Do not write outside the box

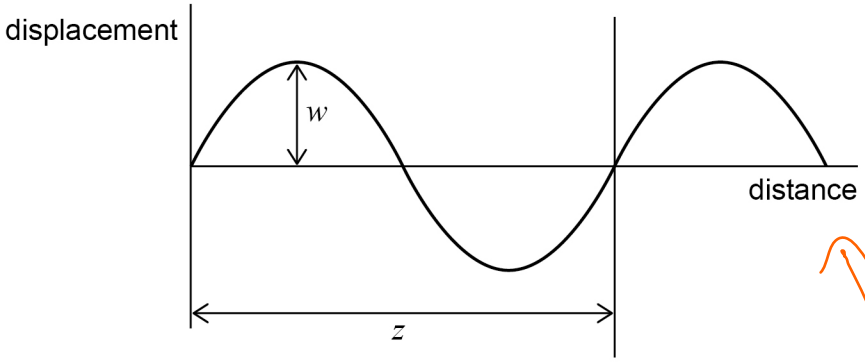
1 4 A monochromatic light wave travels from glass into air.

Which row shows what happens to the wavelength, speed and photon energy?

[1 mark]

	Wavelength	Speed	Photon energy	
A	increases	increases	increases	⬭
B	does not change	decreases	does not change	⬭
C	does not change	decreases	increases	⬭
D	increases	increases	does not change	⬭

1 5 A wave travels across the surface of water.
The diagram shows how the displacement of water particles at the surface varies with distance.



not time

Which row correctly describes both w and z?

[1 mark]

	w	z	
A	amplitude	wavelength	⬭
B	half-amplitude	period	⬭
C	half-amplitude	wavelength	⬭
D	amplitude	period	⬭

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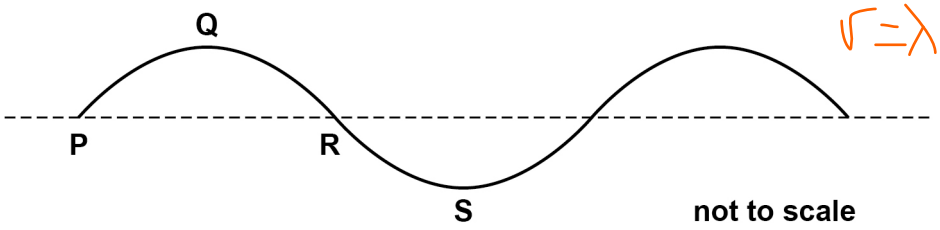
1 6 The diagram shows the cross-section of a progressive transverse wave travelling at $24\ \text{cm s}^{-1}$ on water. The amplitude of the wave is $2.0\ \text{cm}$ and the frequency is $4.0\ \text{Hz}$.



$v = f\lambda$

$\lambda = \frac{0.24}{4}$

$= 0.06$

Which statement is correct?

[1 mark]

A The phase difference between particles at **P** and **S** is $\frac{\pi}{2}\ \text{rad}$. ⬭

B The distance between **P** and **R** is $6.0\ \text{cm}$. ⬭

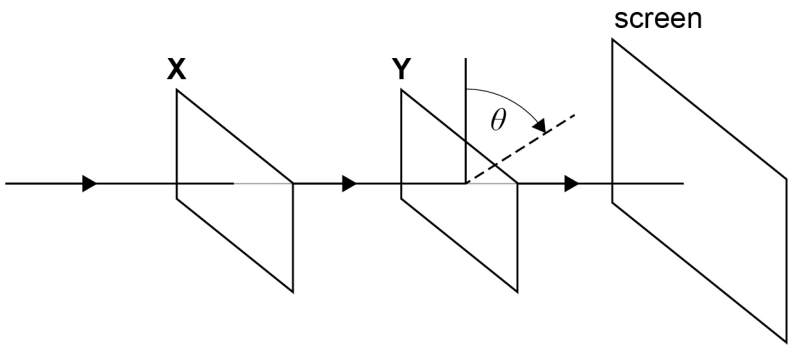
C The particle velocity at **Q** is a maximum. ⬭

D Particles at **P** and **R** are in phase. ⬭

you could also the phase difference of these two points are 3pi/2 - if you just consider the points at P and S then the question is which one is in front - and it is 'both' depending how you look at it

Do not write outside the box

1 7 Unpolarised light travels through two polarising filters **X** and **Y** and is then incident on a screen. When **X** and **Y** are arranged as shown, there is a maximum intensity on the screen.
X is held stationary but **Y** is rotated in a plane at right angles to the beam so that θ increases.



