Physics 235, Homework Set 09

Write the following text on the front cover of your homework assignment and sign it. If the text is missing, 20 points will be subtracted from your homework grade.

Honor Pledge for Graded Assignments
"I affirm that I have not given or received any unauthorized help on this assignment, and that this work is my own."

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Signature _____

1. Perform a numerical calculation using the parameters used in Example 10.2 and Figure 10.4e of the textbook, but find the initial velocity for which the path of motion passes back over the initial position in the rotating system. At what time does the puck exit the merry-go-round?

2. Determine how much greater the gravitational field strength g is at the pole than at the equator. Assume a spherical Earth. If the actual measured difference is $\Delta g = 52$ mm/s2, explain the difference. How might you calculate this difference between the measured result and your calculation?

3. If a projectile is fired due east from a point on the surface of the Earth at a northern latitude λ with a velocity of magnitude V_0 and at an angle of inclination to the horizontal α, show that the lateral deflection when the projectile strikes Earth is

$$d = \frac{4\omega V_0^3}{g^2} \sin \lambda \cos \alpha \sin^2 \alpha$$

   where ω is the rotation frequency of the Earth.

4. Consider a particle moving in a potential $U(r)$. Rewrite the Lagrangian in terms of a coordinate system in uniform rotation with respect to an inertial frame. Calculate the Hamiltonian and determine whether $H = E$. Is H a constant of motion? If E is not a constant of motion, why isn't it? The expression for the Hamiltonian thus obtained is the standard formula $(1/2)mv^2 + U +$ an additional term. Show that the extra term is the centrifugal potential energy.