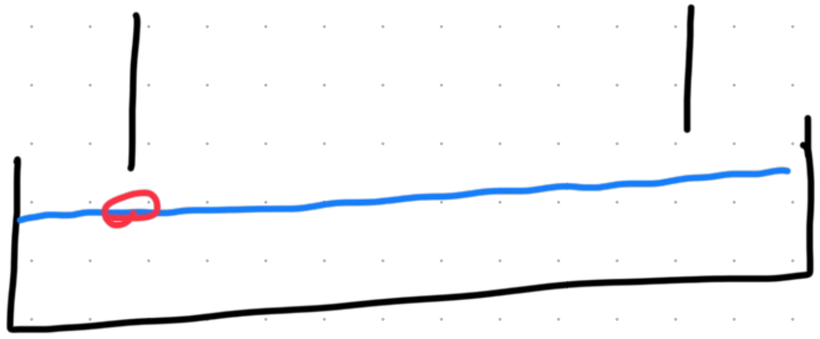
2019 B #7

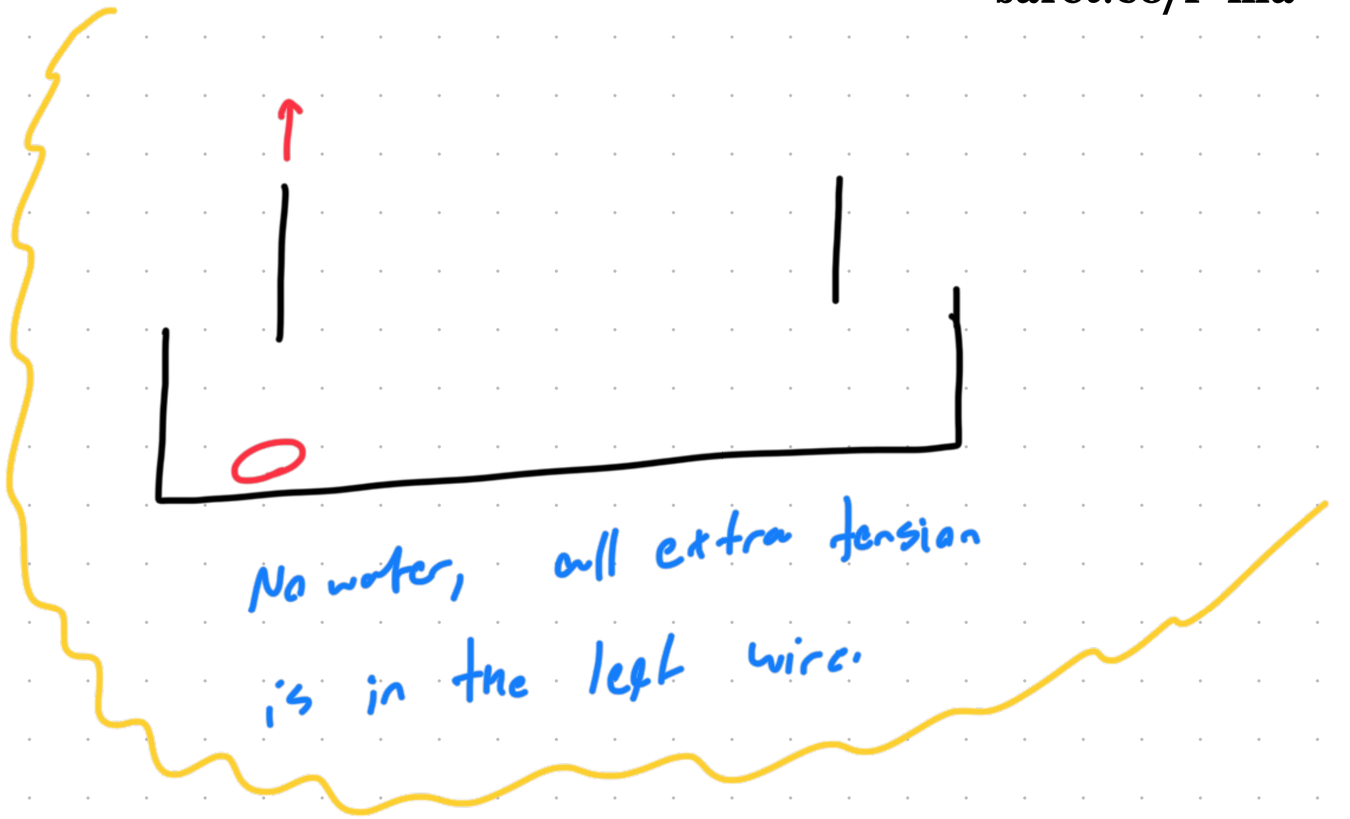


Pascal's Law:

