Magentic Properties of materials

1. In the case of magnetostatics, the Maxwell equation for the curl of $\vec{B}$ can be written,
$$\vec{\nabla} \times \vec{H} = \vec{J}_f,$$
which can be solved by the use of Stoke's theorem and the techniques used to find $\vec{B}$ in Ampere's law. Explain what condition must be satisfied in order for $\vec{H}$ to be determined solely by the free currents.

2. An infinitely long cylinder of radius R carries a "frozen-in" magnetization, parallel to the axis,
$$\vec{M} = ks\hat{z},$$
where k is a constant and s is the distance from the axis; there is no free current anywhere. Find the magnetic field $\vec{B}$ inside and outside the cylinder by two different methods:

   (a) Locate all the bound currents, and calculate the field they produce.

   (b) Use Ampere's Law to find $\vec{H}$, and then get $\vec{B}$ from the definition,
$$\vec{H} = \frac{1}{\mu_o}\vec{B} - \vec{M}$$
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