NAME SOLN

e. (2 pts) Compute the phase voltage at the turbine's terminals.

$$V_{turbine} = V_{load} + \bar{I} \cdot (R + jX)$$
$$= 277\angle 0 + 80.22\angle -25.84\,(.1 + j.5)$$
$$= 277 + 40.9\angle 52.8 = 303.45\angle 6.16^\circ \text{ ANS.}$$

f. (3 pts) Compute the per phase real power at the turbine terminals?

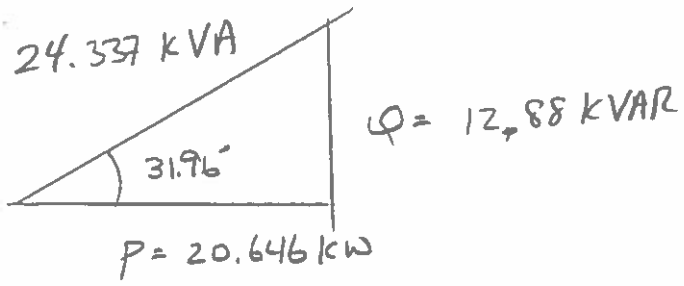
$$S = \bar{V}_t \bar{I}^* = (303\angle 6.1^\circ)(80\angle -25.8)^* = (303\angle 6.1)(80\angle +25.8)$$
$$= 24{,}337\angle 31.96^\circ = 20{,}646 + j\,12{,}885$$

$R = 20.646$ kW ANS.

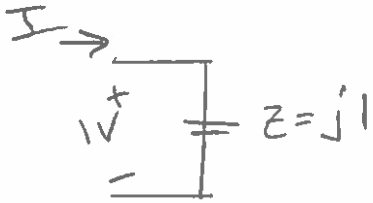
g. (3 pts) Draw and label the power triangle for one-phase at the turbine terminals with computed S, P, Q, and angle values.

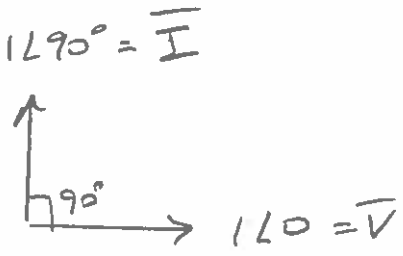
From f

$S = 24{,}337\angle 31.96^\circ$



BONUS (2 pts) Draw and label a phasor diagram showing the relationship between current through and voltage across a capacitor. The voltage is 1 V per unit. The capacitor's impedance magnitude is 1 per unit.





$$\bar{I} = \frac{\bar{V}}{\bar{Z}} = \frac{1\angle 0}{1\angle -90} = 1\angle 90^\circ \text{ ANS.}$$

$$Z = \frac{1}{j1} = -j1 = 1\angle -90^\circ$$

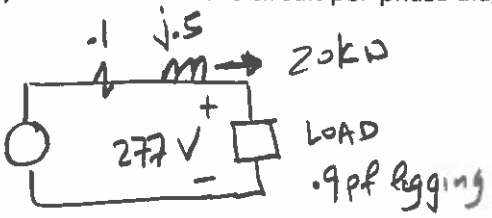
LAST NAME SOLUTION Alphabetic # _____

FIRST NAME _____

Quiz 2

1. A small wind turbine is delivering 60 kW through a 3-phase power line to a load having a power factor of 0.9 lagging power factor.
   - The line voltage is 480 V at the load.
   - Each transmission line phase has inductive reactance X = 0.5 Ω and resistance R = .1 Ω
   - The system is operating at 60 Hz
   - Assume the zero reference is phase "a" voltage at the load.

a. (3 pts) Draw and label the circuit per-phase diagram. Use this diagram for all subsequent computations.



$V_p = \frac{480}{\sqrt{3}} = 277\,V$

$P_{1\phi} = \frac{60kW}{3} = 20kW$

b. (3 pts) Compute the voltage phasor on phase "a" at the load terminals.

$\bar{V}_a = 277\angle 0^\circ$ ANS

ELI →

c. (3 pts) Compute the phasor line current at the load.

$pf = .9 = \cos\theta$

$\theta = \cos^{-1}(.9) = 25.84^\circ$

$P = 20kW = VI\cos(25.84) = VI\,pf$

$I = \frac{20000}{277(.9)} = 80.22\,A$ ANS

d. (3 pts) Write the current equation time-domain current equation $i(t)$

$i(t) = \sqrt{2}(80.22)\cos(\omega t - 25.84^\circ)$; $\omega = 2\pi f = 2\pi 60$