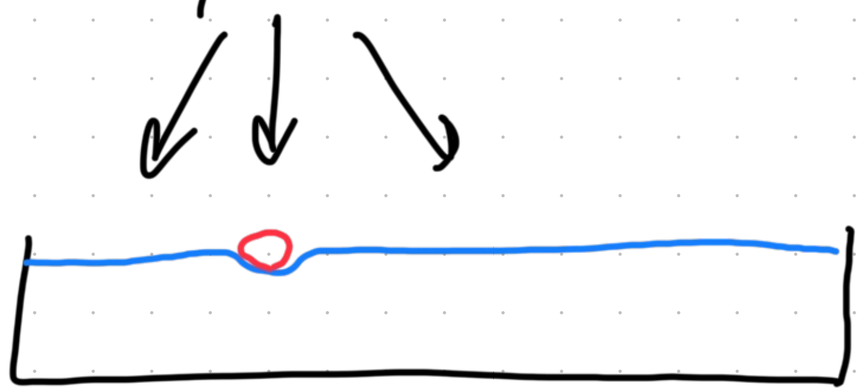
all pressure is transmitted (distributed) equally throughout the water.

So, tension increases equally!

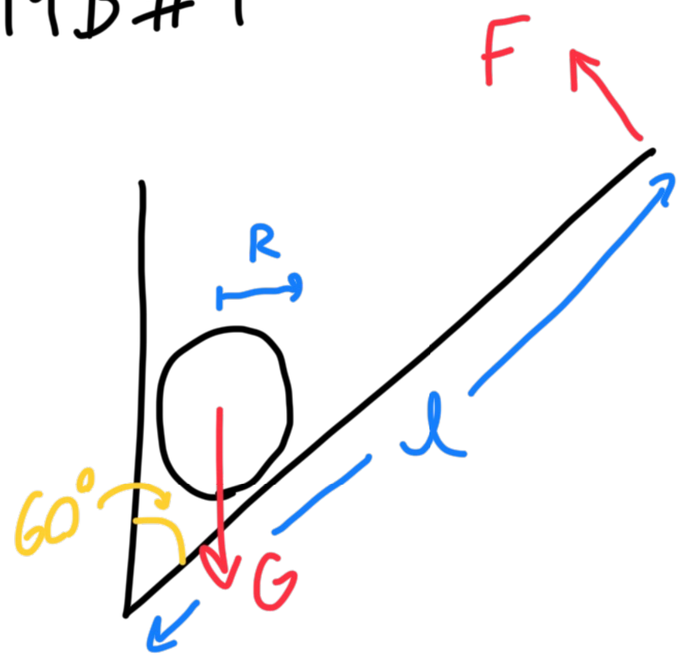
B



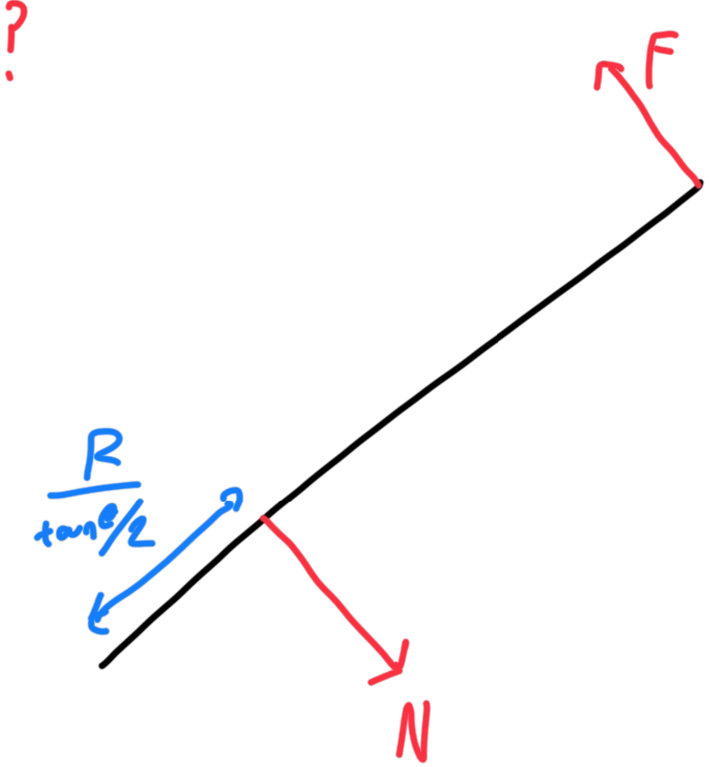
mass/width is constant!



