

$$bf(A, B)(X, Y) = ABX + AYA + XBA \quad \text{... 1.86} \quad .2.1$$

∴ $f(A+x, B+y) - f(A, B) = (ABx + AYx + XBA)$

$$\frac{\|f(A+x, B+y) - f(A, B) - (ABx + AYx + XBA)\|}{\|(X, Y)\|}$$

$$= \frac{\|(A+x)(B+y)(A+x) - ABA - (ABx + AYx + XBA)\|}{\|(X, Y)\|}$$

$$= \frac{\|AYx + XBx + AYx + XYx\|}{(\|X\|^2 + \|Y\|^2)^{\frac{1}{2}}} \leq \frac{2\|A\|\|Y\|(\|X\| + \|B\|\|x\|) + \|X\|^2\|Y\|^2}{(\|X\|^2 + \|Y\|^2)^{\frac{1}{2}}}$$

$$\rightarrow 0$$

$$\|Y\|, \|X\| \rightarrow 0$$

$$g(p) = \min \{g(u) : u \in M\} \quad .10.2$$

$$(A, -3, -1, B) = \text{Row } Df(p) = \text{Row} \begin{bmatrix} -4 & -3 & 2 & 1 \\ -1 & -3 & 1 & 1 \end{bmatrix}$$

$$(A, -3, -1, B) = (-4\alpha - \beta, -3\alpha - 3\beta, 2\alpha + \beta, \alpha + \beta) \quad .11.1$$

~~(\alpha, \beta)~~

$$\Leftrightarrow \begin{cases} -3 = -3\alpha - 3\beta \\ -1 = 2\alpha + \beta \end{cases}$$

$$(\alpha, \beta) = (-2, 3)$$

$$\begin{cases} A = -4\alpha - \beta = 8 - 3 = 5 \\ B = \alpha + \beta = 1 \end{cases}$$

| 2.1

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1) $f: \mathbb{R}^4 \rightarrow \mathbb{R}^3$

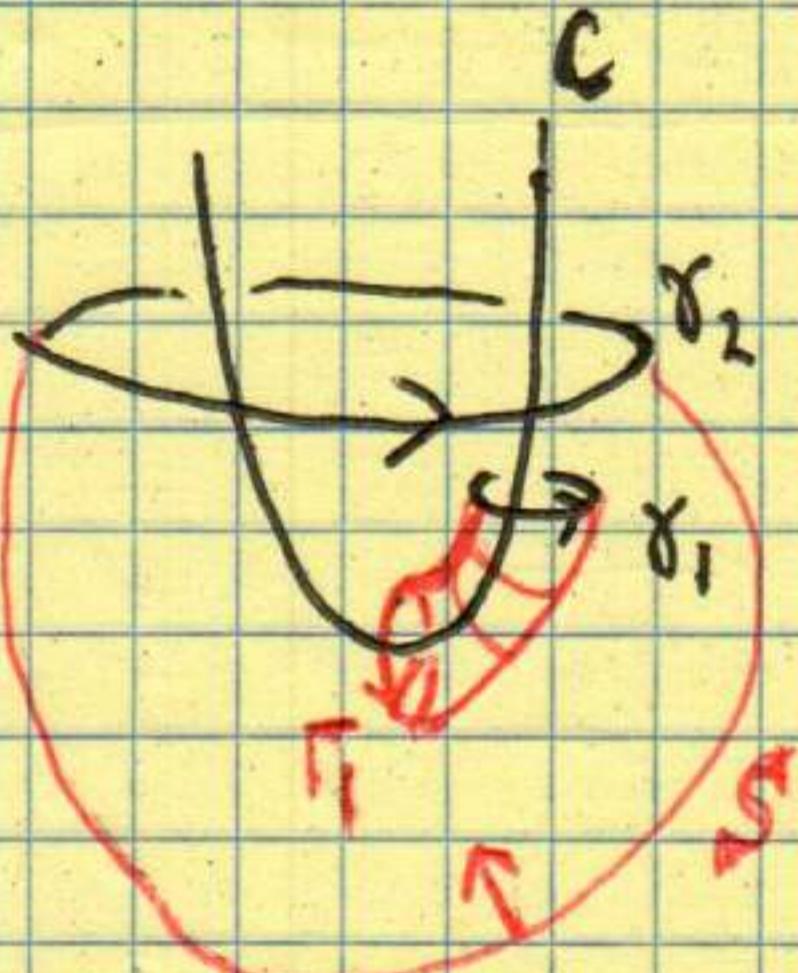
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.2 .2

