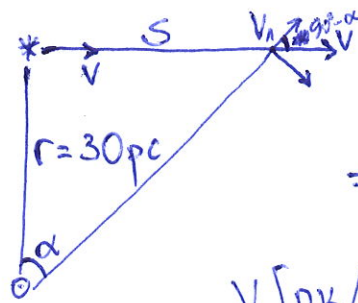


1.



$$V [\text{km/c}] = \omega [\text{"/год}]. r [\text{пк}]. 4,74$$

$$\Rightarrow V = 0,5 \cdot 30 \cdot 4,74 = 71,1 \text{ км/с}$$

$$V [\text{пк/год}] = \omega [\text{рад/год}]. r [\text{пк}]$$

$$V = \frac{0,5}{206265} \cdot 30 \text{ пк/год}$$

$$S = Vt = \frac{71,1 \cdot 100}{13751} = \frac{100}{13751} \text{ пк}$$

лучевая скорость

$$V_r = \sin \alpha \cdot V$$

$$S \ll r \Rightarrow \sin \alpha \approx \text{tg } \alpha \approx \alpha [\text{rad}]$$

$$V_r = 71,1 \cdot \sin \frac{100}{13751 \cdot 30} \approx \frac{71,1 \cdot 100}{13751 \cdot 30} = \frac{237}{13751} \text{ км/с}$$

$$z = \frac{V_r}{c} = \frac{\Delta \lambda}{\lambda}$$

$$\Delta \lambda = \frac{237 \cdot 4500}{13751 \cdot 300000} \approx \frac{80 \cdot 45}{1380000}$$

оптический диапазон
 $\approx 450 - 750 \text{ нм}$

$$= \frac{360}{1380000} \approx 0,002 \text{ \AA} \ll 0,1 \text{ \AA}$$

$\Delta \lambda$ - максимально $\Rightarrow \lambda$ - минимально

Нет.

2. абсолютная звездная величина \rightarrow Сирэнце $M_0 = 4,8^m$
 \rightarrow светимости \rightarrow звезда $M_* = -0,6^m$

$$\frac{L_*}{L_0} = 10^{0,4(4,8+0,6)} = 10^{2,16} \approx 100 \cdot \sqrt[5]{10} \approx 160$$

$$\frac{L_*}{L_0} = \left(\frac{R_*}{R_0}\right)^2 \cdot \left(\frac{T_*}{T_0}\right)^4 = \left(\frac{R_*}{R_0}\right)^2 \cdot \left(\frac{34 \cdot 10^3}{58 \cdot 10^3}\right)^4 = 160 \approx 169$$

$$\frac{R_*}{R_0} \cdot \left(\frac{14}{29}\right)^2 = 13$$

$$\frac{R_*}{R_0} \approx 13 \cdot \frac{30^2}{18^2} = \frac{13 \cdot 100}{6^2} \approx 43,6 \approx 45$$

равновесно ускорение \rightarrow Сирэнце a_0
 на поверхности \rightarrow звезда a_*

$$a_0 = \frac{GM_0}{R_0^2} \approx \frac{6,7 \cdot 10^{-11} \cdot 2 \cdot 10^{30}}{4000000000^2} = \frac{134 \cdot 10^2}{49} \approx 270 \text{ м/с}^2$$

$$\frac{a_*}{a_0} = \frac{M_*}{M_0} \cdot \left(\frac{R_0}{R_*}\right)^2 \Rightarrow \frac{M_*}{M_0} = \frac{45 \cdot 45}{13} \cdot \frac{0,7}{270} \approx 5,25$$

$\checkmark T_p = 73 \text{ д} = \frac{73}{365} \text{ год} \approx 0,2 \text{ год}$
 период экзопланета

a_p - большая полуось экзопланета

$$\frac{a_p^3 [\text{AU}]}{T_p^2 [\text{год}]} = M_* [M_0]$$

$$a_p^3 = 5,25 \cdot 0,04 = 5,25 \cdot \frac{1}{25} = 0,21$$

$$\Rightarrow a_p \approx 0,6 \text{ а.е.} = 0,6 \cdot 1500000000 = \frac{3}{5} \cdot 15 \cdot 10^7 = 9 \cdot 10^7 \text{ км}$$

