

**Instructions:** This test is divided into two parts. Part A is entitled short answer questions where you are to pick the *best* word, phrase or choice of answers which best answers or, in some cases, defines the statement. Please be careful to read the entire set of answers for multiple choice questions. Part B is entitled longer answer questions. Make your answers clear and concise. If you need more room turn over the test paper and continue on the back, but please write "over" on the test. For problems, it is the procedure that will be checked, not only the answer so please try to make it clear. Be sure to include units in answering problems (such as we've done in class). For problems that include underlined precision digits, be sure to use the corresponding precision rule or significant figure rule, accordingly. Point weighing is indicated in parentheses. So for this, the third quiz of the fall poets' course, Good Luck!

Here are some recipes:  $d = vt$   $v = at$   $d = \frac{1}{2} at^2$   $F = m \frac{v^2}{R}$   $F = ma$   $w = mg$   $F = G \frac{mM}{r^2}$   $v = f\lambda$

Use  $g = 9.8 \text{ m/s}^2 = 32 \text{ ft/s}^2$ . Not needed:  $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$  Use  $v_{\text{Sound}} = 345 \text{ m/s} = 1100 \text{ ft/s}$

A. Short Answer Questions (1 Point each question except as marked. Questions 1 through 20 are multiple choice.)

C 1. What is the period of the hand on a clock that measures the seconds? (a) 1/60 s (b) 1 s (c) 60 s (d) 3600 s

b 2. A short pendulum has a frequency of 2 Hz, its period is (a) 2 s (b) 1/2 s (c) 2 cycles/s (d) 1/2 cycle/s

b 3. Why do soldiers break step before crossing a suspension bridge?  
(a) They cannot walk as fast on the bridge. (b) Their cadence might match the natural frequency of the bridge.  
(c) Because of long standing tradition passed down from Hannibal. (d) Superstition.

C 4. The distance from trough to trough on a periodic wave is called its (a) frequency (b) period (c) wavelength (d) amplitude.

a 5. How far does a wave travel during one period? (a) a wavelength (b) a crest (c) a trough.

a 6. Two waves with the same speed have different wavelengths. Which has the lower frequency? The one with the (a) longer wavelength (b) shorter wavelength (c) smaller amplitude (d) larger amplitude.  
 *$v = f\lambda$  or  $f = \frac{v}{\lambda}$  → Need large  $\lambda$  to get small  $f$ .*

a 7. If the speed of a 25 Hz wave doubles, the wavelength (a) doubles (b) quadruples (c) stays the same (d) is cut in half.  
 *$v = f\lambda$  If  $v$  is  $2x$  then  $\lambda$  is  $2\lambda$  ( $f$  is constant here).*

a 8. While standing on a dock, you observe water waves passing beneath you. If you observe 20 wave crests passing directly below you in 2 minutes and judge the crests to be 1 m apart, what is the speed of the waves?

(a) 0.17 m/s (b) 10 m/s (c) 20 m/s (d) 40 m/s  *$f = \frac{20 \text{ cycles}}{120 \text{ s}} = \frac{1 \text{ cycle}}{6 \text{ s}}$  or  $v = f\lambda = (\frac{1}{6 \text{ s}})(1 \text{ m}) = \frac{1 \text{ m}}{6 \text{ s}}$*

a 9. Standing waves (a) are a result of the superposition of incident and reflected traveling waves. (b) can only occur in vibrating strings. (c) only occur when the system is at certain temperatures. (d) move with a speed equal to the speed of sound.

b 10. A node of a standing wave is a (a) spot of maximum amplitude. (b) spot of minimum amplitude. (c) traveling wave. (d) note that's an octave higher than the fundamental

a 11. Increasing the tension in the rope ? the fundamental frequency of a rope. (a) increases (b) decreases (c) does not change.

b 12. The fundamental wavelength for standing waves on a rope fixed at both ends is ? the length of the rope. (a) four times (b) two times (c) the same as (d) one-half  
 *$L = \frac{1}{2}\lambda$  or  $\lambda = 2L$*

a 13. If the fundamental frequency for a 2-m-long rope fixed at both ends is 10 Hz, the speed of the wave is (a) 40 m/s (b) 20 m/s (c) 10 m/s (d) 5 m/s  *$v = f\lambda = (10 \frac{1}{\text{s}})(4 \text{ m}) = 40 \frac{\text{m}}{\text{s}}$*

a 14. The threshold of hearing (a) is 0 dB (b) is 1 dB (c) is 120 dB (d) varies per individual  
*BY DEFIN.*

$$f_3 = 3f_1$$

b 15. The frequency of the third harmonic on a rope fixed at both ends is ? times that of the fundamental frequency. (a) 5 (b) 3 (c) 2 (d) 1/3

b 16. Sound wave are ? waves. (a) transverse (b) longitudinal (c) oblique (d) particle

b 17. You see the lightning before you hear the thunder because (a) the speed of sound is faster than that of light. (b) the speed of light is faster than that of sound. (c) the thunder forms after the lightning. (d) your eyes are more sensitive to light.