What are the next three values of θ, in rad, for which the beam hits the screen with maximum intensity?

[1 mark]

180, 360, 540
π 2π 3π

A $\frac{\pi}{2}, \frac{2\pi}{2}, \frac{3\pi}{2}$ ⬭

B $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}$ ⬭

C $\pi, 2\pi, 3\pi$ ⬭

D $2\pi, 4\pi, 6\pi$ ⬭

1 8 Stationary waves are set up on a rope of length 1.0 m fixed at both ends.

Which statement is **not** correct?

[1 mark]

A The first harmonic has a wavelength of 2.0 m. ⬭

B The midpoint of the rope is always stationary for even-numbered harmonics. ⬭

C A harmonic of wavelength 0.4 m can be set up on the rope. ⬭

D There are five nodes on the rope for the fifth harmonic. ⬭

1 of 2

Turn over ►

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1 9 Monochromatic light is incident normally on a diffraction grating that has 4.50×10^5 lines m^{-1}.

The angle between the second-order diffraction maxima is 44°.

What is the wavelength of the light?

so $\theta = 22°$

[1 mark]

A 208 nm ○

B 416 nm ○

C 772 nm ○

D 832 nm ○

$n\lambda = d \sin\theta$

$\lambda = \frac{d \sin\theta}{n}$

$d = \frac{1}{4.5 \times 10^5}$

$= \frac{1}{4.5 \times 10^5} \frac{\sin(22)}{2}$

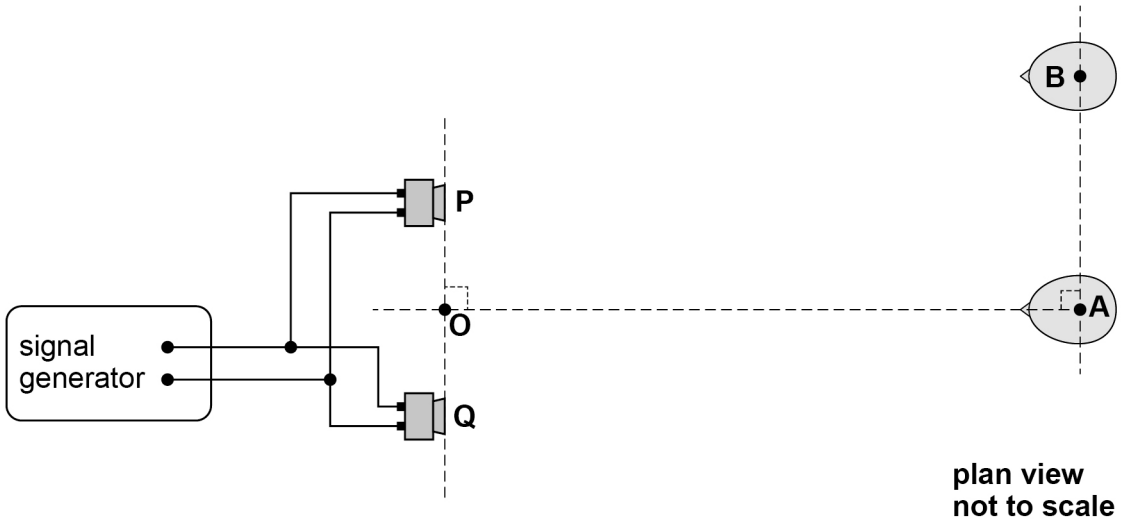
$\lambda = 4.16 \times 10^{-7}$ m

Do not write outside the box

0 3 A student investigates the interference of sound waves using two loudspeakers, **P** and **Q**, connected to a signal generator (oscillator). Each loudspeaker acts as a point source of sound.

Figure 3 shows the arrangement.

Figure 3



plan view
not to scale

Point **O** is the midpoint between **P** and **Q**.

0 3 . 1 Explain why the two loudspeakers are coherent sources of sound waves.

[2 marks]

coherent means same freq, constant phase difference. Both loudspeakers are connected to the same signal generator so will have the same freq. The will also have a contant phase difference because the cables connecting the speakers to the signal generator are not altered. (ie the cables' length doesn't change)

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0 3 . 2 The student faces the two loudspeakers at point **A**. Point **A** is at equal distances from **P** and **Q**.
He then moves to point **B**, at right angles to the line **OA**, still facing the two loudspeakers.
As his head moves from **A** to **B** the amplitude of the sound wave he hears decreases and then increases. The amplitude starts to decrease again as he moves beyond **B**.

