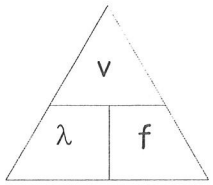
Physics 100
Practice Test: Waves

Name: Answers

Key Equations:

f = waves/seconds **T = seconds/waves**

$T = \frac{1}{f}$ $f = \frac{1}{T}$ $v = \lambda f$



1. Define "wave."
(3) An oscillation that travels through space, transferring energy

2. Name one example of a mechanical wave.
Water waves (at the beach), sound waves

3. Name one example of an electromagnetic wave.
Light

(4) Describe **two** ways in which mechanical waves different from electromagnetic waves?

Mechanical -	Oscillating Matter	Need matter to travel
Electromagnetic -	Oscillating Electric + magnetic Fields	Can travel in a vacuum

5. What is the primary difference between a longitudinal wave and a transverse wave?
Longitudinal: Oscillate parallel to travel direction
Transverse: Oscillate perpendicular to travel direction

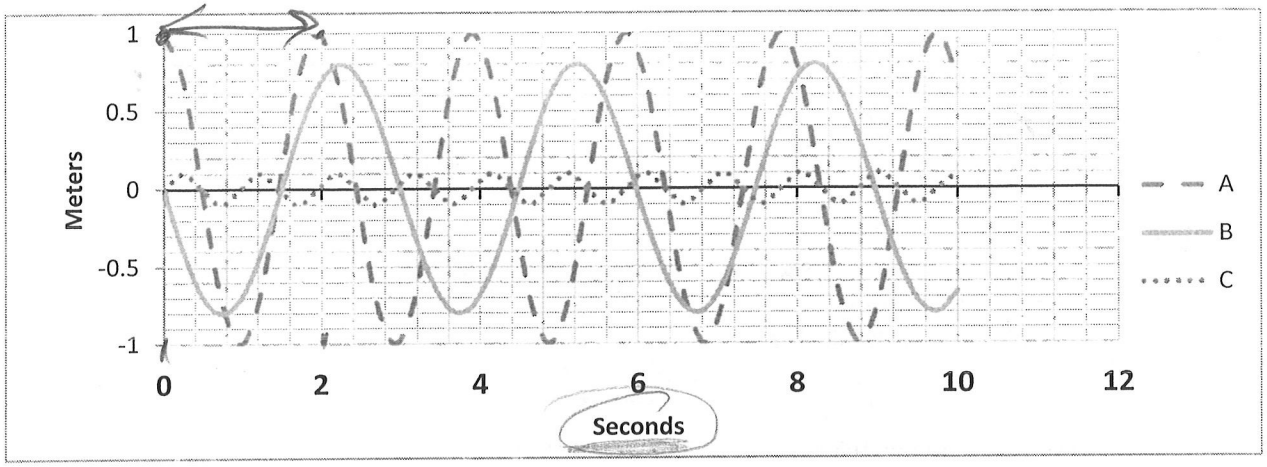
6. Identify each of the following as either a transverse or a longitudinal wave.
   a. A surfer is surfing on this wave. Transverse
   b. A sound wave. Longitudinal
   a. A cowboy sends a wave down the length of a whip. Transverse

7. Fill in the table below with the correct abbreviations and units

Quantity	Abbreviation/Symbol	SI Units
Wave Speed	v	m/s
Frequency	f	hertz (hz)
Wavelength	λ	m
Period	T	s

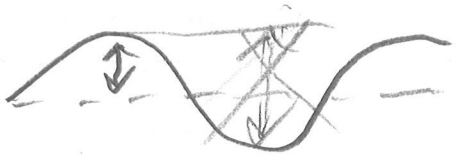
8. Use the graph below to fill in the table on the right.

