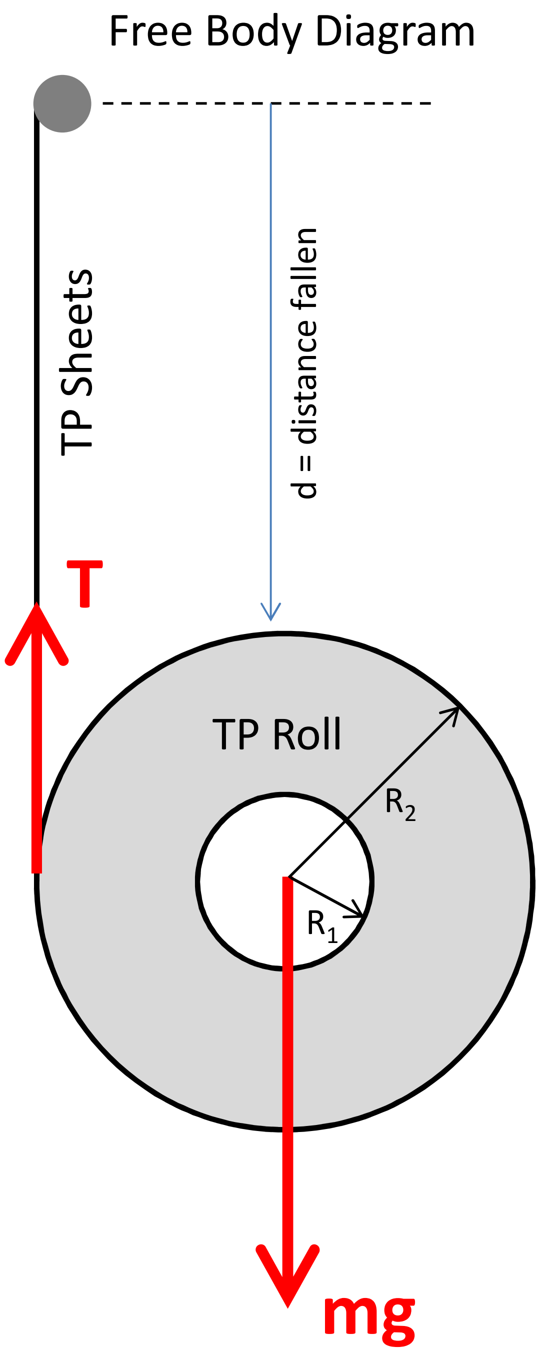

Solutions to Exercises:
The Physics of a Falling and Unrolling TP Roll

(1) ω_f = (1650 °/s) (π radians/180°) = 28.8 rad/s
(2) α = (6626 °/s^2) (π radians/180°) = 116 rad/s^2
(3) $a = \alpha R_2$ = (116 rad/s^2) (0.0575 m) = 6.67 m/s^2
(4) $v_f = \text{sqrt}(v_o^2 + 2ad)$ = sqrt(0 + 2·6.67 m/s^2·0.35) = 2.16 m/s
(5) $F_{net} = mg - T = ma \rightarrow T = m(g - a)$ = 0.155 kg(9.81 m/s^2 – 6.67 m/s^2 = 0.49 N

Optional Exercise Solution:

- Translation motion: $F_{net} = mg - T = ma$
- Rotational motion: $\Sigma\tau = I\alpha$
- Moment of inertia, I, of an annular cylinder about cylinder axis = $\frac{1}{2}m\cdot(R_1^2 + R_2^2)$
- $\alpha = a/R_2$
- $\Sigma\tau = R_2T$ (mg, acting on the center-of-mass, provides no torque)
- A fair amount of algebraic manipulation will yield the following formula:

$$T = \frac{mg(R_1^2 + R_2^2)}{R_1^2 + 3R_2^2}$$