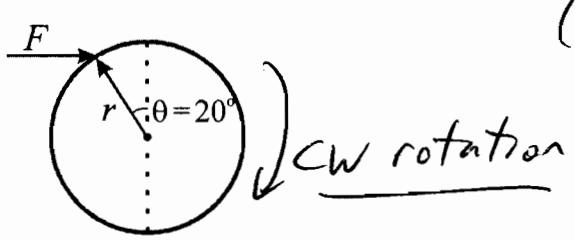
EE 330/330L Energy Systems (Spring 2012) Quiz #2

Name Key A

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

Answer the following:

a) A force of $F = 15$ 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

Note: $\bar{r}$ vector into page

(1-6) $\tau = r F \sin\theta$

$\theta = 20° + 90° = 110°$

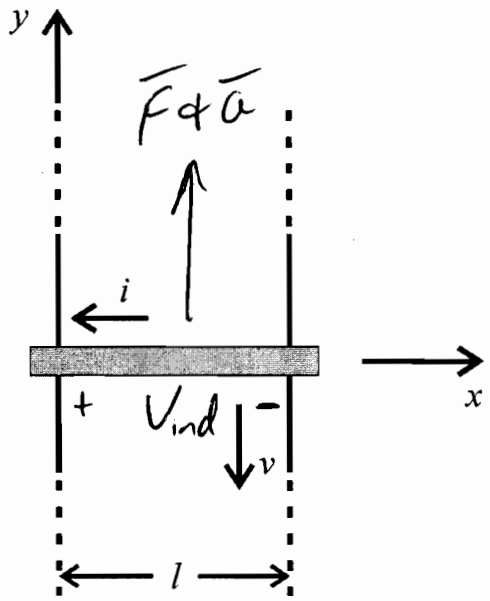
$r = \frac{\text{diameter}}{2}$

$= \frac{2}{2}(15)\sin 110°$

$= 14.095389$ N·m

torque = 14.095 N·m

b) The 2.5 kg, brass cylinder shown below is set on conducting rails spaced by $l = 1.4$ m, carries a current $i = 13$ A, and has a velocity $v = 28$ m/s in the direction shown. If a magnetic flux density of $\bar{B} = 320\,\hat{a}_z$ (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**.



(1-43) $\bar{F} = i(\bar{l} \times \bar{B}) = 13(-\hat{a}_x 1.4 \times \hat{a}_z 0.32)$

$= 13(1.4)(0.32)(+\hat{a}_y)$ ← points in direction of i

$= 5.824\,\hat{a}_y$ N

$\bar{a} = \bar{F}/m = \frac{5.824\,\hat{a}_y}{2.5\text{ kg}} = 2.3296\,\hat{a}_y$ m/s²

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

$= (-\hat{a}_y 28 \times \hat{a}_z 0.32) \cdot \bar{l}$

$= -\hat{a}_x 8.96 \cdot -\hat{a}_x 1.4$

$= 12.544$ V

← points in direction of $\bar{v} \times \bar{B}$

$F =$ 5.824 N $\quad a =$ 2.3296 m/s² $\quad V_{ind} =$ 12.544 V