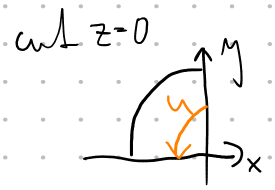
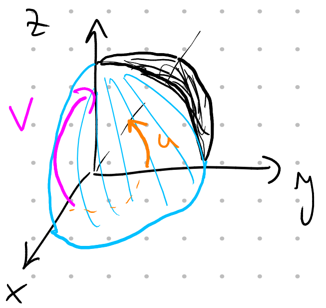
3.) $\vec{f}(x,y,z) = (0;0;z^2)$



$Q: x^2+y^2+z^2=4$



$x = 2\cos u \cos v$

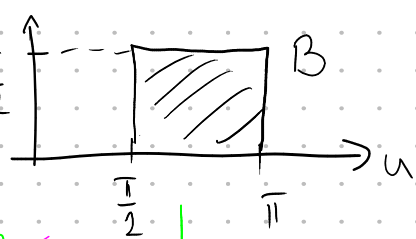
$y = 2 \sin u \cos v$

$z = 2 \sin v$

$\varphi \sim u \in \langle \frac{\pi}{2} ; \pi \rangle$

$\vartheta \sim v \in \langle 0, \frac{\pi}{2} \rangle$

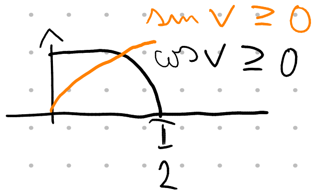
$P(u,v) = (2\cos u \cos v ; 2\sin u \cos v, 2 \sin v)$



$$\begin{array}{c} \begin{array}{ccc} i & j & k \end{array} \\ \left| \begin{array}{ccc} P_u = (-2\sin u \cos v ; & 2\cos u \cos v ; & 0) \\ P_v = (-2\cos u \sin v ; & -2 \sin u \sin v ; & 2\cos v) \end{array} \right| \end{array}$$

$\vec{m} = P_u \times P_v = (. ; . ; \underbrace{4\cos^2 u \cos v \sin v + 4 \sin^2 u \cos v \sin v}_{4 \cos v \sin v})$

$\vec{m}_P \cdot \hat{k} = 4 \cos v \sin v \geq 0$



same orientation (in agreement)

$$\Phi = \iint_{\sigma} \vec{f} \cdot d\vec{p} = + \iint_{B} (0,0,4\sin^2 v) \cdot (. ; . ; 4 \cos v \sin v) \, du \, dv =$$

$$= \int_0^{\frac{\pi}{2}} \left(\int_{\frac{\pi}{2}}^{\pi} (0+0 \; 16 \cos v \sin^3 v) \, du \right) dv = \int_0^{\frac{\pi}{2}} 16 \cos v \sin^3 v \, [u]_{\frac{\pi}{2}}^{\pi} \, dv =$$

$$= 8\pi \int_0^{\frac{\pi}{2}} \sin^3 v \cos v \, dv \; \left| \begin{array}{ll} \sin v = t & \frac{\pi}{2} \to 1 \\ \cos v \, dv = dt & 0 \to 0 \end{array} \right| = 8\pi \int_0^1 t^3 \, dt =$$

$$= 8\pi \left[\frac{t^4}{4} \right]_0^1 = \underline{\underline{2\pi}}$$