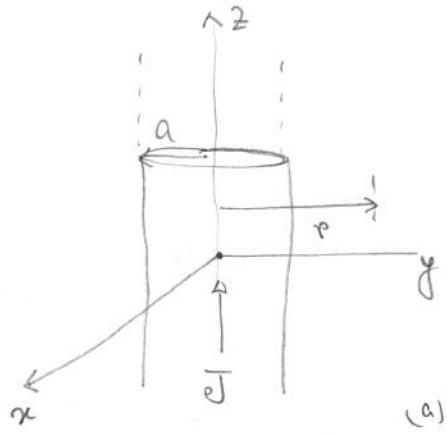
Problem set III

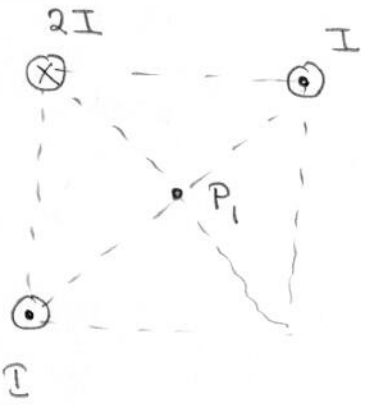
1.



Consider:
a cylinder (infinitely long) with uniform volume current density $\vec{J}$, along $\hat{z}$ direction

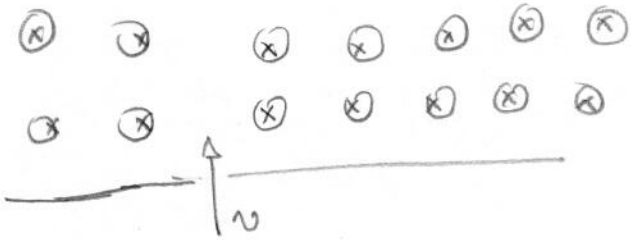
(a) Use Ampere's law to calculate the magnetic field at a distance r from the axis of the cylinder. Consider both the cases, $r<a$ and $r>a$.

2.



Three long (intinitely) straight parallel wires are located as shown in figure, with current $2I$ into the plane (X) and I and I out of the plane (·). What is the magnetic field at the point P_1 ?

3. Consider a .303 bullet of mass 10 gm moving with speed 844 ms^{-1}. If it carries a charge of 1 coulomb (which is never the case) and enters a region with 1 Tesla magnetic field; as shown in figure



(c) what is the radius of the circular path the bullet will take?

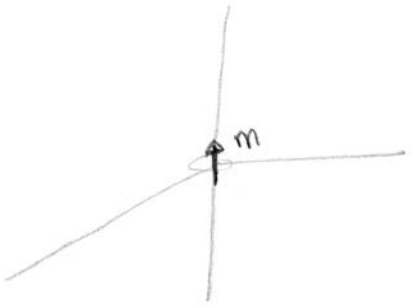
(b) sketch the path.

4. The vector potential of a magnetic dipole is given by the expression:

$$A_x = -\frac{my}{r^3}$$

$$A_y = \frac{mx}{r^3}$$

$$A_z = 0$$



for a dipole of dipole moment m pointing along the true z axis.

where $r^2 = x^2 + y^2 + z^2$

By explicitly calculating:

$$\vec{B} = \vec{\nabla} \times \vec{A}$$

where $\vec{\nabla} = \hat{i}\,\partial_x + \hat{j}\,\partial_y + \hat{k}\,\partial_z$

show that,

$$B_x = \frac{3mxz}{r^5}$$

$$B_y = \frac{3myz}{r^5}$$

$$B_z = \frac{m(3z^2 - r^2)}{r^5}$$