ONAA 2014
SENIORI
PROBA TEORETICĂ - BAREM

Subiectul I – Probleme scurte

Problema 1

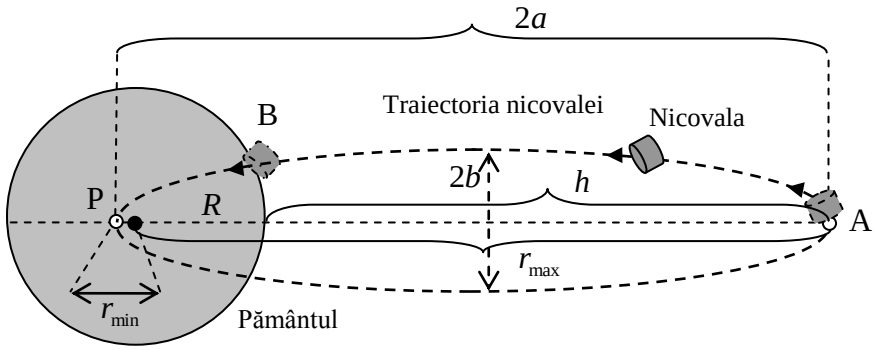


Fig.

$h = 2a_{\mathrm{L}}\left(\frac{2\tau}{T_{\mathrm{L}}}\right)^{2/3}$; $h \approx 580000\,\mathrm{km}$.....**2p**

Problema 2

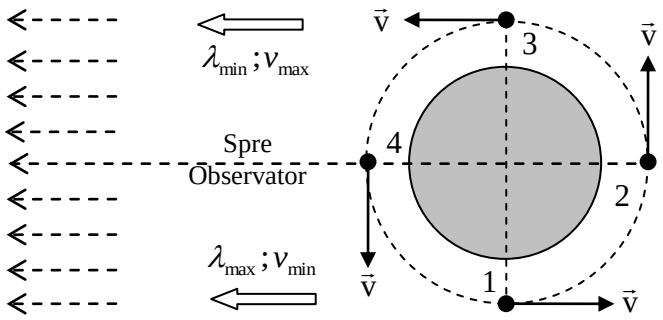
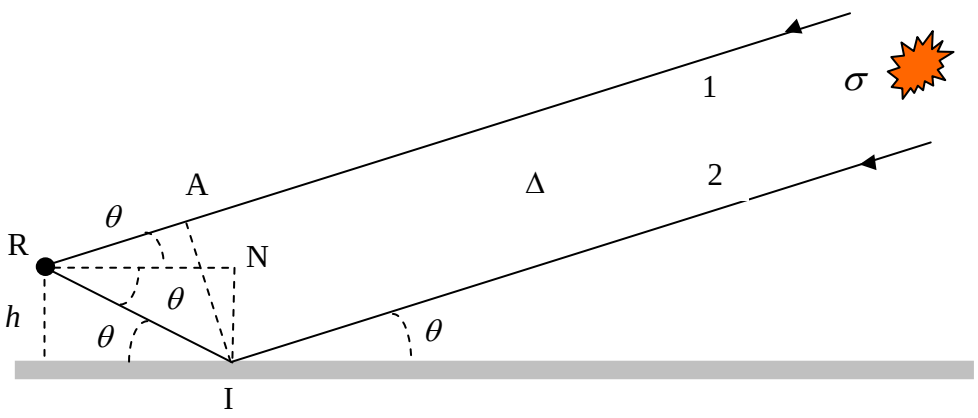


Fig.

$\rho = \frac{3c^2}{4\pi R^2 K}\left(\frac{\lambda_{\max}-\lambda_{\min}}{\lambda_{\max}+\lambda_{\min}}\right)^2$ **2p**

Problema 3



$$(\sin\theta)_{\max} = 1\frac{\lambda}{4h}; 3\frac{\lambda}{4h}; 5\frac{\lambda}{4h}; 7\frac{\lambda}{4h} \text{.....} \textbf{1p}$$

$$(\sin\theta)_{\min} = 0; 2\frac{\lambda}{4h}; 4\frac{\lambda}{4h}; 6\frac{\lambda}{4h}; 8\frac{\lambda}{4h} \text{.....} \textbf{1p}$$

Problema 4

$$m_{\text{stea}} = m_{\text{S}} + 5 \cdot \log\left(\frac{r_{\text{PS}}}{R_{\text{P}}} \cdot \frac{p_{\text{S}}}{p_{\sigma}}\right);$$

$$m_{\text{stea}} = -26{,}78^{\text{m}} + 5^{\text{m}} \cdot \log\left(\frac{149000000\,\text{km}}{6380\,\text{km}} \cdot \frac{8{,}8''}{0{,}022''}\right) = -26{,}78^{\text{m}} + 5^{\text{m}} \cdot 6{,}97 \approx 8^{\text{m}},$$

reprezentând magnitudinea aparentă a stelei.