$$\text{. } F^{-1}(0) = C \quad \text{'sk} \quad F(u) = (f(u), h(u))$$

$$DF(p) = \begin{bmatrix} -4 & -3 & 2 & 1 \\ -1 & -3 & 1 & 1 \\ \nabla h(0) \end{bmatrix} = \begin{bmatrix} -4 & -3 & 2 & 1 \\ -1 & -3 & 1 & 1 \\ 5 & -3 & 3 & -11 \end{bmatrix}$$

$$T_p G = \ker DF(p) = \text{Span} \{(1, 1, 3, 1)\}$$



$$\nabla \times \mathbf{f} = 0$$

10 .3

$f_1: [0, 2\pi] \rightarrow U$ defines a path γ_1 in U .

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$$\text{For } \gamma(t) = (0, \cos t, \sin t)$$

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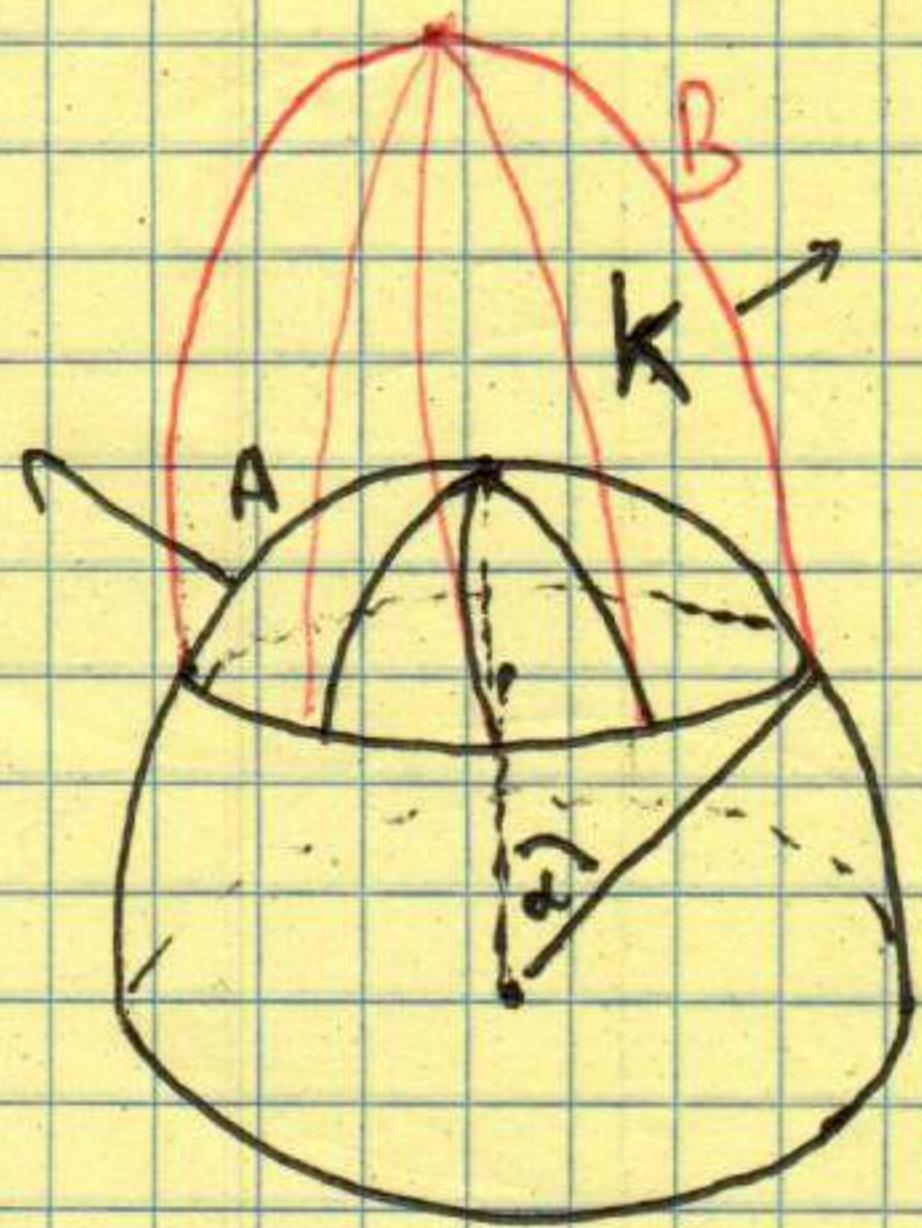
$$\int_{\gamma_1} f d\omega = \int_{\gamma_1} f dr = \int_{t=0}^{2\pi} \frac{(\sin t, -\cos t)}{\sin^2 t + \cos^2 t} \cdot (0, -\sin t, \cos t) dt$$