Explain why the variation in amplitude occurs as he moves from **A** to **B**.

[3 marks]

the sound waves superpose
at A (and B) the sound waves are in phase and therefore have zero phase difference and so interfere costructively
As yoiu move away from A so the phase difference increases until half way between the phase difference is 180 degrees and so they interfere destructively and a minumum is produced where the sound is zero (or more likely quiet and not quite zero)

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 The student records the following data:

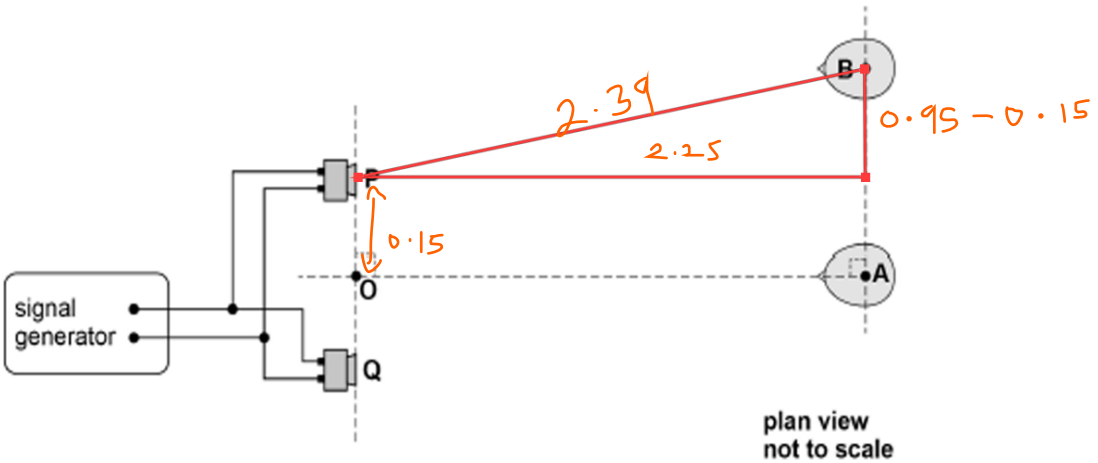
separation of the two loudspeakers = 0.30 m
distance **OA** = 2.25 m
distance from **A** to **B** = 0.95 m

Show that the path difference for the sound waves from the two loudspeakers to point **B** is about 0.1 m.

use pythagoras

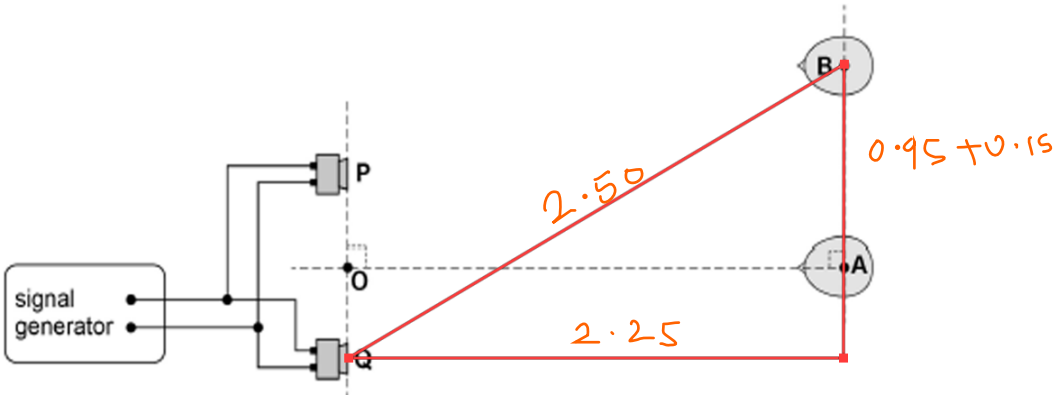
[3 marks]

Figure 3



plan view
not to scale

Figure 3



Path difference = QB − PB

= 2.50 − 2.39

= 0.11 m

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0 3 . 4 The frequency of the sound wave is 2960 Hz.

Calculate the speed of sound from the student's data.

