarrow n = 2$
$2 < n < 3$
$n = 3$

Discarding $n = 0$

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

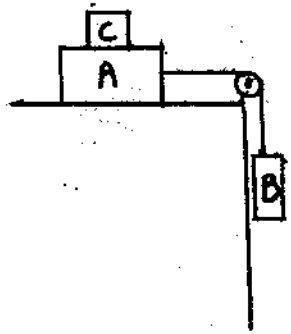
$\uparrow 3^{rd}$ step

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

$y = 0.6\,m \quad t = 0.35\,s \Rightarrow x = 0.56\,m < 0.6\,m$

$\Rightarrow 3^{rd}$ 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 μ_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 μ_k between A and the table is 0.15. (5 pts)



a) For B: $T - m_B g = 0 \Rightarrow T = m_B g = 22N$

For A+C: $\mu_s (m_A g + m_C g) = T = 22N$

$0.2\,(44N + m_C g) = 22N \Rightarrow$ **$m_C g = 110N - 44N = 66N$**

b) If C is lifted, we get:

For A: $T - \mu_k \times 44N = m_A a$

For B: $22N - T = m_B a$

$\Rightarrow 22N - \mu_k \times 44N = (m_A + m_B) a$

$\Rightarrow$ **$a = 2.3\ m/s^2$**