your name(s)_____

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Physics 321 Quiz #7 - Friday, October 26

You can work in groups of up to 3 for this quiz. You should turn in one quiz for your group, with all three names. This is CLOSED book, CLOSED notes.

1. Consider a particle of mass m moving in a radially symmetric potential

$$U(r) = V_0 r^\alpha.$$

(a) (5 pts) If $V_0 > 0$ and $\alpha > 0$, for what values of α can you have stable orbits? all α

(b) (5 pts) If $V_0 < 0$ and $\alpha > 0$, for what values of α can you have stable orbits? no α

2. Consider a particle of mass m moving in a radially symmetric potential

$$U(r) = \frac{V_0}{r^\alpha}.$$

(a) (5 pts) If $V_0 > 0$ and $\alpha > 0$, for what values of α can you have stable orbits? no α

(b) (5 pts) If $V_0 < 0$ and $\alpha > 0$, for what values of α can you have stable orbits? $\alpha < 2$

3. Consider a particle of mass m moving in an attractive radially symmetric potential

$$U(r) = -\frac{V_0}{r^2}.$$

If the particle reaches $r = 0$, it is annihilated.

(a) (5 pts) Are there any stable orbits? NO

(b) (5 pts) What angular momenta keep the particle from being annihilated?

(c) (5 pts) Imagine a particle far away ($x \to \infty$) with velocity directed inward $\mathbf{v} = -v_0\hat{x}$. Let the initial y position be $y = b$. (b is what is known as the impact parameter). Find the maximum value of b that leads to annihilation. Your answer should be in terms of m, v_0 and V_0. Check dimensions!

b) $L^2/2m \geq V_0$, $L \geq \sqrt{2mV_0}$

c) $L = \sqrt{2mV_0} = mv_0 b$

$$b \leq \sqrt{\frac{V_0}{m v_0^2}}$$