$$R_* = 45 \cdot 4000000 = 315000000 = 3,15 \cdot 10^8 \text{ км}$$

периастрий - близко до поверхности звезда

$$\Rightarrow a_p(1 - e_{\text{макс}}) \approx R_*$$

$$1 - e_{\text{макс}} = \frac{3,15 \cdot 10^8}{3,9 \cdot 10^7} = 0,35$$

$e_{\text{макс}} \approx 0,6$

3) Сириус

$r = 50 \text{ пк}$ $m = 1,3^m$
↳ расстояние до Антареса ↳ видимая зв. величина

Антарес - красный сверхгигант \Rightarrow холодн и огромен

$$M_0 = 4,8^m$$

$$\frac{L_a \rightarrow \text{сверхгигант}}{L_0} = 10^{0,4(4,8-1,3)} = 10^{1,4} = 10 \cdot 2,512 = 25,12$$

$$\frac{L_a}{L_0} = 25,12 \cdot 25 = 628 = \left(\frac{R_a}{R_0}\right)^2 \cdot \left(\frac{T_a}{T_0}\right)^4$$

$$T_a \approx \frac{1}{2,5} T_0$$

\downarrow $\approx 2300 \text{ K}$ \downarrow 5800 K

$$\frac{R_a}{R_0} \cdot \left(\frac{T_a}{T_0}\right)^2 \approx 25$$

$$\frac{R_a}{R_0} = 25 \cdot 2,5^2 \approx 150$$

$$\delta_0 = \frac{2R_0}{1 \text{ a.e.}} = 0,5''$$

$$\delta_a = \frac{300 R_0}{50 \cdot 206000 \text{ a.e.}}$$

\leftarrow $206265'' \rightarrow \text{a.e./pk}$

$$\Rightarrow \frac{\delta_a}{\delta_0} = \frac{3}{50 \cdot 206000 \cdot 2 R_0}$$

$$\Rightarrow \left[\delta_a = \frac{3}{206000} \cdot \frac{1}{2} \cdot 18'' = \frac{54}{2060} \approx 0,026'' \approx 0,03'' \right]$$

4) яквири 2003 \rightarrow июли 2097 $\Rightarrow T_{\text{сум}} = 94,5 \text{ год}$

$$\frac{1}{T_{\text{асг}}} = \frac{1}{T_3} + \frac{1}{T_{\text{сум}}} \quad \frac{1}{T_{\text{асг}}} = 1 + \frac{1}{94,5} / 94,5 T_{\text{асг}}$$

$$\Rightarrow 94,5 = 94,5 T_{\text{асг}} + T_{\text{асг}} = 95,5 T_{\text{асг}}$$

$$T_{\text{асг}} = \frac{94,5}{95,5} \text{ год} = \frac{189}{191} \text{ год}$$

$$\frac{a_{\text{асг}}^3 \cdot a_{\text{асг}}}{T_{\text{асг}}^2 [\text{год}]} = 1$$

$$a_{\text{асг}}^3 = \left(\frac{189}{191}\right)^2 = \left(\frac{3^3 \cdot 7}{191}\right)^2 = 9^3 \cdot \left(\frac{7}{191}\right)^2 =$$

$$\left(\frac{191}{7}\right)^2 = \frac{36481}{49} = \frac{9^3}{744,5102}$$

$$= 744,5102$$

(малки аметки
в перкова)

$$a_{\text{асг}} = \sqrt[3]{744,5102} = \frac{9}{9,064} = 0,992 \text{ а.е.}$$

$$9,1^3 = 753,571 - \text{трябва малко
малко}$$

$$9,07^3 = 746,142643 - \text{още малко
не го да}$$

$$9,066^3 = 748,1559... - \text{още малко
малко}$$

\rightarrow трябва разлика 0,6
 $\Rightarrow 0,6 \cdot 0,004 =$

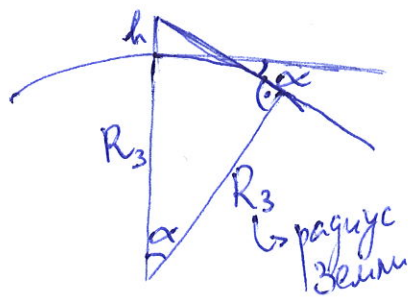
$$= 0,0024$$

$$\Rightarrow 9,066 - 0,0024 = 9,064$$

$$9,064^3 = 744,662$$

$$9000 : 9064 = 0,9920...$$

5.



