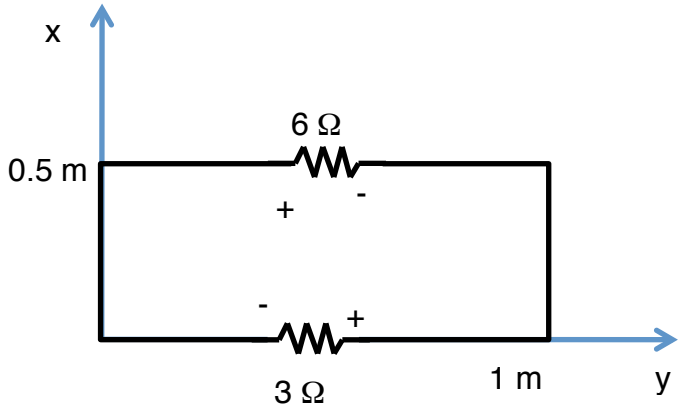
ENEL 476 – Assignment #1

Due at Monday February 6 at 5 pm

Drop boxes on 2nd floor of ICT

Question 1: The loop shown below is placed in an external magnetic flux density of

$$\mathbf{B}=-0.3e^{-t}\,\mathbf{a}_z \quad \text{Wb/m}^2$$



a) Find the total magnetic flux (ϕ) passing through the surface of the loop.
b) Find the voltage across the 6 Ω resistor
c) Find the induced current.
d) The induced current flows around the loop in the following direction (circle one):
   - Clockwise
   - Counterclockwise

   Explain how the direction of induced current flow satisfies Lenz's law.

Question 2: An electric field in free space is given by:

$$\mathbf{E}(z,t)=(10\,\mathbf{a}_x + 4\,\mathbf{a}_y)\cos\,(3 \times 10^6 t-\beta z)\ \ \text{V/m}$$

a) Find the displacement current density, $\mathbf{J}_d(z,t)$.
b) Write the electric field in phasor form, $\mathbf{E}_s(z)$.
c) Using Faraday's law, find the magnetic field in phasor form, $\mathbf{H}_s(z)$. Leave your answer in terms of β.
d) Using Ampere's law, find the value for β.
e) Write the magnetic field in time-domain form, $\mathbf{H}(z,t)$, substituting in the value of β .

Question 3

Consider a uniform plane wave propagating in a source-free region of free space (ε_r=1, μ_r=1, σ=0 S/m). The electric field is given by:

$$\mathbf{E}(z,t)=(10\,\mathbf{a}_x + 4\,\mathbf{a}_y)\cos\,(3 \times 10^6 t-\beta z)\ \ \mathrm{V/m}$$

Find:

a) The phase constant, β.
b) The wavelength, λ.
c) The phase velocity, v_p or u.
d) The intrinsic impedance, η.
e) The magnetic field, **H**(z,t).