

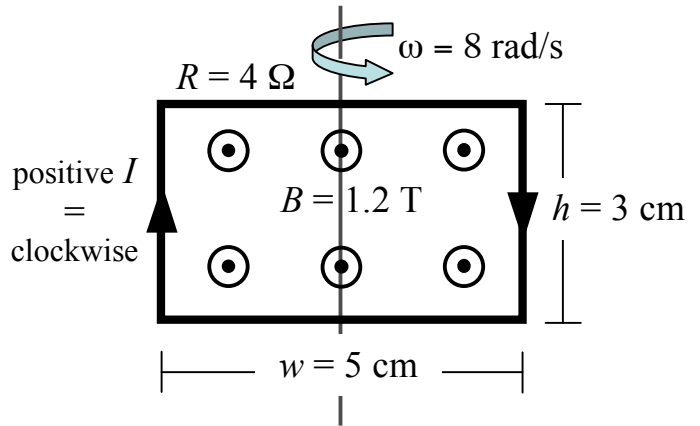
### Discussion Question 9D

#### Phys141 Unit 26

#### Faraday's Law: Rotating Loop

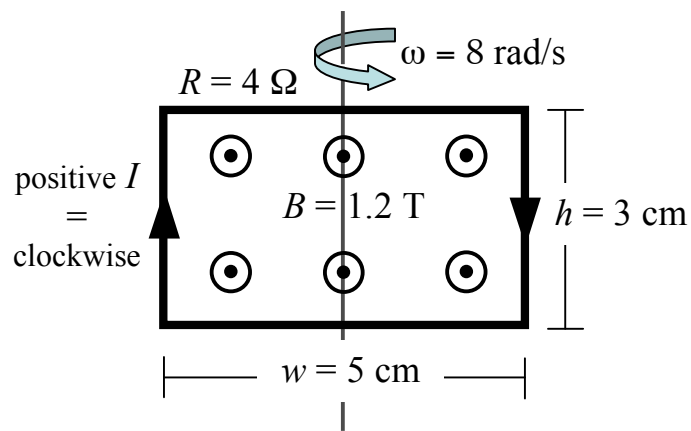
Consider a rectangular loop of wire with width  $w$ , height  $h$ , and total resistance  $R$ . The region of space occupied by the wire loop contains a uniform magnetic field  $\mathbf{B}$  pointing out of the page.

A motor attached to the loop keeps it rotating about the vertical axis with constant angular velocity  $\omega$ . At time  $t = 0$ , the loop is parallel to the paper (as shown in the figure).



(a) Plot the magnetic flux  $\Phi_B$  through the loop as a function of time. Find the maximum value (amplitude) of the flux, and write it on your plot.

(b) Plot the induced EMF  $\mathcal{E}$  through the loop as a function of time. Find the maximum value (amplitude) of the EMF, and write it on your plot.



(c) Plot the induced current  $I$  through the loop as a function of time. Find the maximum value (amplitude) of the current, and write it on your plot.

(d) Plot the torque  $\tau$  provided by the motor to keep the loop rotating at a constant angular velocity. Find the maximum value (amplitude) of the torque, and write it on your plot.