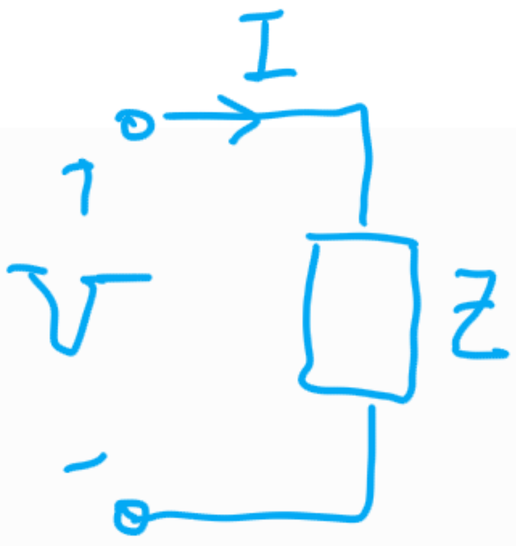
EXAMPLE 11.12

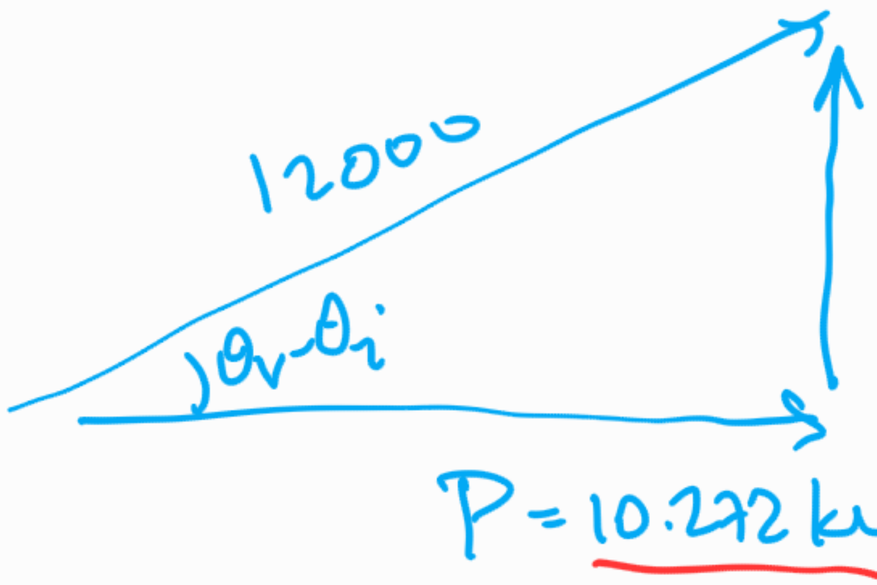
A load **Z** draws 12 kVA at a power factor of 0.856 lagging from a 120-V rms sinusoidal source. Calculate: (a) the average and reactive powers delivered to the load, (b) the peak current, and (c) the load impedance.



$S = 12\,kVA$

g.f. lagging : indüktif

güç üçgeni yukarı



$$\frac{P}{12000} = 0.856 = 10.272\,kW$$

$$Q = \sqrt{12^2 - 10.272^2}\ kVAR$$

$$= 6.204\ kVAR$$

$S = V_{rms}\, I_{rms}$ görünen güç.

