Inertia Wheel Lab Report

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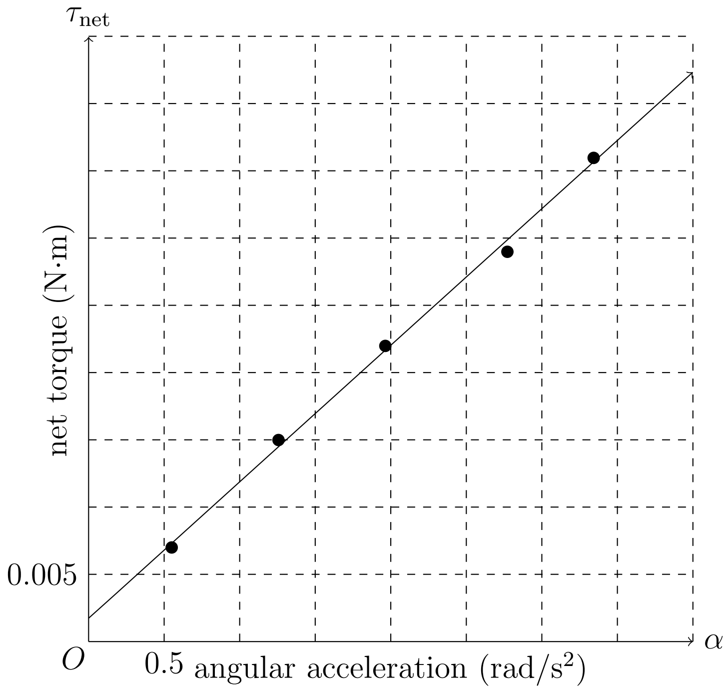
Data

m_w (kg)	$(\Delta t)_{\text{avg}}$ (s)	Δy (m)	a $\left(\text{m/s}^2\right)$	α $\left(\text{rad/s}^2\right)$	τ_{net} $(\text{N} \cdot \text{m})$
0.02	96 | 1, 1 97 | 0 98 | 99 | 1, 7 100 | 0 101 | 6 $\boxed{11\|1 = 1.11}$ $(\Delta t)_{\text{avg}} = 9.85$		$v_0 = 0$ $\Delta y = v_0 \Delta t + 0.5a(\Delta t)^2$ $= v_0(\Delta t)_{\text{avg}} + 0.5a(\Delta t)^2_{\text{avg}}$ $a = \dfrac{2(\Delta y - v_0(\Delta t)_{\text{avg}})}{(\Delta t)^2_{\text{avg}}}$ $= \dfrac{2(1-0)}{9.85^2} \approx 0.021$	$\alpha = \dfrac{a}{r_p}$ $\approx \dfrac{0.021}{0.125}$ ≈ 0.275	$\tau_{\text{net}} = F_{\text{net}} \times r_p$ $= mr_p(g-a)$ $\approx 0.02(9.8 - 0.021)$ ≈ 0.007
0.04	64 | 1 65 | 0, 1, 1, 5 66 | 0 $\boxed{11\|1 = 1.11}$ $(\Delta t)_{\text{avg}} \approx 6.513$		≈ 0.047	≈ 1.257	≈ 0.015
0.06	49 | 2 50 | 0, 3 51 | 52 | 53 | 1 54 | 0, 1, 1 $\boxed{11\|1 = 1.11}$ $(\Delta t)_{\text{avg}} \approx 5.211$	1	≈ 0.074	≈ 1.964	≈ 0.022
0.08	42 | 6 43 | 0 44 | 1, 2, 5, 8 $\boxed{11\|1 = 1.11}$ $(\Delta t)_{\text{avg}} \approx 5.211$		≈ 0.104	≈ 2.772	≈ 0.029
0.1	37 | 3 38 | 4 39 | 3 40 | 1, 8 41 | 0 41 | 5 $\boxed{11\|1 = 1.11}$ $(\Delta t)_{\text{avg}} \approx 3.994$		≈ 0.125	≈ 3.343	≈ 0.036

I_{net}

$$\begin{aligned} I_{\text{net,th}} &= 0.5 m_d r_d^2 + m_p r_p^2 \\ &= 0.5(1.3)(0.125)^2 0.1(0.0375)^2 \\ &\approx 0.01\,\mathrm{N}\cdot\mathrm{m} \end{aligned}$$



$$\tau_{\text{net}} \approx 0.00174015 + 0.0101685\alpha$$
$$r^2 \approx 0.998$$

$$\begin{aligned} I_{\text{net,exp}} &\approx 0.01 \\ \%\ \text{error} &= \left|\frac{I_{\text{net,exp}} - I_{\text{net,th}}}{I_{\text{net,th}}}\right| \approx 1.25\% \end{aligned}$$

The reason that the least-squares regression line relating τ_{net} to α does not display direct variation is that a lack of angular acceleration may occur when torque is not great enough to overcome friction.