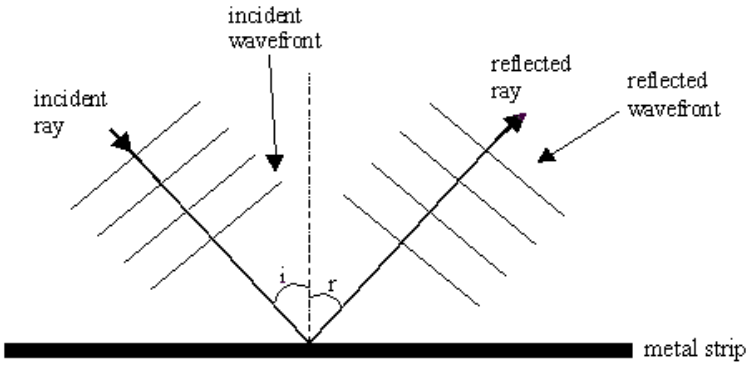
Waves and sounds review answers

1) **Water wave properties**

The diagram on the right represents a water wave reflecting off a barrier.



(a) What is the angle between the wave fronts and the direction of travel of the wave?
90^0.

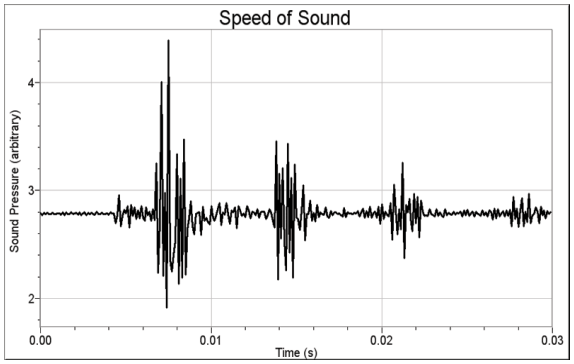
(b) The wave fronts are draw at the crest of each wave. If there is 12cm between the first and last of the group of four wave fronts drawn what is the wavelength of the wave?
4 wave fronts is three wavelength intervals so wavelength = 12cm ÷ 3 waves = 4cm

(c) Why are water waves considered to be transverse waves?
The water particles mostly move up and down while the wave travels past them horizontally so the oscillations are at 90^0 to the direction of the wave.

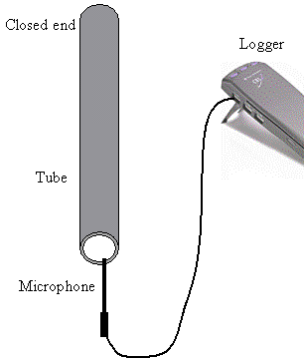
(d) If the height difference between the crest and trough of a wave if 0.8cm what is the amplitude of the wave? **0.4cm (amplitude is height from crest/trough to mid-point.)**

(e) If the waves are travelling at 30 cm/s (0.3 m/s) use your answer to (b) to work out the frequency of the waves: **speed = wavelength x frequency**
➔ 30 = 4 x f ➔ f = 30/4 = 7.5 Hz

2) **Speed of sound**



The graph above shows a microphone recording of a microphone placed at the end of a tube. A sound is made next to the microphone at the open end of the tube. The sound reflects at the ends of the tube.



a) If the tube is 1m long how far has the sound travelled when the microphone receives the first echo? **2m**

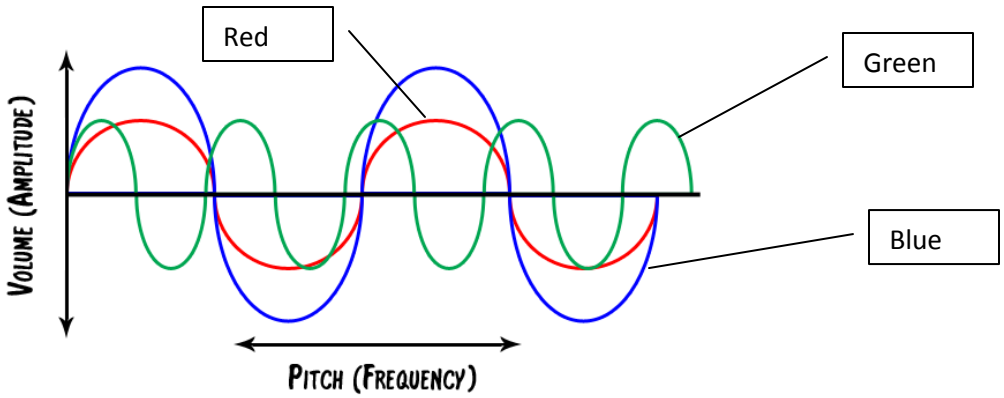
b) How long does the sound take to travel to the end of the tube and back?
First sound is at 0.007s and first echo is received after 0.013s so time = 0.006s (your answer should be close to this 0.005-0.007s)

c) What is the speed of sound in the tube? **speed = distance ÷ time = 2 ÷ 0.006 = 330 m/s**

d) Sound waves are longitudinal. What does this mean? **The air particles oscillate parallel to the direction the sound wave is travelling.**

e) If the sound wave has a frequency of 1000Hz what is its wavelength?
speed = wavelength x frequency ➔ 330 = λ x 1000 ➔ λ = 330/1000 = 0.33m

3) Sound wave properties



The diagram above shows a sound wave traces recorded on an oscilloscope using a microphone. Which trace is from the sound which is:

a) The loudest? **BLUE** b) The highest pitch? **GREEN**

c) Compare the green and the red recordings in terms of frequency, time period and amplitude.

The green trace is from a sound of higher frequency, smaller time period (it takes less time to vibrate) and smaller amplitude).

d) The trace from most musical instruments, for example a guitar, will be different from the traces above. Explain the differences.

The traces above show a pure waveform of one frequency. A guitar note will be a more complex waveform as it would contain harmonics / overtones / multiple wave frequencies.

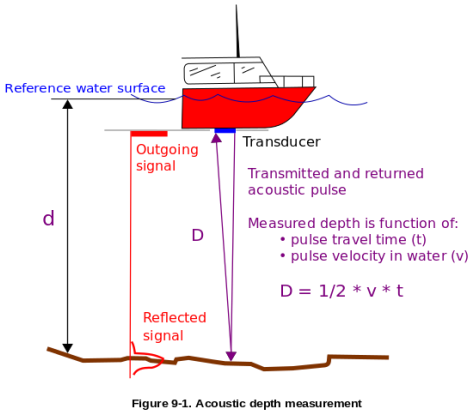


Figure 9-1. Acoustic depth measurement

4) Echo location

The speed of sound in water is about 1450m/s. The ship uses echo-sounding. The echo of an acoustic pulse takes three seconds to travel from the ship to the sea bed and back.

a) How deep below the echo sounder if the sea bed?

1450m/s x 1.5s = 2175m

b) If the boat is a fishing boat explain how sonar might be used to detect a school of fish?

The sonar equipment will detect a partial reflection of the pulse from the fish and use the timings to calculate how deep the fish are.

Sources:
http://www.themeandvariations.org/Images/other/soundwave.png
http://www.engineeringtoolbox.com/sound-speed-water-d_598.html
http://en.wikipedia.org/wiki/Echo_sounding
http://www.animatedscience.co.uk
http://www.vernier.com/innovate/speed-of-sound-in-a-snap/