COLORADO SCHOOL OF MINES
ELECTRICAL ENGINEERING DEPARTMENT
ENG 577
M1-A1 Assignment KEY

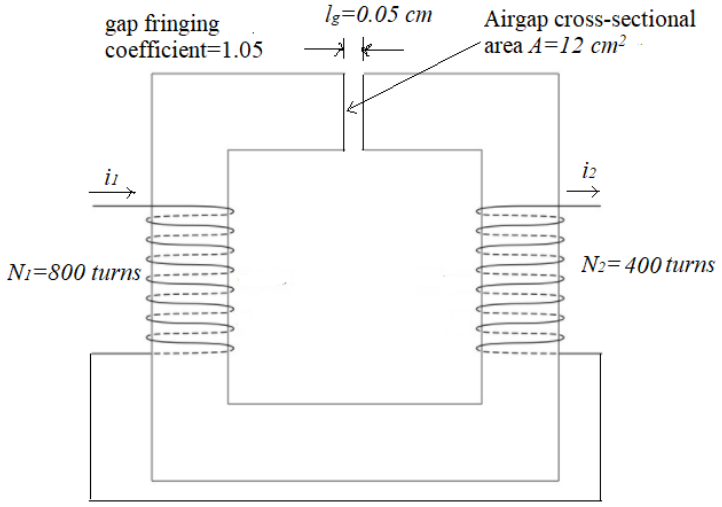
Multiple Choice: Each multiple-choice question is worth **10 point**. Please choose the best answer for each question.

Q-1. A load has a voltage **V**=208 ∠-30° V and the current **I**=2 ∠20° A. The load power factor is about:

a) 0.24 Lagging **b)** 0.51 Leading **c)** 0.64 Leading **d)** None of the above

Solution:
Z=V/I =208 ∠-30° /2 ∠20° =104∠-50°
PF=cos (-50°) = 0.643 Leading

Q-2. The magnetic core shown has infinite permeability. The mutual inductance L_{12} is about:
a) L_{12}= 0.345 H **b)** L_{12}= 0.648 H **c)** L_{12}= 1.013 H **d)** None of the given answers



Solution:

$$R = \frac{l_g}{\mu_0 A_g} = \frac{0.0005m}{(4\pi x10\_7)(1.05)(0.0012m^2)} = 316{,}000 \text{ A.T/Wb}$$

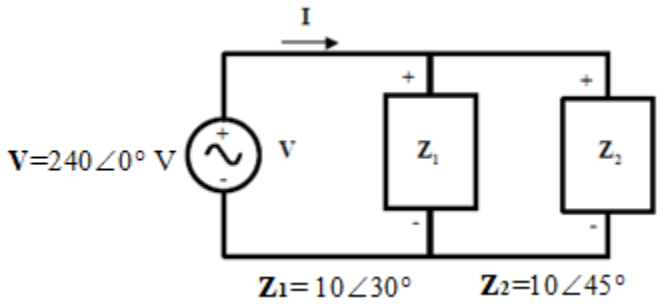
$L_{12} = N_1N_2/\mathcal{R} = 1.013$ H

Also, the self-inductances are:

$L_{11} = N_1^2/\mathcal{R} = 2.025$ H

$L_{22} = N_2^2/\mathcal{R} = 0.506$ H

Q-3. Consider the system shown.



The system power factor is about:

a) PF=0.89 Lead. **b)** PF=0.37 Lag. **c)** PF= 0.79 Lag. **d)** None of the given answers

Solution:

The current I_1 in load Z_1

$$\mathbf{I}_1 = \frac{240\angle 0^\circ \text{ V}}{10\angle 30^\circ \text{ A}} = 24\angle -30^\circ \text{ A}$$

The current $\mathbf{I}_2$ in Load 2 is

$$\mathbf{I}_2 = \frac{240\angle 0^\circ \text{ V}}{10\angle 45^\circ \text{ A}} = 24\angle -45^\circ \text{ A}$$

