Harmonic Motion In Class Review

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

$$\frac{1.2}{3} \times 2 = \frac{2.4}{3} = .8m$$

5) Calculate the string's wave speed.

$$V = f\lambda = 60(.8) = 48 \, m/s$$

6) What is the wavelength of the fundamental? 2.4 m

7) What is the natural frequency of this string? 20 Hz
8) Which one has the greatest amplitude? H1
9) What is the wave speed for harmonic 1?

$$48 \, m/s$$

10) These are the frequencies at which the string is r esonant .
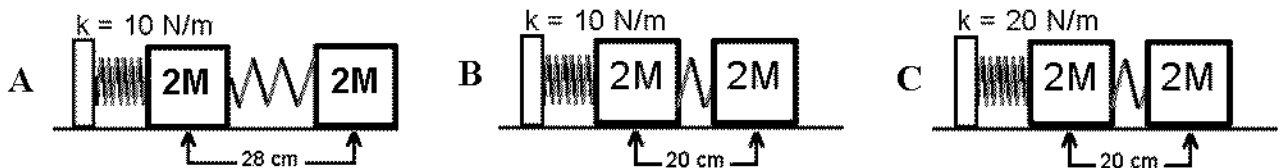
20 Hz   40   60 Hz
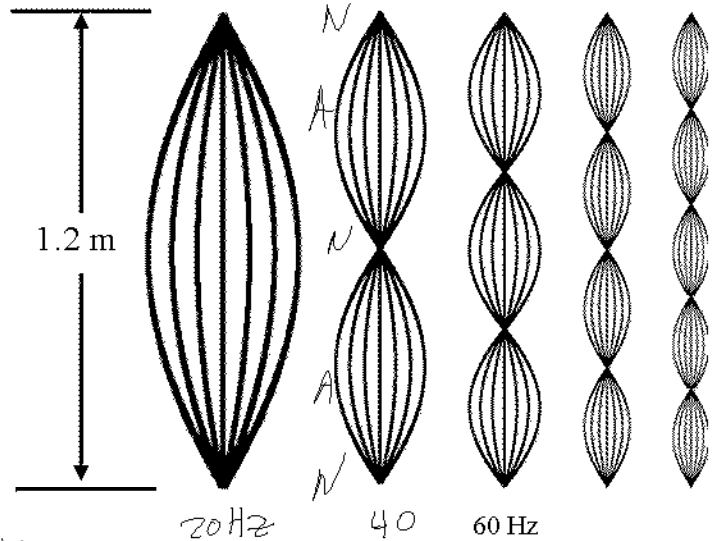
11) A pendulum swings faster.
   A. Does the cycle occur (more) or less frequently?
   B. Therefore, does the frequency go (up) or down?
   C. Is the period (faster) or slower?
   D. Therefore, does the period go up or (down)?
   E. If the period goes up the frequency goes up or (down)?
   F. Is this direct or (inverse) relationship?

12) How do you make a pendulum go faster (2 ways)?
   shorter length or more gravity (g)

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? ampl.
15) What is the same between pendulum B and C? period
16) Does A or B have the highest frequency? A (oscillates faster)
17) What is the amplitude of pendulum C? 25/2 = 12.5°
18) Find the period of pendulum B.

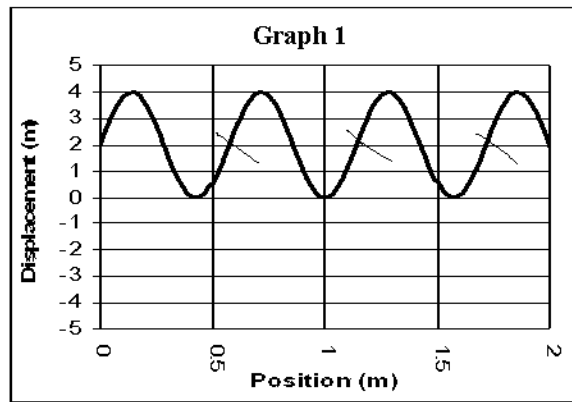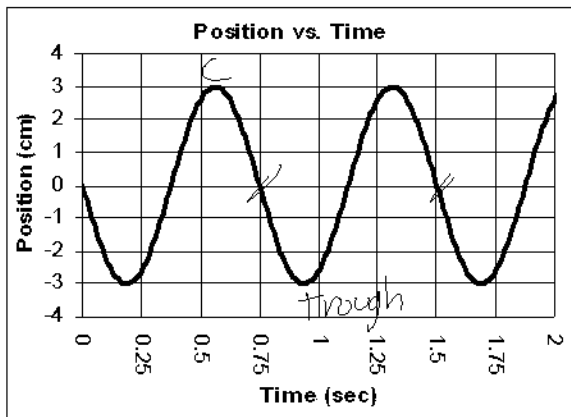$$T = 6.28 \sqrt{\frac{.2}{10}} = 6.28 \sqrt{.02} = 6.28(.1414)$$
$$= .89 \, sec$$

