A) Fe shell structure is:

$(1s)^2\ (2s)^2\ (2p)^6\ (3s)^2\ (3p)^6\ (3d)^6\ (4s)^2$

$\therefore\ S = 2,\ L = 2,\ J = 4$

$\therefore\ g = 1 + \dfrac{J(J+1) + S(S+1) - L(L+1)}{2J(J+1)} = 1.5$

$\therefore\ \boxed{\mu_m = 6\,\mu_B}$

Fe^{2+} also has $(3d)^6$, but $L=0$ owing to quenching of orbital moment.

$\therefore\ \boxed{\mu_m = 4\,\mu_B}$

B) Let $\vec{M} = \sin\theta\cos\phi\,\hat{x} + \sin\theta\sin\phi\,\hat{y} + \cos\theta\,\hat{z}$

$E_{surf} = -K_{surf} \oiint dS\,(\hat{n}\cdot\vec{M})^2$

Along the curved edge; $\hat{n} = \cos\phi'\hat{x} + \sin\phi'\hat{y}$

$E^{curve}_{surface} = -K_{surf}\cdot r\int_0^{2\pi} d\phi' \int_0^h dz\,(\cos\phi'\sin\theta\cos\phi + \sin\phi'\sin\theta\sin\phi)^2$

where h and r are the height and radius.

$E^{curve}_{surface} = -K_{surf}\cdot r\cdot h\int_0^{2\pi}(\cos^2\phi'\sin\theta\cos\phi + \sin^2\phi'\sin^2\theta\sin^2\phi + 2\cos\phi'\sin\phi'\sin^2\theta\cos\phi\sin\phi)d\phi$

$= -K_{surf}\cdot r\cdot h\cdot\pi\sin^2\theta$

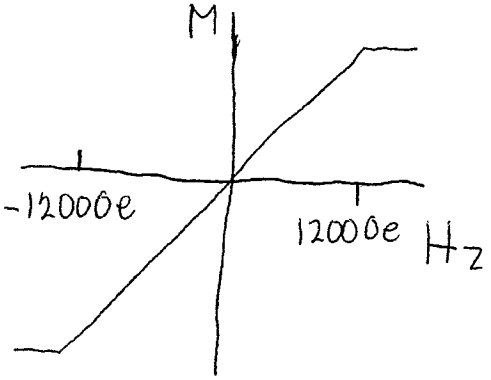
$E^{and\ surfaces}_{surfaces} = -K_{surf}\cdot\pi\cdot r^2\cdot 2\cos^2\theta$

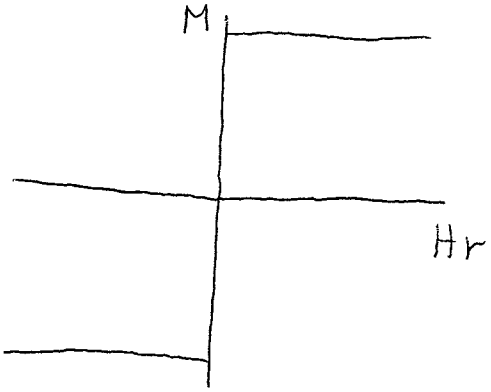
$\therefore\ E_{surface} = -K_{surf}\cdot\pi\cdot r(2r-h)\sin^2\theta + Constant$

$\therefore\ E_{anisotropy} = 5\cdot10^5\cdot20\cdot10^{-7}\cdot\pi\,(5\cdot10^{-7})^2\ ergs$
$* (\sin^4\theta\cos^2\phi\sin^2\phi + \cos^2\theta\sin^2\theta)$
$+ 1\cdot\pi\cdot5\cdot10^{-7}(10^{-6} - 2\cdot10^{-6})\sin^2\theta$

$$\therefore E_{anisotropy} = 7.9\cdot10^{-13}\,ergs\,(\sin^4\theta\cos^2\phi\sin^2\phi + \cos^2\theta\sin^2\theta) - 1.6\cdot10^{-12}\,ergs\,(\sin^2\theta)$$

C) The particle has an easy plane.





$$H_K = \frac{2K}{M} = \frac{1.6\cdot10^{-12}\cdot 2}{\pi(5\cdot10^{-7})^2(20\cdot10^{-7})\cdot 1700}\ Oe$$

$$H_K \approx 1200\ Oe$$

D) Thermal fluctuations help the magnetization jump the energy barrier at a lower field. Also K decreases with temperature. The two effects can be distinguished by measuring at different time scales. K will not be affected, but jumping will reduce with more rapid measurements.