Physics 3344 **Professor Scalise**
Fall 2006 **Assignment #9**

Due: 2 November 2006

1. Some clocks (oscillators) that have been calibrated for the Earth's surface are taken to the Moon where the surface gravity is smaller by a factor of 6. Compare the Moon clocks to those on Earth: (run fast, run slow, or keep the same time)
   (a) simple pendulum clock (point mass on a string)
   (b) horizontal Hooke's law spring clock (mass, spring, frictionless track)
   (c) vertical Hooke's law spring clock (mass, spring)
   (d) light clock (laser beam bouncing between parallel mirrors)
2. Three identical masses m are at the vertices of an equilateral triangle formed by springs with force constants k and with equilibrium lengths ℓ. Find the period of oscillations if all three masses are displaced outward from center and then released.
3. A mass m attached to a spring of force constant k is constrained to move along a frictionless (no damping) one-dimensional horizontal track. For $t < 0$, the mass is at rest and the spring is unstressed. At $t = 0$, the free end of the spring suddenly acquires a speed v_0 along the track which remains constant thereafter. What is the displacement $x(t)$ of the mass? Hint: the initial velocity of the mass is zero, not v_0.
4. A mass m is attached to a spring of force constant k and natural length ℓ. It is spun in a horizontal circle on a frictionless table with angular speed $\Omega < \sqrt{\frac{k}{m}}$.
   (a) Draw a free-body diagram in the non-inertial frame, labeling and explaining all forces clearly.
   (b) What is the equilibrium length of the spring?
   (c) What is the natural angular frequency of radial oscillations?
5. Use the Green function method to solve for the response of a damped harmonic oscillator driven by the exponentially decaying force $F(t) = F_0 e^{-\beta t}$ for $t > 0$.