(a) **∴ The reason why the reflected pulse is smaller in amplitude than the original pulse is**

the body of sea is a great absorber of energy. As the original pulse travels through water, a good part of the pulse energy is absorbed by water, schools of fish and seabed or scattered to other directions. By the time the reflected pulse returns, the total energy contained in the pulse is greatly reduced. As the pulse energy is manifested as amplitude of the pulse, pulse of a smaller amplitude is detected. **(ans)** [1]

☺ **Exam Report**

Some candidates suggested the answer as:

"*Part of the wave is absorbed … hence, the reflected pulse is smaller in amplitude than the original pulse.*" or "*Some of the sound energy is absorbed by the seabed. There is also attenuation of sound as it travels in water.*"

OR

"*Reflection by a school of fish occurs.*"

"*Energy is lost when the pulse hits the seabed.*"

These answers were not credited.

After part of the wave is absorbed, it cannot miraculously appears as pulse of a smaller amplitude. After part of the wave, it could manifest itself as a pulse of narrower width, but of the same amplitude.

It was therefore a requirement for the answer to state that energy of the pulse is manifested as amplitude of the wave. With the absorption of energy, a reflected pulse of smaller amplitude is detected.

(b) The speed of ultrasound in water is 1500 ms^{-1}.

(i) ∴ Let t s be the time taken for the pulse to travel from the ship to the sea bed.

Number of intervals on c.r.o. = 6 intervals of 100 ms

Time taken for the pulse to travel from the ship to the sea bed and double back

$= 6 \times 100 \text{ ms} = 600 \text{ ms} = 0.60 \text{ s}$

∴ The time taken for the pulse to travel from the ship to the sea bed,

$t = 0.60 \div 2$

$= 0.30$ s (2sf) **(ans)** [1]

☺ **Exam Report**

Some candidates suggested the answer as 0.3 s (1sf).

These answers were not credited in full.

Candidates were expected to apply correct number of significant figures to the answer.

(i) ∴ Let d m be the distance from the ship to the sea bed.

Recall,

Distance travelled = speed × time taken

$2 \times d = 1500 \text{ m s}^{-1} \times 0.30 \text{ s} = 450 \text{ m}$

∴ The distance from the ship to the sea bed,

$d = 450 \text{ m} \div 2 = 225 \text{ m}$

$= 230$ m (2sf) **(ans)** [2]

☺ **CheckBack**

If the answer is 225 m (230 m),

The sound would need to travel double the distance

$= 225 \text{ m} \times 2 = 450 \text{ m}$

∴ Speed of sound = distance travelled ÷ time taken

$= 450 \text{ m} \div 0.3 \text{ s}$

$= 1500 \text{ ms}^{-1}$ (as before) **(checked)**

☺ **Exam Report**

More than half of the candidates suggested the answer as 450 m.

These answers were not credited.

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