b 18. If you have to wait 10 seconds between the arrival of the flash and the thunder, you know that the lightning bolt occurred ? away. (a) 1/10 mile (b) 2 miles (c) 5 miles (d) 10 miles

$d = v(t) = (100 \frac{ft}{s})(10s) = 11,000 ft \approx 2 mi$

a 19. What length of closed organ pipe is required to produce the note B4 with a frequency of 494 Hz? Assume that it is a sunny spring day and the speed of sound is 345 m/s (a) 0.17 m (b) 0.69 m (c) 1.4 m (d) 2.8 m

C 20. Beats occur because (a) waves reflect off fixed boundaries. (b) harmonics interfere destructively. (c) waves exhibit superposition (d) frequencies shift when the source of sound moves.

$L = \frac{1}{4} \lambda$   
 $V = f\lambda$  or  $\lambda = \frac{V}{f} = \frac{345 m/s}{494 Hz} = .70 m$   
 $L = .17$

light-year 21. REVIEW QUESTION: The distance that light travels in one year is an astronomical distance unit called ?.

Jupiter 22. REVIEW QUESTION: Which planet is known for its "great red spot."

He, Be, Mg 23. (1 1/2) From the periodic chart list three symbols of elements which have only two electrons in their outer shell.  
Ca, Sr, Ba, Ra

atomic number 24. The number of protons in the nucleus of an atom is called the ?.

6 25. (2 1/2) For Carbon 14, the number of protons in the nucleus is ?, the number of neutrons in the nucleus is ?, the total number of electrons in a neutral carbon atom is ?. Of this total number of electrons, ? are in the first shell and ? are in the second shell.  
8  
6  
2, 4

9, 16 26. (1 1/2) The molecule C<sub>9</sub>H<sub>16</sub>O<sub>4</sub> consists of ? carbon atoms, ? hydrogen atoms, and ? oxygen atoms.  
4

There exists an associated solar system 27. (1 1/2) What is the significance of the "wobbling" of a star?

frequency 28. A physical quantity designating the number of waves given off by a vibrating object every second is called ?, and is in units of ?.  
Hertz (Hz)

Period 29. A physical quantity designating the time that it take for one complete cycle or oscillation to occur is called ?.

density 30. The mass of an object per unit volume is a description of a physical quantity called ?.

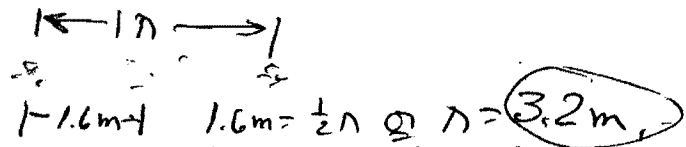
frequency 31. One divided by the "period" gives another physical quantity called ?.

false 32. The speed of a sound wave is a measure of the speed of a typical molecule of air that results when a person speaks. (true, false)  
*(It is the speed of the disturbance)*

b 33. At a rarefaction (or expansion), the density of air (as well as the air pressure) is ? what it would normally be. Choose from (a) higher than; (b) lower than; (c) the same as.

0.5 m/s 34. A pulse travels the length of a 5 m long slinky in 10 s. The speed of the pulse is ?.

$$V = \frac{d}{t} = \frac{5m}{10s} = \frac{1}{2} \frac{m}{s} = 0.5 \frac{m}{s}$$



3.2m 35. (1 1/2) If the distance from a condensation of a sound wave to the next successive rarefaction is 1.6 meters, what is the wavelength of the wave?

1.6m 36. (1 1/2) If the distance from a condensation of a sound wave to the next successive condensation is 1.6 meters, what is the wavelength of the wave?

1024 Hz 37. (2) If the fundamental frequency of an open ended organ pipe is 256 HZ, the frequency of its third overtone is ? and the frequency of its third harmonic is ?.