$$\cos \alpha = \frac{R_3}{R_3+h} = \frac{4200}{4201}$$

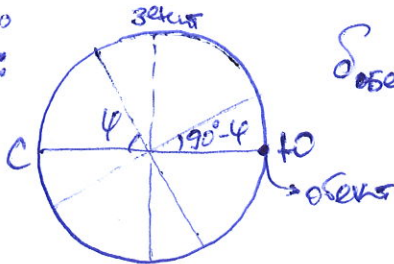
$$h = \frac{885}{6370000} R_3 \approx \frac{1}{4200} R_3$$

$$\sin \alpha = 1 - \left(\frac{4200}{4201}\right)^2 = \frac{(4200+1)^2 - 4200^2}{4201^2} =$$

$$= \frac{2 \cdot 4200 + 1}{4201^2} \approx \frac{8400}{3600} = \frac{1}{3600} \approx \alpha \text{ [rad]}$$

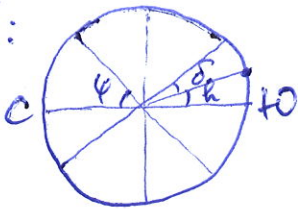
$$\alpha = \frac{1}{3600} \cdot \frac{180}{\pi} \approx \frac{1}{60} = 1'$$

$$\varphi = 62^\circ$$



$$\delta_{\text{обект}} = -(90 - 62)^\circ = -28^\circ$$

$$\varphi = 44^\circ$$



$$h'_{\text{max}} = 90^\circ - \varphi - |\delta| = 90^\circ - 44^\circ - 28^\circ = 18^\circ$$

над хоризонта: трябва да добавим и α - понижението хоризонта

$$\Rightarrow h'_{\text{max}} = 18^\circ 01'$$

$\lambda_{\text{АРК}} = 31^\circ < \lambda_{\text{ВАС}} = 43^\circ \Rightarrow$ Василий увидя обект по-късно.

$$\Delta \lambda = 12^\circ$$

$$\frac{12^\circ}{360^\circ} \cdot 24 \text{ h} = 48 \text{ мин по-късно}$$

Ако отчитаме изгрева на обекта за Василий:



$$\beta \approx \sin^{-1} 18^\circ \approx 25,2^\circ > \Delta \lambda$$

Възниква грешно приближение

\Rightarrow Изгревът на обекта за Василий ще е преди южната кулиминация за Аркедий.

$$\frac{25,2 - 12}{360} \cdot 24 \text{ h} = \frac{13,2}{15} \text{ h} = 0,88 \cdot 60 \text{ мин} \approx$$

≈ 50 мин по-рано изгрев обекта за Василий

3. R Чертова $r = 50 \text{ pc}$ $m = 1,3$

$\frac{2R}{r} = 4,8$ $\frac{L_a}{50^2} = 10^{3,5} = \frac{L_a}{10^2}$

$\frac{2300}{5800}$

$\frac{L_a}{L_0} = 1000$ $3,1 \cdot 25 = 45000 = \left(\frac{R_a}{R_0}\right)^2 \cdot \frac{1}{16}$

$58 : 25 = \frac{58}{5} \cdot 2 = 11,6 \cdot 2 = 23,2$ $12 \cdot 25 = 3000$ $0,4 \cdot 3,5 = 7,0, 2 = 628 = 1,4$

$$\begin{array}{r} 625 \cdot 25 \\ \hline 3125 \\ 1250 \\ \hline 156,25 \end{array}$$

$\frac{300}{50 \cdot 206265}$

$54 : 2060 = 0,026$

$$\begin{array}{r} 54 \\ \hline 5400 \\ 4020 \\ \hline 12800 \end{array}$$

Черткова

0,07:9

(4)

$$\begin{array}{r} 9,1,9,1 \\ \hline 9,1 \\ \hline 82,81,9,1 \\ \hline 8281 \\ \hline 74529 \\ \hline 753571 \end{array}$$

$$\begin{array}{r} 9,07,9,07 \\ \hline 6349 \\ \hline 8163 \\ \hline 82,2649,9,07 \\ \hline 5758543 \\ \hline 7403841 \\ \hline 7461,072643 \end{array}$$

$(9+0,07)^3 = 9^3 \cdot (1 + \dots)$

$$\begin{array}{r} 9,066,9,066 \\ \hline 848976 \\ \hline 54396 \\ \hline 54396 \\ \hline 81594 \end{array}$$

$$\begin{array}{r} 9,064,9,064 \\ \hline 36256 \\ \hline 54384 \\ \hline 81576 \\ \hline 82,156,9,064 \end{array}$$