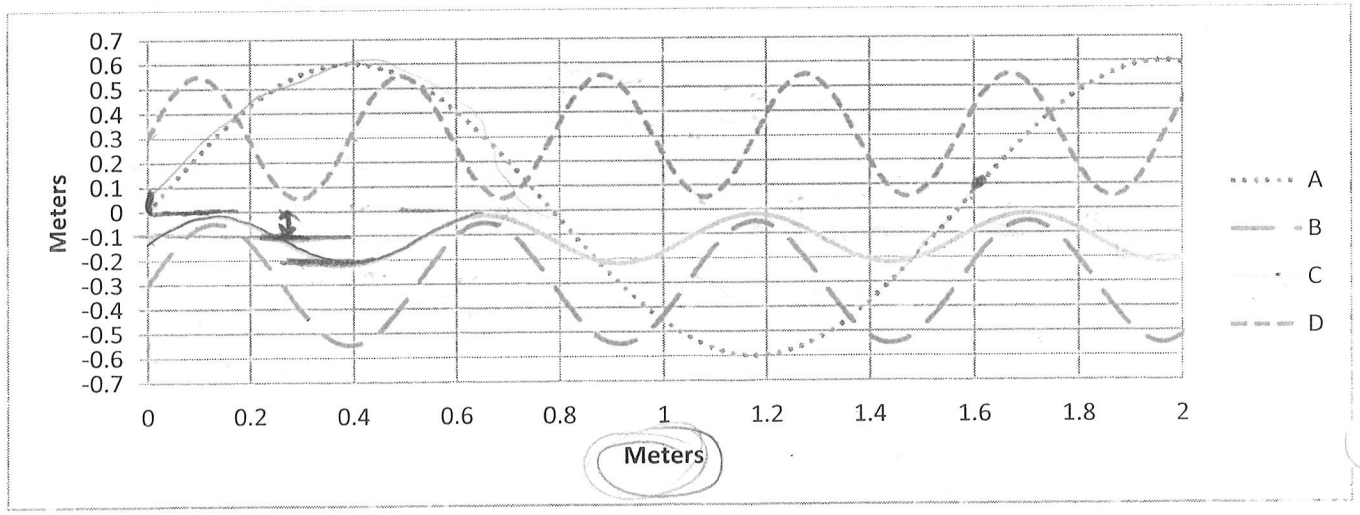
	Period	Frequency
Wave A	2s	0.5 hz
Wave B	3s	0.33 hz
Wave C	1s	1 hz



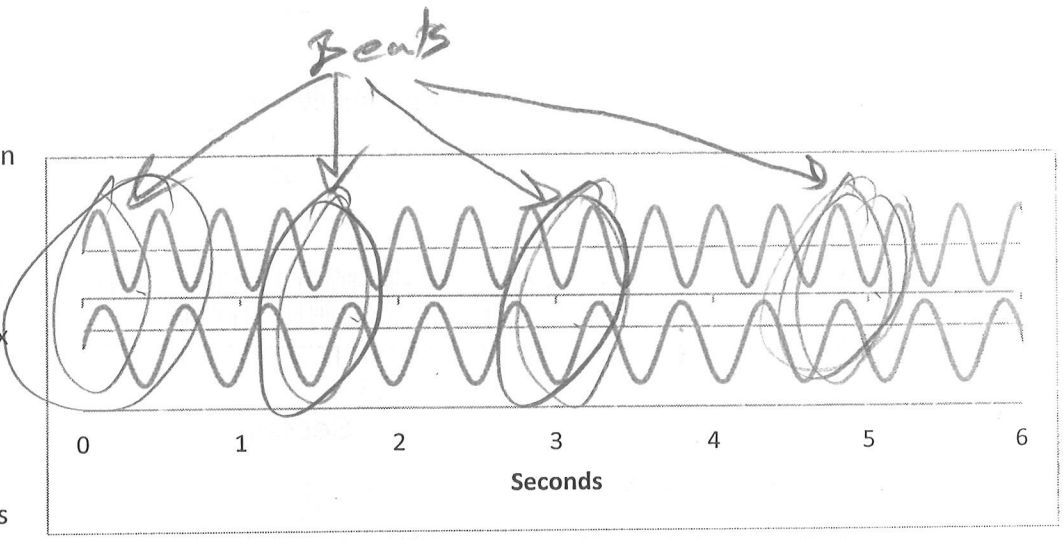
9-17. Answer the following questions using the graph below.