$f_1 = 256 \text{ Hz}$   
 $f_2 = 512$   
 $f_3 = 768$   
 $f_4 = 1024$

98N 38. (2) REVIEW QUESTION: The weight of a 100 g object is ? while its mass is ?.  
100g = 0.100 kg (Caution: Watch units.)

$W = mg = (.1 \text{ kg})(9.8 \frac{\text{m}}{\text{s}^2})$   
 $W = 0.98 \text{ N}$

3rd HARM  $f_3 = 3f_1 = 768$   
 3rd Overtone  $f_4 = 4f_1 = 1024$

B. Longer Answer Questions

1. (+2 Bonus) It is one thing for "Carbon-Water-Oxygen" life to exist on another planet. List two additional requirements discussed in class that is necessary for us to communicate with another life form?

- ① There must be intelligent life elsewhere.
- ② " " an overlap in ~~time~~ time where we are alive & can receive the communication (& vice versa)
- ③ Radio Waves need to be available

2. (3) If you take a water drop 1/4" in diameter and magnify it, explain what you would see if you magnified it by (a) x2000 (b) x2000 (again) and then (c) by 250 times.

- (a) Small microscopic organisms such as paramecia (the world of biology).
- (b) One starts to see division of particles but can't identify.
- (c) One sees individual molecules.

3. (4) List 4 characteristics necessary for a carbon-oxygen-water type of life according to Dr. Bracewell of Stanford University.

- (a) A parent star of sufficient mass
- (b) " " " " " Temperature
- (c) An associated solar system
- (d) A planet the right distance away.
- (e) " " " " " mass (to hold an atmosphere)
- (f) " " " " " rotational speed.

4. (5) Why are electron shells important in determining how molecules are formed from atoms? Give an example of a molecule formed from atoms by discussing the number of electrons of each in the outer shell.

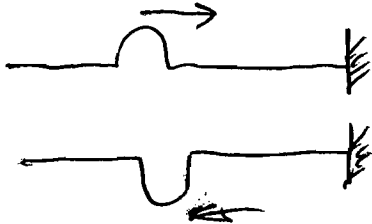
It is most energetically favorable for an atom to have its outer shell filled. If a sodium atom (with one extra electron in its outer shell) meets a ~~chloride~~ chlorine atom (with one vacancy in its outer shell), then they join. The extra electron of the sodium fills in the vacancy of the chlorine and ~~the~~ the molecule sodium chloride (NaCl) is formed.

5. (6) Define and distinguish between a longitudinal wave and a transverse wave and give two examples of each.

For a longitudinal wave, the original disturbance is along or opposite the direction of travel of the wave. (Examples: classroom slinky, sound, dominoes, ---)

For a transverse wave, the original disturbance is at right angles to (or perpendicular to) the direction of travel (Examples: class room slinky, water waves, waves in strings, light).

6. (3) What happens when a transverse wave bounces off a fixed support? You may wish to draw a series of diagrams and also refer to our class slinky demonstration.



The wave bounces off on the opposite side!

7. Define the following: (a) (2) atomic mass (or atomic weight) The atomic mass is the "weighted average" mass numbers of the naturally occurring isotopes of an element that is found in nature.

(b) (2) resonance - every object has a natural set of frequencies at which it prefers to vibrate. If an external source has a frequency that matches one of these natural frequencies, huge amplitudes result.

(c) (2) standing waves - are an example of resonance when an integral number of half wavelengths (or in some cases quarter-wavelengths) just fit in a given length of pipes or strings.

(d) (2) wave train - is a single wave that consists of condensation, rarefaction, etc. that is directed outward away from the source of sound & travels at the speed of sound.

8. Draw in the positioning of nodes (N) and antinodes (A) for:

(a) (2) a closed ended pipe playing its 2<sup>nd</sup> overtone.

FUND.  $f_1$ : N A

1<sup>st</sup> overtone  $f_3$ : N A N A

2<sup>nd</sup> overtone  $f_5$ : N A N A N A or 3<sup>rd</sup> Harmonic

(b) (2) an open ended pipe playing its 3<sup>rd</sup> overtone.

1<sup>st</sup> overtone  $f_2$ : A N A

2<sup>nd</sup> overtone  $f_3$ : A N A N A

3<sup>rd</sup> overtone  $f_4$ : A N A N A N A

(c) (2) a string vibrating in its 2<sup>nd</sup> harmonic.

FUNDAMENTAL or 1<sup>st</sup> HARMONIC  $f_1$ : N A N

2<sup>nd</sup> Harmonic (also 1<sup>st</sup> Overtone)  $f_2$ : N A N A N