Știind că ochiul omului poate vedea stele la limita magnitudinii $m_{\text{limita}} = 6^{\text{m}}$, rezultă că steaua σ, analizată în problema propusă, nu poate fi observată cu ochiul liber pe cerul senin al nopții.....**2p**

Problema 5

$$E_{\text{initial}} = \frac{\sigma R_0^2 T^4}{d^2}, \quad E_{\text{final}} = \frac{4\sigma R_0^2 T^4}{d^2} \cdot 4^{1/3}; \ \log\frac{E_{\text{initial}}}{E_{\text{final}}} = -0{,}4\left(m_{\text{initial}} - m_{\text{final}}\right);$$

$$m_{\text{initial}} - m_{\text{final}} = 2^{\text{m}}; \ \ m_{\text{final}} = m_{\text{initial}} - 2^{\text{m}} = 3^{\text{m}} - 2^{\text{m}} = 1^{\text{m}};$$

$$m_{\text{final}} < m_{\text{initial}}. \text{.....} \textbf{2p}$$

Subiectul II – Probleme lungi

a) $r = \dfrac{2\tau c}{\pi T(\Delta\theta + \Delta\phi)} \sqrt{\dfrac{2\Delta\lambda}{(\lambda_0 + \Delta\lambda)\Delta\phi} \sqrt{\dfrac{P}{\sigma}}}$ **3p**

b)

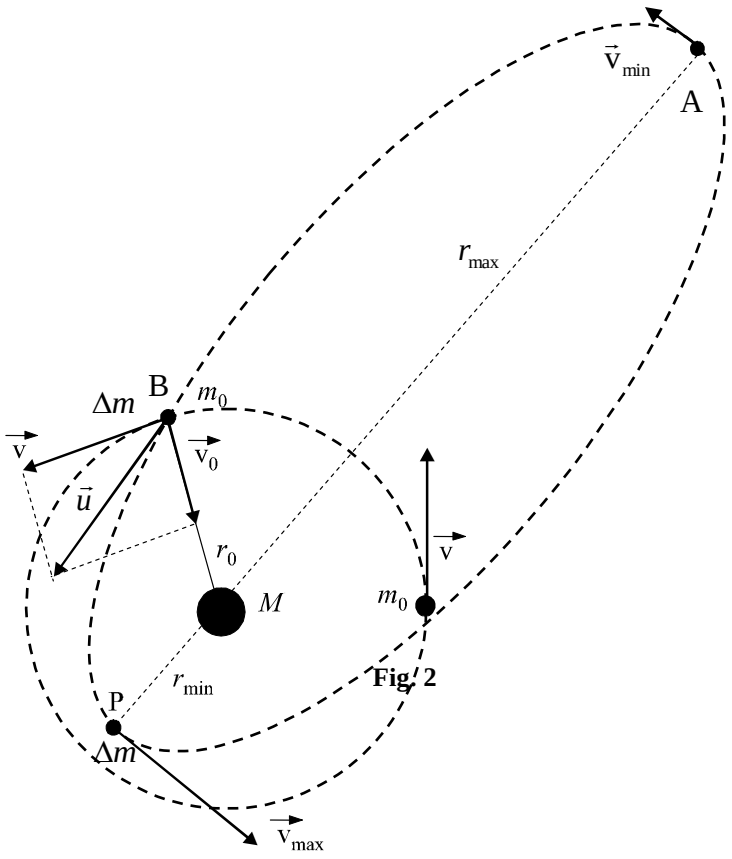


Fig. 2

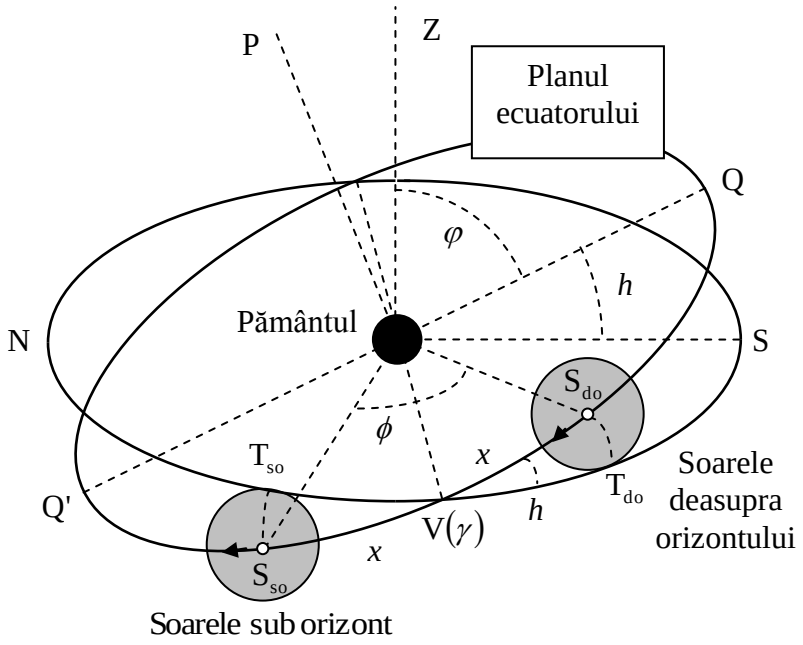
$$r_{\min} = r_0 \frac{\mathrm{v}_0\sqrt{KMr_0} - KM}{\mathrm{v}_0^2 r_0 - KM} > 0; \quad r_{\min} < r_0 . \text{.....3,5p}$$

