This is a Class 1 exam

Lebanon Evangelical School for Boys and Girls

Loueizeh - Baabda

SE01 Exam

10NOV2025

Do NOT write in this box. Your MARK will be placed here.

Subject :	Physics
Class :	11S1 and 11S2
Teacher :	Krikor Bazarbashian
Duration :	1 hour

Show your work clearly by including all important steps of calculations.
Be careful with your vector notations.
Do NOT change the notation given by the exercise. (Example: if the mass is given as upper case (M), do NOT use lower case (m).)
Do NOT abbrevia

You are to answer the questions to this exam on : Squared paper

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Exercise 1: **(3 points)**

A standing wave is established in a string fixed at both ends. The distance between the second node and the fifth antinode is $\mathbf{7}\ \boldsymbol{cm}$.

a) Determine the wavelength $\boldsymbol{\lambda}$ of the standing wave.

b) A point $\boldsymbol{A}$ is at a distance of $\mathbf{4.5}\ \boldsymbol{cm}$ from a node. Specify whether $\boldsymbol{A}$ is a node, an antinode, or neither a node nor an antinode.

c) The string has a length of $\mathbf{12}\ \boldsymbol{cm}$, calculate the number of points which are at rest and those which vibrate with maximum amplitude.

Exercise 2: **(4 points)**

Two spherical dippers S_1 and S_2 vibrate at a frequency $\boldsymbol{f = 10\ Hz}$ on the surface of water in a ripple tank. The dippers are $\mathbf{14.5}\ \boldsymbol{cm}$ apart. The waves propagate on the surface of water at $40\ cm/s$.
Consider a point A on the segment $[\boldsymbol{S_1S_2}]$ so that $\boldsymbol{AS_1 = 10.5\ cm}$.

a) Determine the total number of fringes between S_1 and S_2.

b) Specify whether constructive interference, destructive interference or none of them takes place at point $\boldsymbol{A}$.

c) $\boldsymbol{C}$ is a point at the surface of water located at $\mathbf{5}\ \boldsymbol{cm}$ from S_1. $\boldsymbol{C}$ vibrates with minimum amplitude. Determine all the possible positions of $\boldsymbol{C}$.
(Take into consideration that $CS_2 \geq S_1S_2 - CS_1$).

Exercise 3: **(3 points)**



Two microphones M_1 and M_2 are placed respectively at points A and B, in front of a loudspeaker. The loud speaker is connected to a function generator adjusted to a frequency $\boldsymbol{f = 1700\ Hz}$. The two microphones are connected to the two channels of an oscilloscope which thus displays two waveforms that are in phase.
Given: The local speed of sound is $\mathbf{340}\ \boldsymbol{m/s}$.

a) Write the distance **AB** in terms of the wavelength of the sound $\boldsymbol{\lambda}$ and a natural number $\boldsymbol{k}$.

b) M_2 is gradually displaced towards M_1 along the segment $[AB]$. Determine the minimum distance displaced by M_2 in order to observe, on the screen of the oscilloscope, two anti-phase waveforms for the first time.

c) When M_2 reaches point A, the microphones become side by side in front of the loudspeaker. Compare the waveforms displayed on the screen of the oscilloscope.

d) During the motion of M_2 from B to A, we observe anti-phase waveforms three times. Determine the distance AB.

Exercise 1: **(3 points)**

A standing wave is established in a string fixed at both ends. The distance between the second node and the fifth antinode is $\mathbf{7\ cm}$.

a) Determine the wavelength $\boldsymbol{\lambda}$ of the standing wave.

b) A point $\boldsymbol{A}$ is at a distance of $\mathbf{4.5\ cm}$ from a node. Specify whether $\boldsymbol{A}$ is a node, an antinode, or neither a node nor an antinode.

c) The string has a length of $\mathbf{12\ cm}$, calculate the number of points which are at rest and those which vibrate with maximum amplitude.

Solution:

a)

$$d = (k_2 - k_1)\frac{\lambda}{2} + \frac{\lambda}{4}$$

$$7 = (5 - 2)\frac{\lambda}{2} + \frac{\lambda}{4}$$

$$7 = \frac{7\lambda}{4}$$

$$\boldsymbol{\lambda = 4\ cm}$$

(1 point)

b)

$$\frac{d_A}{\lambda/2} = \frac{4.5}{2} = 2.25$$

$\mathbf{2.25}$ is neither an integer nor half of an odd integer, therefore $\boldsymbol{A}$ is **neither a node nor an antinode.**

(1 point)

c)

$$\frac{L}{\lambda/2} = \frac{12}{2} = 6\ loops$$

For 6 loops we have $6 + 1 = \mathbf{7}$ **nodes and 6 anti-nodes.**

(1 point)