9. Which wave has the longest wavelength? A
10. What is that wavelength? 1.6m
11. Which wave has the shortest wavelength? D
12. What is that wavelength? 0.4m
13. Which wave has the largest amplitude? A
14. What is that amplitude? 0.6m
15. Which wave has the smallest amplitude? C
16. What is that amplitude? 0.1m
17. Which two waves, when added together, will give complete <u>constructive</u> interference? C + D





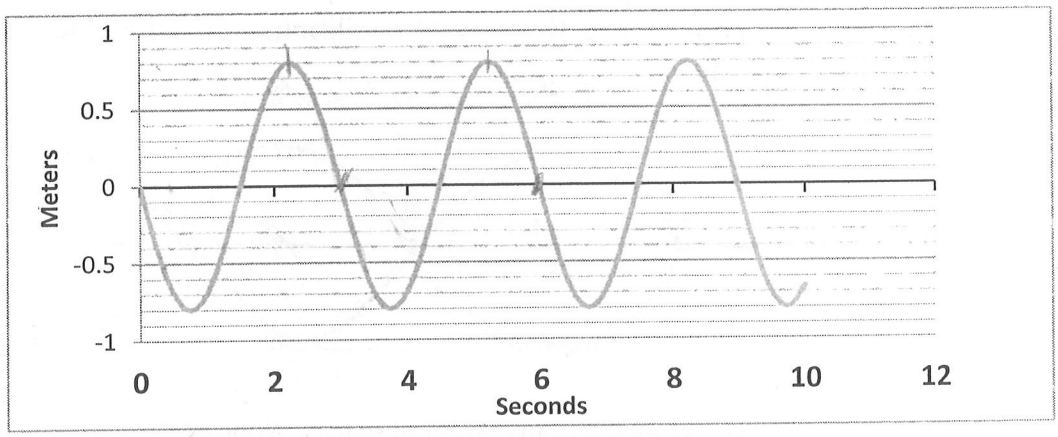
18. When the two waves on the right interact, they will create beats.



a. How many beats occur during the six seconds shown on the graph? 4

b. Show the locations of the beats.

19. Given v = 60 m/s, use the graph on the right to find T, f, A, and λ.



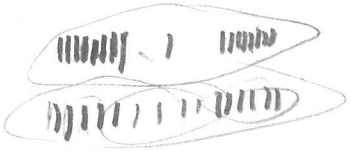
T = 3s

f = 1/3 s = 0.33hz

A = 0.8m

λ = 180m

$\lambda = \frac{v}{f} = \frac{60\,m/s}{0.33\,hz} = 180\,m$



20. Suppose you are listening to some sound waves, and volume suddenly increases. This volume change is caused by a change in the waves':

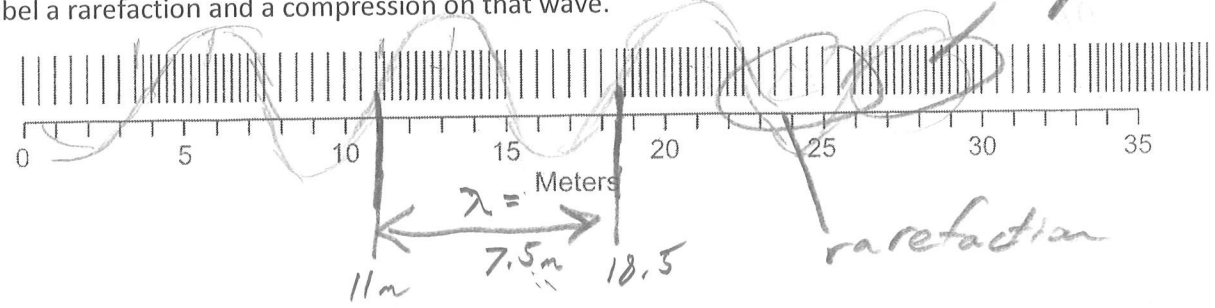
a. Frequency b. period c. amplitude d. wavelength

