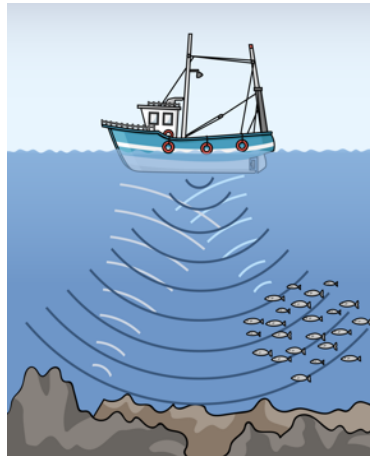
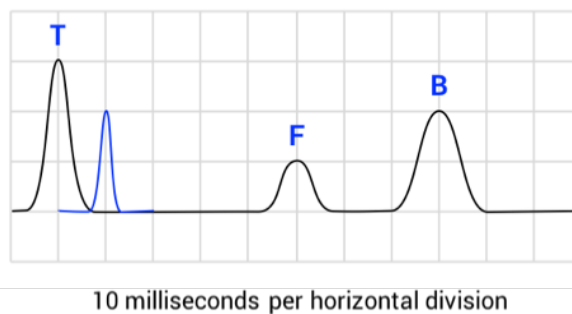


0	1
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A fishing boat is using sonar to locate a shoal of fish.



Two reflected pulses are received for each transmitted pulse, as shown on the below oscilloscope trace.



0	1	.	1
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On the above trace, label the transmitted pulse **T**, the pulse reflected from the fish **F**, and the pulse reflected from the sea bed **B**.

0	1	.	2
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Calculate the distance of the shoal of fish from the boat.  
The speed of sound in water is 1500 m/s.

Total time between sending and receiving of pulse:

$$T = 5 \times 0.01 = 0.05 \text{ seconds}$$

Time take for pulse to travel from boat to fish,  $t = 0.025 \text{ seconds}$

$$\text{Answer, } s = v t = 1500 \times 0.025 = \underline{\underline{37.5 \text{ m}}}$$

0	1	.	3
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Safety guidelines state that the boat should not travel through water which is less than 7.5 m deep. **Calculate** the amount of time between the sending and receiving of a pulse which is reflected from the sea bed in water of this depth, then **sketch** the position of such a pulse on the above trace.

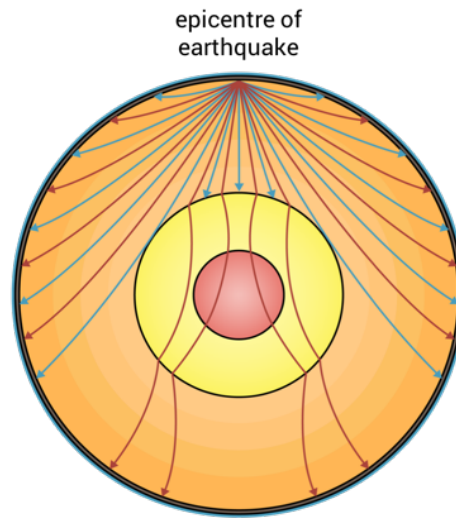
$$\text{Total distance travelled by pulse} = 2 \times 7.5 = 15 \text{ m}$$

$$t = s \div v = 15 \div 1500 = 0.01 \text{ seconds} = 10 \text{ milliseconds}$$

(equivalent to one horizontal square on the above trace, as shown)

0 2

The below diagram shows the path of P-waves through the mantle and the outer and inner cores following an earthquake.



0 2 . 1

P-waves are longitudinal waves. Explain the meaning of the term *longitudinal wave*.

The oscillations / vibrations in a longitudinal wave are parallel to [1] the direction of motion of the wave / the direction in which the wave is travelling [1].

0 2 . 2

S-waves, which are transverse waves, are also produced in an earthquake. Besides the fact that one is longitudinal and one is transverse, write down one other difference between these two types of seismic waves.

S-waves can only travel through solids, but P-waves can travel through both solids and liquids.

0 2 . 3

On the above diagram, sketch the path through the centre of the Earth of the S-waves produced at and near the epicentre of the earthquake.

As shown above in blue.

0 2 . 4

Describe and explain the path taken by P-waves in the above diagram as they travel *from* the mantle *into* the outer core.

When P-waves travel *from* the mantle *into* the outer core, they refract *towards* the normal [1]. This is because they travel more slowly in the outer core (which is liquid) than in the mantle (which is solid) [1].