c)

$$r_{\max} = r_0 \frac{\mathrm{v}_0\sqrt{KMr_0} + KM}{KM - \mathrm{v}_0^2 r_0}; \; r_{\max} > r_0 . \text{.....3,5p}$$

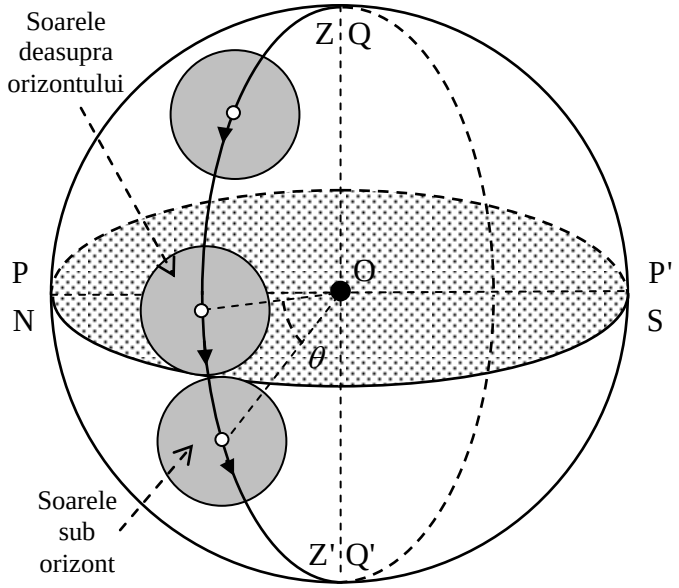
Problema 2
A.

a)



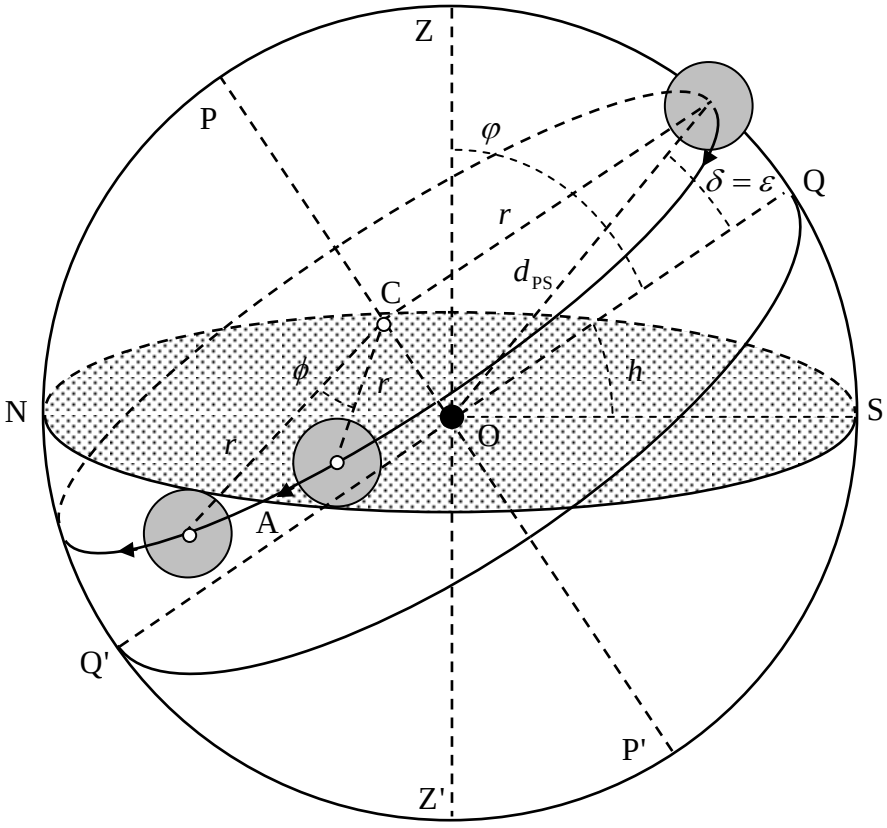
$$\tau = \frac{\theta \cdot T_{\mathrm{p}}}{2\pi \cdot \cos\varphi}, \; \theta = 31'\,59{,}3'' = 31{,}98'; \; \tau \approx \frac{2\,\mathrm{m}\,8\,\mathrm{s}}{\cos\phi}, \text{.....1p}$$

b)