$12000\angle 0$ $\quad$ $120\angle 0$

$$I_{rms} = \frac{1200\angle 0}{120} = 10\angle 0\ A\ (rms)$$

$$I_m = 10\sqrt{2}\ A$$

$$\bar{S} = \bar{V}_{rms}\, \bar{I}_{rms}^{*}$$

$$\bar{S} = \bar{I}_{rms}\, Z\, \bar{I}_{rms}^{*} = |\bar{I}_{rms}|^2 Z$$

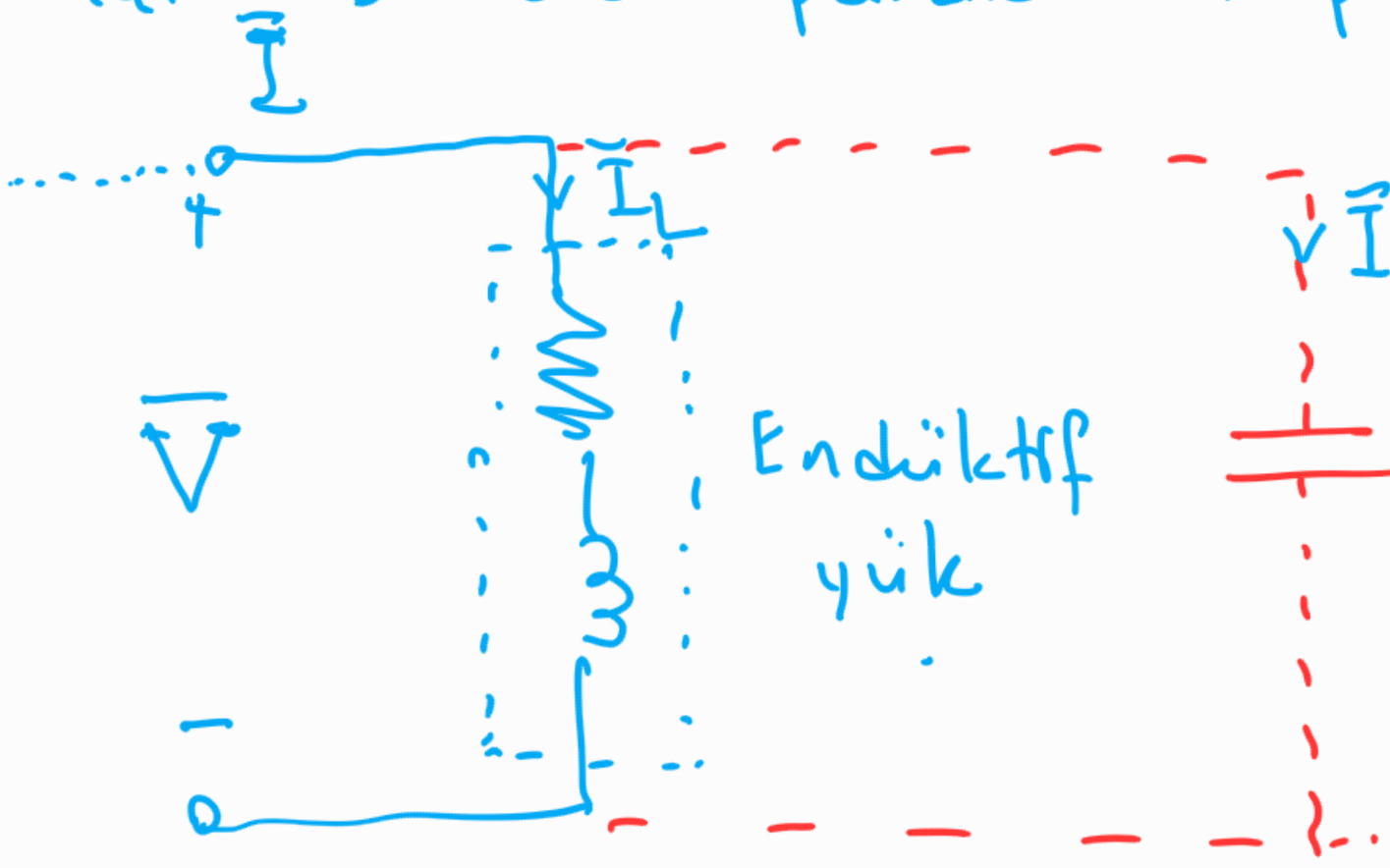
$10272 + j6204$ $\quad$ 100^2

$$Z = 1.0272 + j0.6204\ \Omega$$

