Problem 2

You are designing a screw lift system that will be used in auto repair shops as shown below. Each screw lift will be required to support loads up to 20kN.

- Assuming a coefficient of friction of .1, what is the lead angle at which the system will be self-locking?
- Assuming a 5cm diameter screw, and an available motor torque of 60Nm, what is the maximum pitch that could be used to lift the 20kN load?

a) $\theta_{locking} = \tan^{-1}(.1) = \boxed{5.7^\circ}$

b) $$T = \frac{\sin\theta + \mu_k \cos\theta}{\cos\theta - \mu_k \sin\theta}(F_{load})(r_{shaft})$$

$$60\,Nm = \frac{\sin(\theta) + .1\cos(\theta)}{\cos(\theta) - .1\sin(\theta)}(20{,}000\,N)(.025m)$$

$$.12 = \frac{\sin(\theta) + .1\cos(\theta)}{\cos(\theta) - .1\sin(\theta)}$$

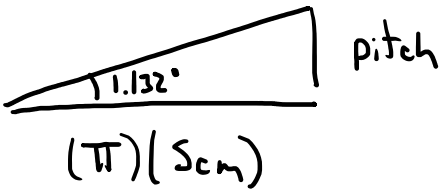
$$.12\cos(\theta) - .012\sin(\theta) = \sin(\theta) + .1\cos(\theta)$$

$.02\cos(\theta) = 1.012 \sin\theta$

$$\frac{.02}{1.012} = \frac{\sin\theta}{\cos\theta} = \tan(\theta)$$

$$\theta = \tan^{-1}\left(\frac{.02}{1.012}\right) = \underline{1.132^\circ}$$

find pitch



$$\tan(1.132) = \frac{\text{pitch}}{(\pi)(5\text{cm})} \longrightarrow \boxed{\text{pitch} = .31\text{cm} = 3.1\text{mm}}$$