

5. $\frac{dw}{ds} = \nabla f \cdot \frac{\vec{v}}{|\vec{v}|} = D_{\frac{\vec{v}}{|\vec{v}|}} f$

$\nabla f = (2y^2, 4xy, -1)$

$\nabla f(1, -1, 1) = (2, -4, -1)$

$\vec{v} = (1, 2, -1) \quad |\vec{v}| = \sqrt{1+4+1} = \sqrt{6}$

$\nabla f \cdot \frac{\vec{v}}{|\vec{v}|} = (2, -4, -1) \cdot \frac{(1, 2, -1)}{\sqrt{6}}$

~~a~~ b = $\frac{2-8+1}{\sqrt{6}} = -\frac{5}{\sqrt{6}}$

6. $\vec{a} = \vec{r}''(t) = -\omega^2 \vec{r}(t) = -G \frac{T^2}{R^3}$

So $\omega^2 = \frac{G}{R^3}$. But $\omega = \frac{2\pi}{T}$ so

$\frac{4\pi^2}{T^2} = \frac{G}{R^3} \Rightarrow \frac{T^2}{R^3} = \frac{4\pi^2}{G}$ c