4,3 · 57000 / 7,4

43 · 57000 / 74

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57000 · 43
228000
171000
2451000
/ 74

2451000 : 74 = 702
5
51

Short Solutions:

Diameter of a moon: <u>600km</u>

1 · 10^15 · 256

256 · 10^15 / 1,7 · 10^13

Period of moon: <u>5 h</u>

0,21 · 24
48
5,04

2,56 / 1,7 · 10

Period of conjunction: <u>0,22 d</u>

2,56 :
25
26 : 17 = 1
0,7

What would happen if Titan had the same orbit as unknown moon? See big yellow sign.

1,4
1,1

r(ry − rx) / x

57

1,5 · 60000
90 000 0,0

0,3 · 7,4
0,7 2
0,5

~~77~~ ~~36~~ ~~28~~ 9
~~50~~ ~~20~~ ~~12~~ 6 = 3/2

900000 : 24
45,0000 : 17 =
2
18

57000 · 7,4 / 1,5

57000 · 1,5 / 7,4
28
270000

Na prvi fotografij je vidna Saturnova luna, ki se giblje v zunanjem območju kolobarjev, na drugi pa je Saturn v negativu. Znano je, da je v času opazovanja luna bila v ravnini, ki je pravokotna na kolobarje in hkrati na zveznici med središčema Sonca in Saturna. Kot med ravnino kolobarjev in smerjo proti Soncu je 1 stopinja. Polmer Saturna je 9-krat večji od polmera Zemlje.

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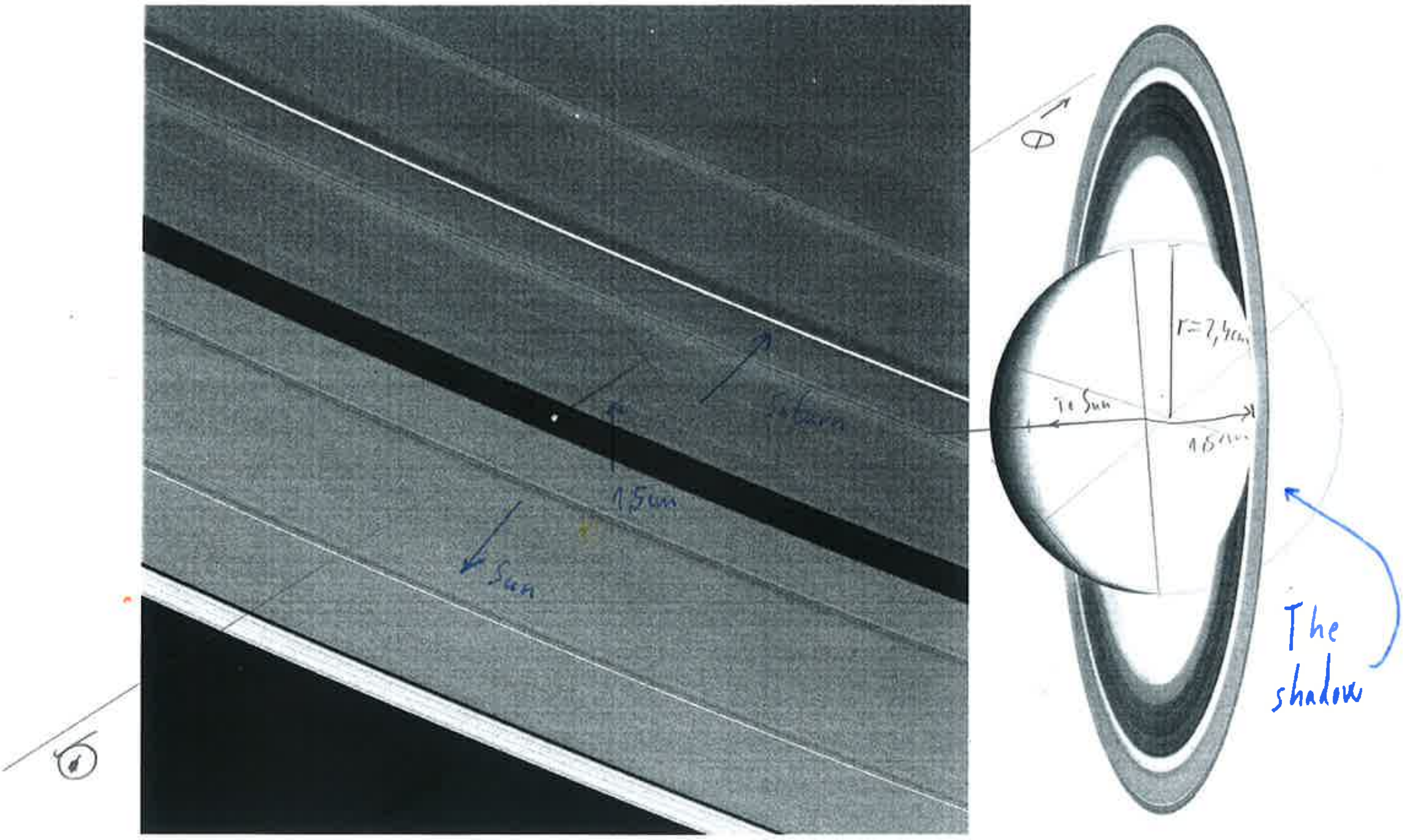
Oceni premer lune in njegov obhodni čas okoli Saturna. Vsake koliko časa je ta luna v konjunkciji s Saturnovo luno Titan? Titan se okoli Saturna giblje po krožnici s polmerom 1,2 milijona kilometrov, njegov obhodni čas pa je 16 dni. Opiši, kaj bi se zgodilo, če bi se Titan nahajal na isti orbiti kot opazovana luna.

