36.1a.

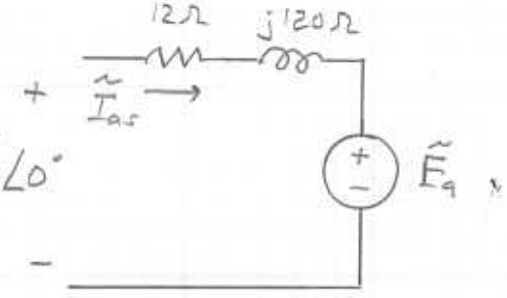
(i) $S_{3P} = \sqrt{P_{3P}^2 + Q_{3P}^2} = \sqrt{(150)^2 + (75)^2} = 167.71\,VA$

$\hat{S}_{3P} = P_{3P} + jQ_{3P} = 150 + j75 = 3\tilde{V}_{as}\,\tilde{I}_{as}^*$

$\rightarrow \tilde{I}_{as}^* = \dfrac{150 + j75}{3\frac{208}{\sqrt{3}}\angle 0^\circ} = 0.4655\angle 26.57^\circ$

$\tilde{I}_{as} = 0.4655\angle -26.57^\circ$

(ii)



KVL:

$-\tilde{V}_{as} + \tilde{I}_{as}(r_s + jX_s) + \tilde{E}_a = 0$

$\tilde{E}_a = \dfrac{208V}{\sqrt{3}}\angle 0^\circ - 0.4655\angle -26.57^\circ\,(12\Omega + j120\Omega)$

$\tilde{E}_a = 101.8V\angle -27.78^\circ$

(iii) $|\tilde{E}_a| = \dfrac{L_{SF} I_F \omega_e}{\sqrt{2}} = \dfrac{(0.9)\,I_F\,(2\pi 60)}{\sqrt{2}} = 101.8$

$\rightarrow I_F = 0.4243A\ DC$

(iv) $P_{Loss} = 3|\tilde{I}_{as}|^2 r_s = 3(0.4655)^2(12) = 7.8W$

$P_{mech} = P_{3P} - P_{Loss} = 142.2W$

$\eta = \dfrac{P_{mech}}{P_{3P}} \times 100 = 94.8\%$

36.1b

(i) $S_{3P} = \sqrt{(150W)^2 + (-75)^2} = 167.71\,VA$

$\hat{S}_{3P} = 150 - j75 = 3\,\tilde{V}_{as}\,\tilde{I}_{as}^{*}$

$\rightarrow \tilde{I}_{as}^{*} = 0.4655A\angle -26.57^\circ$

$\tilde{I}_{as} = 0.4655A\angle +26.57^\circ$

(ii) As before $\tilde{E}_a = \tilde{V}_{as} - \tilde{I}_{as}(r_s + jX_s)$

$\tilde{E}_a = 149.6V\ \angle -20.53^\circ$

(iii) $|\tilde{E}_a| = \dfrac{L_{SF} I_F \omega_e}{\sqrt{2}} = \dfrac{0.9\, I_F (2\pi 60)}{\sqrt{2}} = 149.6$

$\rightarrow I_F = 0.624\,A\ DC$

(iv) $P_{Loss} = 3|\tilde{I}_{as}|^2 r_s = 7.8W$

$P_{mech} = P_{3P} - P_{Loss} = 142.2W$

$\eta = \dfrac{P_{mech}}{P_{3P}} \times 100 = 94.8\%$