$$= 1.2\angle 31.13^{\circ}$$

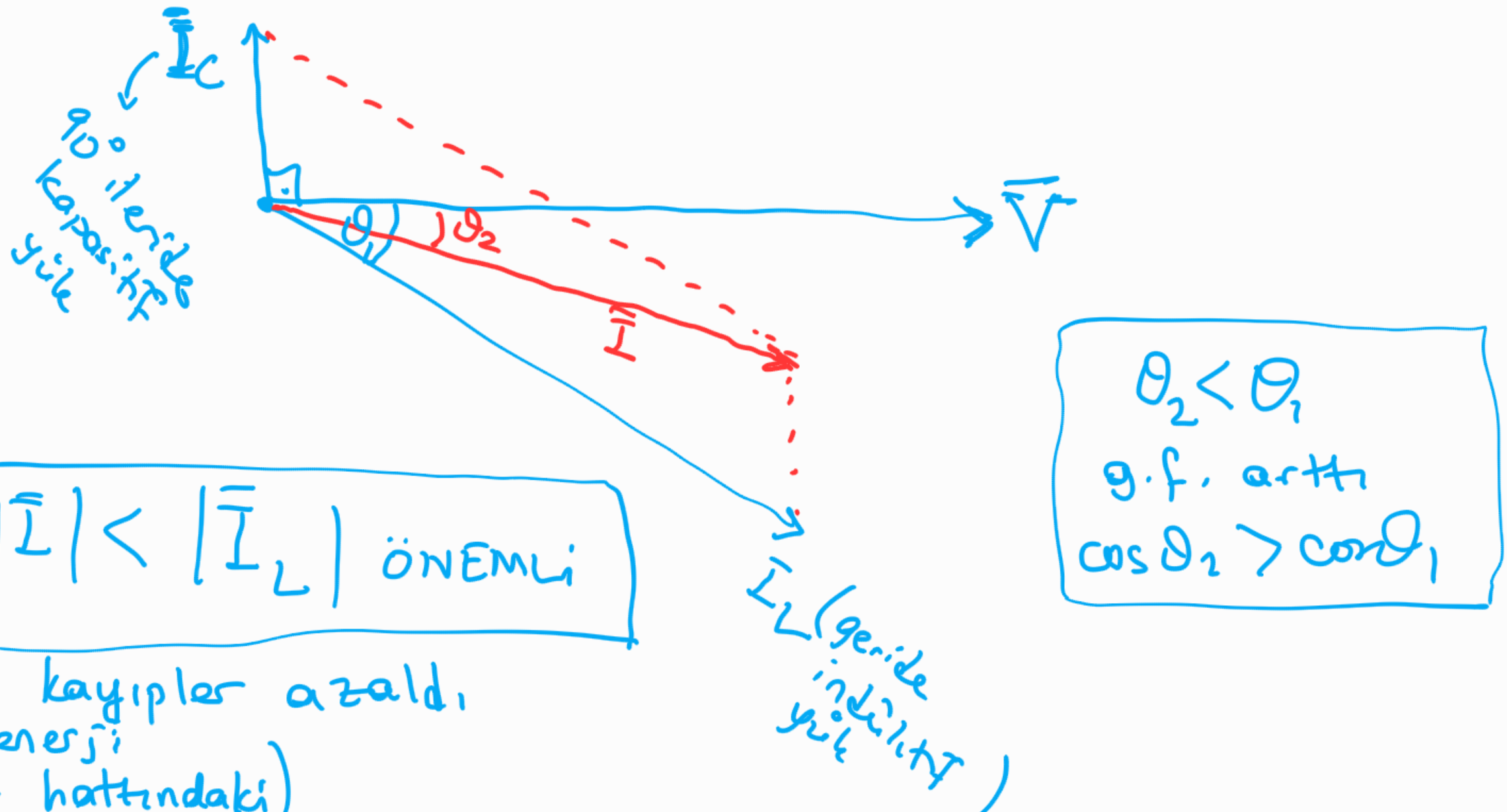
11.7 Güç Faktörü Düzeltme (Power Factor Compensation)

Çoğu ev aleti (çamaşır, buzdolabı, havalandırma) endüstriyel araç gereçler (motorlar) indüktiftir. İçinde bobinler, trafolar vardır. Dolayısıyla düşük bir "takip eder" g.f. ile çalışırlar. Reaktif gücü azaltmak için bunlara paralel kapasitörler bağlanır.



