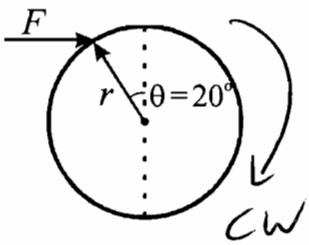
EE 330/330L Energy Systems (Spring 2012) Quiz #2

Name Key B

Instructions: Open notes & homework. Place answers in indicated spaces & show all work for credit.

Answer the following:

a) A force of $F = 20$ N is applied to a wheel with a diameter of 2 m as shown. What is the magnitude of the torque applied? What is the direction of wheel rotation? Indicate answers on figure (e.g., arrow with label).



CW rotation

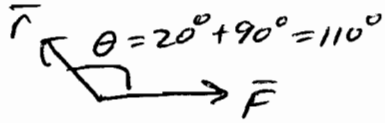
or $\bar{T}$ into page

$(1\text{-}6)\ T = r F \sin\theta$

$= \frac{2}{2}(20)\sin 110°$

$= 20 \sin 110°$

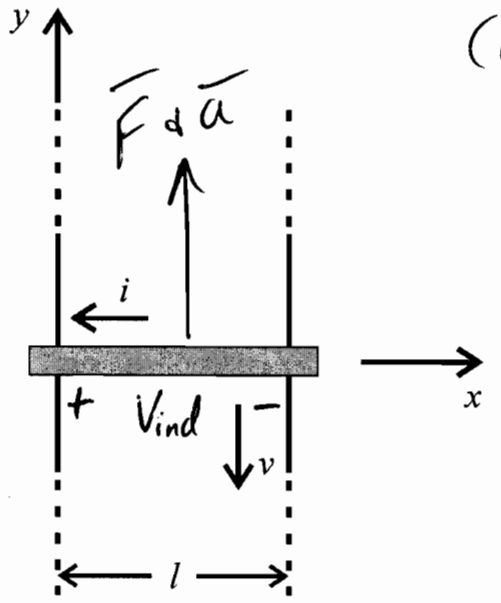
$= 18.79385\ N\cdot m$



$r = \frac{\text{diameter}}{2}$

torque = 18.794 N·m

b) The 1.5 kg, brass cylinder shown below is set on conducting rails spaced by $l = 1.2$ m, carries a current $i = 11$ A, and has a velocity $v = 33$ m/s in the direction shown. If a magnetic flux density of $\bar{B} = 280\,\hat{a}_z$ (mT) is suddenly applied to the region containing the cylinder, what magnitude of force F and acceleration a does it experience? What voltage V_{ind} is induced between the conducting rails? Indicate direction of F & a and polarity of V on **figure**.



$(1\text{-}43)\ \bar{F} = i(\bar{l} \times \bar{B}) = 11\left(-\hat{a}_x 1.2 \times \hat{a}_z 0.28\right)$

$= (11)(1.2)(0.28)(+\hat{a}_y)$ ← points in direction of i

$= 3.696\,\hat{a}_y\ N$

$\bar{a} = \frac{\bar{F}}{m} = \frac{3.696\,\hat{a}_y}{1.5\,kg} = 2.464\,\hat{a}_y\ m/s^2$

$(1\text{-}45)\ V_{ind} = e_{ind} = (\bar{v} \times \bar{B}) \cdot \bar{l}$

$= \left(-\hat{a}_y 33 \times \hat{a}_z 0.28\right) \cdot \bar{l}$

$= -\hat{a}_x 9.24 \cdot -\hat{a}_x 1.2$

$= 11.088\ V$ ↑ points in direction of $\bar{v} \times \bar{B}$

$F =$ 3.696 N $\quad a =$ 2.464 m/s² $\quad V_{ind} =$ 11.088 V