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4.3 Wave Characteristics

Hard

PHYSICS

IB HL

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4.3 Wave Characteristics

Question Paper

Course	DP IB Physics
Section	4. Waves
Topic	4.3 Wave Characteristics
Difficulty	Hard

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Time allowed: 20

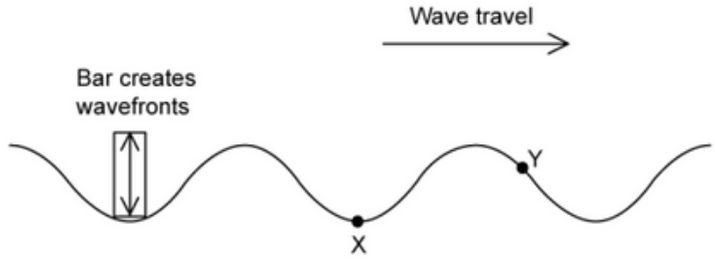
Score: /10

Percentage: /100

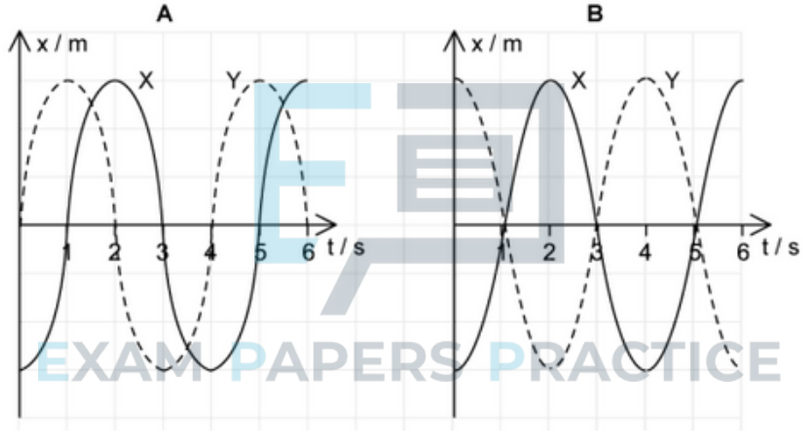
Question 1

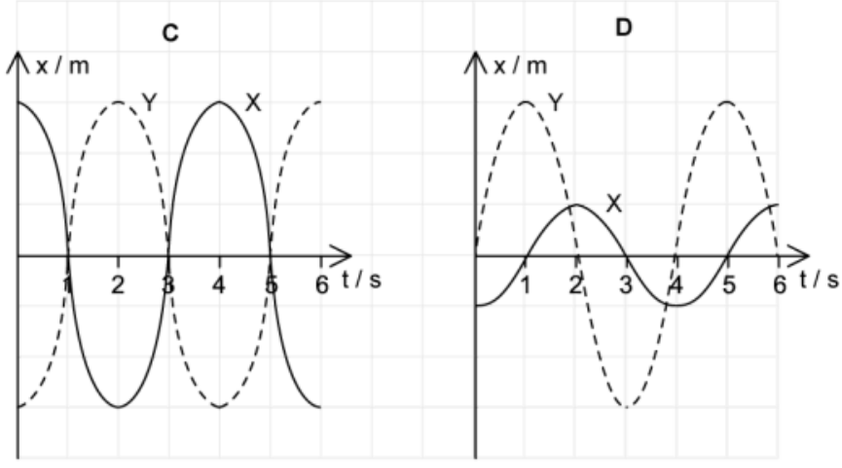
A ripple tank is used to demonstrate the movement of progressive waves. In the tank, a wave is set in motion from left to right.

The wave is shown at time t = 0. Points X and Y on the wave have been marked.



Which option correctly shows the displacement-time graphs for both X and Y?





[1 mark]

Question 2

Two polarisers have polarising axes that make an angle of 30° to each other. Unpolarised light of intensity I_0 is incident on the first polariser. Light of intensity I_1 passes between the first and second polarisers. After passing through the second polariser, light of intensity I_2 emerges.

$$\sin(30) = \frac{1}{2}$$

$$\cos(30) = \frac{\sqrt{3}}{2}$$

$$\tan(30) = \frac{\sqrt{3}}{3}$$

Considering the trigonometric ratios above, which line in the table correctly identifies the ratio $\frac{I_0}{I_1}$ and $\frac{I_0}{I_2}$?

	$\frac{I_0}{I_1}$	$\frac{I_0}{I_2}$
A.	$\frac{1}{2}$	$\frac{3}{4}$
B.	$\frac{1}{2}$	$\frac{3}{8}$
C.	$\frac{3}{4}$	$\frac{3}{8}$
D.	$\frac{3}{4}$	$\frac{3}{4}$

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[1 mark]

Question 3

Two microwave transmitters are arranged to ensure that their waves undergo superposition and create a stationary wave made up of nodes and antinodes.

Which line correctly identifies the formula and a likely value for the minimum distance between the nodes of the stationary wave?

	formula	distance /cm
A.	$\frac{c}{f}$	30
B.	$\frac{c}{f}$	0.05
C.	$\frac{c}{2f}$	30
D.	$\frac{c}{2f}$	0.05

[1 mark]

Question 4

Two pulses are travelling towards each other.

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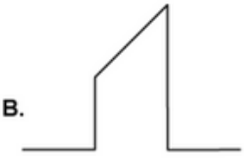
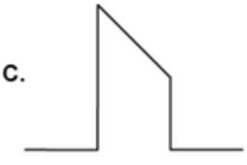
What is a possible shape observed when the pulses undergo superposition?

A.