$\theta_V - \theta_I > 0$

Fazör diyagramı



$|\bar{I}| < |\bar{I}_L|$ ÖNEMLİ

kayıplar azaldı (enerji hattındaki)

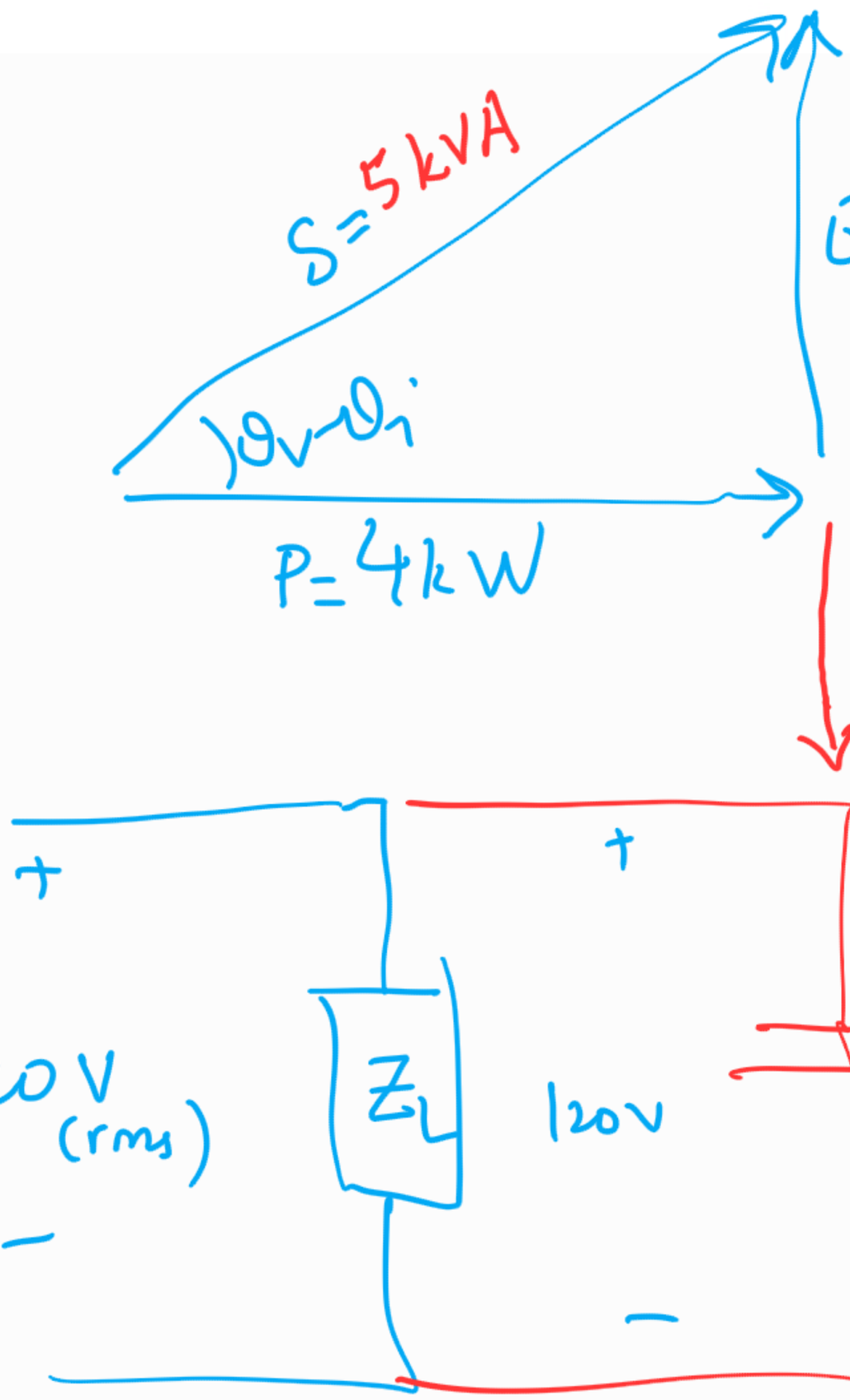
$\theta_2 < \theta_1$

g.f. arttı

$\cos\theta_2 > \cos\theta_1$

EXAMPLE 11.15

When connected to a 120-V (rms), 60-Hz power line, a load absorbs 4 kW at a lagging power factor of 0.8. Find the value of capacitance necessary to raise the pf to 0.95.



