O Level Combined Physics Structured

Sound Test 1.0

Q1

(a) A student goes for a walk along Bukit Timah hill. During a storm, she sees lightning above the top of the hill. Several seconds later, she hears the thunder caused by the lightning.

(i) Explain why she hears the thunder several seconds after she sees the lightning.

.....

.....[1]

(ii) Explain how sound is transmitted through air.

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.....[2]

Q2

A siren is located at some distance from a large building, as shown in **Fig. 8.1.**

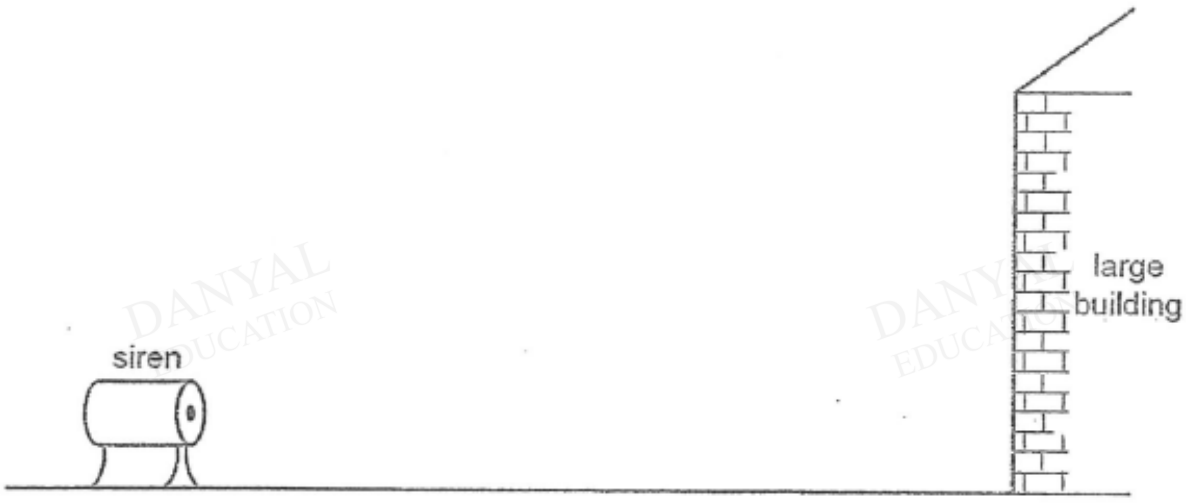

Fig. 8.1.

The siren is sounded once briefly. A short while later, an observer standing near the siren hears the sound again.

(a) (i) Describe why the second sound is heard by the observer. [1]

.....

.....

.....

(ii) Given that the speed of sound in air is 330 m/s and that the second sound is heard 1.6 s later, calculate the distance between the siren and the large building.

distance = _____ m [2]

(b) A microphone connected near the siren picks up the following signal when the siren was first sounded.

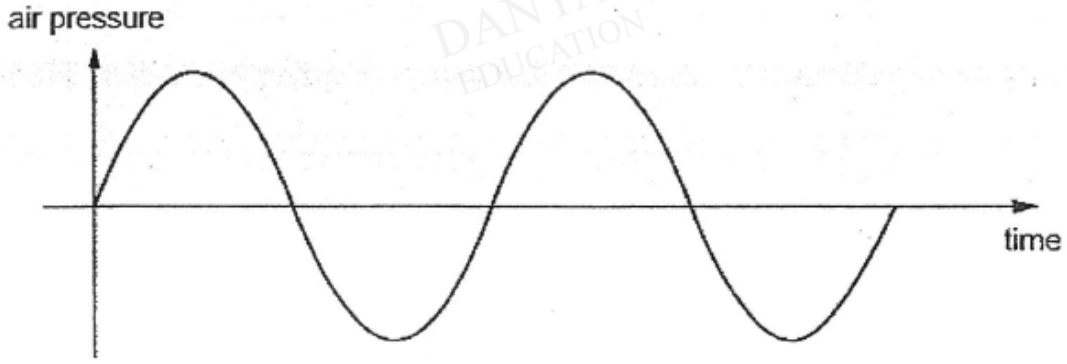

Fig. 8.2

(i) On **Fig. 8.2**, draw how the signal for the second sound would look like. [1]

(ii) Explain the difference(s) in the signal for the second sound that you have drawn in (b)(i). [2]

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Q3

Fig 12.1 shows an electric bell. When the switch is pushed down, the striker will hit the bell repeatedly.