21. By looking at sets of longitudinal waves, how can you tell which waves have the greatest amplitude?

Greater amplitude = tighter compressions and looser rarefactions

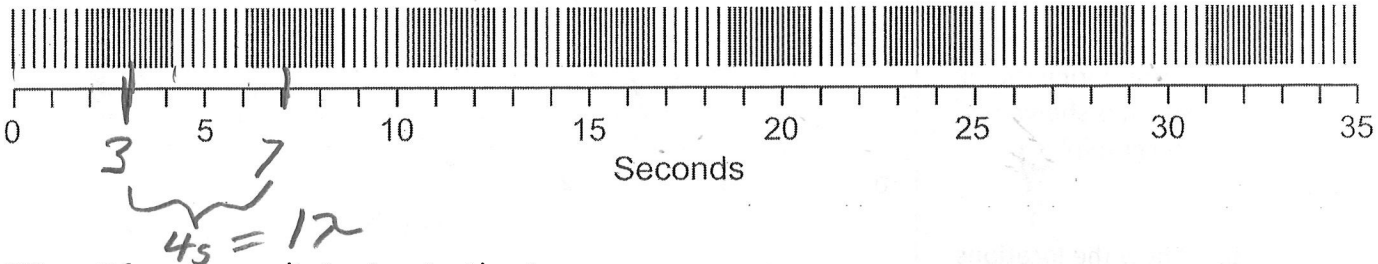
22. What is the wavelength of the longitudinal wave, below? 7.5m

23. Label a rarefaction and a compression on that wave.



24. Find the period and frequency of the longitudinal wave, below.

Period = 4s Frequency = 1/4s = 0.25hz

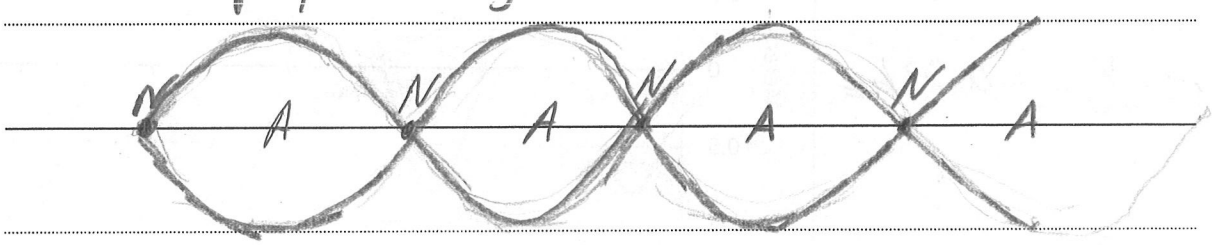


25. If you were listening to the two sound waves on the right, which one would have a higher pitch?

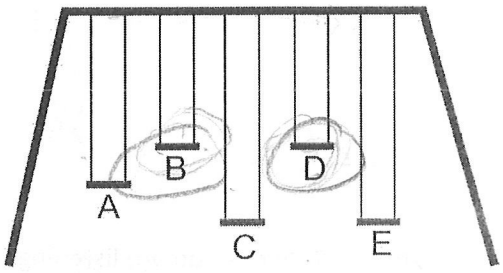
Bottom one → Higer frequency = higher pitch

26. Sketch a standing wave in the space provided below that has 4 antinodes and 4 nodes. The dark line represents the wave's equilibrium position How many wavelengths are present? (3 pts)

1 3/4 wavelengths



27. A school playground has an odd set of swings. None of the children can swing by themselves, and there is only one adult to push.



a. If there are kids sitting on all of the swings, but only the kid on swing D is being pushed, which other child starts to swing? B

b. Explain why. 1 They have the same resonant frequency, 2 so the swinging of D wobbles the swing at the right frequency for B.