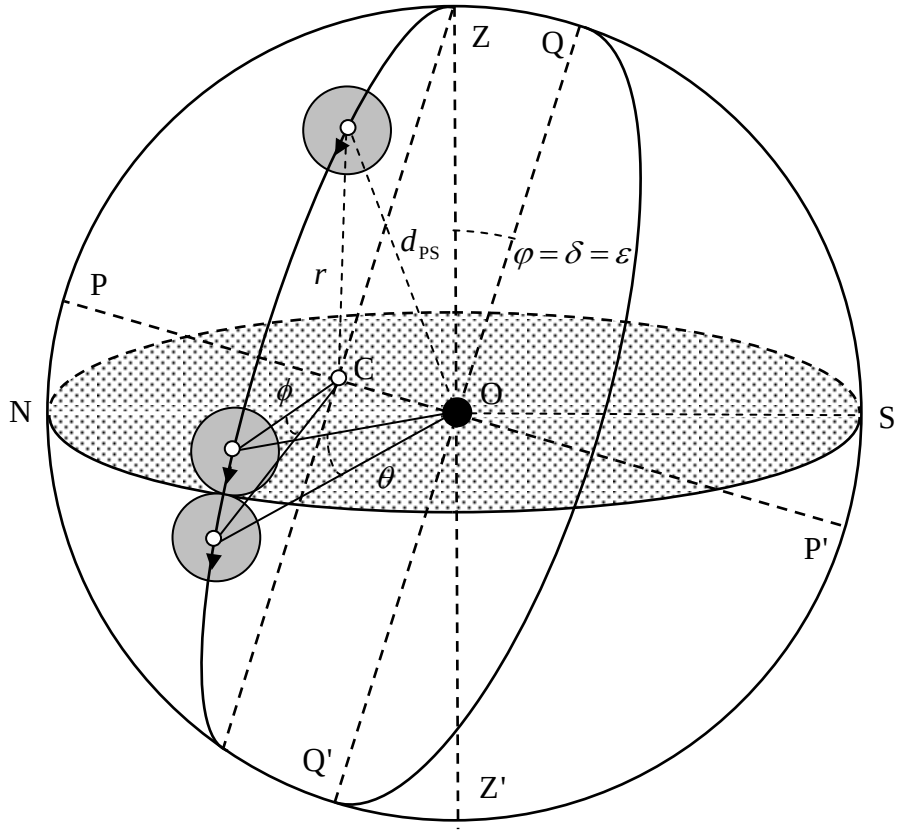
$\tau_{\min} = 2\,\text{m}\,8\,\text{s}$. **1p**

c)



$$\tau = \frac{\theta \cdot T_{\text{p}}}{2\pi \cdot \cos\varphi \cdot \cos\delta},$$ **1p**

d)



$$h = 90^\circ - \varphi;\ \delta = \varepsilon = 23{,}45^\circ;$$

$$\tau_{max} = \frac{\frac{\theta \cdot T_P}{2\pi}}{\cos\varphi \cdot \cos\varepsilon} = \frac{\frac{31{,}98'}{360 \cdot 60'} \cdot 24 \cdot 3600\,\text{s}}{\cos^2\varepsilon} = \frac{\tau_{min}}{\cos^2\varepsilon};$$

$$\tau_{max} = \frac{2{,}132\,\text{min}}{\cos^2 23{,}45^\circ} = \frac{2{,}132}{0{,}84}\,\text{min} \approx 2{,}54\,\text{min} = 2\,\text{m}\,32{,}4\,\text{s}. \text{ .....} \textbf{1p}$$

B.

$$\text{v} = \sqrt{\left(\sqrt{2}-1\right)^2 V_0^2 + 2\text{v}_0^2} \approx 16{,}7\,\frac{\text{km}}{\text{s}}, \text{ .....} \textbf{4p}$$

reprezentând viteza corpului C în momentul lansării sale de pe Pământ, în raport cu Pământul, astfel încât corpul să ajungă la limita zonei de atracţie gravitaţională a Soarelui şi acolo el să fie în repaus în raport cu Soarele (a treia viteză cosmică).

C. $t = \frac{T_P}{4\sqrt{2}} \approx 5{,}6 \cdot 10^6\,\text{s}. \text{ .....} \textbf{2p}$