Homework #2

Phys 3344 Prof. Olness
Due: 4 September 2018 *(at the beginning of class)*

Problem 1:

You jump out of an airplane (with a parachute). Compute your terminal velocity (before you hit the ground). Is this dominated by the linear or quadratic air resitance term???

Problem 2:

Using Mathematica or equivalent, solve for $v[t]$ for general {b,c}. Solve each limit b=0 and c=0. Choose values for initial conditions, and plot these curves as a function of time. NOTE: to keep it simple, I suggest starting with no gravity g=0. BONUS: If you want, re-do the problem but this time including gravity.

Problem 3:

Consider a block of mass m on an incline of angle θ which slides down the incline a distance of d meters. The surface of the include has a coeficient of friction μ.
For both a) and b) compute i) the acceleration of the block, and ii) the velocity when it reaches the bottom (a distance d).
a) Solve this using Newtons 2nd law: F=ma.
b) Solve this using work and energy.
c) Verify the results of a) and b) match.

Problem 4:

a) A bike wheel is hung from a rope and spun with velocity ω. Find the directions of L, τ, and the direction of precession.

Problem 5:

a) Consider the rotation of the earth about it's axis. Calculate the moment of interia, the angular velocity, the angular momentum.
b) If I want to stop the rotation of the earth in one day using a uniform torque, compute the angular accelleration and the torque required. If the torque is generated by a force F exerted at the equator, what is the magnitude of this force.
c) Consider Dallas on the surface of the earth specified by the vector r. Compute the linear speed at Dallas, v. Also compute the directions and magnitude of $\omega \times \omega \times \vec{r}$ and $\omega \times \vec{v}$.

Problem 6:

4.3 ⋆⋆ Do the same as in Problem 4.2, but for the force $\mathbf{F} = (-y, x)$ and for the three paths joining P and Q shown in Figure 4.24(b) and defined as follows: **(a)** This path goes straight from $P = (1, 0)$ to the origin and then straight to $Q = (0, 1)$. **(b)** This is a straight line from P to Q. (Write y as a function of x and rewrite the integral as an integral over x.) **(c)** This is a quarter-circle centered on the origin. (Write x and y in polar coordinates and rewrite the integral as an integral over ϕ.)

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