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

General Physics I, Midterm 1
PHYS10000AA, AB, AC, Class year 108
10-24-2019

SN:_____, Name:_____

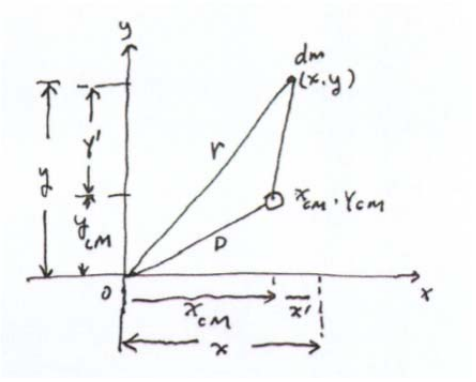
*Note: You can use pencil or any pen in answering the problems. Dictionary, calculators and mathematics tables **are** allowed. Please hand in both solution and this problem sheet.* ***ABSOLUTELY NO CHEATING!***

Problems (total 5 problems, 100%)

1. **Circular Motion:** (20%) A hawk flies in a horizontal arc of radius 12.0 m at constant speed 4.00 m/s. (a) Find its centripetal acceleration. (b) It continues to fly along the same horizontal arc, but increases its speed at the rate of 1.20 m/s^2. Find the acceleration (magnitude and direction) in this situation at the moment the hawk's speed is 4.00 m/s.

2. **Lennard-Jones Potential:** (25%) 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? (10%) (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%) (c) Draw the potential curve qualitatively (5%) (d)When the two atoms are separated at a distance of 4.5×10^{-10} m, the two atoms are subject to a restoration or repelling force? (5%), (e) Explain you answer in (d) (5%)

   This problem is from Page 201 (Example 7.9) of text book; in lecture notes p8-4



3. **Parallel axis theorem: (25%)** Use the figure to the right, if the rotational moment of inertia of an object rotates around an axis through its center of mass (x_{cm}, y_{cm}) is $\boldsymbol{I_{CM}}$, prove that when it rotates about a parallel axis the origin (0, 0), its rotation moment of inertia can be derived to be:

   $\mathbf{I} = \boldsymbol{I_{CM}} + \mathbf{MD^2}$

4. **Inelastic collision: (15%)** Two objects engage in an inelastic collision and stick together. If the two objects have mass $\boldsymbol{m_1}$ and $\boldsymbol{m_2}$, and initial velocity $\boldsymbol{V_{1i}}$ and $\boldsymbol{V_{2i}}$, respectively; what is the velocity $\boldsymbol{V_f}$ after the collision

5. **Conservation of energy: (15%)** An object of mass ***m*** is raised to a height, as shown in the figure to the right, and falls down to the floor. At the lowest position, what is its change in kinetic energy? (b) What is its change in potential energy? (c) What is its total energy change?