№1.

$\vec{r}(t) = 2t^3\vec{e}_x + 3t^2\vec{e}_y + 4t\vec{e}_z$

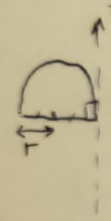
$\vec{v}(t) = r'(t) = 6t^2\vec{e}_x + 6t\vec{e}_y + 4\vec{e}_z$

$|\vec{v}| = \sqrt{(6\cdot 4)^2 + (6\cdot 2)^2 + 4^2} = \sqrt{736} = 4\sqrt{46} \approx 27\ м/с$

Ответ: $27\ м/с$

№2

m
r
I - ?



Разобьём шар на шарики ΔV_i и Δm_i.

$\sum_i V_i = \frac{4}{6}\pi R^3 \qquad \sum_i m_i = m$

Т.к. однородный, то $m_i = \rho \Delta V_i$, $\sum m_i = \rho \sum V_i$

$I_z = \sum_i m_i r_i^2 = \rho \sum_i \Delta V_i r_i^2 = \int \rho (x^2+y^2)\,dx\,dy\,dz.$

$x^2 + y^2 = r^2 \sin^2\theta$

$I_z = \rho \int_0^{2\pi} d\varphi \cdot \int_0^R r^4 dr \int_0^{\pi} \sin^3\theta\, d\theta = \rho \frac{4}{3} \cdot \frac{r^5}{5} \int_0^{2\pi} d\varphi = \frac{8\pi\rho r^5}{15}$

$m = V\rho = \frac{4}{6}\pi R^3 \cdot \rho \Rightarrow \rho = \frac{m\cdot 6}{4\pi R^3}$; $I_z = \frac{4mr^2}{5}$.

Ответ: $\frac{4mr^2}{5}$

№4

ν, α.

$V(T) = \alpha T^{\frac{1}{3}}$

$A = p\Delta V = p(2V_0 - V_0)$

$A = \nu R \frac{7V_0^3}{\alpha^3}$

$p\Delta V = \nu R \Delta T$

$pV_0 = \nu R (T_2 - T_1)$

$pV_0 = \nu R \left(\frac{8V_0^3 - V_0^3}{\alpha^3}\right) = \nu R \cdot \frac{7V_0^3}{\alpha^3}$

$T_1 = \left(\frac{V}{\alpha}\right)^3$

Ответ: $\frac{7\nu R V_0^3}{\alpha^3}$

№3

$\omega_0 - ?$

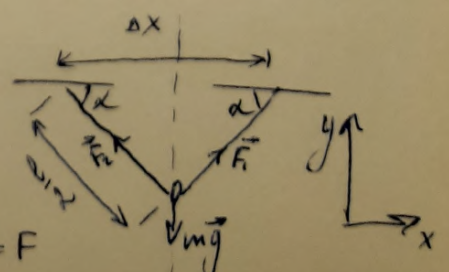
$\vec{F}_{равн} = \vec{F}_1 + \vec{F}_2 + m\vec{g}$

ox: $F_{равн} = F_1 \cos\alpha - F_2 \cos\alpha = 0$

oy: $F_{равн} = -mg + F_1 \sin\alpha + F_2 \sin\alpha$; $|\vec{F}_1| = |\vec{F}_2| = F$

$F_{равн} = -mg + 2F\sin\alpha$

$F_{равн} = -mg + \frac{4F}{\ell} \cdot \sqrt{\frac{\ell^2}{4} - \frac{(\Delta x)^2}{4}}$



$\sin\alpha = \frac{\Delta x \cdot 2}{\ell} = \frac{2\sqrt{\frac{\ell^2}{4} - \frac{(\Delta x)^2}{4}}}{\ell}$

$T = 2\pi\sqrt{\frac{m\ell}{2F}}$

$\omega_0 = \frac{2\pi}{T} = \sqrt{\frac{2F}{m\ell}}$