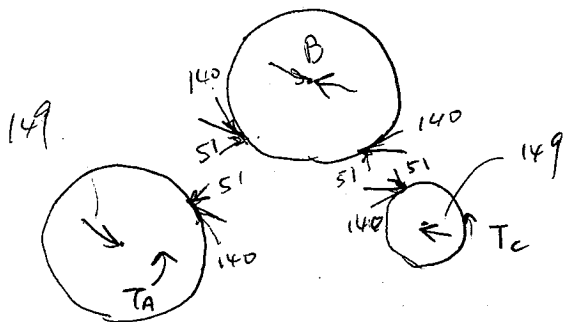


#

a) 
$$W_A = W_B \cdot \frac{N_B}{N_A} = W_C \cdot \frac{N_C}{N_B} \cdot \frac{N_B}{N_A} = 900 \cdot \frac{10}{20} = 450 \text{ rpm same as C}$$

b) no loss  $\Rightarrow$  10 hp

c)



d)

$$10 = \frac{\overline{W}_r \cdot \pi \cdot d \cdot \frac{900}{12}}{33000}$$

$$\overline{W}_r = 140 \text{ lb}$$

$$\overline{W}_r = 140 \tan 20^\circ = 51 \text{ lb}$$

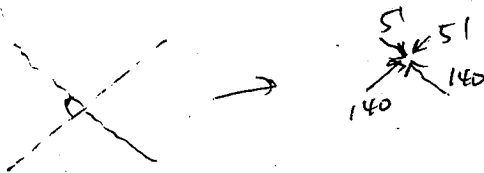
$$T_C = 140 \cdot \frac{10}{2} = 700 \text{ lb} \cdot \text{in}$$

$$T_A = 140 \cdot \frac{20}{2} = 1400 \text{ lb} \cdot \text{in}$$

$$\overline{W} = \sqrt{140^2 + 51^2}$$

$$\overline{W} = 149$$

shate B  $\Rightarrow$



$$F_B = \sqrt{(140-51)^2 + (140-51)^2} = 126$$

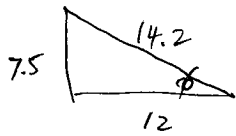
e)

a  $\rightarrow$  no change

b  $\rightarrow$  no "

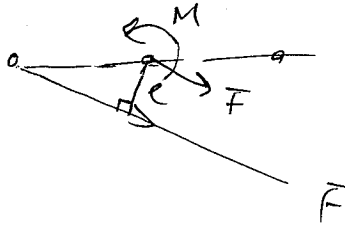
d  $\rightarrow$  no "

#2. (a)



$$\phi = \tan^{-1} \frac{7.5}{12}$$

(B) centroid



$$M = F \cdot e$$

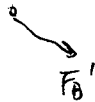
$$\frac{e}{15} = \frac{7.5}{14.2} \quad e = 7.9$$

$$M = 7.9F$$

$$F_A' = \frac{7.9F}{3}$$

$$F_A'' = \frac{M \cdot r_A}{r_A^2 + r_B^2 + r_C^2} = \frac{7.9F \cdot 15}{15^2 + 0^2 + 15^2} = 0.26F$$

(1/2)



(b)

A has largest force

$$F_{Ax}' = F_A' \cos \phi = \frac{F}{3} \cdot \frac{12}{14.2} = 0.283F$$

$$F_{Ay}' = F_A' \sin \phi = \frac{F}{3} \cdot \frac{7.5}{14.2} = 0.176F$$

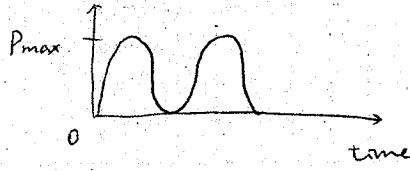
$$F_{Ay}' + F_A'' = 0.176F + 0.26F = 0.436F$$

$$\Rightarrow F_A = \sqrt{(0.436F)^2 + (0.283F)^2} = 0.52F$$

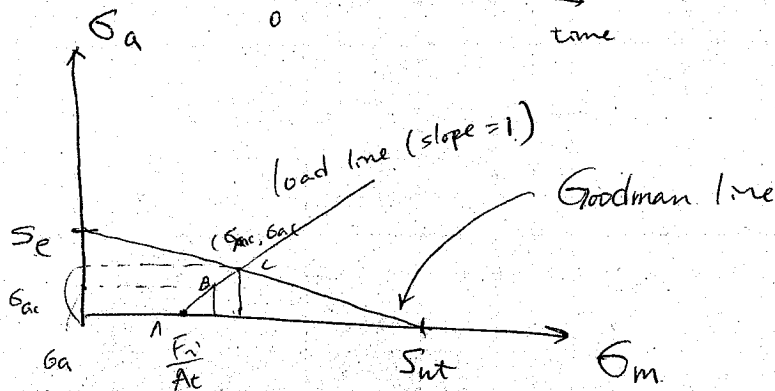
$$T = \frac{F}{A} = \frac{0.52F}{\frac{\pi}{4} (20 \times 10^{-3})^2} = 110 \times 10^6$$

$$\Rightarrow F = \frac{66456}{1} \text{ Newton}$$

#3



(a)



$$P_a = \frac{1}{2} P_{max}$$

$$P_m = \frac{1}{2} P_{max}$$

force on bolt

$$F_b = F_i + cP$$

$\uparrow$  fixed       $\uparrow$  time dependent

$$\left\{ \begin{aligned} \sigma_a &= \frac{c F_{max}}{2 A t} \\ \sigma_m &= \frac{F_i}{A} + \frac{c F_{max}}{2 A t} \end{aligned} \right.$$

$$\Rightarrow \sigma_a = \sigma_m - \frac{F_i}{A t}$$

(b)

$$S.F. = \frac{\sigma_{ac}}{\sigma_a}$$

$$\sigma_{ac} = \frac{S_{ut} - \frac{F_i}{A t}}{1 + \frac{S_{ut}}{S_e}}$$

$$S.F. = \frac{AC}{AB} = \frac{\sigma_{ac}}{\sigma_a} = \frac{S_{ut} - \frac{F_i}{A t}}{1 + \frac{S_{ut}}{S_e} \cdot \frac{c F_{max}}{2 A t}}$$

(c)

$$F_{max} \leq \frac{2}{S.F. \cdot c} \frac{S_{ut} A t - F_i}{1 + \frac{S_{ut}}{S_e}} = \frac{2}{3 \cdot 0.25} \frac{70,000 \cdot 0.375 - 7500}{1 + \frac{70,000}{124,000}} = 6140$$

$$\Rightarrow \text{total pressure} = \frac{6140 \times 10}{\pi \cdot \left(\frac{20.3 \times 10^{-3}}{2}\right)^2} = 27,409 \text{ psi} = 8.5 \text{ MPa}$$

$$276 \text{ M} \cdot 244 \left(\frac{10^{-3}}{10}\right)^2 = 33360$$