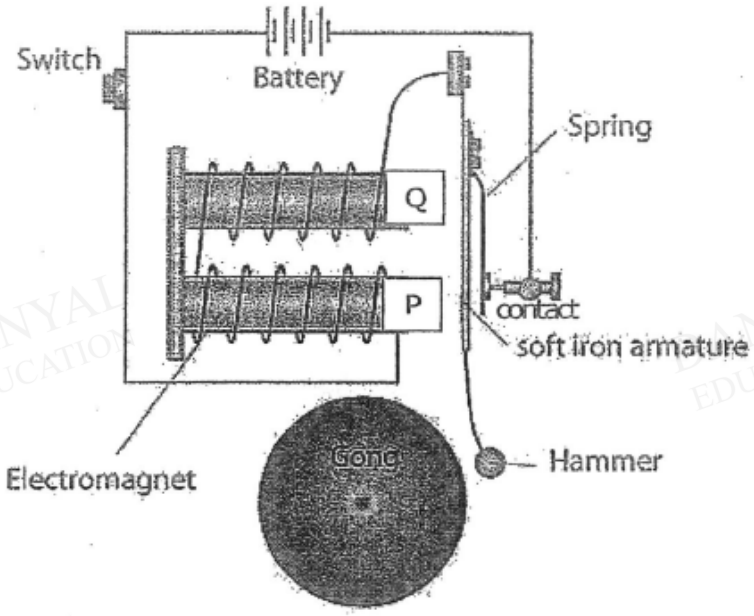

Fig 12.1

(c) Describe how longitudinal sound waves from the bell is propagated through the air.

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..... [2]

Q4

(b) Fig. 12.1 shows the top view of a large hall, 100 m long, which has sound-absorbent sidewalls and a smooth hard wall at each end.

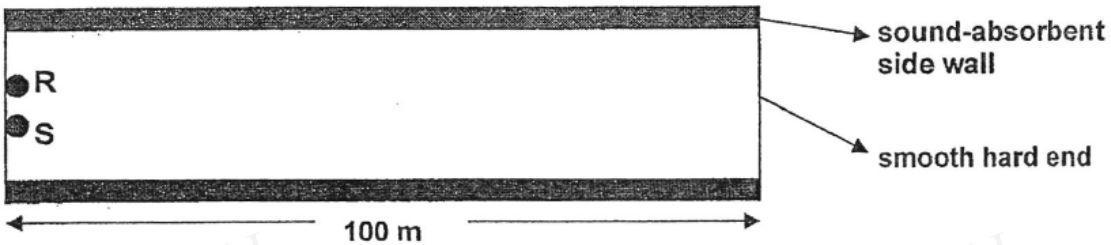


Fig. 12.1

A source of sound at S emits a short single blast.

(i) Explain the observation that "***several echoes of decreasing loudness*** are heard by an observer at R".

.....

.....

.....[2]

(ii) By expressing your answers in 2 decimal places, calculate the time it takes for the **first** and **second echoes** to be heard at R respectively, given that the speed of sound in air is 340 ms^{-1}.

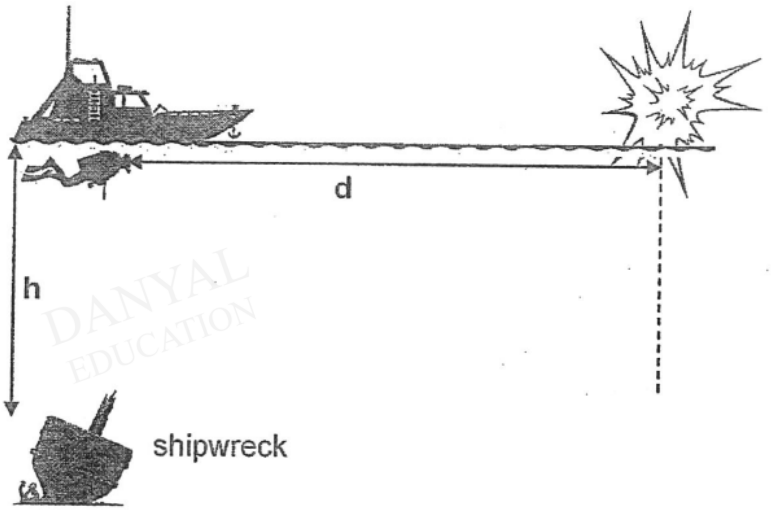
time for 1st echo = ...

time for 2nd echo = ...

