Exam II Solution Spring 1997

#1. $kw \times 3 = \frac{480}{\sqrt{3}}$ $kw = 92.3\,\Omega$, $92.3 \times 2 = 10 X_s$ $X_s = 18.46\,\Omega$

$$92.3 I_f \angle\delta = 10\angle 0 \times j18.46 + \frac{480}{\sqrt{3}}\angle 0 = 277 + j184.6 = 333\angle 34^\circ$$

$$\boxed{I_f = 3.6\ A}$$

#2. $\frac{480}{\sqrt{3}}\angle 0 = j18.46\,\bar{I} + 92.3 I_f \angle\delta$ $20\,HP = 14{,}920\,w$

minimum $|\bar{I}|$ means $pf = 1.0$

(a) $\bar{I} = \left(\frac{\frac{1}{3}14{,}920}{480/\sqrt{3}}\right)\angle 0 = 17.95\angle 0$

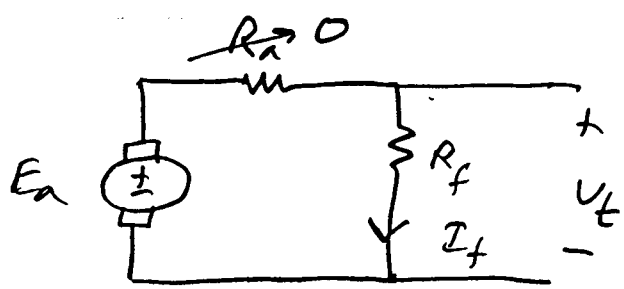
$$92.3 I_f \angle\delta = 277\angle 0 - j18.46 \times 17.95 = 277 - j331 = 432\angle -50^\circ$$

$$\boxed{I_f = 4.7\ A}$$

(b) Minimum I_f when $P_{in} = P_{max} = \frac{3 \times 277 \times 92.3 I_f}{18.46} = 14{,}920$

$$\boxed{I_f = 3.6\ A}$$

#3.



$$E_a = C_1 \omega + K_f^{SH} \omega I_f \approx V_t = R_f I_f$$

$$C_1 1200 + k_f^{SH} 1200 \times \frac{100}{100} = 100$$

$$C_1 1200 + k_f^{SH} 1200 \times \frac{120}{80} = 120$$

Subtract

$$k_f^{SH} 1200 \times 0.5 = 20 \qquad k_f^{SH} = \frac{40}{1200} \qquad C_1 = \frac{60}{1200}$$