2019B#9



F = ?

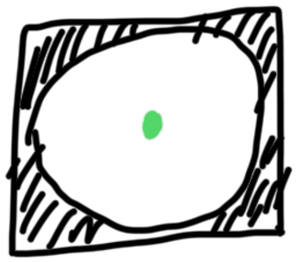


$N\sin\theta = G \Rightarrow N = G/\sin\theta$

$$\frac{GR}{\sin\theta\tan\frac{\theta}{2}} = Fl \Rightarrow F = \frac{GR}{l}\cdot\frac{1}{\sin\theta\tan\frac{\theta}{2}} = 2GR/l^2$$

(B)

2019 B #11



$I = ?$

$I_{disk} = \frac{1}{2} M_{disk} \left(\frac{L}{2}\right)^2$

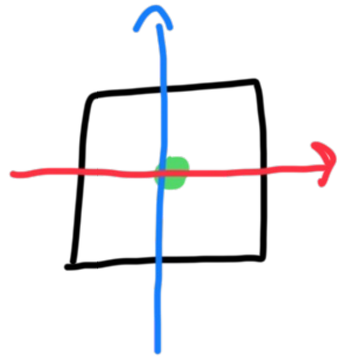
$M_{disk} = \frac{A_{disk}}{A_{sq}} M_{sq}$

$= \frac{\pi(\frac{L}{2})^2}{L^2} M = \frac{\pi}{4} M$

$I_{disk} = \frac{1}{2} \frac{\pi}{4} M \left(\frac{L}{2}\right)^2$

$= \frac{\pi}{32} ML^2$

Subtract!



$I_{sq_z} = ? = \frac{1}{6} ML^2$

GUESS A?

Perpendicular Axis Theorem

(very thin object in xy plane)

$I_x + I_y = I_z$

$I_{sq_x} = I_{sq_y} = \frac{1}{12} ML^2$

$\Rightarrow \quad I = I_{sq} - I_{disk} = \left(\frac{1}{6} - \frac{\pi}{32}\right) ML^2$

A

⊥ AT

$$I_z = \sum_{x,y} (\delta m) r^2 = \sum_{x,y} \delta m (x^2+y^2) = \sum_{xy} \delta m (x^2) + \sum_{x,y} \delta m (y^2)$$

$$= I_x + I_y$$

2019 B #18

$V_0 \pm 10\%$ $a \pm 10\%$

how do these relate to the longest a race?

$$x = v_0 t + \frac{1}{2}at^2$$

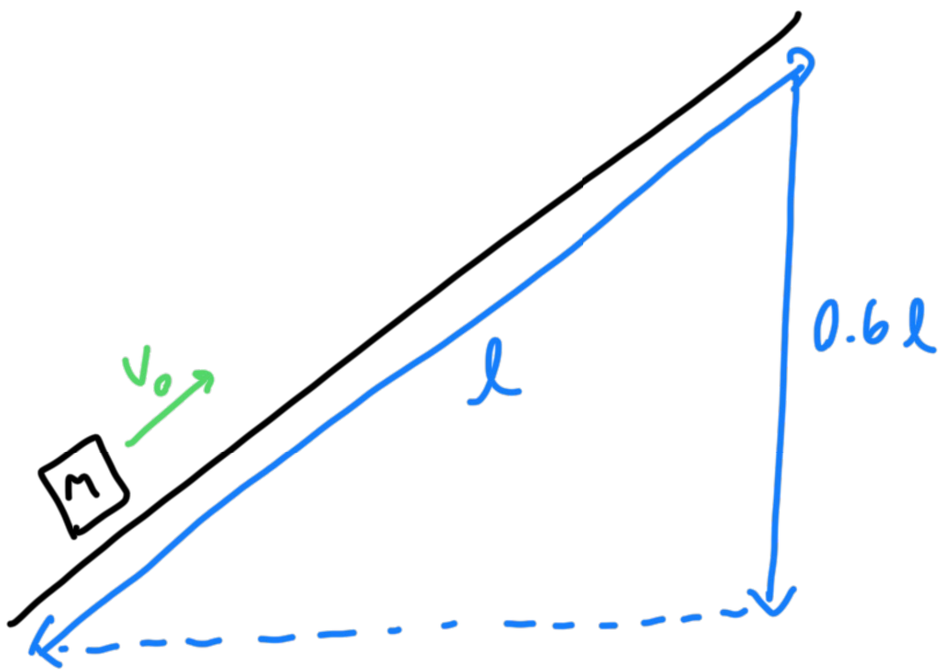
$$x = (v_0 \pm \Delta v)t + \frac{1}{2}(a \pm \Delta a)t^2$$

