1. The mass of a planet is $4.8 \times 10^{25}$ kg and its radius is $1.20 \times 10^7$ m. What is the acceleration due to gravity at a distance of $2.40 \times 10^7$ m from the center of the planet?

2. A cannon shell is fired from the surface of the earth with a speed of 5000 m/s at an angle of 30 degrees with respect to the earth's surface. How far above the surface of the earth is the shell when its speed is 1000 m/s?
3. A 0.200kg mass attached to a spring of force constant 8.00 N/m vibrates with simple harmonic motion. When the stretch in the spring is 10.0cm, the speed of the mass is 50.0cm/s.

(a.) What is the angular frequency of vibration?

(b.) What is the amplitude of the vibration?

(c.) How long does it take the mass to move from x=0 to x=8 cm?
4. A piece of aluminum is suspended from a string and then completely immersed in a container of water. The mass of the aluminum is 1.50 kg, and its density is $2.70 \times 10^3$ kg/m$^3$. Calculate the tension in the string after the aluminum is immersed.
A fluid whose density is 1.20 gm/cm³, fills a cylindrical chamber whose cross-sectional area is 100.cm². A tight-fitting, but smoothly moving piston whose weight is $4.00 \times 10^3$ N encloses the upper end of the cylinder. As fluid is pushed out of the tube, the piston falls, maintaining contact with the fluid in the chamber. An atmospheric pressure of $1.01 \times 10^5$ N/m² surrounds the chamber and tube.

(a.) Determine the pressure in the fluid at point A which is just below the piston.

(b.) What is the ratio of the fluid speed at B to the fluid speed at A?

(c.) Determine the speed of the fluid as it leaves the tube at B.
EQUATION SHEET for EXAM #4

\[ x = A \cos(\omega t + \delta) \]

\[ T = \frac{1}{f} \]

\[ T = \frac{2\pi}{\omega} \]

\[ \omega = 2\pi f \]

\[ T = 2\pi \sqrt{\frac{1}{mgd}} \]

\[ T = 2\pi \sqrt{\frac{L}{g}} \]

\[ V = \frac{dx}{dt} \quad a = \frac{dv}{dt} \]

\[ U = \frac{1}{2}kx^2 \]

\[ K = \frac{1}{2}mv^2 \]

\[ \omega = \sqrt{\frac{k}{m}} \]

\[ E = \frac{1}{2}kA^2 \]

\[ F = G\frac{m_1m_2}{R^2_{12}} \]

\[ G = 6.672 \times 10^{-11} \text{Nm}^2\text{kg}^{-2} \]

\[ F = ma \]

\[ \rho = \frac{m}{V} \quad P = \frac{F}{A} \]

\[ a = \frac{v^2}{R} \]

\[ V = \frac{D}{T} \]

\[ W = mg \]

\[ U = \frac{Gm_1m_2}{R} \]

\[ A_1v_1 = \text{const} \]

\[ P + \frac{1}{2}\rho v^2 + \rho g y = \text{const} \]

mass of earth = \(5.98 \times 10^{24}\) kg

radius of earth = \(6.37 \times 10^6\) m

1 atm = \(1.01 \times 10^5\) N/m²

density of water = \(1.00\frac{g}{\text{cm}^3}\)