

Name: \_\_\_\_\_

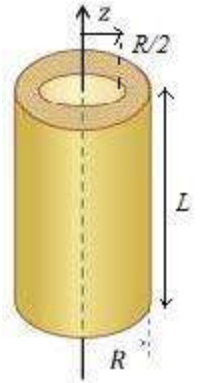
Section Number: \_\_\_\_\_

Instructor's Name: \_\_\_\_\_

## Take Home Problem Set 7

Work the problems below on your own paper, using multiple sheets if necessary. Staple all of your work together for submission. To receive full credit, you must show all relevant work and commentary,\* and all numerical values must include appropriate units. (\*When in doubt, write it out!)

1) A copper wire (radius  $R = 1.0$  mm and length  $L = 1.0$  m) carries a current with current density of magnitude  $J = ar$ ,  $0 \leq r \leq R$ , along the length of the wire, where  $a = 1.5 \times 10^3$  A/m<sup>3</sup>. For each part you must find first a final symbolic answer before using the given values for each variable.



(a) What is the current  $i_{shell}$  contained in the cylindrical shell of wire defined by  $R/2 < r < R$ ?

(b) What is the total current  $i_{tot}$  running through the wire?

(c) Given your answer to (b), what potential difference  $V$  must be applied between the ends of the wire to achieve the current  $i_{tot}$  through the copper wire?

*Hint: For this part, you may have to look up  $\rho_{Cu}$  the resistivity of copper.*

2) The metal rod in figure has a resistivity  $\rho$  and a constant thickness  $\ell$ , but it tapers down from a height of  $H$  to a height of  $h$  over its length  $L$ . If a voltage  $V$  is put across its two small rectangular faces, what current will traverse the rod?

*[Hint: Cut it into rectangular differential slices. You will need to relate  $x$  and  $y$  via an equation.]*

