NAME: Answers, Sect. #______

Physics 109 **Homework # 1**
due Monday, September 18, 2001

- Prefixes for large numbers are **k** for kilo (**1000**), **M** for mega (**10^6**) and **G** for giga (**10^9**).
- Prefixes for small numbers are **m** for milli (**10^{-3}**), μ for micro (**10^{-6}**), and **n** for nano (**10^{-9}**).
- Weight of a mass depends on how strong gravity is at that location. On earth, the acceleration of gravity is $g = 9.8\ m/s^2$. The weight is figured as $w = mg$.
- spring constant k is related to force F and elongation (stretching) x by $F = -kx$.

1. A dog can hear frequencies up to 40,000 Hz
   a) express this frequency in kHz.

   $40{,}000\ Hz = 40 \times 1000\ Hz = 40\ kHz$

   b) find the period of this oscillation. Express the answer in s, in ms and in μ s.

   $T = \frac{1}{f} = \frac{1}{40{,}000\ oscill/sec} = \frac{1\ sec}{40{,}000} = 0.000{,}025\ sec$; $\frac{1000\ msec}{40{,}000} = 0.025\ msec$

   i.e. for msec shift decimal pt. 3 places. In μsec $T = 10^6/40{,}000 = 25\ \mu sec$

2. If Jim has a mass of 70 kg, how much many Newtons does he weigh on earth where the acceleration of gravity is $g = 9.8\ m/s^2$?

   $weight = mg = 70\ kg \times 9.8\ \frac{m}{s^2} = 686\ N$ (Newtons)

   if Jim is on the moon where the acceleration of gravity is only $0.15\ m/s^2$, how much will he weigh?

   $70\ kg \times 0.15\ \frac{m}{s^2} = 7\ N$ (but note: I gave you wrong number: on moon $1.5\ m/s^2$, not $0.15\ m/s^2$)

3. for the oscillation on the right, the horizontal axis (time) is in msec.

   find the period T in sec and in msec:

   $T = 6\ ms = 6 \times 10^{-3}\ s = 0.006\ sec$

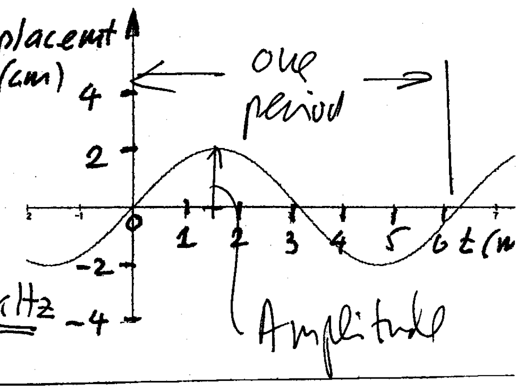
   find the frequency in Hz and in kHz:

   $f = \frac{1}{T} = \frac{1}{0.006}\ Hz = 167\ Hz = 0.167\ kHz$

   note: if in $f = \frac{1}{T}$ the period is in msec, the f comes out in kHz

   find the amplitude

   A = 2 cm



4. The length of a spring is measured for different pulls F:

pull F on spring	2N	4N	6N	8N	10N
length of spring:	20cm	25cm	30cm	35cm	40 cm

Find the spring constant in N/cm and in N/m

2N pull elongates (stretches) the spring by 5cm. = 5×10^{-2} m = x

(note: 1cm = 10^{-2} m = $\frac{1}{100}$ m .. centi = 1/100)

spring constant $k = F/x = \frac{2N}{5cm} = 0.4 \frac{N}{cm}$

in N/m: $k = F/x = \frac{2N}{0.05m} = 40 \frac{N}{m}$

5. For simple harmonic motion (mass on a spring) the frequency is the same, no matter whether the amplitude is large or small. This seems strange at first, becaue for a large amplitude the mass has further to travel.

Explain to a friend in plain language WHY the frequency stays the same even if you make the amplitude twice as large.

twice the displacement → twice the spring force

but twice the spring force → speeds up the mass twice as much.

So now we have: twice the distance of travel

but also twice the speed

thus same travel time → same period

= same frequency