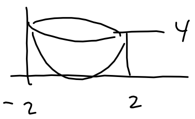
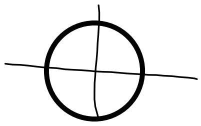
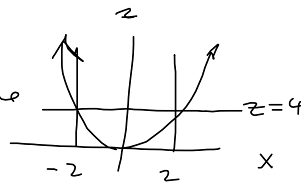
3. $\mathbf{F}(x, y, z) = x^2z^2\,\mathbf{i} + y^2z^2\,\mathbf{j} + xyz\,\mathbf{k}$,
S is the part of the paraboloid $z = x^2 + y^2$ that lies inside the cylinder $x^2 + y^2 = 4$, oriented upward

$\int_C \bar F \cdot d\bar r = \boxed{\iint_S \text{curl}\,\bar F \cdot d\bar S}$ Evaluate this using Stokes'





xz-plane



$\int_0^{2\pi}$

$\bar r = \langle 2\cos\theta, 2\sin\theta, 0\rangle$

$\bar r' = \langle -2\sin\theta, 2\cos\theta, 0\rangle$

$d\bar r = \bar r'(t)\,dt$
$= \langle -2$

? $\|\bar r'\| = \sqrt{4\sin^2\theta + 4\cos^2\theta}$?
$= 2$

$\langle x^2z^2, y^2z^2, xyz\rangle$

$\bar F(\bar r(\theta)) = \langle 4\cos^2\theta \cdot 4^2, 4\sin^2\theta \cdot 4^2, 4\sin\theta\cos\theta \cdot 4\rangle$

$\int_0$ $\int_0^{2\pi} \langle 64\cos^2\theta, 64\sin^2\theta, 16\sin\theta\cos\theta\rangle \cdot \langle -2\sin\theta, 2\cos\theta, 0\rangle\, d\theta$

$= \int_0^{2\pi} \left(-128\cos^2\theta\sin\theta + 128\sin^2\theta\cos\theta\right) d\theta$

$= 128 \int_0^{2\pi} \left((\cos^2\theta)(-\sin\theta) + \sin^2\theta\cos\theta\right) d\theta$

$= 128 \left[\frac{\cos^3\theta}{3} + \frac{\sin^3\theta}{3}\right]_0^{2\pi} = 128\left(\frac{1}{3} - \frac{1}{3}\right) = 0$!