Peter Andolšek



The remark on symbols:

⊙ - Sun

⊕ - Earth

☾ - Saturn's moon

Ⓣ - Titanus

- Saturn

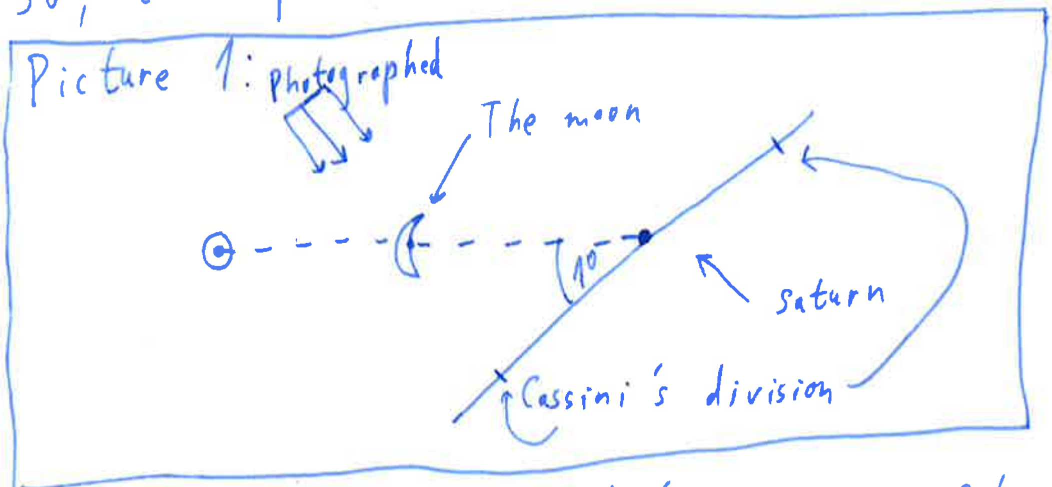
Note:
These are not the official sign (just because of simplicity)

FOR THE SOLUTION FOLLOW THE LINE

Peter Andolšek

Let's say, that the moon is higher than the rings (it doesn't matter, it's equivalent)

So, the picture is as follows:

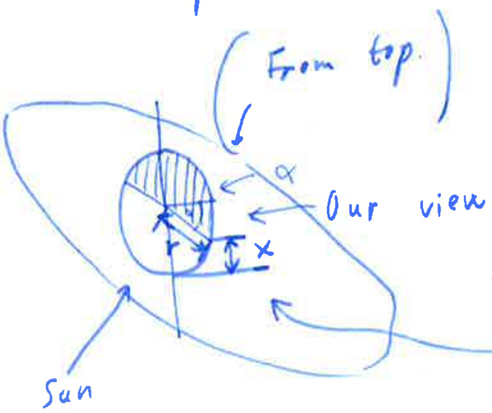


Let's calculate the distance $\underline{\text{moon - Saturn's center}}$. $(=a)$

$r_{\oplus} = 6380 km$

$r_{♄} = 6380 km \cdot 9 = 57420\ km \approx \underline{57000 km}$

From the picture, we get:



$$\alpha = \arcsin\left(\frac{r-x}{r}\right)$$

inclination $= 1° \approx \underline{0°}$

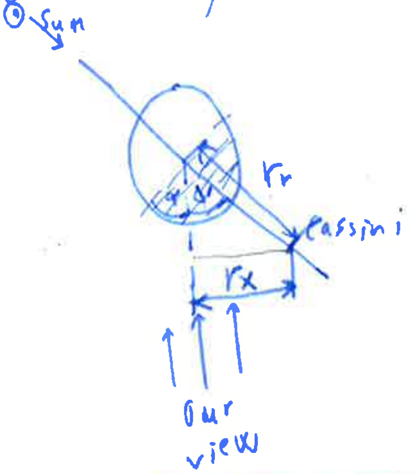
$\underline{\text{IN RADIANS}}$:

$$r_r = \frac{r_x}{\sin\alpha} = \frac{r_x}{\sin\arcsin\frac{x}{r}} =$$

$$= \frac{r_x \cdot r}{x} = \frac{1{,}1cm \cdot 1{,}9cm}{0{,}5\,cm} =$$

$$= 4{,}28 cm$$

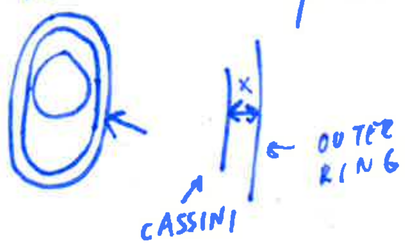
(From the left:)



GO TO 1

2

From the previous equations we get:



$$x = \frac{r_y \cdot r}{X} - \frac{r_x \cdot r}{X} = \frac{r(r_y - r_x)}{X} = \cancel{87000\,km}$$

$$= \frac{2{,}4\,cm\,(1{,}4\,cm - 1{,}1\,cm)}{0{,}5\,cm} = 1{,}5\,cm$$

1,5 cm ⇝ 27000 km

27 000 km .... 1,5 cm

600 km .... 0,1 cm

Result: 600 km is size of moon.

Peter Andolšek 5/8

This correspondents to:

1

2,4 cm ..... 57000 km

4,3 cm ...... 102000 km

Let's alculate k for Titan:

$$k = \frac{a^3}{P^2} = \frac{(1{,}2\cdot 10^6)^3\,km^3}{(16\,d)^2} = \frac{1{,}7\cdot 10^{18}\,km^3}{256\,d^2}$$

Now the period for the unknown moon:

$$P = \sqrt{\frac{a^3}{k}} = \sqrt{\frac{(10{,}2\cdot 10^4)^3\,km^3 \cdot 256\,d^2}{1{,}7\cdot 10^{18}\,km^3}} \doteq 0{,}21\,d = 5\,h$$

BUT...

The instructions weren't true at all. They say this:

But I can see the shadow on the rings. So the moon isn't entirely on the line.

$$\left|\frac{1}{P_1} - \frac{1}{P_2}\right| = \frac{1}{P_S}$$

$$\frac{1}{\left|\underbrace{\frac{1}{16\,d}}_{\text{VERY SMALL}} - \frac{1}{0{,}21\,d}\right|} = P_S = \frac{1}{5 - 0{,}05}\,d \doteq 0{,}22\,d$$

If these two moons were on the same orbit, there would nothing happen. (Like by the Troyans and the Greecs in Jupiter orbit.) But if they were very close, they will collide and at some time they will form a new moon.

