1. (38 pts) A capacitor (C) is used to partially correct the power factor of a motor to 0.92. That is, the power
   factor as seen by the source is 0.92. Two ammeters (A_1 and A_2) read the currents shown.

Find the following:
a) The original power factor of the motor.
   As part of your solution, find
   the P and Q of the motor.

$V_S := 120 \cdot V$
$60 \cdot Hz$

$6.5 \cdot A$

A_1

A_2

$1.2 \cdot A$

Motor

$pf_s := 0.92$

C

lagging
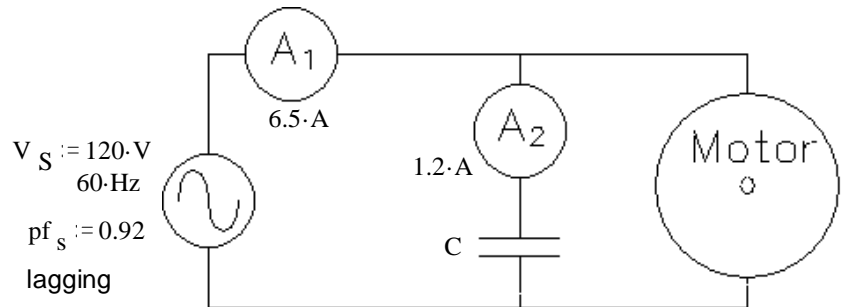
If you can't find this power factor, mark an x here _____ and assume $pf_m = 0.82$ for the rest of the problem.
You may salvage some points from a) if you find the motor Q from this pf_m , otherwise skip to b)
b) How much current flows through the motor (magnitude).

c) Add an additional component to the drawing above in order to completely correct the power factor.
   Find the value of the component.

d) What would ammeter A_1 measure now that the power factor has been completely corrected?

2. (34 pts) A 3-phase generator produces 300-V, 60-Hz 3-phase power. It is connected through 3 lines to a single, balanced, 3-phase load, which consumes 3.6 kW with a 82% lagging power factor. Each line has a resistance of $R_{line} = 1.5\Omega$ and an unknown reactance of X_{line}. The line current is 10A.

Source end: 300-V Lines: $R_{line} := 1.5\cdot\Omega$ & $X_{line} = ?$ $I_L := 10\cdot A$ Load end: 3.6 kW, 82% pf, lagging

a) Find the complex power (P and Q) provided by the source.

b) What is the line voltage at the load? Just magnitude.

c) What is the value of the line reactance? $X_{line} = ?$

d) What is the efficiency of this system?

The transformer is loaded with the $\mathbf{Z_L}$ shown below. The known characteristics of the transformer are as follows:

$$R_m := 800 \cdot \Omega \qquad R_s := 2 \cdot \Omega \qquad X_s := 3 \cdot \Omega \qquad \mathbf{Z_L} := (5 + 2 \cdot j) \cdot \Omega$$

a) Draw a circuit or model which will help you answer questions about this transformer.

b)   Find the secondary voltage. Magnitude only. $\left| \mathbf{V_2} \right| = ?$

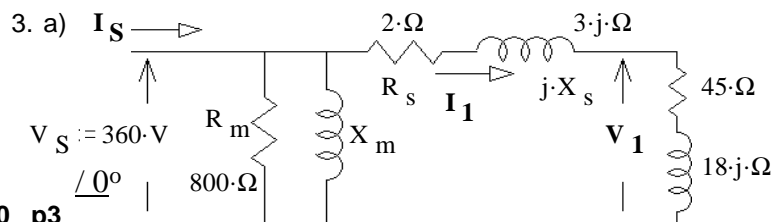c) The source provides $Q_S := 1300 \cdot \text{VAR}$ Find X_m

Answers 1. a) $717.6 \cdot \text{W}$ $449.7 \cdot \text{VAR}$ 0.847 b) $7.06 \cdot \text{A}$ c) $56{\cdot}3 \cdot \mu\text{F}$ cap in parallel with C   d) $5.98 \cdot \text{A}$

2. a) $4.05 + 3.26 \cdot j$ kVA   3. a)

b) $253.5 \cdot \text{V}$

c) $2.48 \cdot \Omega$

d) $88.9 \cdot \%$

b) $113 \cdot \text{V}$

c) $475 \cdot \Omega$