

System Dynamics Exam 1 Sp 2008 Svn

1) See code at end

$$m = 114.8$$

$$b = -84.2$$

$$J = 3.685 \times 10^4$$

$$S = 1.69 \times 10^5$$

$$r^2 = 0.78$$

Obviously not a great fit because the form of the function chosen was bad

2) $\omega_3 = \frac{1}{1.4^2} \omega_1$

$$KE = \frac{1}{2} I_y \omega_1^2 + \frac{1}{2} I_s \omega_3^2$$

$$= \frac{1}{2} \left(I_y + \left(\frac{1}{1.4^2} \right)^2 I_s \right) \omega_1^2$$

so I_{eff} where the torque is applied

$$I_{eff} = I_y + \frac{1}{1.4^4} I_s$$

$$T = I_{eff} \ddot{\omega}_1$$

$$\text{since } \omega_1^2 = (1.4)^4 \omega_3^2$$

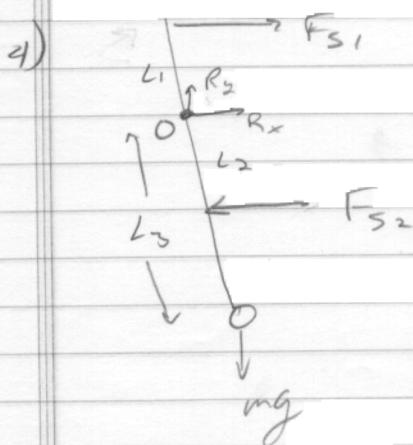
$$T = I_{eff} (1.4)^4 \ddot{\omega}_3$$

or

$$T = \left(I_y + \left(\frac{1}{1.4} \right)^4 I_s \right) (1.4)^2 \ddot{\omega}_3$$

$$T = 0.09 \ddot{\omega}_3$$

- 3) a) unstable
 b) unstable
 c) unstable
 d) unstable, but book calls it neutrally stable
 e) neutrally stable
 f) unstable, but book calls it neutrally stable



$$\sum M_O = I \ddot{\theta}, \quad I = m L_3^2$$

$$F_{S1} = L_1 \Theta K_1$$

$$F_{S2} = (L_2 \Theta - x) K_2$$

$$I \ddot{\theta} = -F_{S1} L_1 - F_{S2} L_2 - L_3 \sin \theta mg$$

$$m L_3^2 \ddot{\theta} = -L_1^2 K_1 \Theta - L_2^2 K_2 \Theta + L_2 K_2 x - L_3 \sin \theta mg \Theta$$

$$m L_3^2 \ddot{\theta} + (L_1^2 K_1 + L_2^2 K_2 + L_3 mg) \Theta = L_2 K_2 x$$

$\sin \theta \approx \theta$ for small θ

```
x=[0:4]
y=[1 8 50 178 490]
a=polyfit(x,y,1)
plot(x,y,x,a(1)*x+a(2))
J=sum((a(1)*x+a(2)-y).^2)
S=sum((y-mean(y)).^2)
r2=1-J/S
```