GO TO 2

$$\frac{729 \cdot \cancel{10^{12}} \cdot 256}{1,7 \cdot 10^{\cancel{18}\,6}}$$

$$\frac{9 \cdot 9}{81 \cdot 9} \quad 729$$

$$\frac{\left(1,7 \cdot 10^{6}\, km^{3}\right)}{\left(16^{2} d^{2}\right)^{2}}$$

$$\frac{1,2 \cdot 1,2}{\cancel{14}}$$

6/8

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$$\frac{1,4\cancel{4} \cdot 1,2}{14}$$

$$\frac{28}{1,68}$$

$1,7\ km^{3}$

$$\frac{7,29 \cdot 2,56 \cdot \cancel{10^{4}}}{1,7 \cdot 10^{12}}$$

$$\frac{1,1 \cdot 2,4}{0,5}$$

$$\frac{7,3 \cdot 2,6}{1,7 \cdot 10^{2}} \quad d =$$

$$\frac{16 \cdot 16}{256}$$

$$\frac{1,7 \cdot 10^{18}\, km^{3}}{256\, d^{2}}$$

$$\frac{0,112 \cdot 24}{224}$$

$$\frac{2,64 \cdot 2}{4,28}$$

448

2,688

$$\frac{7,3 \cdot 2,6}{146}$$

438

18,98

2,74

$1,1,2 \cdot 10^{-2}$

3,4 · 1,1

$$\frac{\cancel{24}}{26}$$

$$\sin \alpha = \frac{r_x}{r_r}$$

$$\frac{1,5 \cdot 2,4}{\cancel{\sin}\ 0,5}$$

19 : 1,7 =

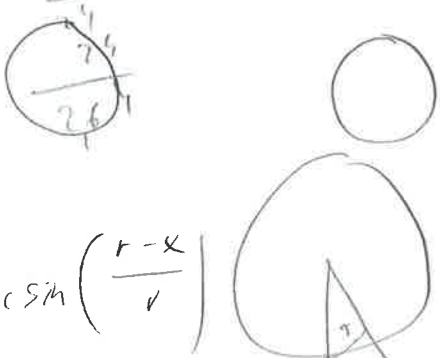
0,112 d

arcsin

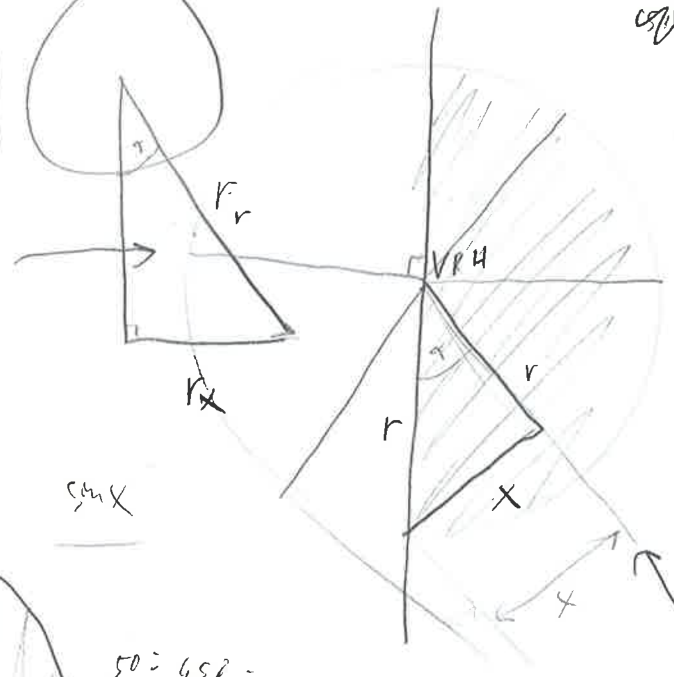
130 : 17 = 11,2

$$\frac{r_x}{\cancel{\sin}\ \frac{x}{r}}$$

$$\frac{r_x \cdot r}{x}$$



$$\alpha = \arcsin\left(\frac{r-x}{r}\right)$$



$$r_r = \frac{r_x}{\sin \alpha}$$

$$\frac{1,5 \cdot 2,4}{3}$$

1

x → 2

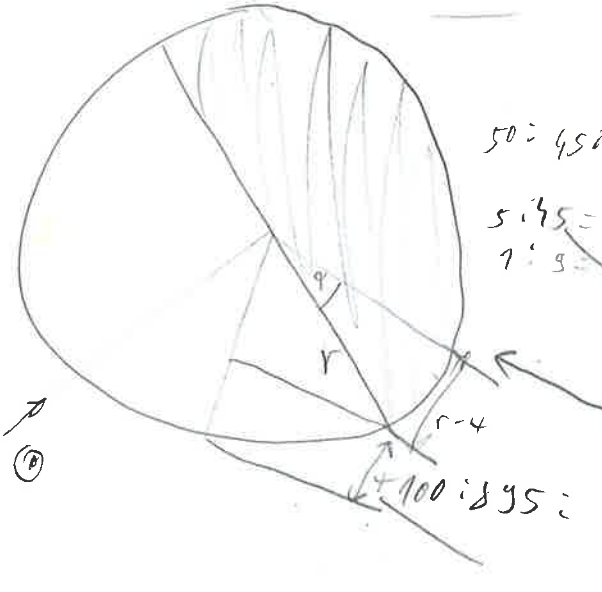
$$\frac{r_x \cdot x}{(r - x)}$$

$$\alpha = \arcsin\left(\frac{x}{r}\right)$$

sin x

$$\frac{1,5 \cdot 2,4}{}$$

$$\frac{r_x \cdot r}{x}$$



50 : 450 =

5 : 45 =

1 : 9 = 0,11 d

1 :

1 000 : 112 =

100 : 895 =

500 : 56 =