$$\equiv -2\pi$$

$$|DF_1| = 25$$

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$$\int_{t_1}^{t_2} f dr = \int_S \nabla \cdot f d\sigma = \int_S 0 d\sigma = 0$$



$$\cos \alpha = \frac{1}{2} \Rightarrow \alpha = \pi/3.$$

, 4

$$\operatorname{div} \vec{F} = 0$$

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$$T_R(\phi, \theta) = R(\sin\phi \cos\theta, \sin\phi \sin\theta, \cos\phi)$$

$$N_{T_R}(\phi, \theta) = R \sin\phi T_R(\phi, \theta)$$

$$\int_A F d\sigma = \int_0^\alpha \int_0^{2\pi} f(T_R(\phi, \theta)) N_{T_R}(\phi, \theta) d\phi d\theta$$

$$= 2\pi \int_0^\alpha \frac{T_R(\phi, \theta) \cdot R \sin\phi T_R(\phi, \theta)}{|T_R(\phi, \theta)|^3} d\phi$$

$$= 2\pi \int_{\phi=0}^\alpha \sin\phi d\phi = 2\pi [-\cos\phi]_{\phi=0}^{\phi=\alpha} = 2\pi(1 - \cos\alpha) = \pi$$

$$\partial K = B - A$$

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$$\int_A F - \int_B F = \int_{\partial K} F d\sigma = \int_K \operatorname{div} \vec{F} = 0$$

$$\int_B F d\sigma = \int_A F d\sigma = \pi$$

'sk $\oint (x, y, z) \cdot \hat{r} dx + dy + dz = 0$ (NO) .3, 4

$$\text{'sk } F = \nabla \times G \quad \text{pk} \quad \int_S F \cdot d\sigma = 4\pi$$

$$4\pi = \int_S F \cdot d\sigma = \int_S \nabla \times G \cdot d\sigma = \int_S G \cdot d\omega = 0$$

dS \uparrow
 $dS = \phi$ \downarrow

(1) für $(2,0,0), (0,1,0), (0,0,4)$ gilt $\text{grad } \varphi = (M_N)$ auf S . (c) .5

$$2x+4y+z=4$$

$$\int\limits_{\partial S} (4z-y, x-2z, 2y-4x) \, d\sigma = \int\limits_S \nabla \times F \, d\sigma$$

$$= \int\limits_S (4, 8, 2) \, d\sigma = (4, 8, 2) \cdot \frac{(2, 4, 1)}{|(2, 4, 1)|} \cdot \text{area}(S)$$

$$= 2 \cdot |(2, 4, 1)| = 2\sqrt{21}$$

$$M \cap P = \{(x, y, z) : x^2 + y^2 \leq z = 4 - 2x - 4y\}$$

$$= \{(x, y, z) : (x+1)^2 + (y+2)^2 \leq 3^2, z = 4 - 2x - 4y\}$$

$$A = \{(x, y) : (x+1)^2 + (y+2)^2 \leq 3^2\}$$

$$\varphi: A \rightarrow M \cap P \quad \text{definiert } \varphi$$

$$\text{Maximalwert} \quad \varphi(x, y) = (x, y, 4 - 2x - 4y) \quad "y"$$

$$|f| \quad N_f(x, y) = \sqrt{x^2 + y^2 + 4} = (2, 4, 1)$$

$$\text{area}(M \cap P) = \int\limits_{(x, y) \in A} |(2, 4, 1)| \, dx \, dy = \sqrt{21} \cdot \text{area}(A) = \sqrt{21} \cdot 3^2 \cdot \pi$$