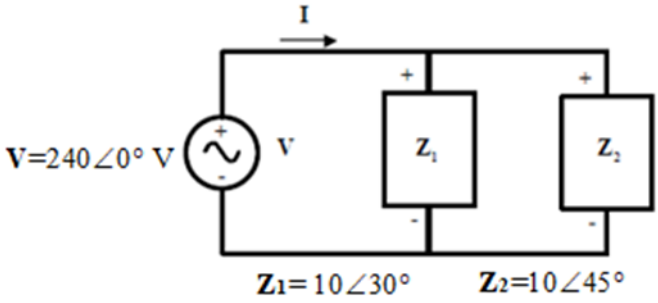
Therefore the total current from the source is

$$\mathbf{I} = \mathbf{I}_1 + \mathbf{I}_2 = 24\angle -30^\circ \text{ A} + 24\angle -45^\circ \text{ A} = 47.59\angle -37.5^\circ \text{ A}$$

The power factor supplied by the source is

$$\text{PF} = \cos\theta = \cos(37.5^\circ) = 0.793 \text{ lagging}$$

Q-4. Consider the system shown.



The total apparent power S supplied by the source is about:

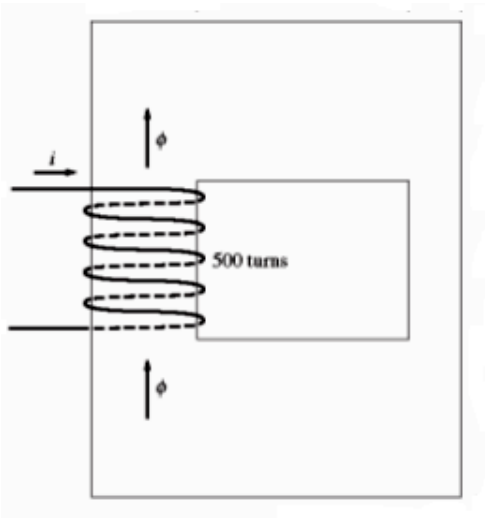
a) 5,760 VA **b)** 11,420 VA **c)** 4,073 VA **d)** None of the above

Solution

S=VI= (240V)(47.59A)=11,420 VA

Q-5. The system shown has a reluctance *R*= 252 kA.t/Wb. The current that will produce a flux of 0.001 Wb is about:

a) 2A **b)** 0.5 A **c)** 1.5A **d)** None of the given answers

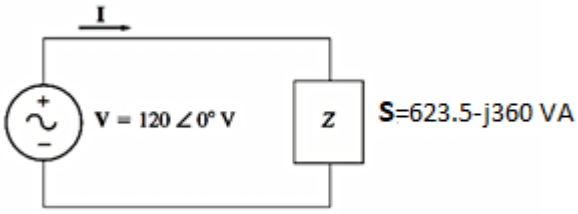


Solution:

$F = \phi R = (0.001\ \text{Wb})(252\ \text{kA} \cdot \text{t/Wb}) = 252\ \text{A T}$ and the required current is

I=F/N=252/500= 0.5 **A**

Q-6. The load power factor is about:



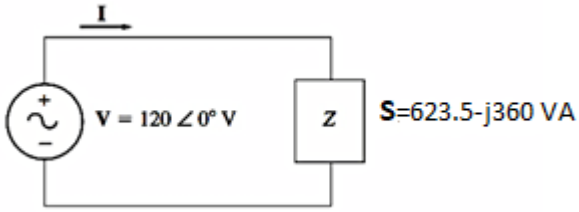
a) PF=0.87 Lead. **b)** PF=0.43 Lead. **c)** PF=0.5 Lag. **d)** None of the above

Solution

$\theta = \tan^{-1}(Q/P) = \tan^{-1}(360/623.5) = 30^{\circ}$

PF=cos(θ)=0.866 Leading since it supplies reactive power.

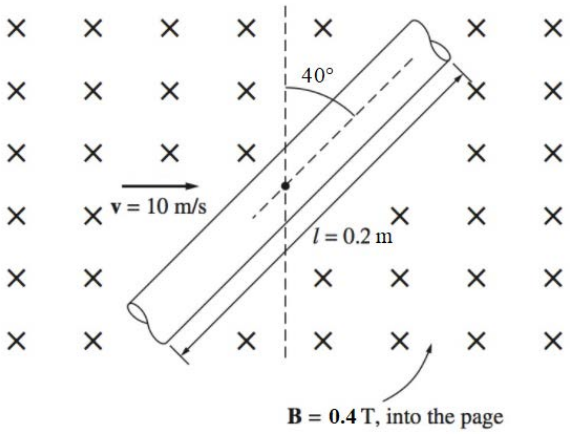
Q-7. The load current **I** is about:



a) **I**= 6 ∠30° A **b)** **I**= 16 ∠43° A **c)** **I**= 9 ∠15° A **d)** None of the above