A   B L=20 cm   C L=20 cm
15°   15°   25°
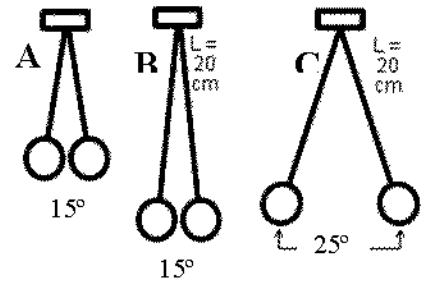
19) How do you change the period of a spring? (2 ways) mass or k (spring constant)

A k = 10 N/m 2M 2M —28 cm—
B k = 10 N/m 2M 2M —20 cm—
C k = 20 N/m 2M 2M —20 cm—

20) Which of the three springs will have the fastest period? C
21) Why? Biggest spring constant (biggest force)

22) Which spring was disturbed the most? A
23) Why? Biggest distance

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?
   20 × 2 = 40 cm
27) If M = 400 g, find the period of Spring A.
   m = .4 kg

$$T = 6.28 \sqrt{\frac{2(.4)}{10}} = 6.28 \sqrt{.08} = 6.28(.28)$$
$$= 1.78 \, sec$$

Position vs. Time

Position (cm) vs Time (sec) graph with amplitude 3, showing marks for "C" (crest), crest, and "trough" at -3.

Graph 1

Displacement (m) vs Position (m) graph with amplitude 4.

28) A. Amplitude = 3cm B. Equilibrium position = 0
C. Mark a crest and a trough.
D. # of cycles = 2.75 cycles
E. Period = .75 sec F. Frequency = $\frac{1}{.75}$ = 1.33 Hz

29) A. Where will it come to rest? 2m
B. Amplitude? 2m C. # of wavelengths 3.5 λ = 2m
D. Length of the graph = 2m
E. Calculate the wavelength. $\lambda = \frac{2}{3.5}$ = .57m

30) If a sound wave has a wavelength of 15 cm,
A. Calculate its frequency.
$V = F\lambda$ $f = \frac{V}{\lambda} = \frac{340}{.15}$ = 2267 Hz

B. What is its speed if you double the amplitude?
340 m/s

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

32) What is the speed of sound in space? 0 m/s
33) Which has a higher frequency: long or (short) wavelengths?
34) Higher frequency: (bird) or elephant?
35) Which has the shorter wavelength: a (bird) or an elephant?

36) f_1 = 820 Hz; f_2 = 815 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? pitch drops

38) What is "timbre"?
color of sound - how can tell difference of instr. on same note.

39) Sound waves are (longitudinal) or transverse?

40) How different is 60 dB from 50 dB? twice 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 r estoring force.
B. This force has to pull to the m iddle.

43) Give an example of motion that repeats, but is NOT harmonic motion. bouncing ball (doesn't end up in the middle)

44) A person yells up to a ceiling and hears the echo 0.6 seconds later. How high is the ceiling?
$V = \frac{2D}{T}$ $340 = \frac{2D}{.6}$ $D = \frac{340(.6)}{2}$ = 102m

45) A 250 g object is hung onto a spring. It stretches 18 cm. Find the spring's spring constant.
$F = -kx$ $F = F_w = mg = .25(10) = 2.5 N$
$2.5 = -k(.18)$ $k = \frac{2.5}{.18}$ = 13.9 N/m

46) Draw what will happen when the wave passes.
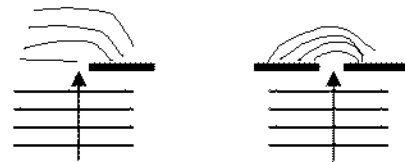
47) The above pictures show:
48) Echoes occur when sound reflects
49) Light bends as it passes from air to glass: refraction
50) Sound dying out in a soft boundary is called: absorption
51) When two waves interact with each other, causing a greater amplitude: constructive interference
52) When two waves interact with each other, causing a smaller amplitude: destructive interference
53) When one object vibrates from the energy of another wave (like one tuning fork causing another to vibrate):
resonance