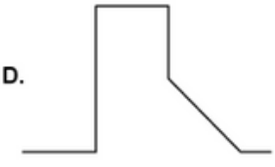
B.



C.



D.



[1 mark]

Question 5

Two wave fronts, each having amplitude A, travel towards each other, superpose, and continue with their motion.

What is the total amplitude during superposition and then the individual amplitudes following it?

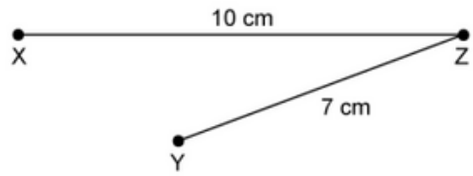
	total amplitude during superposition	individual amplitudes following superposition
A.	A	A
B.	2A	< A
C.	2A	A
D.	4A	> A

[1 mark]

Question 6

Two waves which are in phase are produced by point sources at X and Y. The waves have amplitude A when they pass position Z.

In the arrangement shown, if the wavelength of the waves is 2 cm, what is the amplitude of the oscillation seen at Z?



A. 0

B. A

C. $2A$

D. A^2

[1 mark]

Question 7

A signal generator emits sound waves of amplitude *A*. The sound intensity at a distance *d* from the source is *I*.

What is the correct sound intensity detected at a distance $\frac{d}{3}$ from the source when the source emits waves of amplitude 3*A*?

A. $\frac{1}{81}I$

B. $\frac{1}{9}I$

C. $9I$

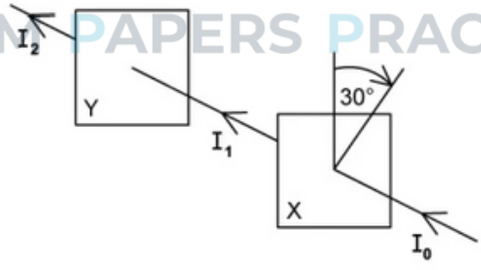
D. $81I$

[1 mark]

Question 8

A beam of unpolarised light, I_0, is incident on a polarising filter X. The filter has been set up so that its transmission axis is parallel to that of a second filter Y.

Filter X is rotated by an angle which is approximately 30°.



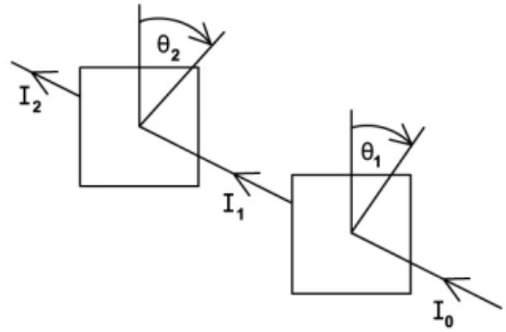
Which line correctly describes beam I_2 being emitted from filter Y?

	polarisation	intensity
A.	no change	different
B.	different	different
C.	no change	no change
D.	different	no change

[1 mark]

Question 9

Unpolarised light of intensity I_0 is incident on the first of two polarising sheets. Initially the transmission axes are parallel.



Which sheet must be rotated and by what angle so that light of intensity $\frac{1}{4}I_0$ emerges from the second sheet?

You may use the fact that

$$\cos 45 = \frac{\sqrt{2}}{2}$$

$$\cos 60 = \frac{1}{2}$$

$$\cos 90 = 0$$

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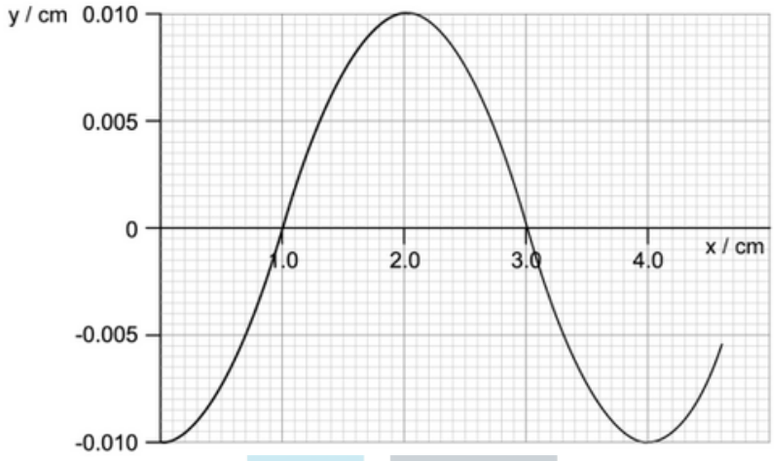
	sheet	angle of rotation
A.	1 only	$\cos^{-1}\frac{2}{\sqrt{2}}$
B.	1 and 2	$\cos^{-1}\frac{\sqrt{2}}{2}$
C.	1 or 2	$\cos^{-1}\frac{\sqrt{2}}{2}$
D.	2 only	$\cos^{-1}\frac{1}{2}$

[1 mark]

Question 10

The graph shows the displacement y, with distance x, of air molecules vibrating due to a sound wave of frequency 261 Hz travelling to the right.

Positive values of y indicate displacement of the particles to the right.



Which row correctly shows the positions of a compression (C) and rarefaction (R) at the moment shown and then 3.8×10^{-3} seconds later?

	0.0 seconds		3.8×10^{-3} seconds	
	C / cm	R / cm	C / cm	R / cm
A.	0.0	1.0	0.0	1.0
B.	1.0	2.0	2.0	3.0
C.	3.0	1.0	3.0	1.0
D.	3.0	1.0	4.0	2.0

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