PreAP Harmonic Motion 4

1. Remembering that 1000 g = 1 kg, what is the period of a spring that has a 400 g mass and a spring constant of 120 N/m?

Example: How long is a pendulum that has a period of 3.2 seconds?

$$T = 2\pi \sqrt{\frac{\ell}{g}}$$

$$3.2 = 6.28 \sqrt{\frac{\ell}{10}}$$

$$\frac{3.2}{6.28} = \frac{6.28}{6.28} \sqrt{\frac{\ell}{10}}$$
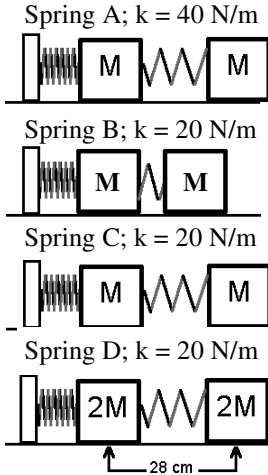
$$0.5096 = \sqrt{\frac{\ell}{10}}$$

$$(0.5096)^2 = \frac{\ell}{10}$$

$$0.2597 = \frac{\ell}{10}$$

$$10(0.2597) = \ell$$

$$\ell = 2.597m = 259.7cm$$

2. * A spring-mass system has a period of 2.5 seconds and a spring constant that is 65 N/m. How much mass is attached?

From the lab:
3. Give two ways to change the period of a spring-mass system.

Spring A; k = 40 N/m

Spring B; k = 20 N/m

Spring C; k = 20 N/m

Spring D; k = 20 N/m

— 28 cm —

4. The spring-mass systems at the left are shown at their left and right-most positions.

  A. ____ Which spring has a faster period: A or B?
  B. ____ Which spring has a faster period: B or C?
  C. ____ Which spring has a faster period: C or D?
  D. ____ Which spring has a faster period: A or D?
  E. What is the amplitude of spring D?

  F. If spring C has a period of 0.33 seconds, calculate its frequency.

  G. If m = 1.5 kg, calculate the period of spring D.

  H. How far does Spring D travel in one full period?
  I. What is the displacement of Spring D after two full cycles?
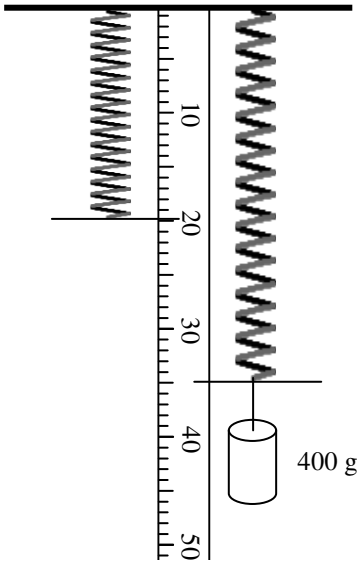
5. A spring is unstretched to begin with, but the coils of the spring are not touching. Then a 400 g mass is attached and stretches the spring as shown. Remember that the spring constant has the units of N/m.

  A. Its original (relaxed) position is known as its equilibrium position. What is the spring's equilibrium position (in m)?

  B. * x is the displacement from this equilibrium position. In this case, what is x?

  C. * Calculate the force pulling down on the spring.

  D. * Given that F = −kx and that k is always a positive number (a constant), calculate the spring stiffness constant for the spring.

  E. Now that you have both m and k, calculate the period of the spring.

400 g

Initial Position

0:00.0

5m   10m   15m   20m   25m

0:05.0
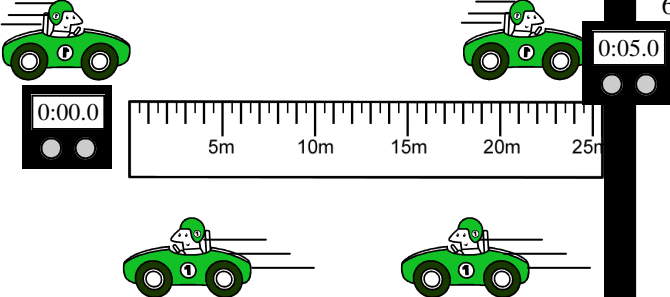
Final Position

6. A bumper car goes a certain distance, bumps off the wall and comes back to its initial position.

  A. * How far did it go in total (total **distance** there and back)?

  B. If it took 5 seconds to go to the wall and it stays at constant speed, how long did it take for the whole journey?

  C. Calculate the speed of the object.

Graph I — Position vs. Time

Graph II — Position vs. Time
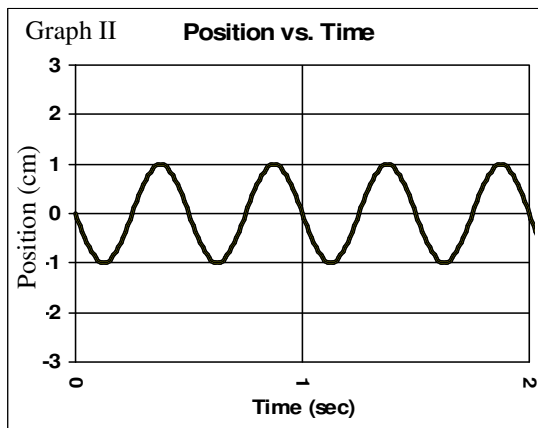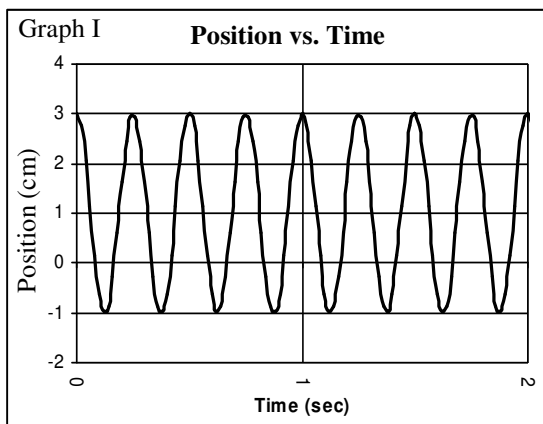
7. Given the following situations, which is Graph I or Graph II?

    A. _____ Which shows faster period?
    B. _____ Which shows greater energy?
    C. _____ Which shows higher frequency?
    D. _____ Two pendulums have the same mass.   Which one is the longest?
    E. _____ Two springs have the same mass. Which one has the smaller spring constant?
    F. _____ Two pendulums are the same length. Which one is on the moon?
    G. _____ Two springs have the same spring constant. Which one has less mass?

2. 10.3kg
5B. 15 cm
5C = mg
5D 26.7 N/m
6A 50 m