1. A metallic sphere of radius 1.5 cm carries a surface charge density of 0.25 $\mu C/cm^2$ on its surface in free space. (a)Calculate the electrostatic energy density at r = 10cm. (b) Calculate the capacitance for this sphere.

2. A current filament of $2a_z$ (A) lies along the Z-axis. Find the magnitude and direction of the magnetic field at (a) $P_1(1,1,0)$, (b) $P_2(-1,1,2)$.

3. A uniform current sheet is located in free space at z=-10 m, 10 a_x (A/m). A current filament of 2 a_x (A) is parallel to the x-axis located at z = -1 m. Find the magnetic flux density, B, at (a) $P_1(0,0,2)$, (b) $P_2(0,2,2)$.

4. Three planar current sheets are located in the free space as follows: 5 a_x (A/m) at z = -2, 5 a_x (A/m) at z = 2, and -10 (A/m) at z = 0. Find the magnetic energy density for all z.

Exam II

1

a) $\int E \cdot ds = \frac{Q}{\varepsilon_0} \rightarrow E \times 4\pi r^2 = \frac{\rho_s}{\varepsilon_0} \times 4\pi a^2 \rightarrow E = \frac{\rho_s}{\varepsilon_0}\left(\frac{a}{r}\right)^2 = 6.35 \times 10^6 \ \frac{V}{m}$

$W_e = \frac{1}{2} \varepsilon_0 E^2 = 178 \ \frac{J}{m^3}$

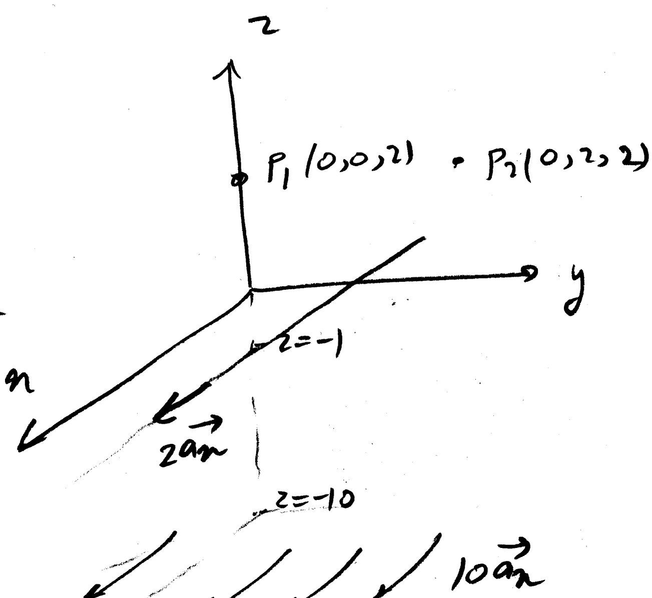
b) $C = 4\pi\varepsilon_0 a = 1.66 \times 10^{-12} \ F$

2

a) $H = \frac{2}{\sqrt{1^2+1^2}} a_\phi$

b) $H = \frac{2}{\sqrt{(-1)^2+1^2}} a_\phi$

3



a)

$B_{plate} = \frac{1}{2} \mu_0 \, 10 \, (-a_y)$

$B_{wire} = \frac{\mu_0 \times 2}{2\pi \, 3} (-a_y)$

$\rightarrow B = B_{plate} + B_{wire}$

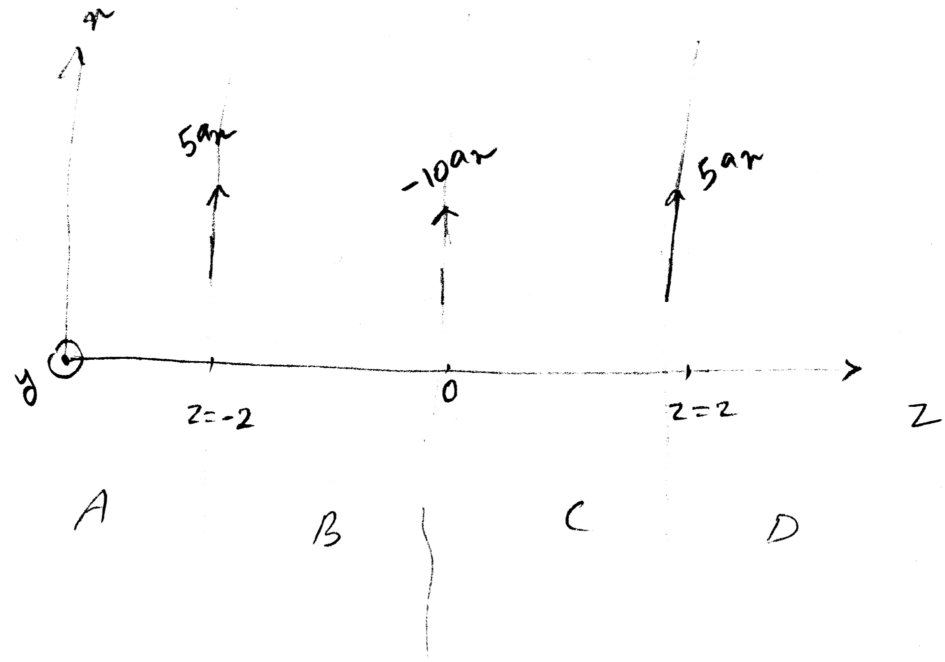
b)

$B_{plate} = \frac{1}{2} \mu_0 (10) (-\vec{a_y})$

$B_{wire} = \frac{\mu_0 \times 2}{2\pi \sqrt{2^2+3^2}} \ \vec{a_x} \times \frac{(2\vec{a_y} + 3\vec{a_z})}{\sqrt{2^2+3^2}}$

$B = B_{plate} + B_{wire}$

4.



$$H_A = \frac{1}{2} 5 a_y - \frac{1}{2} 10 a_y + \frac{1}{2} 5 a_y = 0 \rightarrow w_h = \frac{1}{2} \mu_0 H^2 = 0$$

$$H_B \quad -\frac{1}{2} 5 a_y - \frac{1}{2} 10 a_y + \frac{1}{2} 5 a_y = -5 a_y \rightarrow w_h = \frac{1}{2} \mu_0 H^2 = 1.57 \times 10^{-5} \frac{J}{m^3}$$

$$H_C = -\frac{1}{2} 5 a_y + \frac{1}{2} 10 a_y + \frac{1}{2} 5 a_y = 5 a_y \rightarrow w_h = \frac{1}{2} \mu_0 H^2 = 1.57 \times 10^{-5} \frac{J}{m^3}$$

$$H_D = -\frac{1}{2} 5 a_y + \frac{1}{2} 10 a_y - \frac{1}{2} 5 a_y = 0 \rightarrow w_h = 0$$