[3]

Q5

In a marine rescue, a boat of divers found part of a ship wreck underwater using a sonar. One of them then went underwater to search for survivors in the ship wreck. Assume speed of sound in air to be 330 m/s and speed of sound in water to be 1500 m/s.



a) Calculate the depth **h**, of the ship wreck, if it took 0.08 s for the sonar to receive the reflected pulse from the ship wreck. [2]

depth = ... m

b) When the diver was just underwater, he heard a loud bang from an explosion at the surface of the sea which occurred at a distance **d** away. He reported this to his partner who was staying on board the boat but his partner did not hear the loud bang until 6 seconds later.

i) Explain why there was a time lag between their observations. [1]

.....

.....

ii) Find the distance, **d** they are away from the explosion. [2]

distance = ... m

Answers

Sound Test 1.0

Q1

(a)(i) The speed of sound is slower than the speed of light. B1

(ii) The air particles move through a series of compressions and rarefactions
Or the air particles move parallel to the direction that the sound wave travels. B1
The sound energy is passed as the air particles collide with each other. B1

Q2

(a) (i) Describe why the second sound is heard by the observer. [1]

The sound wave was reflected off the large building back to the position of the siren, the second sound heard is the echo. [B1]

(ii) Given that the speed of sound in air is 330 m/s and that the second sound is heard 1.6 s later, calculate the distance between the siren and the large building.

speed = distance / time
330 = (distance x 2) / 1.6 [M1]
distance = $\frac{330 \times 1.6}{2}$ = **264 m** [A1]

distance = _____ m [2]

(b) A microphone connected near the siren picks up the following signal when the siren was first sounded.

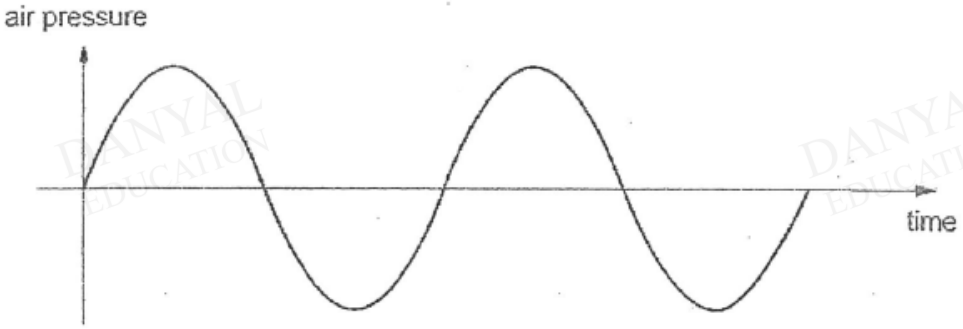
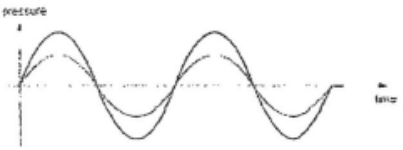


Fig. 8.2

(i) On Fig. 8.2, draw how the signal for the second sound would look like. [1]



[B1]
- Smaller applitude
- Same period

(ii) Explain the difference(s) in the signal for the second sound that you have drawn in (b)(i). [2]

The second sound would be softer, as some energy is transferred to the surrounding. As such, the **amplitude of the sound wave is smaller as the sound is softer** [B1]. There should be **no change to the frequency / period** [B1] of the sound as the pitch remains unchanged

Note: students must explain in terms of the signal / graph

Q3

c)	Bell vibrates Air molecules push and pull on each other to set up a series of compressions and rarefactions	1 1

Q4

bi Several echoes: due to repeated reflections of sound from the walls at both ends.
Decreasing loudness: part of the sound energy is absorbed by / lost to the sound absorbent walls.

bii 1st echo

time = 2x distance/time (t = 2d/v or 2s/v)
= (2x100) /340
= 0.588 s = 0.59 s

2nd echo

time = distance/time
= (4x100) /340
= 1.176 s = 1.18 s

Both answer in 2 d.p.

Q5

a) $v = 2d/t \Rightarrow 1500 = 2h / 0.08$ [1] $\Rightarrow h = 60$m

b) i) Sound wave travel faster through water and the diver in water will hear the bang first.

ii) $t_{air} - t_{water} = 6$ s

$(d / 330) - (d/1500) = 6$ s [1] $\Rightarrow d\,(1/330 - 1/1500) = 6 \Rightarrow d = 2540$ m [1]