1. (15 points) Show that the horizontal range of a projectile having an initial speed $v_0$ and angle of projection $\theta_0$ is $R = \left(\frac{v_0^2}{g}\right) \sin 2\theta_0$. Then show that a projection angle of 45 degrees gives the maximum horizontal range.

2. (10 points) One end of a vertical spring is fastened to the ceiling. A weight is attached to the other end and slowly lowered to its equilibrium position. At this condition the spring is extended by an amount of $d$. Please show the amount of extension of the spring when the weight is attached and permitted to act as a freely falling body.

3. (15 points) Prove that the total translational kinetic energy per mole ($0.5 M v_{rms}^2$) of the molecules of an ideal gas is proportional to the temperature of the gas. (hint: $p = \frac{1}{3} \rho v_{rms}^2$)

4. (15 points) Derive an expression for $B$ at a distance $r$ from the center of a long cylindrical wire of radius $R$, where $r < R$. The wire carries a current $i_0$, distributed uniformly over the cross section of the wire.

5. (15 points) Prove that the potential due to a point charge can be expressed as $V = \frac{1}{4\pi\varepsilon_0} \left(\frac{q}{r}\right)$ (hint: $E = \frac{1}{4\pi\varepsilon_0} \left(\frac{q}{r^2}\right)$).

6. (30 points) Explain briefly the following terms. (a) photoelectric effect (b) Hooke’s Law (c) Bernoulli’s equation (d) Gauss’s Law (e) Uncertainty Principle (f) Pauli Exclusion Principle

(以下無試題)