0.95 için:

$$0.95 = \frac{4}{S}$$

$\rightarrow S = 4.21$ kVA (yeni S)

$\rightarrow$ yeni Q: 1.31 kVAR

$Q_c = 3 - 1.31 \simeq 1.69$ kVA

$$S_c = Q_c = \frac{120\ \bar{I}_c^*}{}$$

$P_c = 0$

$$Q_c = 120 \times \frac{120}{Z_c^*}$$

$$Q_c = \frac{120^2}{+j/\omega C} = \frac{120^2\,\omega C}{+j}$$

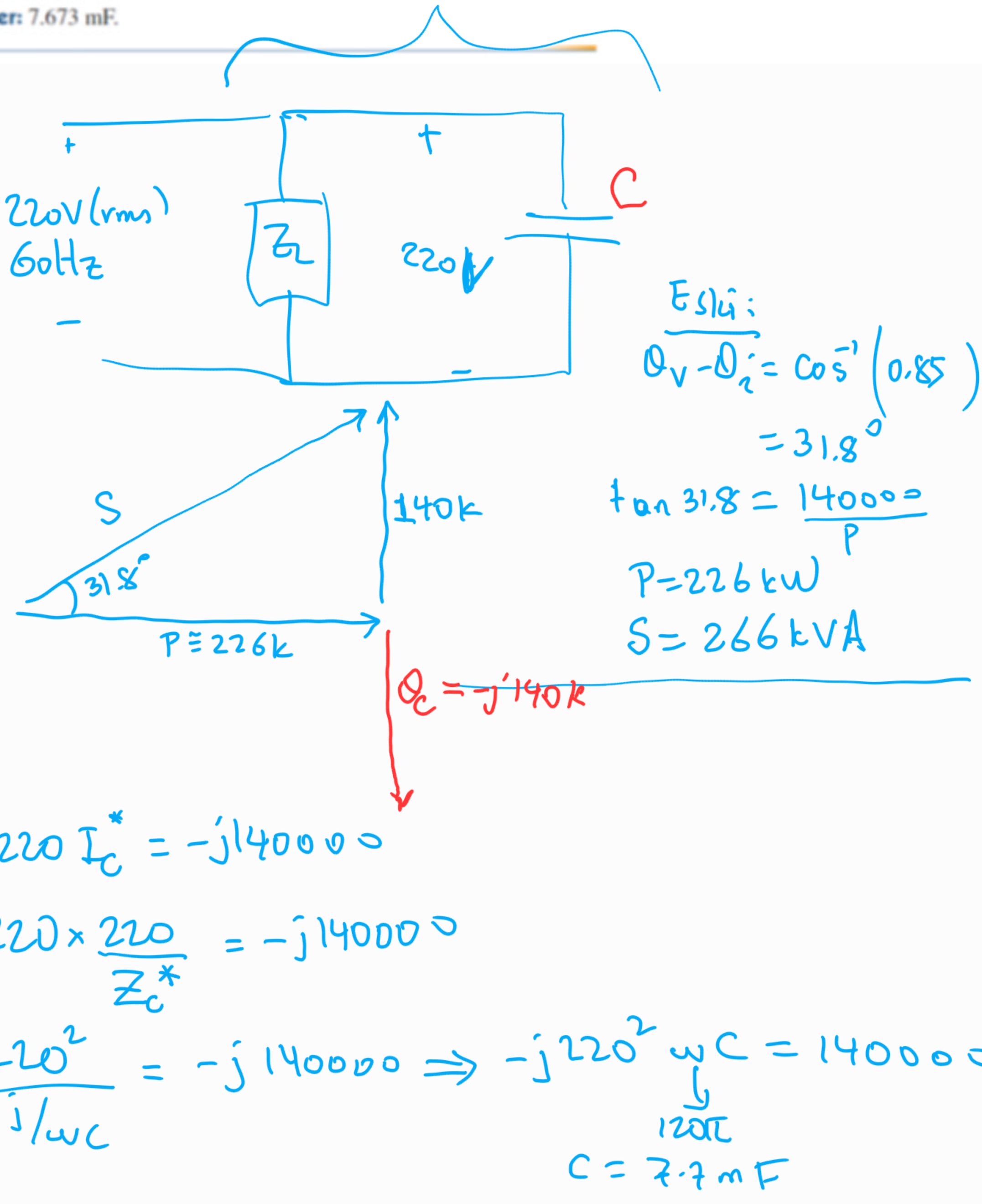
$$-j1690 = -j120^2\,\omega C \quad (120\pi)$$

$$C = \frac{1690}{120^2 \times 120 \times \pi} = 311\,\mu F$$

Practice Problem 11.15

Find the value of parallel capacitance needed to correct a load of 140 kVAR at 0.85 lagging pf to unity pf. Assume that the load is supplied by a 220-V (rms), 60-Hz line.

