

- 1) Which harmonic is 2λ long? H_4
- 2) Which has 4 antinodes? 4
- 3) Which has 3 nodes? 2
- 4) Calculate the wavelength of harmonic 3.

$$1.5 \lambda = 1.2 \text{ m}$$

$$\lambda = 0.8 \text{ m}$$

- 5) Calculate the string's wave speed.

$$V = f \lambda$$

$$60 \text{ Hz} (0.8 \text{ m}) = 48 \text{ m/s}$$

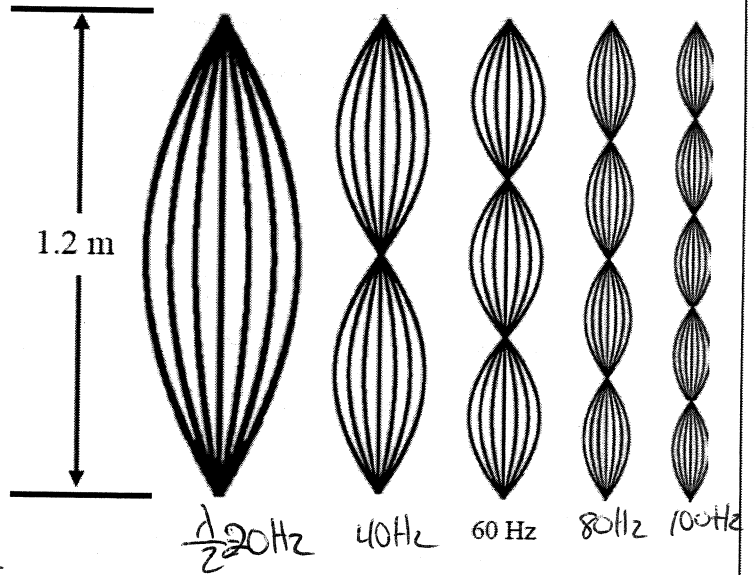
- 6) What is the wavelength of the fundamental?

$$\frac{\lambda}{2} = 1.2 \text{ m} \quad \lambda = 2.4 \text{ m}$$

- 7) What is the natural frequency of this string? 20 Hz
- 8) Which one has the greatest amplitude? H_1
- 9) What is the wave speed for harmonic 1?

$$f \lambda = 20 \text{ Hz} (2.4) = 48 \text{ m/s}$$

- 10) These are the frequencies at which the string is resonant.



- 11) A pendulum swings faster.

- A. Does the cycle occur more or less frequently?
- B. Therefore, does the frequency go up or down?
- C. Is the period faster or slower?

- D. Therefore, does the period go up or down?
- E. If the period goes up the frequency goes up or down?
- F. Is this direct or inverse relationship?

- 12) How do you make a pendulum go faster (2 ways)?

shorter λ , more gravity

- 13) Pendulum A, B, or C:

- A. Has the smallest period? **A**
- B. Has the biggest amplitude? **C**

- 14) What is the same between pendulum A and B? **Amplitude**

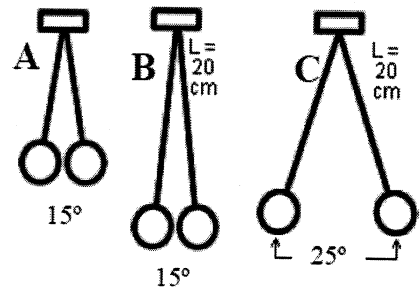
- 15) What is the same between pendulum B and C? **period**

- 16) Does **A** or **B** have the highest frequency?

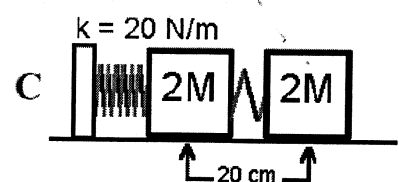
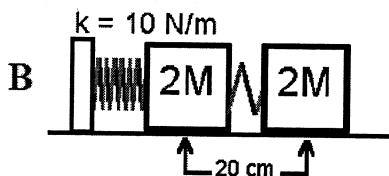
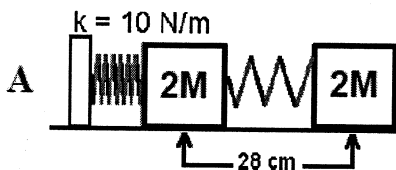
- 17) What is the amplitude of pendulum C? $25^\circ / 2 = 12.5^\circ$

- 18) Find the period of pendulum B.

$$T = 6.28 \sqrt{\frac{0.2}{10}} = 0.89 \text{ sec}$$



- 19) How do you change the period of a spring? (2 ways) **Mass or Spring Constant**



- 20) Which of the three springs will have the fastest period? **C**

- 21) Why? **biggest k (stronger springs)**

- 22) Which spring was disturbed the most? **A**

- 23) Why? **biggest Amplitude**

- 24) What is Spring B's amplitude? **10 cm**

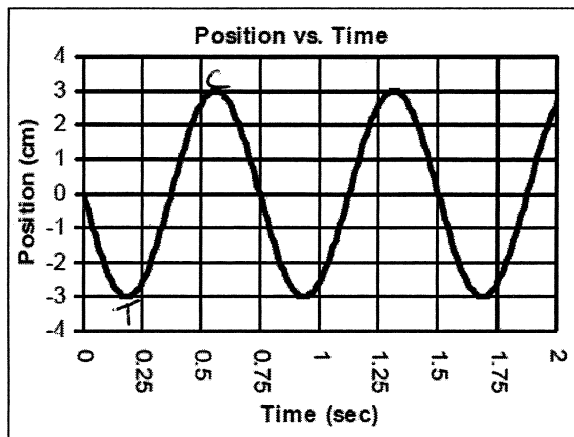
- 25) How far does Spring A travel side-to-side? **28 cm**

