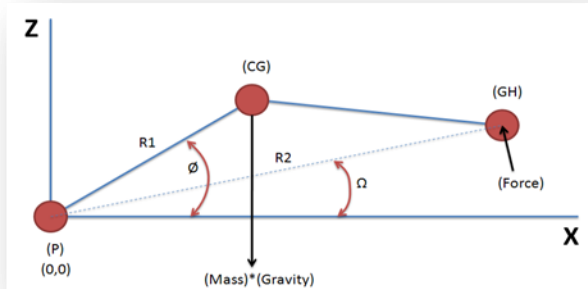


Objective:

Calculate torque requirements to rotate system from 43.5 to 133.5 degrees. Also calculate angular velocity, and angular speed of system.



Input Values

Mass = 43 Kg

Starting Spring Rate at (P) = 76 Nm

Ending Spring Rate at (P) = 16 Nm

(GB) Grab Handle Force = 95N (Constant)

Starting Angle = 43.25 Deg = 0.754833 Radians

Ending Angle = 133.25 Deg = 2.32563 Radians

R1 = .258m

R2 = .541m

Torque at (P)

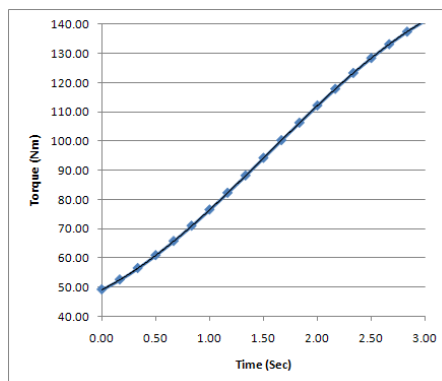
From (CG) = $-(\text{Mass}) \times (\text{Gravity}) \times (R1) \times (\cos \phi) = -[(43)\text{Kg} \times (9.81) \text{ M/s}^2 \times (.258)\text{m} \times \cos \phi]$

From (GH) = $(\text{Force}) \times (R2) = [(95)\text{N} \times (.541)\text{m}] = 51.4 \text{ Nm}$

Linear Torsion Spring = Starts at 76 and reduces to 16 in equal increments over 90 degree sweep

$$\Sigma \text{ Torques} = -(108.8)\cos(\phi)\text{Nm} + (51.48)\text{Nm} + \text{Spring Rate Nm}$$

Angle		Torque (Nm)			
Actual	Incremental	CG	Handle	Spring	Net
43.25	0.00	-78.34	51.48	76.00	49.14
48.25	5.00	-71.62	51.48	72.67	52.53
53.25	10.00	-64.35	51.48	69.33	56.46
58.25	15.00	-56.60	51.48	66.00	60.88
63.25	20.00	-48.41	51.48	62.67	65.74
68.25	25.00	-39.86	51.48	59.33	70.96
73.25	30.00	-31.00	51.48	56.00	76.48
78.25	35.00	-21.90	51.48	52.67	82.24
83.25	40.00	-12.64	51.48	49.33	88.17
88.25	45.00	-3.29	51.48	46.00	94.19
93.25	50.00	6.10	51.48	42.67	100.24
98.25	55.00	15.43	51.48	39.33	106.24
103.25	60.00	24.65	51.48	36.00	112.13
108.25	65.00	33.68	51.48	32.67	117.83
113.25	70.00	42.45	51.48	29.33	123.27
118.25	75.00	50.90	51.48	26.00	128.39
123.25	80.00	58.97	51.48	22.67	133.12
128.25	85.00	66.58	51.48	19.33	137.40
133.25	90.00	73.69	51.48	16.00	141.17



Moment of Inertia (Assumption)

$$I = (\text{Mass}) \times (R_1)^2 = (43) \text{ Kg} \times (.258)^2 \text{ m}^2 = (2.836) \text{ Kg M}^2$$

Speed Calculations

$$\Sigma \text{Torques} = (\text{Inertia}) \times (\text{Angular Acceleration})$$

$$\Sigma T = I \alpha$$

$$\alpha = \Sigma T / I$$

However since the torque is not constant the acceleration is not constant. I think need to relate angular velocity to angular acceleration using differential equations.

Kinematic Equations

$$\omega \, d\omega = \alpha \, d\theta$$

						CG Force	Handle Force	Spring Rate
\int	ω			\int	133.25	$-(108.8)\cos(\theta)$	51.4	?????
	0	ω	=		43.25	(I) = 2.836		