СПб-159

N1

~~nt~~ $\frac{n \cdot M_\odot c^2}{2} = 10^{55}$

$\frac{1}{2} n \cdot 2 \cdot 10^{30}\,кг \cdot (3 \cdot 10^{8}\,м/с)^2 = 10^{55}\,Дж$

$9 \cdot 10^{46} n = 10^{55}$

$n = \frac{10^{55}}{9 \cdot 10^{46}} = \frac{10^9}{9} \approx 1{,}11 \cdot 10^8$

Ответ: $1{,}11 \cdot 10^8$

N4

$T = \frac{1}{60} \cdot T_{л} \approx 1{,}5\ сут$

$\left(\frac{T}{T_\oplus}\right)^2 = \left(\frac{d}{1 а.е.}\right)^3$

~~$\left(\frac{1{,}5}{365}\right)^2 = d^3$~~

~~$d = \sqrt[3]{\frac{1}{243^2}}\ а.е. = \sqrt[3]{\frac{1}{590}} \approx \sqrt[3]{1{,}7 \cdot 10^{-3}} \approx 0{,}12\ а.е. =$~~

~~$= 1{,}8 \cdot 10^7\ км$~~

$M = 2 \cdot \frac{4}{3}\pi \rho r^3 = 2 \cdot \frac{4}{3}\pi \cdot 9 \cdot 10^8 \cdot (6{,}4 \cdot 10^6)^3 = 8{,}4 \cdot 9 \cdot 6{,}4^3 \cdot 10^{26} \approx 2 \cdot 10^{31} = 10 M_\odot$

$\frac{T^2 \cdot M}{d^3} = \frac{T_\oplus^2 \cdot M_\odot}{d_\oplus^3}$

$\frac{10 T^2}{d^3} = \frac{T_\oplus^2}{1 а.е.}$

$d^3 = \frac{10 T^2}{T_\oplus^2} = 10 \cdot \left(\frac{1{,}5}{365}\right)^2 \approx \frac{10}{243^2} \approx \frac{1}{5900} \approx 1{,}7 \cdot 10^{-4}$

$d = \sqrt[3]{1{,}7 \cdot 10^{-4}}\ а.е. = 0{,}077\ а.е. = 1{,}15 \cdot 10^7\ км \approx 16 R_\odot$

Ответ: не могла

$$\begin{array}{r|l} 365 & 15 \\ -30 & 24{,}3 \\ 65 & \\ -60 & \\ 50 & \\ -45 & \end{array}$$

243×243: 729, 972, 486 — 59049

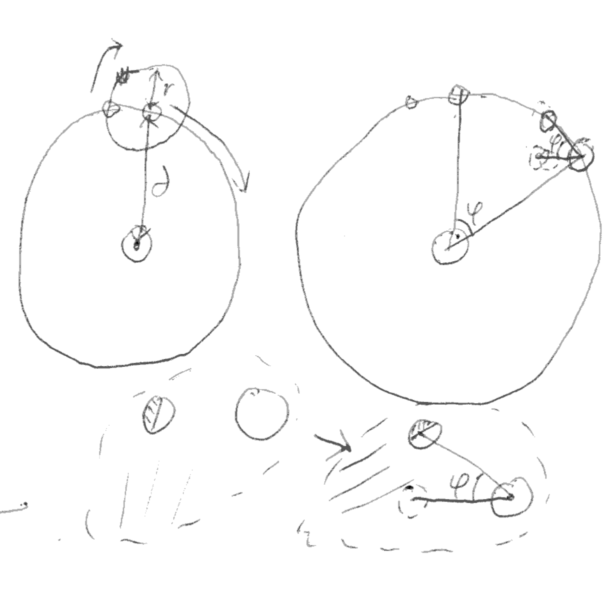
$84 \times 9 = 756$

76×26: 456, 152 — 1976

$$\begin{array}{r|l} 17{,}0 & 22 \\ -154 & 77 \\ 160 & \\ -154 & \end{array}$$

N5

$r = \frac{4 \cdot 10^5}{1{,}5 \cdot 10^8}\ а.е. = \frac{8}{3} \cdot 10^{-3}\ а.е.$



$\frac{T_n^2 \cdot 4M_\odot}{d^3} = \frac{T_\oplus^2 \cdot M_\odot}{(1 а.е.)^3}$

$\left(\frac{T_n}{T_\oplus}\right)^2 = \left(\frac{d}{1 а.е.}\right)^3 \cdot \frac{M_\odot}{4M_\odot} = \frac{64}{4} = 16$

$T_n = \sqrt{16}\ лет = 4\ года$

$\frac{T_л^2 \cdot 1{,}5 \cdot 10^{-6} M_\odot}{r^3} = \frac{T_\oplus^2 \cdot M_\odot}{1 а.е.^3}$