[1 mark]

p.d. A→B = 1λ ∴ λ = 0.11m

∴ $c = f\lambda$ = 2960 × 0.11

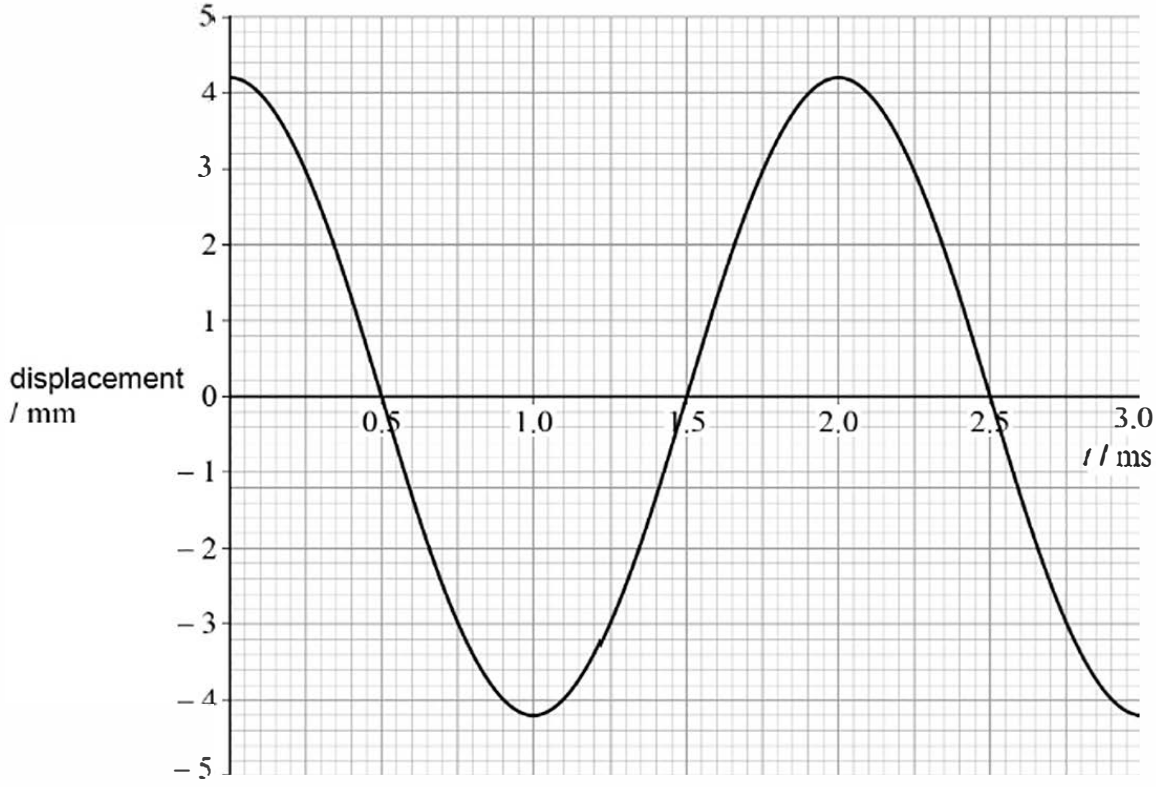
= 326 = 330 (2sf)

speed of sound = _____ $m\ s^{-1}$

Do not write outside the box

0 6 A loudspeaker cone is driven by a signal generator (oscillator).
Figure 8 shows the variation of displacement with time t for a point **P** at the centre of the cone. **P** is oscillating with simple harmonic motion.

Figure 8



0 6 . 1 State the time, in milliseconds, when **P** is moving at its maximum positive velocity.
[1 mark]

time = 1.5 ms

0 6 . 2 Calculate the maximum acceleration of **P**.
[3 marks]

$a_m = \omega^2 A \leftarrow 4.2\times10^{-3}$

$\omega = \frac{2\pi}{T} \Rightarrow a_{max} = \left(\frac{2\pi}{2\times10^{-3}}\right)^2 \times 4.2\times10^{-3}$

4.1×10^{4}

acceleration = _____ m s^{-2}

Question 6 continues on the next page

Turn over ▶

Do not write outside the box

0 6 . 3 The loudspeaker creates variations in pressure and produces a sound wave in the air around it.

State the type of wave produced and describe the motion of the particles in this type of wave.

[1 mark]

Longitudinal. Particles vibrate along the direction of energy transfer

5