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
PHYS10000AA, AB, AC, Class year 106
11-02-2017

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 6 problems, 110%)

1. **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

2. **Kinetic Energy:** (20%) A free particle, which has a mass of 20 grams, is initially at rest. If a force of 100 dyne is applied for a period of 10 seconds, what kinetic energy is acquired by the particle? What is the work done by the force?

3. **Moment of Inertia:** (15%) What is the moment of inertia of a solid annular cylinder with total mass M, with outer radius R2, and Inner radius R1, rotating about any of its central axis?

4. **Linear momentum conservation:** (15%) Two masses are in a collision course with mass $\mathbf{M_1}$, $\mathbf{M_2}$ and velocities $\mathbf{V_1}$ and $\mathbf{V_2}$, respectively. Using Newton's third law, derive (or prove) the conservation of linear momentum in an isolated system.

5. **Elastic potential energy:** (15%) Suppose a massless spring with spring constant ***k*** can be stretched to a maximum displacement of $\boldsymbol{X_{max}}$, derive the elastic potential that can be stored in this spring.

6. **Electric power and kinetic energy:** (20%) Electric car is the future vehicle for transportation. Suppose you buy a new Tesla Model-3 car which have a battery power is 400 kW. Once you charge, it can provide 10 hrs continuous riding. How much distance can you cover during the time? Let the mass of your car is 250 kg and the energy consumed by the engine is totally equal to kinetic energy of the car.