國立東華大學
Department of Physics
National Dong Hwa University, 1, Sec. 2,
Da Hsueh Rd., Shou-Feng, Hualien, 974, Taiwan

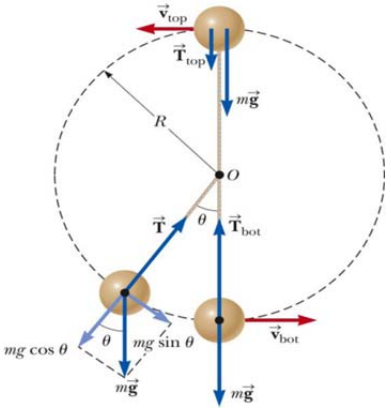
General Physics I, Midterm 1
PHYS10400, Class year 103
10:10-12:00 am
10-30-2014

SN:_____, Name:_____

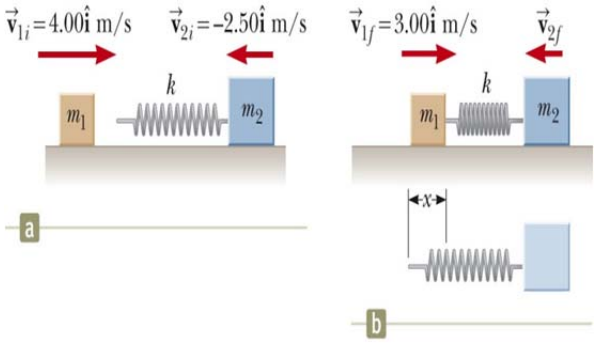
*Note: You can use pencil or any pen in answering the problems. Dictionary, calculators and mathematics tables **are** allowed. Please hand in both solution and this problem sheet.* ***Answer must be in English. ABSOLUTELY NO CHEATING!***

Problems (total 6 problems, 100%)

1. **Moment of Inertia:** (15%) What is the moment of inertia of a solid sphere of mass **M**, radius **R** rotating about any of its diameter?
2. **Rotational Kinetic energy:** (15%) A particle of mass M is rotating in the circle about a certain origin with radius R with an angular velocity**ω**. If you take a snap shot at a certain time t, what is the rotational kinetic energy?
3. **Conservation of linear momentum:** (15%) Suppose two particles (with masses $\mathbf{M_1}$ and $\mathbf{M_2}$, velocities $\mathbf{V_1}$ and $\mathbf{V_2}$, respectively) collide in a two dimensional frictionless floor. During this collision, use Newton's third law; derive what is conserved if no external forces exist. The conserved term is defined as linear momentum.



4. **Circular Motion:** (20%) A small sphere of mass m is attached to the end of a cord of length R and set into motion in a vertical circle about a fixed point O as illustrated in Figure on the right. (a) Determine the tangential acceleration of the sphere and the tension in the cord at any instant when the speed of the sphere is v and the cord makes an angle θ with the vertical. (b) What is the tension when the sphere is on the top and at the bottom positions?
5. **Lennard-Jones Potenetial:** (15%)The potential energy associated with the force between two neutral atoms in a molecule can be modeled by the Lennard-Jones potential as $U(x) = 4\varepsilon\left[(\frac{\sigma}{x})^{12} - (\frac{\sigma}{x})^{6}\right]$, where **x** is the separation of the atoms. (a)What is the most likely distance between the two atoms? (5%) (b) Given **σ**=0.263 nm, and **ε**=1.51×10-^{22}J are two typical constants in a molecule, what is the atom separation in a typical chemical bond? (5%)



6. **Two-body collision with a spring:** (20%) Using the figure on the right, A block of mass m_1=1.6 kg initially moving to the right with a speed of 4.00 m/s on a frictionless, horizontal track collides with a light spring attached to a second block of mass m_2=2.10kg initially moving to the left with a speed of 2.50 m/s as shown in the figure (a). The spring constant is 600 N/m. (a) Find the velocities of the two blocks after the collision. (b) Determine the velocity of block 2 during the collision, at the instant block 1 is moving to the right with a velocity of 3.00 m/s as shown in figure (b).