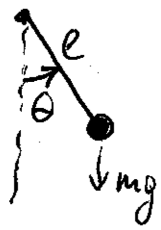
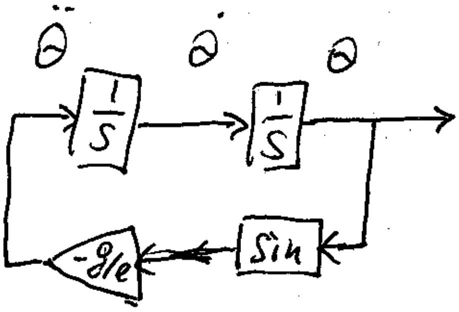
1)

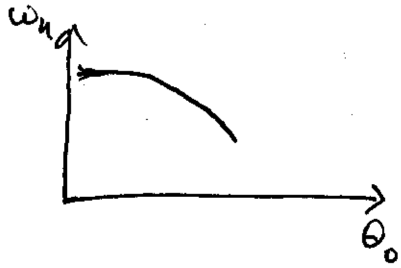


$$\left.\begin{array}{l}\sum C = J\ddot{\theta} \\ C = -mgl\sin\theta\end{array}\right\} \Rightarrow J\ddot{\theta} = -mgl\sin\theta$$

$$\ddot{\theta} = -\frac{mgl\sin\theta}{ml^2} = -\frac{g}{l}\sin\theta$$

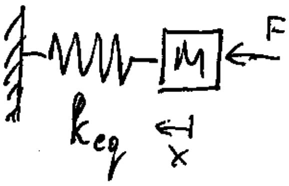
θ_0	5°	20°	40°	60°	80°
ω_n	4,42	4,39	4,3	4,13	3,92





pour le cas linéarisé $\omega_n = 4,42 \ \frac{rad}{sec}$

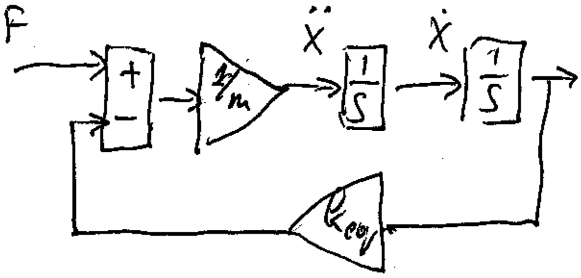
2) a)



$$k_{eq} = k_b + \frac{k_1 k_2}{k_1 + k_2} = 2,25 \cdot 10^7$$

$$\omega_n = \sqrt{\frac{k_{eq}}{M}} = 85,5 \ \frac{rad}{sec} = 13,6 \ Hz$$

b) $m\ddot{x} = F - k_{eq}x \quad \Rightarrow \ddot{x} = \frac{1}{m}(F - k_{eq}x)$



par simulation on trouve $v_{max} = 1$ m/sec

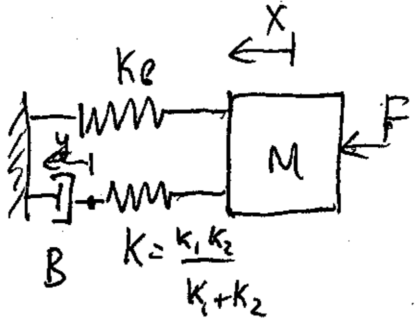
$E_c = \frac{1}{2}Mv^2 = 1539 \ J$

c) Toute l'E_c se tranforme en E_p ($E_c = E_p$)

$$E_p = \frac{1}{2}k_{eq}x^2 \Rightarrow x_{max} = \sqrt{\frac{2E_p}{k_{eq}}} = \sqrt{\frac{2E_c}{k_{eq}}} = 1,17 \ cm$$

$$F_{act} = \frac{k_1 k_2}{k_1 + k_2} x_{max} = 2,59 \cdot 10^5 \ N > 28,35 \ kN \ \left(\text{celle du TD précédent}\right)$$

d)



$$\begin{cases} M\ddot{x} = F - K_e x - K(x-y) \\ B\dot{y} = K(x-y) \end{cases}$$

$$\Rightarrow \begin{cases} \ddot{x} = \frac{1}{M}\left[F - K_e x - K(x-y)\right] \\ \dot{y} = \frac{1}{B} K(x-y) \end{cases}$$

$$B = \frac{\text{Effort Max Actionneur}}{\text{Vitesse max}}$$

$$B = \frac{28350\ N}{1\ m/s} = 28350\ \frac{N}{m/s}$$