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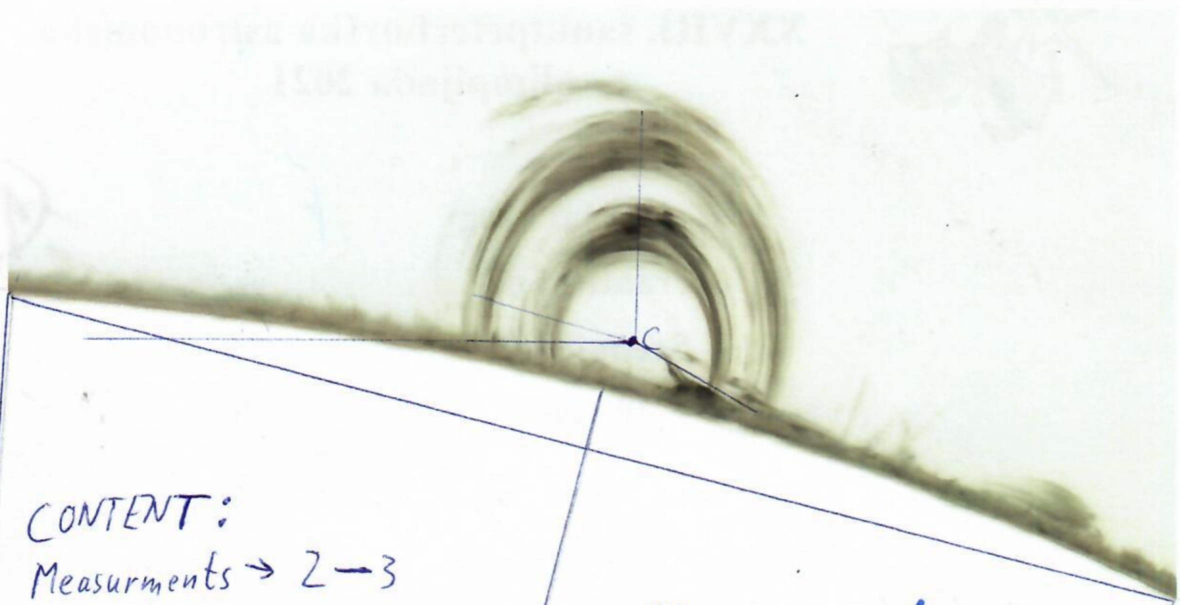
Na sliki je zanka v koroni Sonca, ki je nastala na vidnem robu Sončeve ploskvice zaradi močnega magnetnega polja. Izračunaj prostornino te zanke, če jo obravnavaš kot ukrivljeno cev.



CONTENT:

Measurments

$\frac{1,7 \cdot 1,7}{2,89}$

$\cdot 10^7$

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Calculations

$7 : 4,1 =$

$70 : 40 =$

$7 : 4 = 1,75$

30
20

$1,8 \cdot 1,7$
18
126
3,06

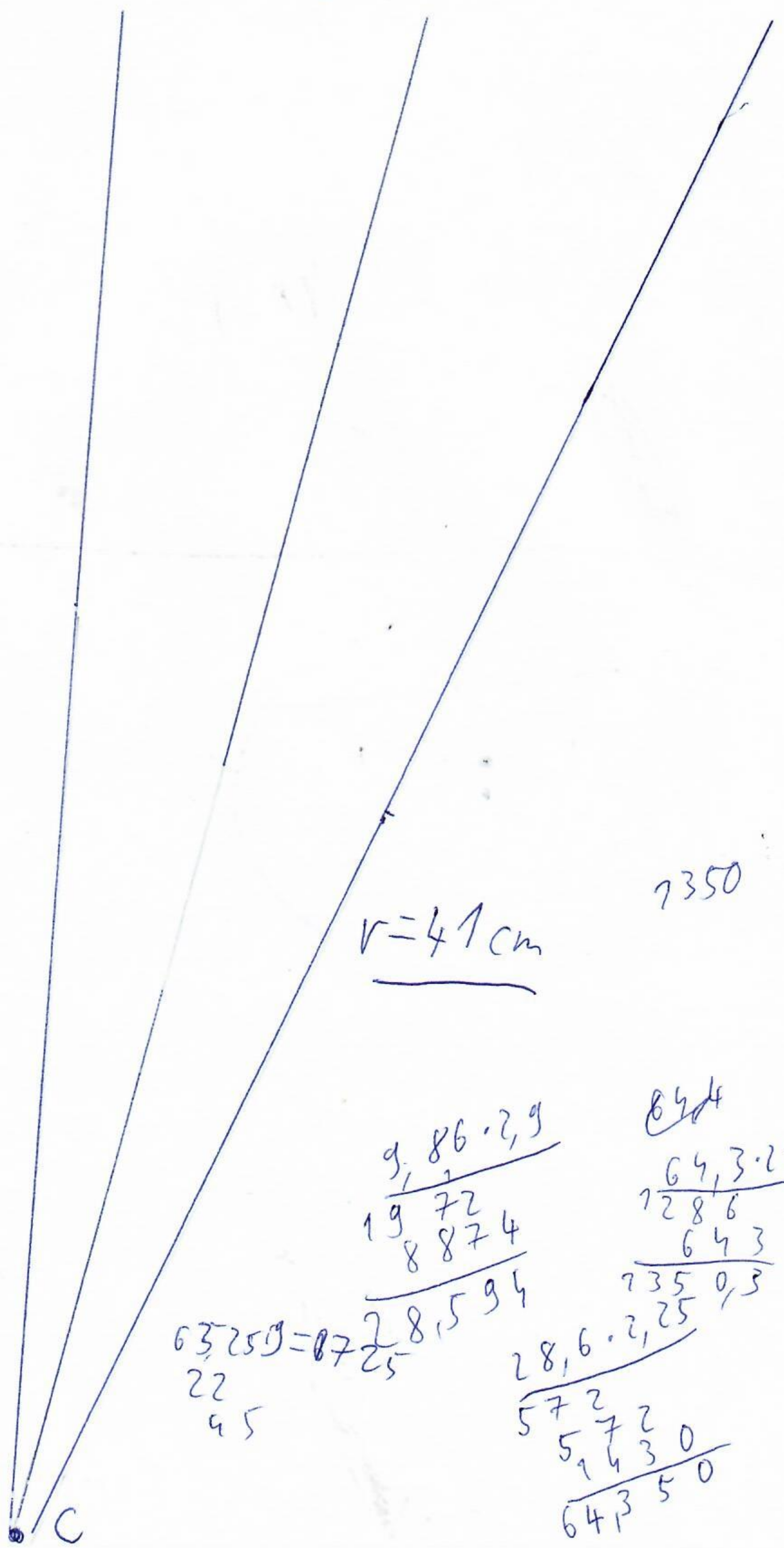
$\frac{7 \cdot 10^{10}}{4 \cdot 10^7}$

700 000 km
$7 \cdot 10^5$ km
$7 \cdot 10^8$ m
$7 \cdot 10^{10}$ cm
$7 \cdot 10$

~~1,221~~

$1,75 \cdot 1,2$
175
350
2,100

Measurments



$1,75 \cdot 2,5$

$1,7 \cdot 2,5$
34
85
4,25

1350

$r = 41$ cm

$3,14 \cdot 3,14$
942
314
1256
9,8596

$1350 : 28 =$

10^5

10^9

$9,86 \cdot 2,9$
1972
8874
28,594

644

$64,3 \cdot 21$
1286
643
1350,3

$63250 = 87$ 25
22
45

$28,6 \cdot 2,25$
572
572
1430
64,350

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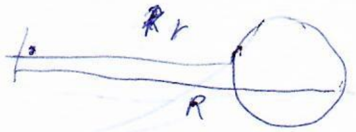


