Unit: Oscillations and Waves

I. Oscillatory Motion: Amplitude, Frequency, and Velocity
   a) Mass on a spring
   b) Pendulums

II. Traveling Waves
   a) Types and properties
   b) Frequency, Velocity, and Wavelength

III. Sound
   a) Intensity vs. distance
   b) Doppler effect

IV. Superposition
   a) Addition of Waves
   b) Standing Waves (strings and pipes)
   c) Beats
Tacoma Narrows Bridge
http://www.youtube.com/watch?v=Ce-PQqkIXe0&feature=related
A mass on a spring oscillates at a frequency of 2 Hz. If the mass is doubled, what is the new frequency of oscillation?

a) 1 Hz
b) 1.4 Hz
c) 2 Hz
d) 2.8 Hz
e) 4 Hz
f) None of the above.
A mass oscillates on a spring. The acceleration of the mass is greatest when the velocity is

a) zero.
b) greatest.
c) half way between zero and its maximum velocity.
d) None of the above.
A person swings on a swing. When the person sits still, the swing oscillates back and forth at its natural frequency. If, instead, two people sit on the swing, the natural frequency of the swing is

a) greater.
b) the same.
c) smaller.
A person swings on a swing. When the person sits still, the swing oscillates back and forth at its natural frequency. If, instead, the person stands on the swing, the natural frequency of the swing is

a) greater.
b) the same.
c) smaller.
A pendulum clock in a freely-falling elevator

a) runs normally.
b) runs a little fast.
c) runs a little slow.
d) runs very fast.
e) none of these.
A pendulum clock is set to run accurately at sea level. It is then brought to the top of a high mountain, where it is found to

a) function unchanged.
b) run slow.
c) run fast.
d) stop running.
e) none of these.
A mass oscillates on a spring. Each time the spring reaches its maximum extension, a person gives a light tap on the mass in the direction of the spring. The amplitude of the spring

a) gradually decreases.
b) decreases at first, then remains constant.
c) remains constant.
d) grows at first, then remains constant.
e) grows with each oscillation.
f) none of these.
Notes:
1. The displacement of the wave as a function of position is a sine function.
2. The displacement of each atom as a function of time is a sine function.
Wave Pulse
Wave Pulse

\[ y = \text{Wave Pulse} \]

\[ x = X - vt \]

\[ x = X \]

\[ x \]
A piston at the end of a pipe moves in and out. What type of wave does the piston produce in the pipe?

a) transverse
b) longitudinal
c) combination
A wave moves along a string at 5m/s. How fast does a molecule in the string move?

a) 5 m/s

b) \(\left(10\frac{\pi}{\lambda}\right)m/s\)

c) \(\left(10\frac{\pi}{\lambda}\right)rad/s\)

d) More information is needed.
You and a friend are floating out in space. Your friend tells you that you look funny. How does the volume, as heard by you, compare to if you and your friend were at home?

a) It is louder.
b) It is the same.
c) It is more quiet.
d) You do not hear anything.
A wave is sent along a long spring by moving the left end rapidly to the right and keeping it there. The figure shows the wave pulse at QR—part RS of the long spring is as yet undisturbed. Which of the graphs 1–5 correctly shows the relation between displacement $s$ and position $x$? (Displacements to the right are positive.)
A heavy rope is hung from the ceiling and plucked at the bottom. What happens to the speed as the wave travels up the string?

a) The speed increases.
b) The speed decreases.
c) The speed is constant.
d) More info is needed.
A wave pulse is moving, as illustrated, with uniform speed $v$ along a rope. Which of the graphs 1–4 below correctly shows the relation between the displacement $s$ of point P and time $t$?
A wave pulse is moving, as illustrated, with uniform speed v along a rope. Which of the graphs 1–4 below correctly shows the relation between the displacement s of point P and time t?
A weight is hung over a pulley and attached to a string composed of two parts, each made of the same material but one having four times the diameter of the other. The string is plucked so that a pulse moves along it, moving at speed $v_1$ in the thick part and at speed $v_2$ in the thin part. What is $v_1/v_2$?

a) 1  
b) 2  
c) $\frac{1}{2}$  
d) $\frac{1}{4}$