Exercise 2: **(4 points)**

Two spherical dippers S_1 and S_2 vibrate at a frequency $\boldsymbol{f = 10\ Hz}$ on the surface of water in a ripple tank. The dippers are $\mathbf{14.5\ cm}$ apart. The waves propagate on the surface of water at $40\ cm/s$.
Consider a point A on the segment $[\boldsymbol{S_1S_2}]$ so that $\boldsymbol{AS_1 = 10.5\ cm}$.

a) Determine the total number of fringes between S_1 and S_2.

b) Specify whether constructive interference, destructive interference or none of them takes place at point A.

c) C is a point at the surface of water located at $\mathbf{5\ cm}$ from S_1. C vibrates with minimum amplitude. Determine all the possible positions of C. (Take into consideration that $CS_2 \geq S_1S2 - CS_1$).

Solution:

a) Using the inequality:

$$(n-1)\frac{\lambda}{2} < S_1S_2$$

$$\lambda = \frac{v}{f} = \frac{40}{10} = 4\ cm$$

$$(n-1)\frac{4}{2} < 14.5$$

$$n - 1 < 7.25$$

$$n < 8.25$$

We have 8 minimum amplitude fringes and 7 maximum amplitude fringes. Therefore, we have **15** fringes in total.

(1 point)

b) $AS_2 = 14.5 - AS_1 = 14.5 - 10.5 = 4\ cm$

$$\frac{AS_2 - AS_1}{\lambda} = \frac{4 - 10.5}{4} = -1.625$$

$\mathbf{-1.625}$ is neither an integer nor half of an odd integer therefore **neither destructive nor constructive interference takes place at *A*.**

(1 point)

c) C vibrates with minimum amplitude, therefore $\frac{CS_2 - CS_1}{\lambda} = \frac{2k+1}{2}$ with k $\in \mathbb{Z}$. Which means

$$CS_2 = \frac{2k+1}{2}\lambda + CS_1 = 4\frac{2k+1}{2} + 5 = 4k + 7.$$

We found previously that there are 8 minimum amplitude fringes. So, the possible values of k are $-4, -3, -2, -1, 0, 1, 2$ and 3. But $CS_1 = 5cm < 14.5/2$ therefore, C lies closer to S_1 and k can only take the positive values.

$$CS_2 \geq S_1S_2 - CS_1$$

$$CS_2 \geq 14.5 - 5$$

$$CS_2 \geq 9.5$$

For $k = 0$

$$CS_2 = 4(0) + 7 = 7\text{cm} < 9.5\ rejected$$

For $k = 1$

$$\boldsymbol{CS_2 = 4(1) + 7 = 11cm < 9.5cm\ \ accepted}$$

For $k = 2$

$$\boldsymbol{CS_2 = 4(2) + 7 = 15cm > 9.5cm\ accepted}$$

For $k = 3$

$$\boldsymbol{CS_2 = 4(3) + 7 = 19cm > 9.5cm\ accepted}$$

(2 points)

Exercise 3: **(3 points)**



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Given: The local speed of sound is $\boldsymbol{340\ m/s}$.

a) Write the distance **AB** in terms of the wavelength of the sound $\boldsymbol{\lambda}$ and a natural number $\boldsymbol{k}$.

b) M_2 is gradually displaced towards M_1 along the segment $[AB]$. Determine the minimum distance displaced by M_2 in order to observe, on the screen of the oscilloscope, two anti-phase waveforms for the first time.

c) When M_2 reaches point A, the microphones become side by side in front of the loudspeaker. Compare the waveforms displayed on the screen of the oscilloscope.

d) During the motion of M_2 from B to A, we observe anti-phase waveforms three times. Determine the distance AB.

Solution:

a) $\boldsymbol{AB = k\lambda}$ (Since the waveforms are in phase.) **(1/2 point)**

b) The minimum distance displaced by M_2 in order to observe, on the screen of the oscilloscope, two anti-phase waveforms for the first time is half a wavelength:

$$\boldsymbol{d = \frac{\lambda}{2} = \frac{v}{2f} = \frac{340}{2(1700)} = 0.1m}$$

(1 point)

c) The waveforms will be **in phase** again because when the microphones are side by side, the distance between them is zero, hence $k = 0 \in \mathbb{N}$. **(1/2 point)**

d) Observing three anti-phase waveforms means they were they 3 wavelengths apart so $k = 3$.

$$AB = k\lambda = 3\frac{v}{f} = 3\frac{340}{1700} = \boldsymbol{0.6\ m}$$

(1 point)

"DON'T WISH IT WAS EASIER, WISH YOU WERE BETTER." – JIM ROHN