$$r_x = \sqrt{r^2 - (r-x)^2}$$

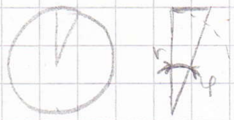
$$A = 2\pi r^2$$

$$\Bigg\} \; V = \int_0^r 2\pi r_x^2 = \pi\left(\int r^2 - \int (r-x)^2\right)$$

$$= \pi\left[r^2 \cdot r + \left[-\tfrac{1}{3}(r-x)^3\right]_0^r\right] = \pi\left[r^3 - \tfrac{1}{3}r^3\right] = \tfrac{2}{3}\pi r^3 \; \overset{\cdot 2}{\Longrightarrow} \; \tfrac{4}{3}\pi r^3$$

Zsmfsg

1) Kreisumfang



$$\tan\varphi = u/r$$
$$u = \tan\varphi\, r$$

$\tan x \approx x \quad \forall x \ll \approx 3°$

$$\Rightarrow U = n \cdot u = n \cdot \tan\left(\tfrac{2\pi}{n}\right) r = \lim_{n\to\infty} \cancel{n} \cdot \tfrac{2\pi}{\cancel{n}}\, r = \underline{\underline{2\pi r}}$$

2) Kreisfläche

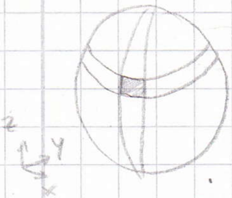
$u = \dots$

$$a = r \cdot u \cdot \tfrac{1}{2} = r^2 \tan\varphi \cdot \tfrac{1}{2}$$

siehe oben

$$\Rightarrow A = n \cdot a = \tfrac{1}{2}\, n\, r^2 \tan\left(\tfrac{2\pi}{n}\right) \underset{n\to\infty}{=} \tfrac{1}{\cancel{2}}\, \cancel{n}\, r^2\, \tfrac{\cancel{2}\pi}{\cancel{n}} = \underline{\underline{\pi r^2}}$$

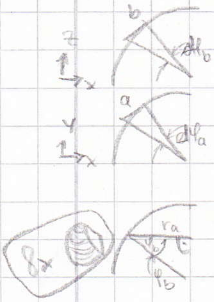
3) Kugeloberfläche



$\square$ a, b $\quad A = ab$

$$= \int_0^{\frac{1}{2}\pi}\int_0^{\frac{1}{2}\pi} r^2 \cos(\varphi_b)\, d\varphi_b\, d\varphi_a$$

$$= r^2 \int_0^{\frac{1}{2}\pi} \left[\sin(\varphi_b)\right]_0^{\frac{1}{2}\pi} d\varphi_a$$



$$b = \frac{d\varphi_b}{2\pi} \cdot 2\pi r_b = d\varphi_b\, r_b$$

$$a = \frac{d\varphi_a}{2\pi}\, 2\pi r_a = d\varphi_a\, r_a$$

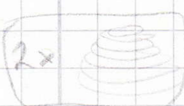
$$r_a = \cos(\varphi_b) \cdot r$$

$$= r^2 \int_0^{\frac{1}{2}\pi} \left(\cancel{\sin \tfrac{1}{2}\pi} - \cancel{\sin 0}\right) d\varphi_a = r^2 \int_0^{\frac{1}{2}\pi} d\varphi_a$$

$$= r^2 \cdot \tfrac{1}{2}\pi \; \overset{\cdot 8}{\Longrightarrow} \; 4\pi r^2$$

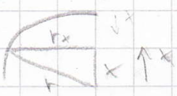
$\cdot 8 =$

4) Kugelvolumen



$$r_x = \sqrt{r^2 - x^2}$$

$$V = A_0(r_x)\, dx = \pi r_x^2\, d_x = \int_0^r \pi (r^2 - x^2)\, d_x = \pi\left[\int_0^r r^2\, dx - \int_0^r x^2\, dx\right]$$



$$= \pi\left[r^2 \cdot r - \left[\tfrac{1}{3}x^3\right]_0^r\right] = \pi\left(r^3 - \tfrac{1}{3}r^3\right) = \tfrac{2}{3}\pi r^3$$

$$\Rightarrow \tfrac{4}{3}\pi r^3$$

$\cdot 2$