↑ dominates for small t

↑ dominates for large t

(A)

2019 B #20



$t_d = ?\ (t_u)$ $\quad \mu = 0 \Rightarrow t_d = t_u$

a_d vs a_u? $\quad \sin\theta = 3/5$

$a_g = g\sin\theta = 3g/5$ downwards

$a_\mu = \mu N/m = \mu g\cos\theta = 2g/5$ opposite motion

$a_d = a_g - a_\mu = g/5$

$a_u = -a_g - a_\mu = g$

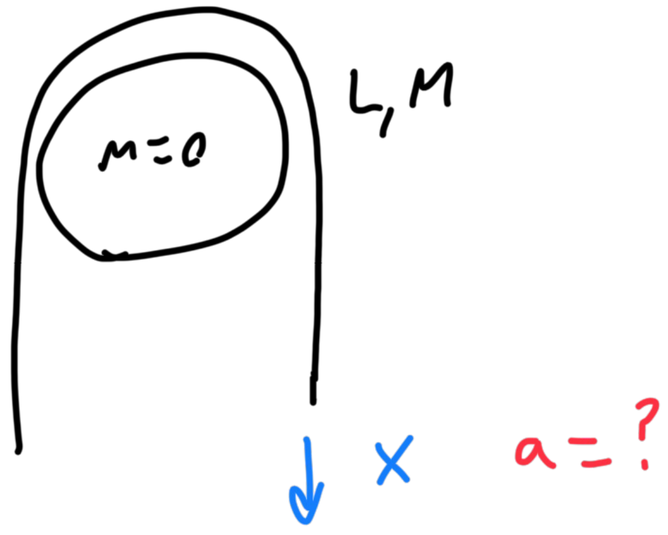
up: $\ell = \frac{1}{2} a_u t_u^2$ $\quad$ down: $\ell = \frac{1}{2} a_d t_d^2$

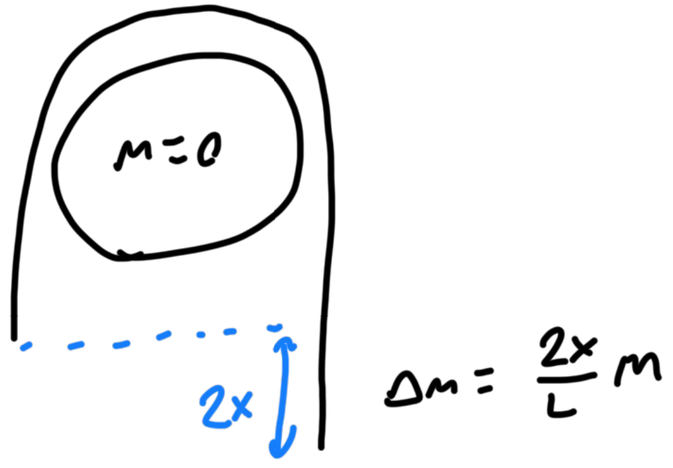
$a_u t_u^2 = a_d t_d^2$

$t_d = \sqrt{\frac{a_u}{a_d}}\, t_u = t_0/\sqrt{5}$

(C)

2019 B #24





$$\Delta m = \frac{2x}{L} m$$

$$F = \frac{2x}{L} mg$$

$$a = F/M = \frac{2xg}{L}$$ (E)

2019 B #25

$$\frac{\Delta(x^p)}{x^p} = |p|\left(\frac{\Delta x}{x}\right)$$

$$\frac{\Delta(xy)}{xy} = \sqrt{\left(\frac{\Delta x}{x}\right)^2+\left(\frac{\Delta y}{y}\right)^2}$$

$$g = \frac{2h}{t^2}$$

$$\frac{\Delta g}{g} = \frac{\Delta(h\,t^{-2})}{ht^{-2}}$$

$$= \sqrt{\left(\frac{\Delta h}{h}\right)^2+\left(\frac{\Delta(t^{-2})}{t^{-2}}\right)^2}$$

$$\frac{\Delta(t^{-2})}{t^{-2}} = |-2|\,\frac{\Delta t}{t}$$

$$\frac{\Delta g}{g} = \sqrt{\left(\frac{\Delta h}{h}\right)^2+4\left(\frac{\Delta t}{t}\right)^2}$$

A: 10%

B: 20%

C: $\sqrt{(5\%)^2+(10\%)^2} \approx 11.2\%$

(A)