Trevor N. tln32 Lab 2: IP PHYS121 Sec 118B Station 14

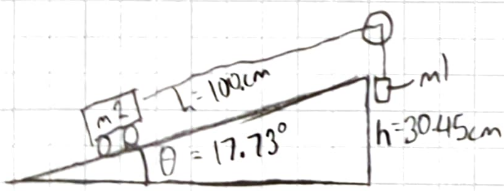
Trial	height (cm)	m_2 (g)	m_1 (g)	$m_1 max$ (g)	$m_1 min$ (g)
1	30.45	489.	180.	159.	150.
2		489.	180.	158.	150.
3		491.	180.	158.	151.
4		489.	180.	158.	150.
5		476.	180.	158.	151.
6		490.	180.	158.	151.
7		490.	180.	158.	151.
8		489.	180.	158.	151.
9		491.	180.	158.	150.
10		491.	180.	158.	151.
Mean	30.45	488.	180.	158.1	150.6
SD	–	4.48	0.		
SE	0.01	1	0.	0.1	0.2

Balanced: $\sin\theta \, m_2 = m_b$

$\Downarrow$

$148.75 \approx \boxed{149 g}$

a m_1 of 149g should balance the cart at an incline



$\theta = \arcsin\left(\frac{O}{h}\right)$

$\Downarrow$

$\boxed{\cancel{17.73}}$ 17.7281°

$h = 100.00 \pm 0.01$ cm

$O = 30.45 \pm 0.01$ cm

$\delta_\theta = \sqrt{\left(\frac{1\cdot\delta_O}{h\sqrt{1-\left(\frac{O}{h}\right)^2}}\right)^2 + \left(\frac{-O\delta_h}{h^2\sqrt{1-\left(\frac{O}{h}\right)^2}}\right)^2} = 0.0001°$

$\boxed{\theta = 17.7281 \pm 0.0001°}$

$m_b = \frac{m_1 max + m_1 min}{2} = 154.35 \approx 154$

$\delta_{m_b} = \frac{m_1 max - m_1 min}{2} = 3.75 \approx 4$

$\Downarrow$

$\boxed{m_b = 154 \pm 4 g}$

$\delta_{\sin\theta} = \frac{\partial \sin\theta}{\partial\theta} \cdot \delta_\theta = \cos\theta \, \delta_\theta$

$\Downarrow$

0.0001

$\sin\theta = \boxed{0.3045 \pm 0.0001}$

$$a = \frac{g(m_1 - m_2 \sin\theta)}{m_1 + m_2} = \boxed{\cancel{0.4586\ m/s^2}}$$

$\sin\theta = \frac{m_b}{m_2}$

$m_1 = m_e = m_b + 25$

$$= \frac{g\left(m_1 - m_2\left(\frac{m_b}{m_2}\right)\right)}{m_1 + m_2} = \frac{g(26)}{m_1 + m_2} = 0.3815\ m/s^2 = \frac{26g}{m_b + m_2 + 26}$$

$$\delta_a = \sqrt{\left(\frac{g26\,\delta_{m_b}}{(m_b + m_2 + 26)^2}\right)^2 + \left(\frac{g26\,\delta_{m_2}}{(m_b + m_2 + 26)^2}\right)^2} = 0.0032\ m/s^2$$

$$\Downarrow$$

$$\boxed{a = 0.382 \pm 0.003\ m/s^2}$$

Experimental accel.

From a: 0.2895

$\delta_a = \frac{\sigma}{\sqrt{N}} = 0.0079$

$a = 0.290 \pm 0.008\ m/s^2$

From v:

$a = 0.287 \pm 0.002\ m/s^2$

Values agree.

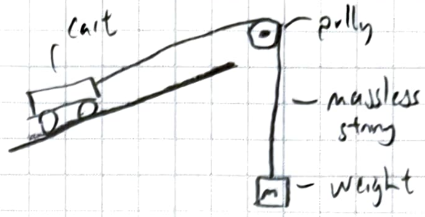
Origin:

Slope: $0.388 \pm 0.003\ m/s^2 = a_{exp}$

$a_{pred} = 0.382 \pm 0.003\ m/s^2$

Our data and predicted values line up and their error ranges touch.

Procedure



- Measure mass of cart, calc mean & uncertainty

- predict value of weight given mass of cart & slope that will put the system in equilibrium

- ~~[illegible]~~ add weight to the weight until the cart does not move., then remove weight until right before it begins moving. Record this weight as m_{min}

- repeat the previous step, but with adding instead of removing weight. Record as m_{max}

- ~~Calculate expected accelerations from~~
- average m_{min} & m_{max} to roughly find the equilibium weight.

- approximate the acceleration with newton's laws if you added ~~[illegible]~~ 25g of weight.

- add 25g of weight and measure the acceleration

- compare accelerations.