Answer: 7.673 mF.



Eqn:

$\theta_V - \theta_i = \cos^{-1}(0.85)$

$= 31.8^\circ$

$\tan 31.8 = \frac{14000}{P}$

$P = 226\ kW$

$S = 266\ kVA$

$220\, I_c^* = -j140000$

$220 \times \frac{220}{Z_c^*} = -j140000$

$\frac{220^2}{1/\omega C} = -j140000 \Rightarrow -j220^2 \omega C = 140000$

120π

$C = 7.7\ mF$

11.8 UYGULAMALAR

Güç ölçümü (AC wattmetre)

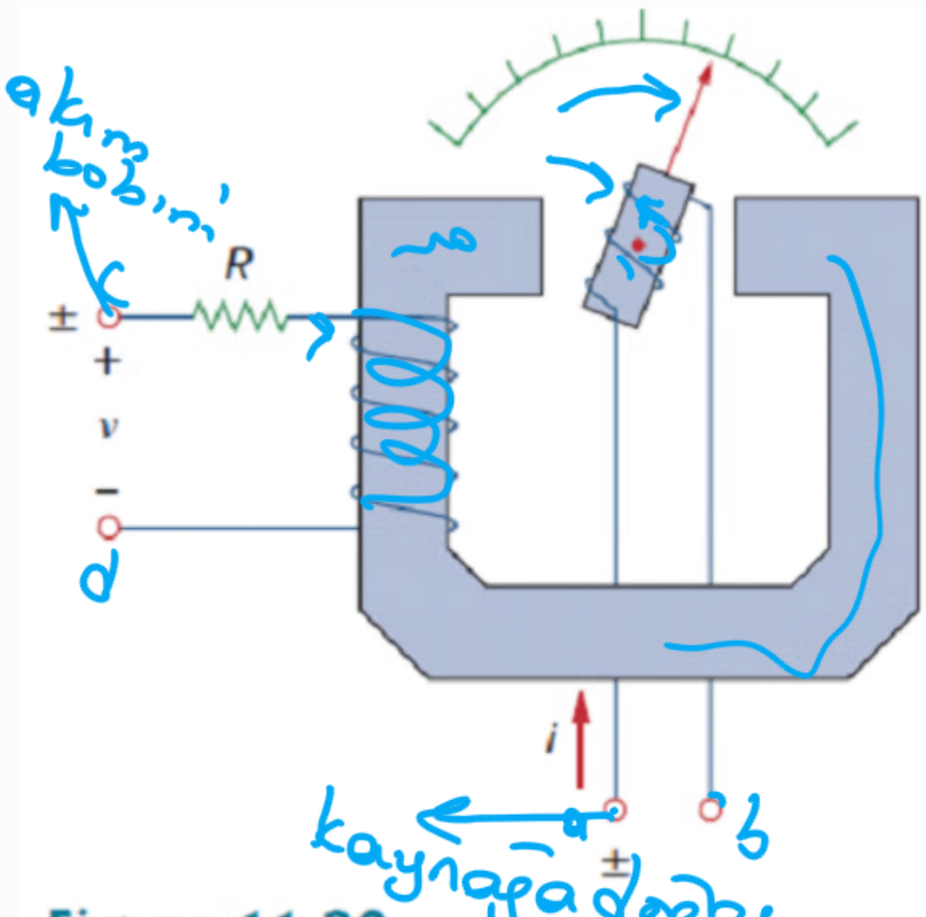


Figure 11.30
A wattmeter.

