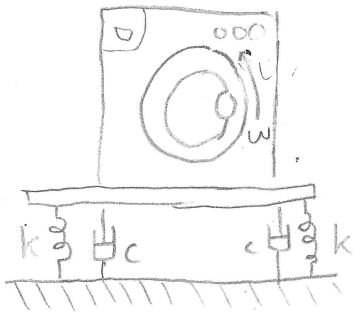
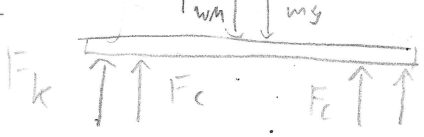
20-R-VIB-DY-38 Intermediate

A 100kg washing machine is mounted on a platform supported by 4 springs and 4 dampers, $c = 10000 N s/m$ each. A load in the machine causes an eccentric motion that is equivalent to a 5kg mass located 0.5m away from the axis of rotation. When the machine is off, the springs are compressed 0.01m. Determine the maximum displacemet, velocity, and acceleration of the platform when the machine is turned on and spinning at 125rad/s



Solution:



$$mg = (4k)y \qquad k = \frac{(100)(9.81)}{4(0.01)} = 245.25\ N/m$$

$$\Sigma F_y = ma$$

$$F_0 = mr\omega^2 = (5)(0.5)(125)^2 = 39062.5$$

$$4(ky) + 4(c\dot{y}) - F_{wm} = -m\ddot{y}$$

$$100\ddot{y} + 4(1000)\dot{y} + 4(24525)y = 39062.5 \sin 125t$$

$$\omega_n = \sqrt{\frac{k}{m}} = 71.32 \qquad c_c = 6264.19$$

$$D = \frac{F_0/k}{\sqrt{\left[1-\left(\frac{\omega}{\omega_n}\right)^2\right]^2 + \left[2\frac{c}{c_c}\frac{\omega}{\omega_n}\right]^2}} = 0.007497\ m$$

max displacement = 0.007497 m

max velocity = 0.9371 m/s

max acceleration = 117.14 m/s^2

$y_p = D\sin(\omega t - \phi)$

$\dot{y}_p = D\omega\cos(\omega t - \phi)$

$\ddot{y}_p = -D\omega^2\sin(\omega t - \phi)$