250 : 28

125 : 13 = 9

1 : 16

100 : 16

1 : 16 = 0,04

$$\frac{1,5 \cdot 2,4 \cdot 2}{}$$

9 −

1,5

$$\frac{1,5 \cdot 2,4}{x}$$

8,95

$90 - \alpha$

$r_r = \sin\left(90 - \arcsin\left(\frac{r - x}{r}\right)\right) \cdot r_x$

$\sin\left(90 - \arcsin\left(\frac{0{,}5cm - 1{,}5cm}{0{,}5cm}\right)\right)$

$\sin\left(90 - \arcsin\left(\frac{1{,}4cm - 0{,}5cm}{1{,}4cm}\right)\right) \cdot 1{,}5cm$

$\frac{a^3}{P^2} = k$

7/8
Peter Andolšek

$\sin\alpha = \frac{r_x}{r_r}$

$\sin\alpha' = \frac{r_r}{r_x}$

4

r

$r_r = \sin\alpha \cdot r_x$

$r - x$

1°

$\frac{1{,}5\,cm \cdot 6}{5}$

$\frac{6\,380 \cdot 9}{57\,420}$

$\frac{1{,}8}{2{,}4}$

$\frac{x}{2{,}4}$ 10,9 1,7

$\frac{a}{c}$

$\frac{28000}{57000 \cdot 3{,}5}$

1,4 1,7

r_r

r_x

$\frac{19}{24}$

$\frac{28000 \cdot 35}{17}$

$\frac{1{,}5 \cdot 5}{4}$

28000 · 33
84000
140000
98000

1,5

60000

$90 - \frac{19}{24}$

$\frac{57}{33}$

50000

$\frac{19 \cdot 180}{24 \cdot \pi}$ $\frac{1{,}5 \cdot 0{,}8}{120}$ $\frac{2160 - 19}{24}$ $\frac{24 \cdot 90}{2160}$

$\frac{\pi}{2} - \frac{5}{6}$

20 : 24

19 : 24

$1'$ $\frac{x}{}$ $\frac{x}{1'}$

$\sin(89) = 1 \cdot 1{,}5cm$

1,6 − 0,8 = 0,8 10 : 12

$\frac{56 \cdot 6}{216}$

89

5 : 6 = 0,8

625 : 125 = 5

0,8

$\frac{5 \cdot 180}{6 \cdot \pi}$ 30

$x - \frac{x^3}{3}$

6^5 $\frac{125}{216 \cdot 3}$

$\tan 1' = 1$

$\frac{150}{3}$ · 50

$\frac{216 \cdot 3}{648}$

$\frac{125}{5}$

$\frac{125}{650}$

625

8/8

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