~~$\left(\frac{T_л}{T_\oplus}\right)^2 = \frac{r^3}{1{,}5 \cdot 10^{-6}} \cdot \left(\frac{1 а.е.}{...}\right)^3 = 6{,}67 \cdot 10^5 \cdot (2{,}67 \cdot 10^{-3})^3$~~

$\left(\frac{T_1}{T_\oplus}\right)^2 = \frac{1}{1,5\cdot10^{-6}} \cdot \left(\frac{r}{1a.e.}\right)^3 = 6,67\cdot10^5\cdot(2,67\cdot10^{-3})^3 = 6,67\cdot2,67^3\cdot10^{-4} = \frac{20\cdot512}{81}\cdot10^{-4} \approx 1,25\cdot10^{-2}$

$T_1 = \sqrt{0,0125} \approx 0,11$ года ≈ 40 ~~дней~~ сут

$\times\begin{array}{r}365\\11\\\hline 365\\365\\\hline 4015\end{array}$

$\frac{\varphi}{\omega_n} = \frac{2\pi-\varphi}{\omega_1}$

$\frac{\varphi T_n}{2\pi} = \frac{(2\pi-\varphi)T_1}{2\pi}$

$\varphi T_n = (2\pi-\varphi)T_1$

$\varphi = 2\pi\cdot\frac{T_1}{T_n+T_1}$

$T_{отн} = \frac{2\pi-\varphi}{\omega_1} = \frac{2\pi\left(1-\frac{T_1}{T_n+T_1}\right)\cdot T_1}{2\pi} = \frac{T_n T_1}{T_n+T_1} = \frac{1460\cdot40}{1460+40} = \frac{58400}{1500} \approx 38\frac{14}{15}$ сут $\approx 38,9$ сут

Ответ: 38,9 сут

№2

$\Delta t = (102,5^\circ - 30^\circ)\cdot\frac{1ч}{15^\circ} = 5ч$

$h_k = 90^\circ - \varphi + \delta = 27^\circ$ (в СПб)

~~$\alpha_{max} = 2^h = 30^\circ$ $\cos\alpha_{max} = \frac{\sqrt3}{2}$~~

~~$\alpha_{min} = 1^h30^m = 22,5^\circ$ $\cos\alpha_{min} =$~~

$x = (90-\varphi)\cdot\cos\alpha$

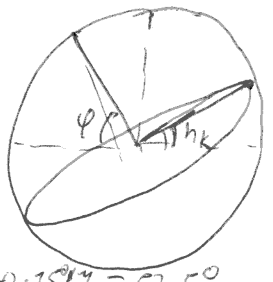
$\alpha_{min} = (12^h - \Delta t)\cdot15^\circ/ч = 45^\circ$; $\alpha_{max} = (12,5^h - \Delta t)\cdot15^\circ/ч = 52,5^\circ$

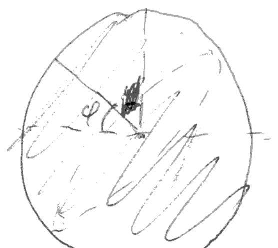
$h = \delta + x = (90-\varphi)\cos\alpha + \varphi =$

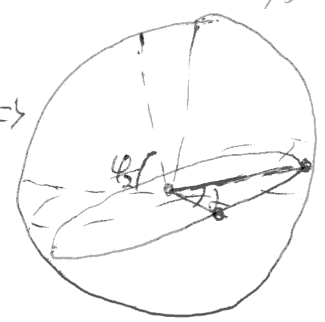
$= 18^\circ\cdot\cos\alpha - 3^\circ$ $\cos\alpha_{min} = \frac{\sqrt2}{2}$; $9\sqrt2 > 3^\circ \Rightarrow$

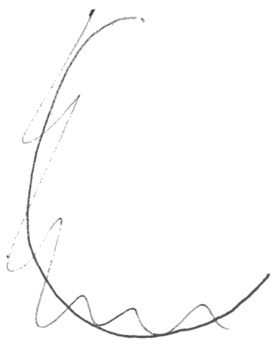
$\Rightarrow h > 0^\circ$

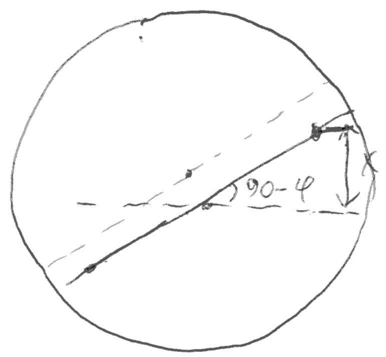
Ответ: может











№3

$a_n = \omega^2\cdot\frac{\ell}{0,5\ell} = \frac{(4\pi^2\nu)^2\cdot2}{\ell}$