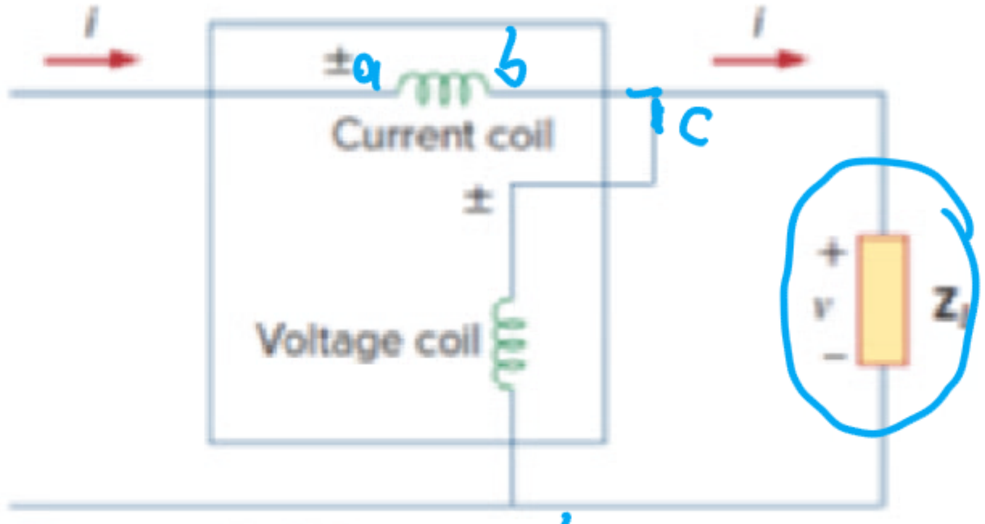
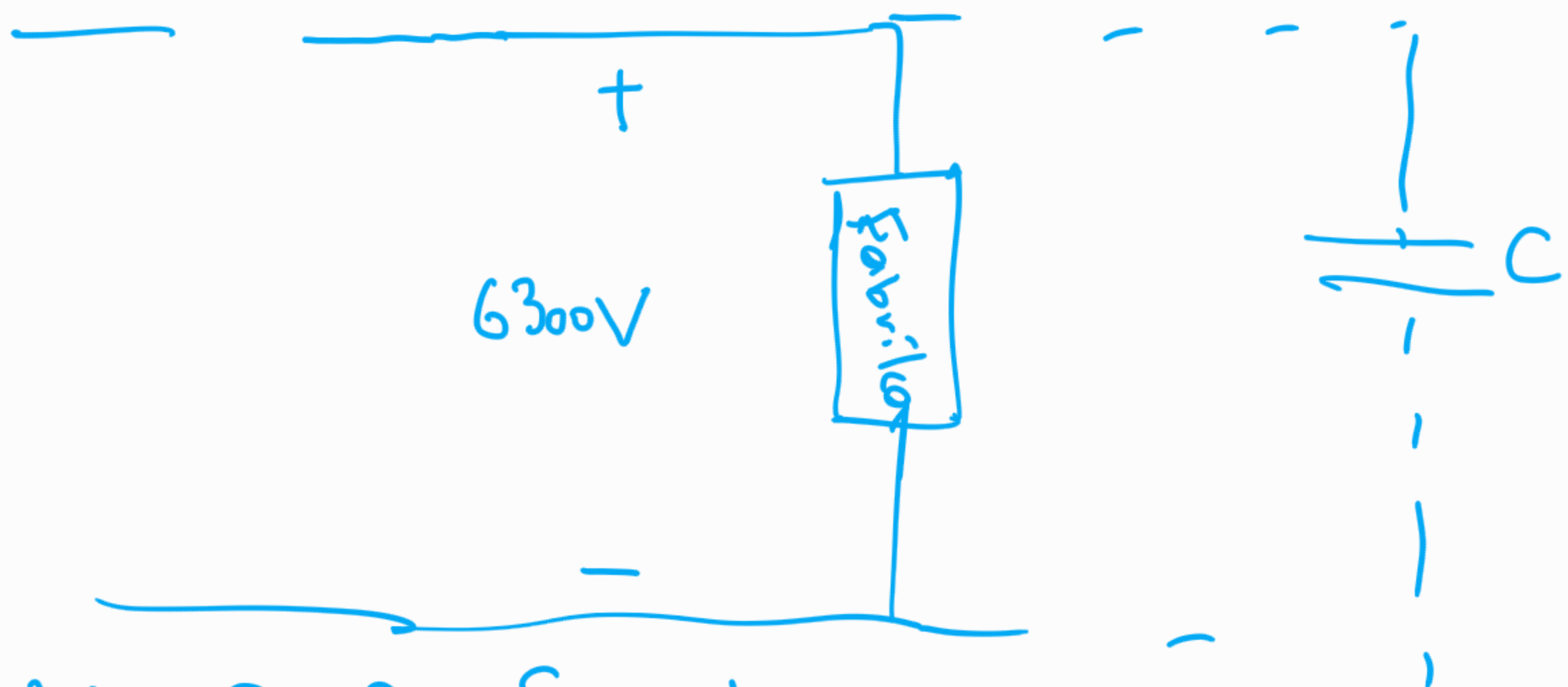


Figure 11.31
The wattmeter connected to the load.