Derivations

$$p = 4\pi r_n^2 = 4\pi\left(\frac{R-r}{2}\right)^2 = \pi(R-r)^2$$

$$V = 2\pi p = 2\pi^2(R-r)^2$$

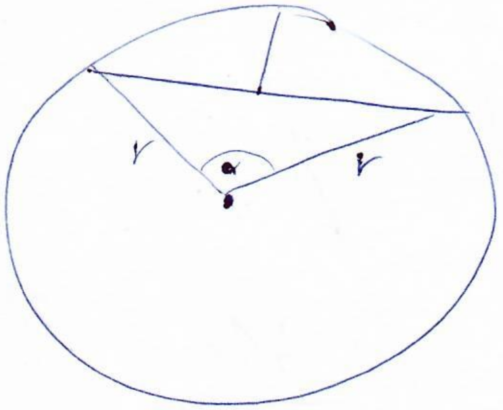
$\pi^2 = 10$

$$v = \pi r^2 \cdot d$$

$$V = \pi(R-r)^2 \cdot 2\pi r = 2\pi^2(R-r)^2 r$$

$$\frac{\cancel{2\pi^2(R-r)^2 r}}{2\pi^2(R-r)^2 r}$$

20 $\quad 2\pi r \cdot \pi r^2$



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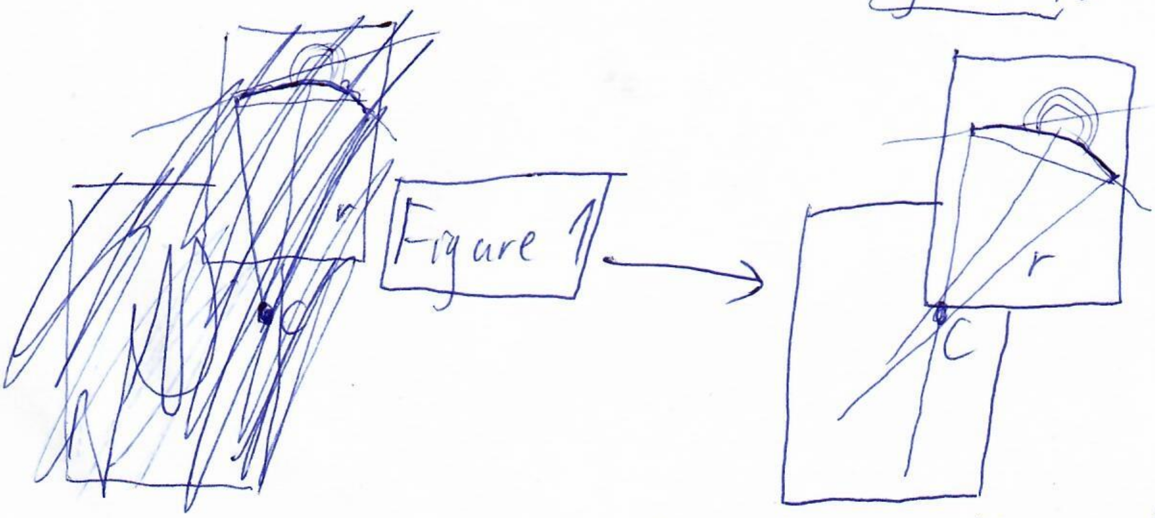
We need to calculate the radius of the arc, so we need to find the ratio between the true size and size on the map. We know the radius of the Sun:
$R_\odot = 7 \cdot 10^8$ m and we can measure the radius of the Sun on the map. I did it using the following techique: I found the tangents at the edges of the photosphere of the Sun and drew lines perpendicular to them. For that I needed two pieces of paper. The intersection of them is the centre of the Sun. But I could get big errors on such scale, so I drew the control and saw that it intersects the radiuses in the nearly same point. The sketch is shown on Figure 1.



With these measurments I got the radius on the map of $\boxed{41 \text{ cm}}$

The ratio is: $\frac{true}{map} = \frac{7 \cdot 10^{10} \cancel{cm}}{41 \cancel{cm}} = \underline{1{,}75 \cdot 10^9}$

Main solution

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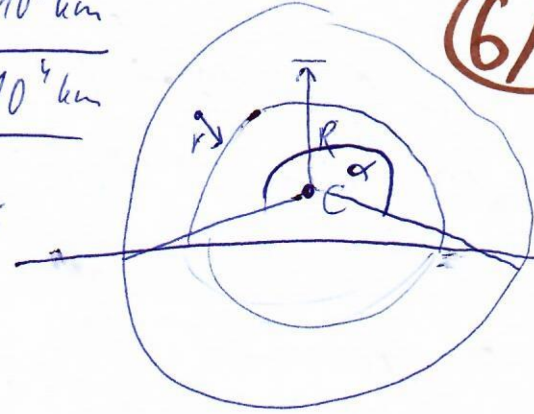
We can easily calculate the true size of R and r (figure 2):

$R = 1{,}7\,cm \cdot 1{,}75 \cdot 10^9 = 2{,}9 \cdot 10^{10}\,cm = \underline{2{,}9 \cdot 10^4\,km}$

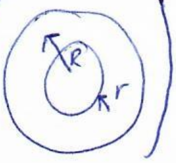
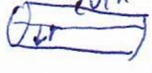
$r = 0{,}9\,cm \cdot 1{,}75 \cdot 10^9 = 1{,}5 \cdot 10^{10}\,cm = \underline{1{,}5 \cdot 10^4\,km}$

We can also measure α (fig. 2):

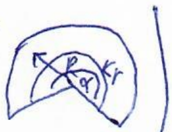
$\underline{\alpha = 210^\circ}$



The only challenge left is to calculate the volume of the torus.

$V\Big($  $\Big) = V\Big($  $\Big) = S\Big($  $\Big) \cdot 2\pi R = \pi r^2 \cdot 2\pi R = \underline{2\pi^2 r^2 R}$

But the given loop isn't perfect torus, so we have to multiply it by $\frac{\alpha^\circ}{360^\circ}$.

$V\Big($  $\Big) = 2\pi^2 r^2 R \cdot \frac{\alpha^\circ}{360^\circ} = \underline{\frac{\pi^2 r^2 R \cdot \alpha^\circ}{180^\circ}}$

Main Solution

Let's plug in the data:

$$V(\text{loop}) = \frac{\pi^2 R r^2 \cdot \alpha^\circ}{180^\circ} = \frac{\pi^2 \cdot 2{,}9 \cdot 10^4\,km \cdot 1{,}5^2 \cdot (10^4)^2\,km^2 \cdot 21\cancel{0}}{18\cancel{0}} =$$

$$= \frac{3{,}14 \cdot 3{,}14 \cdot 2{,}9 \cdot 2{,}25 \cdot 21 \cdot 10^4 \cdot 10^8}{18}\,km^3 = \frac{\cancel{1350}^{6525} \cdot 10^{12}}{\cancel{18}_9}\,km^3 = 725 \cdot 10^{11}\,km^3 =$$

$$= 7{,}25 \cdot 10^{13}\,km^3 = \boxed{7{,}25 \cdot 10^{13}\,km^3}$$

Check: Units → OK

Physics → OK

~~[illegible]~~

Check and discussion

Discussion: the cube with sides of 10^4 km, in scale: → pretty reasonable