Tutorial Quiz-6 **PHYS 101 : Week of October 22, 2007**

Two problems to be done during the first hour on the black board and two to be handed in for marking

For the problems to be marked each problem is worth 10 points
A student may discuss the problems with other students but may not copy from others.

Problem 14.50

A spring with spring constant k is suspended vertically from a support and a mass *m* is attached. The mass is held at the point where the spring is not stretched. Then the mass is released and begins to oscillate. The lowest point in the oscillation is 20 cm below the point where the mass was released. What is the oscillation frequency?

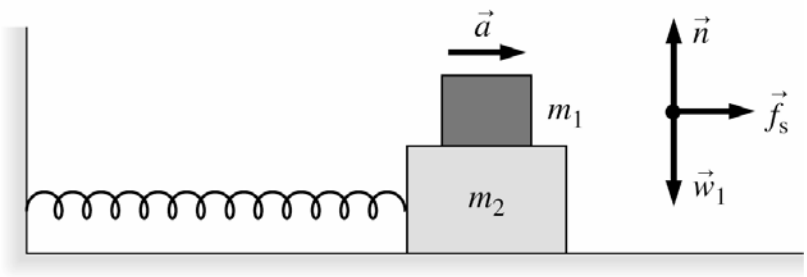
. **Problem 14.53**

A 500 g block slides along a frictionless surface at a speed of 0.35 m/s. It runs into a horizontal massless spring with spring constant 50 N/m that extends outward from a wall. It compresses the spring, then is pushed back in the opposite direction by the spring, eventually losing contact with the spring.

a. How long does the block remain in contact with the spring?
b. How would your answer to part a change if the block's initial speed were doubled?

. **Problem 14.54**

Figure P14.54 shows a 1.0 kg mass riding on top of a 5.0 kg mass as it oscillates on a frictionless surface. The spring constant is 50 N/m and the coefficient of static friction between the two blocks is 0.50. What is the maximum oscillation
amplitude for which the upper block does not slip?



Problem 14.58

Astronauts on the first trip to Mars take along a pendulum that has a period on earth of 1.50 s. The period on Mars turns out to be 2.45 s. What is the Martian acceleration due to gravity?

Problem 14.62

A200 g block attached to a horizontal spring is oscillating with an amplitude of 2.0 cm and a frequency of 2.0 Hz. Just as it passes through the equilibrium point, moving to the right, a sharp blow directed to the left exerts a 20 N force for 1.0 ms. What are the new (a) frequency and (b) amplitude?

Problem 14.71

An oscillator with a mass of 500 g and a period of 0.50 s has an amplitude that decreases by 2.0% during each complete oscillation.
(a) .If the initial amplitude is 10 cm, what will be the amplitude after 25 oscillations?
(b) At what time will the energy be reduced to 60% of its initial value?

Problem 20.40

The displacement of a traveling wave is

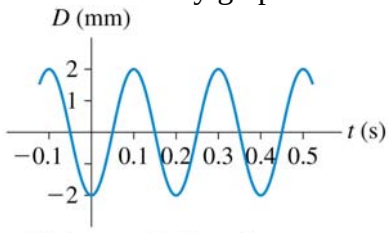
$$D(x,t) = \begin{cases} 1 \text{ cm} & \text{if } |x - 3t| \le 1 \\ 0 \text{ cm} & \text{if } |x - 3t| > 1 \end{cases}$$

where x is in m and t in s.

(a) Draw displacement-versus-position graphs at 1 s intervals from t = 0 to t = 3 s. Use an x-axis that goes from -2 to 12 m. Stack the four graphs vertically.
(b) Determine the wave speed from the graphs. Explain how you did so.
(c) Determine the wave speed from the equation for Does it agree with your answer to part b?

Problem 20.43

This is a history graph at x = 0 of a wave traveling in the positive x-direction at 4.0 m/s



History graph at x = 0 m
Wave traveling right at 4.0 m/s

(a) What is the wave length?
(b) What is the phase constant of the wave?
(c) Write the displacement equation for this wave.

Problem 20.44

An ultrasound unit sends a 2.4 MHz sound wave into a 25-cmlong tube filled with an unknown liquid. A small microphone right next to the ultrasonic generator detects both the transmitted wave and the sound wave that has reflected off the far end of the tube. The two sound pulses are 4.4 divisions apart on an oscilloscope for which the horizontal time sweep is set to 100 ms/division. What is the speed of sound in the liquid?

Problem 20.63

A sound wave of frequency 686 Hz is traveling in 20°C air as a plane wave in the positive *y*-direction. At time $t = 0$ s, one crest of the wave is located in the plane $y = 12.5$ cm.

a. Draw a graph of $D(y, t = 0 \text{ s})$ as a function of y from $y = -150$ cm to $y = +150$ cm.

b. What is the phase constant for this wave? There are *two* values that satisfy the mathematics, so justify your answer.

c. Write the wave equation $D(y,t)$ for the wave, leaving the amplitude A unspecified.

d. Draw an *xy*-coordinate system in which y ranges from -150 cm to +150 cm. Show the wave fronts of the wave at time $t = 0$ s. Number each of the wave fronts (1, 2, . . .) at the side of the graph.

e. Repeat part d at time t = 0.729 ms. Keep the same number attached to each wave front so that you can see how the wave fronts have moved.

f. At $t = 0.729$ ms, what is the phase of the wave at and at $y = 12.5$ cm and at $y = -12.5$ cm?