Pendulum

(1)

$$V_{total} = \sqrt{v_x^2 + v_y^2}$$

(2)

$$KE_{total} = \frac{1}{2} I \omega^2$$

(3)

m_c = mass of cup + mass of plate =
0.007 kg + 0.002 kg = 0.027 kg

m_s = mass of 1 skewer = 0.001 kg

L = length of the skewer = 0.203 m

R = distance of cup from axis of rotation = 0.127 m

$$I = \frac{1}{12} m_s L^2 + m_s \left(R - \frac{L}{2}\right)^2 + m_c (R)^2 = 0.00044$$

$$KE = \frac{1}{2} (0.00044) \omega^2 = \frac{1}{2} (0.00044) \frac{v^2}{R^2}$$

$= (0.00022) \frac{v^2}{R^2}$ → calculated with LoggerPro

(4)

$KE_i = 0$ since $v_i = 0$

$PE_i = KE + PE$

(5)

$PE = m_c g h = 0.865h$

Sample Calcs:

(1)

At time $t = 1.979$:

$x_{velocity} = 0.350$ m/s $y = 0.057$ m

$y_{velocity} = -0.074$ m/s

$v_{total} = \sqrt{(0.350)^2 + (-0.074)^2} = 0.358$ m/s

$KE = \frac{1}{2} I \omega^2 = \frac{1}{2}(0.00044)\frac{(0.358)^2}{(0.127)^2} = \boxed{0.0017\ J}$

(2)

$PE = 0.265(0.043) = \boxed{0.011\ J}$

(3)

$PE_{max} = 0.265(y_{max})$ ← from LoggerPro

$= 0.265(0.08) = \boxed{0.021\ J}$

$KE_{max} = 0.021\ J$

$\frac{1}{2} I \omega^2 = 0.021 J$

$\frac{1}{2}(0.000044)\frac{v_{max}^2}{(0.127)^2} = 0.021$

$v_{max} = \boxed{1.241\ m/s}$