(2)

28. Explain how to break a wine glass using sound.

- Hit the glass and listen to its resonant frequency
- Play back (or sing) that same frequency

29. ~~Explain why your method (from the previous question) works.~~

30. You saw lightning flash 21 seconds before you heard the thunder. Exactly how far away was the lightning strike?

$\frac{21}{5} \approx 4$ miles

$d = vt$

$d = 340\ m/s\ (21s) = 7140\ m$

Good Stuff

$d = v \times t$	$v = d \div t$	$t = d \div v$
$v = f \times \lambda$	$f = v \div \lambda$	$\lambda = v \div f$

Speed of sound in air = 340 m/s

Speed of sound in water = 1500 m/s

31. A dolphin finds food by sending a sound pulse through the water and listening for the echo. If the food is 200m away, how long does it take the dolphin to hear the echo?

one way $\Rightarrow t = \frac{d}{v} = \frac{200\ m}{1500\ m/s} = 0.133s$

Round trip $= 2(0.133s)$

$= 0.267s$

32. A bored child is sitting on the dock, looking out at lake Champlain. She notices that 6 waves hit the dock in 12 seconds, and it takes each wave 3 seconds to travel the length of the 12 meter long dock. Find

a. The frequency of the waves.

$f = \frac{\text{Waves}}{\text{Seconds}} = \frac{6\ \text{waves}}{12\ \text{seconds}} = 0.5\ hz$

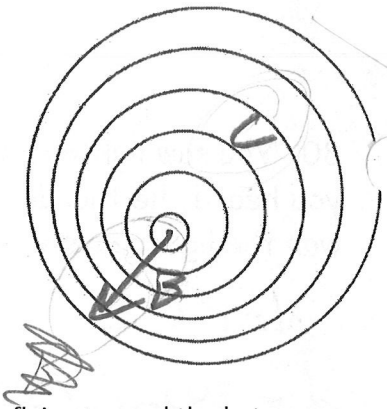
b. The speed of the waves.

$v = \frac{d}{t} = \frac{12\ m}{3s} = 4\ m/s$

c. The wavelength of the waves

$\lambda = \frac{v}{f} = \frac{4\ m/s}{0.5\ hz} = 8\ m$

33. The diagram to the right shows an object moving and giving off sound waves:
   a. Use an arrow to show the object's direction of movement.
   b. Write a "B" in an area where an observer would hear the highest frequency sound.
   c. Write a "C" in an area where an observer would hear the lowest frequency sound.



34. Bats use echolocation to find their prey. How does a bat know if a moth is flying toward the bat or away from the bat?

Pitch of echo gets higher if the moth is going toward the bat.

35. Two moths are flying toward a bat, but one is flying faster. How will the bat know which moth is flying faster?

Higher frequency (and therefore higher pitch) echoes mean faster moth

36. How does a bat know how far away their prey is located?

Listening to how long it takes the echo to return

37. On average the amount of pressure in the atmosphere around us is 14.7 psi.

38. What causes ordinary air pressure?

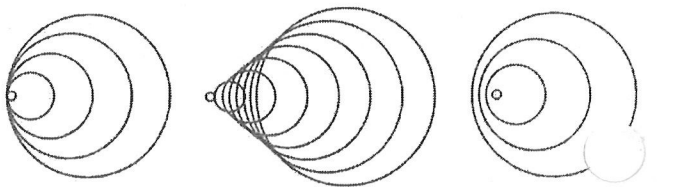
The weight of air above us

39. As sound travels from its source to our ears, the sound wave compressions ~~represent~~ are increases (increases/decreases) in air pressure, and the rarefactions ~~represent~~ are decreases (increases/decreases) in air pressure.

40. Fill in the table below with approximate values:

	Approximate increase in air pressure due to sound waves (psi)	Sound Volume, in decibels
.30-06 rifle fired 1 meter away	1 psi	170 db
Normal Conversation	3×10^{-6} psi $= 0.000003$ psi	60 db

41. The objects on the right are moving and producing sounds. Rank them according to their speed.



B Fastest C Slowest