**AP Physics C Chap 11 Oscillations Review**

1. A 12 cm-long spring has a force constant (k) of 400 N/m. How much force is required to stretch the spring to a length of 14 cm?

2. A block of mass 1.5 kg oscillates on a spring whose force constant k is 500 N/m. The amplitude of the oscillations is 4.0 cm. Calculate the maximum speed of the block.

3. A block of mass 2.0 kg is attached to an ideal spring of force constant 500 N/m. The amplitude of the resulting oscillations is 8 cm.

    a. Determine the total energy of the oscillator and the speed of the block when it's 4 cm from equilibrium.

    b. Find the amplitude of oscillation if an impulsive force acts on the block giving it an initial speed of 2 m/s.

4. Calculate the frequency and period of oscillation when a 2 kg mass is attached to a spring whose constant is 300 N/m.

5. A SH oscillator has an amplitude of 3 cm and a frequency of 4 Hz. At time *t=0* its position of *y=3 cm*. Where is it at time *t=0.3s*?

6. The position of a simple harmonic oscillator is given by the equation
   $y = (4\text{ cm})\sin[(6\pi s^{-1})t - \frac{1}{2}\pi]$

    a. Where is the oscillator at time t=0?

    b. What is the amplitude of the motion?

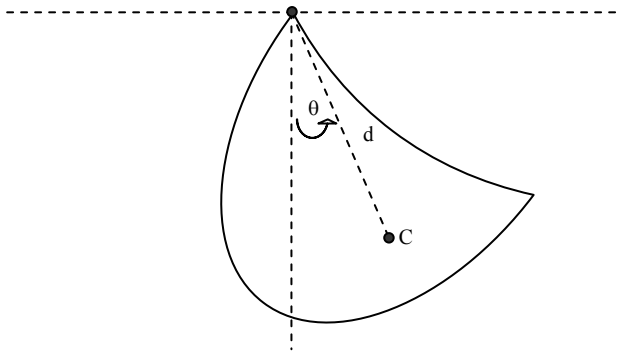
    c. What is the frequency?

    d. What is the period?

7. A simple pendulum has a period of 1s on Earth. What would the period be on Mars?

8. A bullet of mass m is fired horizontally with speed v into a block of mass M initially at rest, at the end of an ideal spring on a frictionless table. At the moment the bullet hits, the spring is at it natural length, L. The bullet becomes embedded in the block, and simple harmonic oscillations results.
   a. Determine the speed of the block immediately after the impact by the bullet.
   b. Determine the amplitude of the resulting oscillations of the block.
   c. Compute the frequency of the resulting oscillations.
   d. Derive an equation which gives the position of the block as a function of time (relative to x=0 at time t=0)

9. An object of total mass *M* is allowed to swing around a fixed suspension point P. The object's moment of inertia with respect to the rotation axis perpendicular to the page through P is donated by *I.* The distance between P and the object's center of mass, C, is *d*.




a. Compute the torque τ produced by the weight of the object when the line PC makes an angle θ with the vertical. (Take the counterclockwise direction as positive for both θ and τ).

b. If θ is small, so that the sin θ may be replaced by θ, write the restoring torque τ computed in part (a) in the form $\tau = -k\theta$.

A simple harmonic oscillator whose displacement from equilibrium, *z*, satisfies an equation of the form $\frac{d^2z}{dt^2} = -bz$ has a period of oscillation given by the formula $T = \frac{2\pi}{\sqrt{b}}$.

c. Taking *z* equal to θ in above equation, use the result of part (b) to derive an expression for the period of small oscillations of the object shown above.

d. Answer the question posed in part © if the object were a uniform bar of mass *M* and length *L* (*whose moment of inertia about one of its ends is given by the equation $I = {}^1/_3 ML^2$).