3.5 a) $S_{BASE} = 200\ MVA \qquad V_{BASE} = 16\ KV$

$$I_{BASE} = \frac{200 \times 10^6\ VA}{\sqrt{3}\,(16 \times 10^3\ V)} = 7216.88\ A$$

$$E_i = 24\ KV / 16\ KV \angle 27.4^\circ = 1.5 \angle 27.4^\circ\ p.u.$$

$$I = \frac{\frac{E_i}{\sqrt{3}} - \frac{V_L}{\sqrt{3}}}{jX} = \frac{.866\angle 27.4^\circ - .5773}{j1.65} = \frac{.7683 + j.3985 - .5773}{j1.65} = \frac{.1915 + j.3985}{j1.65}$$

$$I = \frac{.442 \angle -25.67^\circ}{1.65} = .267 \angle -25.67^\circ\ p.u.$$

$$I_{Line} = I \cdot I_{BASE} = (.267 \angle -25.67^\circ\ p.u.)(7216.88\ A) = 1933 \angle -25.67^\circ\ A$$

$$3\phi\text{-}P = \sqrt{3}\,V_L I_L \cos(25.67^\circ) = (\sqrt{3})(16\ KV)(1933)\cos(25.67^\circ) = 4.829 \times 10^7\ W$$

$$3\phi\text{-}Q = \sqrt{3}\,V_L I_L \sin(25.67^\circ) = (\sqrt{3})(16\ KV)(1933)\sin(25.67^\circ) = 2.320 \times 10^7\ VAR$$

b) $I_{line,New} = .75\, I_{Line} = (.75)(1933)\angle -25.67^\circ = 144.975 \angle -25.67^\circ\ A$

$$I_{Line,p.u.} = \frac{144.975 \angle -25.67\ A}{7216.88} = .2 \angle -25.67\ A$$

$$I = \frac{\left(\frac{E_i}{\sqrt{3}}\right) - \left(\frac{V_L}{\sqrt{3}}\right)}{jX}$$

$$I(jX) = .577\, E_i \angle\phi - .577\, V_L$$

$$I(jX) + .577\, V_L = .577\, E_i \angle\phi$$

$$(.2\angle -25.67^\circ)(1.65\angle 90^\circ) + .577 = .577\, E_i \angle\phi$$

$$.33\angle 64.3^\circ + .577 = .577\, E_i \angle\phi$$

$$.1429 + j.2974 + .577 = .577\, E_i \angle\phi$$

$$.7199 + j.2974 = .577\, E_i \angle\phi$$

$$1.25 + j.515 = E_i \angle\phi$$

$$1.35 \angle 22.39^\circ = E_i \angle\phi$$

$$\text{New } E_i = (1.35)(16\ KV) = 21.6\ KV$$

c) $pf = 1$, so $\theta = 0°$

$$\cdot 2\angle 0° = \frac{.577\, E_i \angle \varphi - .577}{j1.65}$$

$$(.2\angle 0°)(1.65\angle 90°) = .577\, E_i \angle \varphi - .577$$

$$.33\angle 90° + .577 = .577\, E_i \angle \varphi$$

$$.33\cos(90°) + j.33\sin(90°) + .577 = .577\, E_i \angle \varphi$$

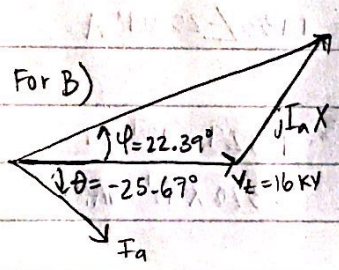
$$.577 + j.33 = .577\, E_i \angle \varphi$$

$$.6647\angle 29.76° = .577\, E_i \angle \varphi$$

$$\text{p.u. } 1.152\angle 29.76° = E_i \angle \varphi$$

New $E_f = (1.15)(16\,KV) = 18.4\,KV$

D) For B)



$I_a = 144.975\angle -25.67°$

$X = j1.65$

For c)