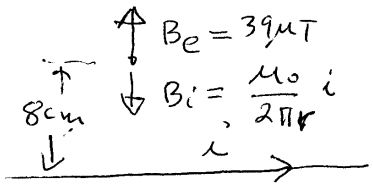
1.



direction to the east. The field at a point 8 cm above it will be $B_i = \frac{\mu_0 i}{2\pi r}$ Pointing south.

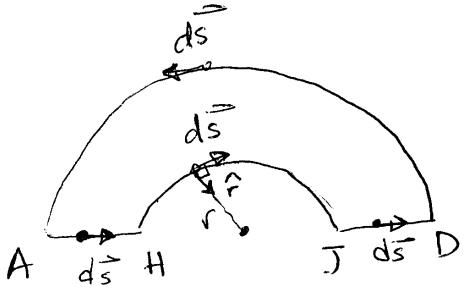
$B_e = B_i$

$$\frac{\mu_0 i}{2\pi r} = 39 \times 10^{-6}$$

$$i = \frac{2\pi (8\times10^{-2})(39\times10^{-6})}{4\pi \times 10^{-7}}$$

$$i = 15.6\,A$$

2.



$$d\vec{B} = \frac{\mu_0}{4\pi} i \times \frac{\vec{ds} \times \hat{r}}{r^2}$$

The field due to the straight portions AH, JD is zero, $\vec{ds} \times \hat{r} = 0$

$$\vec{B} = \left(\frac{\mu_0 i}{4\pi}\frac{\int ds}{R_1^2} - \frac{\mu_0 i}{4\pi}\frac{\int ds}{R_2^2}\right)\hat{k}$$

Due to the smaller semicircle is into and due to the bigger is out of the page

$$\vec{B} = \frac{\mu_0 i}{4\pi}\left(\frac{\pi R_1}{R_1^2} - \frac{\pi R_2}{R_2^2}\right) = \frac{\mu_0 i}{4\pi}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

4. The solenoid can be considered infinitely long because the length is 50 times the diameter.

ℓ is the length of the wire
L is the length of the solenoid.

$$B = \mu_0 i n = \mu_0 i \frac{N}{L}$$

Let ℓ be the length of the wire. One turn has a length $= 2\pi R = \pi d$, $d = 2R$

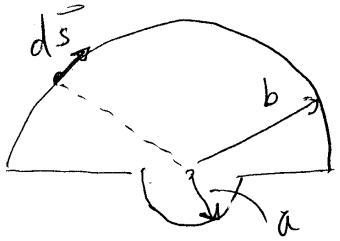
$$N = \frac{\ell}{\pi d}$$

$$B = \mu_0 \frac{i}{L} \frac{\ell}{\pi d}, \quad \ell = \frac{B \ell \pi d}{\mu_0 i}$$

$$\ell = \frac{(23 \times 10^{-3})(1.3)\pi (2.60 \times 10^{-2})}{4\pi \times 10^{-7}(18)}$$

$$= 108 \text{ m}$$

5.



a) $\vec{B}$ is into the page

$$B = \frac{\mu_0 i}{4\pi}\frac{\int ds}{b^2} + \frac{\mu_0 i}{4\pi}\frac{\int ds}{a^2}$$

$$B = \frac{\mu_0 i}{4\pi}\frac{\pi b}{b^2} + \frac{\mu_0 i}{4\pi}\frac{\pi a}{a^2}$$

$$B = \frac{\mu_0 i}{4}\left(\frac{1}{a}+\frac{1}{b}\right) \text{ into}$$

b) $\vec{\mu} = \vec{A} i$

$$\mu i = \left(\frac{\pi b^2}{2} + \frac{\pi a^2}{2}\right) i \text{ into}$$

$$\mu = \frac{\pi i}{2}(a^2+b^2) \text{ into .}$$