A solid conducting pipe of radius 20 cm carries a 24 A current parallel to the pipe axis and distributed uniformly throughout the pipe material. (a) What is the magnitude of the magnetic field 10 cm from the axis of symmetry? (b) If the pipe is perpendicular to the plane of the paper and the current is going away from you, what is the direction of the magnetic field at the point indicated by X in the figure?

\[
\int B_0 \, ds = M_0 \, I_{\text{enclosed}}
\]

\[
I_{\text{enclosed}} = \frac{24 \, A}{\pi (0.2)^2} \times \pi (0.1)^2 = 6 \, A
\]

\[
\int B \, ds = \mu_0 \, (6 \, A)
\]

\[
B = \frac{\mu_0 \, (6)}{2\pi (0.1)} = \frac{30\mu_0}{\pi}
\]

\[
\mu_0 = 1.256 \times 10^{-6} \, \frac{H}{m}
\]

\[
\mu_0 = 9.55 \, \mu_0 \, \text{Tesla}
\]

\[
= (9.55)(1.256 \times 10^{-6}) = 1.2 \times 10^{-5} \, T
\]