Akım bobini düşük endüktansa sahip olmalı (az gerilim çekmeli)

Gerilim bobini büyük endüktansa sahip olmalı (az akım çekmeli)



Eski: $P + jQ = S = 120\,kW + j140\,kVAR$

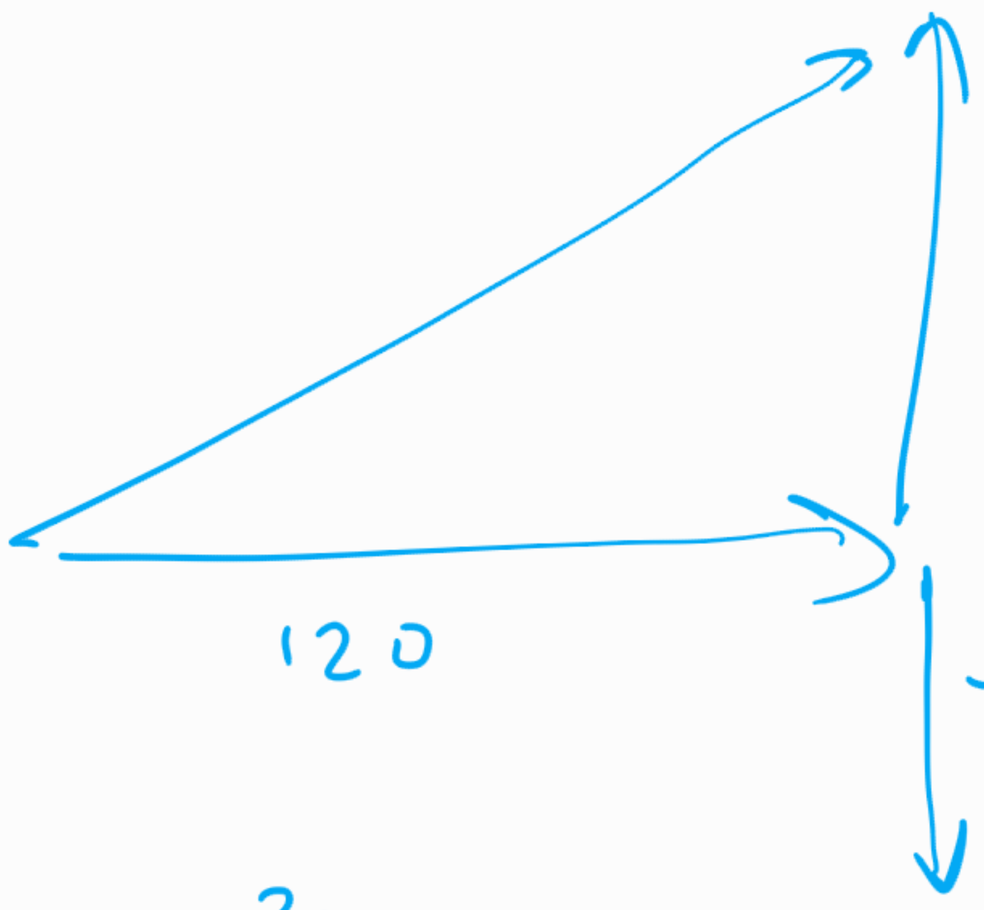
Yeni: g.f. 0.95 olması için ne kadar kapasitif reaktif güç gerekir?

$$\frac{120}{0.95} = 126.3\ kVA = Yeni\ S$$

Yeni: $Q = 39.4\ kVAR$

$Q_C = 39.4 - 140$

$= -100.6$



$$\frac{6300^2}{j/\omega C} = -j100.6 \times 10^3$$

$$-j\,6300^2 \times 2\pi \times 50 \times C = -j100600$$

$$C = \frac{100600}{6300^2 \times 100 \times \pi} = 8.06\ \mu F$$