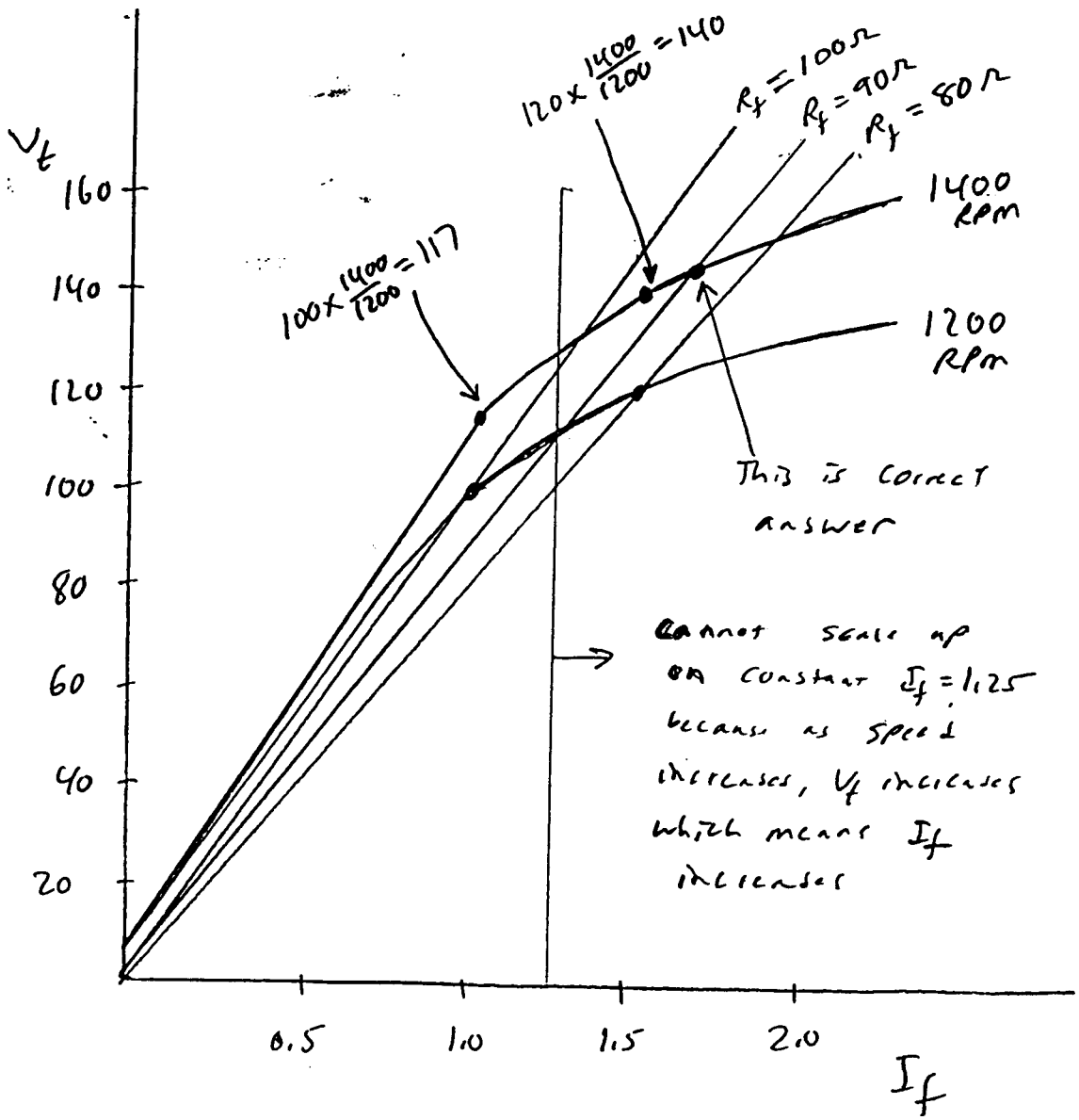
$$V_t \approx \frac{60}{1200} \times 1400 + \frac{40}{1200} \times 1400 \times \frac{V_t}{90} = V_t$$

$R_f = 90$

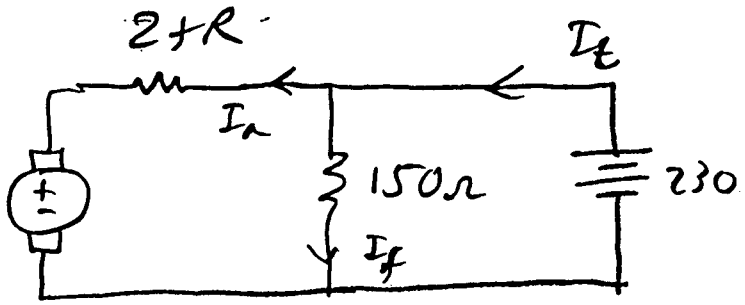
$RPM = 1400$

$$70 \times 90 = 43.33\, V_t$$

$$\boxed{V_t = 145\ V}$$



#4



$I_f = \frac{230}{150} = 1.533\,A$ want $20 = 1.533 + \frac{230}{2+R}$

$\boxed{R = 10.45\,\Omega}$ $T_{TO\ Shaft} = \frac{1.2 w I_f I_a}{w} = 1.2 \times 1.533\, I_a$

(a) $I_a = \frac{230 - 1.2 \times 1.533\, w}{12.45}$

$\boxed{T_{TO\ Shaft} = 33.98 - 0.2718 w}$

$w(.01) = w(0) + \left.\frac{dw}{dt}\right|_0 .01 = 0 + \frac{1}{0.2}(33.98 - 0).01 = 1.699\ r/s$

$w(.02) = 1.699 + \frac{1}{0.2}(33.98 - .2718 \times 1.699) \times .01 = 3.375\ r/s$

(b) As $t \to \infty$ (no load) $w \to \frac{33.98}{0.2718} = 125\ r/s$