

## **5. Magnification and Electron Sources**

### **Problems**

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5.1. An electron probe with lateral diameter  $d = 64 \text{ nm}$  diverges at a semi-angle  $\alpha = 12.0 \text{ mrad}$  at a distance  $p = 0.96 \text{ cm}$  in front of a lens with focal length  $f = 0.75 \text{ cm}$ . In back of the lens, find:

- a) The image distance  $q$ ,  
b) the lateral magnification  $M$ ,  
c) the lateral size  $d'$  of the image,  
d) the angular magnification  $M_\theta$ ;  
e) The convergence semi-angle  $\alpha'$  of the image of the probe.
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5.2. An electron source has brightness  $\beta = 4.2 \times 10^8 \text{ A}/(\text{cm}^2 \cdot \text{sr})$ .

- a) An image of the source at point 1 has diameter  $d_1 = 0.62 \text{ }\mu\text{m}$  and semi-angle of convergence  $\alpha_1 = 8.2 \text{ mrad}$ . Find the probe current  $i_1$ .  
b) A second image of the source at point 2 has diameter  $d_2 = 29 \text{ nm}$  and current  $i_2 = 8.5 \text{ }\mu\text{A}$ . Find the semi-angle of convergence  $\alpha_2$  (in mrad) at point 2.
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