$82,1920366,9,066$

$82,156,9,064$

$$\begin{array}{r} 49315416 \\ \hline 49315416 \\ \hline 73973124 \\ \hline 748,15593576 \end{array}$$

$$\begin{array}{r} 328624 \\ \hline 492936 \\ \hline 739404 \\ \hline 744661984 \end{array}$$

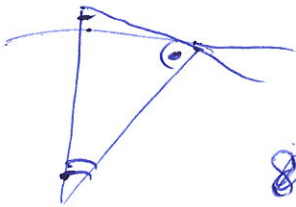
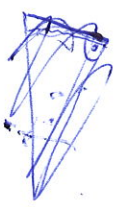
~~$19:9,064 = 2,008$~~
~~9000~~

$9 : 9,064$

$9000 : 9064 = 0,9920$

$$\begin{array}{r} 90000 \\ \hline 81576 \\ \hline 84240 \\ \hline 81576 \\ \hline 26640 \\ \hline 18128 \\ \hline 85120 \end{array}$$

5



6400000
6400000
~~885.25~~

Черкова

0,885 x 7200

6370000 : 0,885 = 7200

~~7200~~
~~5310~~

6370000 : 885 = 7197 = 7200

6195
1750
~~1750~~
885
8850
4965
6850

6370 / (6370 + 0,885) = 7200 / 7201

90 - 72 = 18

1 - (7200^2 / (7200+1)^2) = (2*7200+1) / (7200+1)^2

7272
174
504
5184

4,4 / 5 = 0,88.60 = 52,8



18.14
12
18
252

4

T_syn = 94,5 yr

95,5 T = 94,5

1/T = 1/94,5 + 1/1

94,5 T + T = 94,5

T = 945 / 189

191.191
191
11719
191
36481 : 49 = 744,5102
343
258
196
227
196
504
504
504

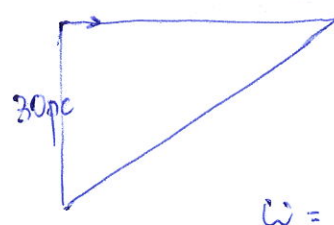
a^3 = (189/191)^2 = (3^3 * 7 / 191)^2 = 9^3 * (7/191)^2

191.191 / 4 = 9^3 * 744,5102

a = 9 / cube root of 744,5102

Чернока

①



$$\omega = \frac{v}{r} = \frac{\text{km}}{\text{s} \cdot \text{km}}$$

$$206265 \text{ rad/s} = 206265.$$

$$\omega = \frac{\text{pc}}{\text{s} \cdot \text{pc}}$$

②

$$\frac{L_{\text{obs}}}{L_0} = 10^{0.4(4.8+0.6)} = 10^{0.4 \cdot 5.4} = 10^{2.16} = 100 \cdot \sqrt[5]{10} = 160$$

$$169 = \frac{R_{\text{obs}}^2 T_{\text{obs}}^4}{R_0^2 T_0^4} = \left(\frac{R_{\text{obs}}}{R_0}\right)^2 \cdot \frac{3.4 \cdot 10^4}{5.8 \cdot 10^4} = \left(\frac{17}{29}\right)^2 \cdot \frac{17}{108}$$

$$13 = \frac{R_{\text{obs}}}{R_0} \cdot \left(\frac{17}{29}\right)^2$$

③

$$v [\text{km/s}] = \omega [\text{rad/yr}] \cdot r [\text{pc}] \cdot 4.74 = 0.5 \cdot 30 \cdot 4.74 = 71.1 \text{ km/s}$$

$$v [\text{pc/yr}] = \omega [\text{rad/yr}] \cdot r [\text{pc}] = \frac{0.5}{206265} \cdot 30$$

$$s = \frac{1500}{206265} \text{ pc} = \frac{68755}{13751}$$

$$v_1 = 71.1 \cdot \sin \frac{100}{13751 \cdot 30} = \frac{7110}{13751 \cdot 30} \text{ km/s}$$

$$\Delta l = \frac{711 \cdot 4500}{13751 \cdot 3 \cdot 3000000} = \frac{700 \cdot 4500}{14000 \cdot 3000000}$$

$$\frac{v_1}{c} = \frac{\Delta l}{4500}$$

$$36 : 138 = 0.2 \quad 0.002$$

④

$$\frac{G \cdot 2 \cdot 10^{30}}{4000000000} = \frac{6.7 \cdot 10^{-11} \cdot 2 \cdot 10^{30}}{49 \cdot 10^{16}} = \frac{134}{49} \cdot 10^2 = 2.714$$

$$43 : 365 = 0.2$$