Physics 300 Practice Midterm Name:
Spring 2010

Preface: Things you knew, or didn't.

$M_{EPM} = 50$ kg

$\int \ln(x)dx = x\ln(x) - x$

$g = 10$ m/s^2 (at the surface of Earth)

$g = 10$ m/s^2 (at the surface of Azeroth)

Prologue: evil meets evil.

The Evil Physics Monkey, while prowling around DigiPen in hopes of scoring some diabolical physics knowledge, overhears a student saying: "the lead designer for WoW must have been the devil. That game is so evil!" Without bothering to find out what was meant by the statement, the excited primate immediately runs off, buys the game, and exactly as would be expected, gets hooked.

1. The addict speaks: 3P|\/| PWZ j00!

The Evil Physics Monkey decides to celebrate getting his twenty-second character, a gnome shaman, to level 60 by having a fireworks extravaganza over the dead body of the King in Stormreach. To do so the EPM logs on all of his characters (of course on different accounts) at the same time and does a multi-box raid, which ends in 22 /dance emotes, an incredible amount of m0nk3y-l33t speak smack talk and an almost unending cascade of fireworks. While taking screen shot after screen shot of the event the fuzzy fiend notices that the fireworks take 1 second to reach their maximum altitude of 20m and then explode.

a) If the fireworks are rockets that burn half of their 1 kg mass at a constant rate before exploding, what is the velocity at which they expel their fuel?

2. Denial is normal.

The Evil Physics Monkey does not like to be denied, and the glowing ball around Dalaraan is like a giant /taunt to him which he cannot ignore. He spends days finding ways to approach the ball from new and different angles, and finally manages to get what he thinks is a map of the magical surface in cylindrical coordinates:

$$S: 10r^2 + z = 50$$

a) What is the normal to this surface?

The wicked primate, not to be denied, thinks he spies a weakness in the shield and leaps onto it from on high. He splats face first onto the shield, and slides down it.

b) What is the Lagrangian of the EPM's gnome shaman?

c) What is the Hamiltonian of the gnome?

d) What are the Lagrangian equations of motion?

e) What are the Hamiltonian equations of motion?

f) What is the additional force that is causing the gnome to slide on the surface (quantitative, not qualitative, answer expected)?

3. Punching out some numbers.

When the Evil Physics Monkey hears that the expansion to WoW won't be out in time for Christmas he flies into a rage. He tosses his computer out the window, cuts down several freshmen with his scimitar, and then begins to savagely punch his *Prof. Mohrmann Punching Bag* (PMPB) while screaming, "level seventy!" at the top of his monkey lungs. The bag is held up by an incredibly complicated and disorganized system of springs and ropes.

If you had to make a simulation display the motion of the PMPB you could use several different numerical integration schemes. Name three, and give advantages and disadvantages to each:

a)

b)

c)

Epilogue: I win.

The Evil Physics Monkey ends up punching the bag so viciously that single wood screw he has holding the tether into the ceiling fails. It fails at just the wrong moment, as the heavy bag is swinging back towards the monkey, and it smashes into him, knocking him out the window where he plummets to the sidewalk below. A moment later, Looney Toon style, the bag smashes down on top of him, sadistic-grinning-Mohrmann-face first.