

$$1. \Delta\theta = 24 \text{ rotations} \left(\frac{2\pi \text{ rad}}{1 \text{ rev}} \right) = \boxed{151 \text{ rad}}$$

$$2. \boxed{s = \theta r}$$

or

$$\boxed{\Delta x = \Delta\theta r}$$

$$0.8 \text{ m} = 151 \text{ rad} (r)$$

↑

Distance traveled
by a point on
the edge of the
axle during descent

↓

$$\boxed{r = 0.0053 \text{ m}}$$

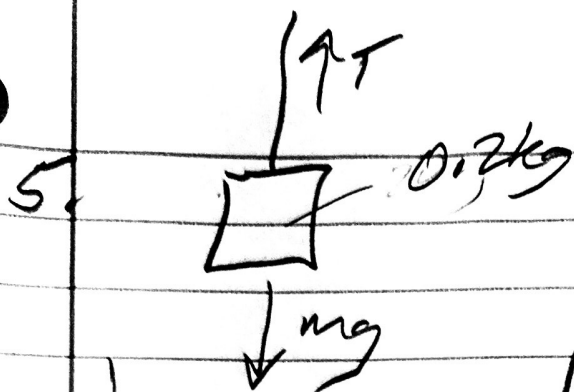
$$3. \boxed{\Delta\theta = \omega_0 t + \frac{1}{2} \alpha t^2}$$

$$151 \text{ rad} = 0(2.7 \text{ s}) + \frac{1}{2} \alpha (2.7 \text{ s})^2$$

$$\boxed{\alpha = 41.4 \text{ rad/s}^2}$$

$$4. \boxed{a = \alpha r} = 41.4 \text{ rad/s}^2 (0.0053 \text{ m})$$

$$\boxed{a = 0.219 \text{ m/s}^2}$$



$$\begin{aligned} \Sigma F &= ma \\ \Sigma F &= T - mg \end{aligned}$$

$$\checkmark a = 0.219 \text{ m/s}^2$$

$$ma = T - mg$$

$$ma + mg = T$$

$$T = m(a + g) \quad \text{Downward}$$

$$T = 0.2 \text{ kg} (-0.219 \text{ m/s}^2 + 9.8 \text{ m/s}^2)$$

$$\boxed{T = 1.92 \text{ N}}$$

6. $\boxed{\omega = \omega_0 + \alpha t} = 0 + 41.4 \text{ rad/s}^2 (2.7 \text{ s})$
 $\boxed{\omega = 112 \text{ rad/s}}$

7. $\boxed{v = \omega r} = 112 \text{ rad/s} (0.08 \text{ m})$ ↙ wheel radius

$$\boxed{v_{\text{edge of wheel}} = 8.96 \text{ m/s}}$$

8. $s = r\theta$ (arc length)

or $\Delta x = r\Delta\theta$ (Linear displacement)

radius of rotation wheel radius
 $d = 264 \text{ rad} (0.08 \text{ m}) = 21.1 \text{ m}$

distance traveled by a point on the wheel edge

9. $PE_0 + KE_0 + W_{nc} = PE + KE$
 $mgh_0 + 0 + W_{nc} = mgh + 0$

$0.2 \text{ kg} (9.8 \text{ m/s}^2) (0.8 \text{ m}) + W_{nc} = 0.2 \text{ kg} (9.8 \text{ m/s}^2) (0.8 \text{ m})$

$W_{nc} = -0.392 \text{ J}$

10. $s = r\theta$ $(0.8 \text{ m} + 0.6 \text{ m}) = \theta (0.0053 \text{ m})$
 distance traveled by edge of axle axle radius

$\theta = 264 \text{ rad}$

It's like $W = Fd$
↓ ↓ ↓
 W_{work}

11. $W = \tau \Delta \theta$ $-0.392 \text{ J} = \tau_{\text{friction}} (264 \text{ rad})$

$$\tau_{\text{fr}} = -0.00148 \text{ Nm}$$

12. $\tau = rF$

$\tau_{\text{string}} = (\text{axle radius}) (\text{string tension})$

$$\tau_{\text{string}} = (0.0053 \text{ m}) (1.92 \text{ N}) = 0.0102 \text{ Nm}$$

13. $\tau_{\text{net}} = \tau_{\text{string}} + \tau_{\text{friction}}$

$$\tau_{\text{net}} = 0.0102 \text{ Nm} - 0.00148 \text{ Nm}$$

$$\tau_{\text{net}} = 0.00872 \text{ Nm}$$

14. $\tau_{\text{net}} = I \alpha$ $0.00872 \text{ Nm} = I (41.4 \text{ rad/s}^2)$

$$I = 0.00211 \text{ kg m}^2$$