Solution
S=VI*=623.5-j360=720∠30°
I=(S/V)* = 6∠30° A

Q-8. The wire moving as shown has an induced voltage e_{ind} of about:

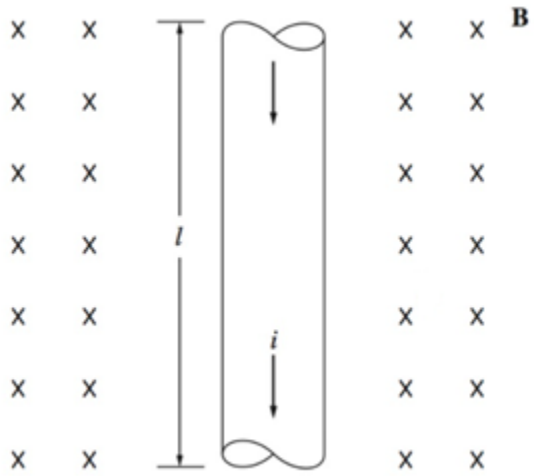


a) e_{ind}= 0.613 V positive up **b)** e_{ind}= 0.613 V positive down **c)** e_{ind}= 0.35 V positive up
d) e_{ind}= 0.35 V positive down

e_{ind} = (vxB).I = *vBl* cos40° = (10m/s)(0.4T)(0.2m) cos40° = 0.613 V positive up

Q-9. Consider the wire shown below which carries current in the presence of a magnetic field. The magnetic flux density is 0.25 T, directed into the page. If the wire is 10 m long and carries 0.5 A of current in the direction from the top of the page to the bottom of the page, the magnitude and direction of the force induced on the wire is about:

a) 0.125 N directed to the right **b)** 1.25 N directed to the right **c)** 12.5 N directed to the left
d) None of the given answers



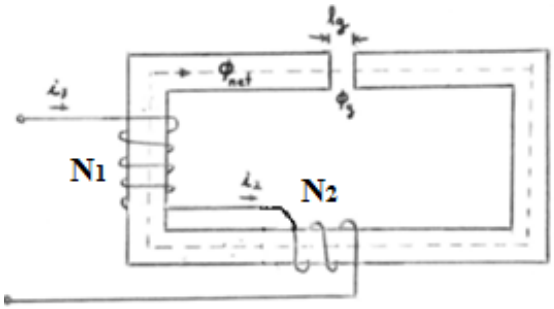
Solution

The direction of the force is given by the right-hand rule as being to the right. The magnitude is given by

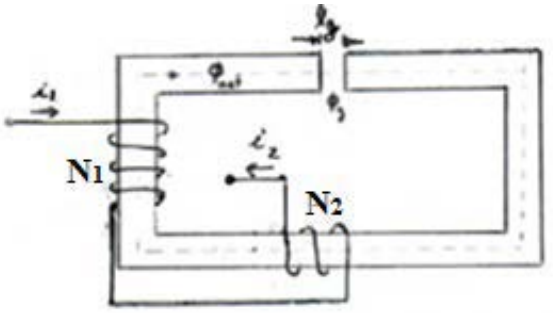
$$F = ilB \sin\theta$$
$$= (0.5\ \text{A})(1\ 0\ \text{m})(0.25\ \text{T}) \sin 90° = 1.25\ \text{N} \quad \text{directed to the right.}$$

Q-10. The magnetic cores shown have infinite relative permeability and no fringing effects in the air gaps. Also, assume N1>N2. If the magnetic core for both designs are identical, except the way the coils are connected. If Core-1 mutual inductance is LM1, and Core-2 mutual inductance is LM2, the following can be stated:

a) $L_{M1} > L_{M2}$ **b)** $L_{M1} < L_{M2}$ **c)** $L_{M1} = L_{M2}$ **d)** None of the given answers



Core-1 Design



Core-2 Design

Solution

$L_{M1}=L_{M2}=N1\ N2/R$