- 26) How far will Spring C travel in one complete cycle? **40 cm**

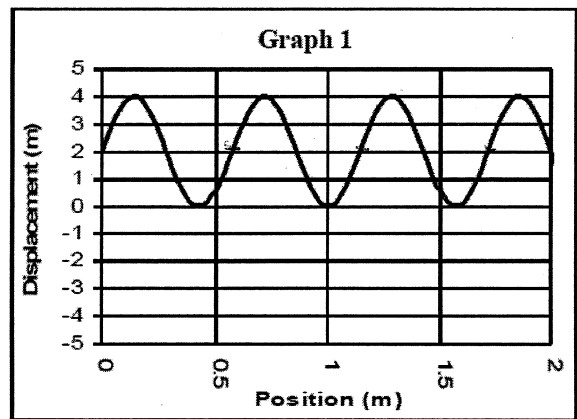
- 27) If $M = 400 \text{ g}$, find the period of Spring A.

$$m = 2M = 2(400 \text{ g}) = 0.8 \text{ kg}$$

$$T = 2\pi \sqrt{\frac{m}{k}} = 6.28 \sqrt{\frac{0.8 \text{ kg}}{10 \text{ N/m}^2}} = 1.78 \text{ sec}$$



- 28) A. Amplitude = 3cm B. Equilibrium position = 0cm
 C. Mark a crest and a trough.
 D. # of cycles = 2.75
 E. Period = 0.75sec F. Frequency = $f = \frac{1}{T} = \frac{1}{0.75} = 1.33\text{Hz}$



- 29) A. Where will it come to rest? 2m (equilibrium point)
 B. Amplitude? 2m C. # of wavelengths 3.5λ
 D. Length of the graph = 2m
 E. Calculate the wavelength.
 $3.5\lambda = 2\text{m} \quad \lambda = \frac{2\text{m}}{3.5} = 0.57\text{m}$

- 30) If a sound wave has a wavelength of $15\text{cm} = 0.15\text{m}$
 A. Calculate its frequency. $v = f\lambda \quad f = \frac{v}{\lambda}$
 $f = \frac{340\text{m/s}}{0.15\text{m}} = 2266.7\text{m/s}$
 B. What is its speed if you double the amplitude?

Same

- 31) Sound is generally faster in:
 A. Solids or gases?
 B. Helium or oxygen? talk higher
 C. Tight things or loose things?
 D. Denser objects or less dense objects?

- 32) What is the speed of sound in space? No sound in space
 33) Which has a higher frequency: long or short wavelengths?
 34) Higher frequency: bird or elephant? shorter λ
 35) Which has the shorter wavelength: a bird or an elephant?

- 36) $f_1 = 820\text{Hz}; f_2 = 815\text{Hz}$
 A. How many beats will you hear? 5 Beats
 B. What causes the beats?

Interference

- 37) A race car is moving towards you.
 A. Is the pitch of car higher or lower than normal?
 B. Is the wavelength of the sound longer or shorter?
 C. What is this called? Doppler effect
 D. What will happen when it passes you?
 goes lower

- 38) What is "timbre"?
 diff. of sounds that are same freq

- 39) Sound waves are longitudinal or transverse?

- 40) How different is 60 dB from 50 dB? $2\times$ as loud

- 41) A longitudinal wave is moving up, which way are the vibrations moving? up & down

- 42) For motion to be harmonic:
 A. It has to have a restoring force.
 B. This force has to pull to the middle.

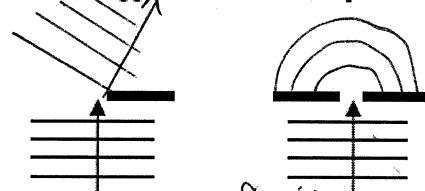
- 43) Give an example of motion that repeats, but is NOT harmonic motion. jumping jacks, wings, ball bouncing

- 44) A person yells up to a ceiling and hears the echo 0.6 seconds later. How high is the ceiling?

$$v = \frac{2D}{t} \quad 340\text{m/s} = \frac{2D}{0.6\text{s}} = 110.5\text{m}$$

- 45) A 250 g object is hung onto a spring. It stretches 18 cm. Find the spring's spring constant.

- 46) Draw what will happen when the wave passes.



- 47) The above pictures show: reflection

- 48) Echoes occur when sound reflects.

- 49) Light bends as it passes from air to glass: refraction

- 50) Sound dying out in a soft boundary is called: damping

- 51) When two waves interact with each other, causing a greater amplitude: Superposition positive interference

- 52) When two waves interact with each other, causing a smaller amplitude: negative interference

- 53) When one object vibrates from the energy of another wave (like one tuning fork causing another to vibrate):

RESONANCE