Physics 1B Quiz 2

NATHAN LIN

TOTAL POINTS

46 / 50

QUESTION 1

1 Honor Pledge 0 / 0

✓ **+ 0 pts** **Correct**

QUESTION 2

Problem 1 20 pts

2.1 Part a 3 / 3

✓ **+ 3 pts** **Correct**

+ 2 pts Math error

+ 1 pts $$\lambda$$ = 4L

+ 0 pts No credit

2.2 Part b 3 / 3

✓ **+ 3 pts** **Correct**

+ 2 pts Partial credit

+ 0 pts No credit

2.3 Part c 3 / 3

✓ **+ 3 pts** **Correct**

+ 2 pts Partial credit

+ 0 pts No credit

+ 3 pts Correct by above

+ 1 pts Partial credit

2.4 Part d 5 / 5

✓ **+ 5 pts** **Correct**

+ 4 pts Math error

+ 2 pts Intensity

+ 2 pts Convert to decibels

+ 0 pts No credit

2.5 Part e 6 / 6

✓ **+ 6 pts** **Correct**

+ 5 pts Math error

+ 2 pts Wavelength

+ 3 pts Frequency

+ 0 pts No credit

+ 2 pts Partial credit

+ 4 pts Wrong harmonic

QUESTION 3

Problem 2 30 pts

3.1 Part a 7 / 7

✓ **+ 7 pts** **Correct**

+ 5 pts mistake

+ 3 pts wrong

+ 2 pts incomplete

+ 1 pts no work

3.2 Part b 7 / 7

✓ **+ 7 pts** **Correct**

+ 6 pts mistake

+ 4 pts wrong

+ 3 pts incomplete

+ 1 pts no work

3.3 Part c 8 / 8

✓ **+ 8 pts** **Correct**

+ 5 pts mistake

+ 3 pts wrong

+ 2 pts incomplete

+ 1 pts no work

3.4 Part d 4 / 8

+ 8 pts Correct

+ 6 pts mistake

✓ **+ 4 pts** **wrong**

+ 1 pts no work

Quiz 2

Physics 1B, Fall 2020
November 5, 2020
Dr. Alec Vinson

Students are allowed open notes and open book for this quiz. Besides online materials specifically for this course (e.g. postings on CCLE and the eText), all other online resources are considered unauthorized material access for this quiz.

To receive full credit, the student must **show all work**.

Answers may be typed using typesetting software that can utilize mathematical symbols (e.g. LaTeX, or Microsoft Word in conjunction with the use of its "equation" tool, etc.), or may be written with note-taking software (e.g. Microsoft OneNote, etc.) using a stylus + touchscreen, or may be written on physical paper. If writing on physical paper, the student must save their work by taking pictures, preferably converting those pictures to PDF format.

Student are to submit their work on Gradescope to the appropriate assignment labeled "Quiz 1" before the deadline of 2pm PT on November 5, 2020.

Students are provided a 4 hour window to complete the quiz, though it should only take between one and two hours to complete.

Important: Please print your name on the provided line within the statement below, and then sign your name next to the line marked with an '×' below it. You may do this by signing this paper via note-taking or PDF-editing software, or printing the page, signing it physically, and taking a picture. Alternatively, you may write out the statement on your own piece of paper, exactly as written, sign it, and take a picture. The signed pledge should be the first page of your Quiz 1 submission on Gradescope.

I, Nathan Lin, affirm that I will not give or receive any unauthorized help on this quiz, that all work will be my own, and that I will not share or disseminate the quiz or my solutions in any manner, online, physically, or otherwise.

Sign: × 

1 Honor Pledge 0 / 0

✓ + 0 pts Correct

Nathan Lin

Quiz 2

1a. $\lambda_n = \frac{4L}{n}$

$\lambda_1 = \frac{4(0.75m)}{1}$

$\boxed{\lambda_1 = 3\,m}$

b. $\boxed{0.75\,m}$ at the open end of the pipe since there is a y-antinode, so there is maximum particle amplitude

c. $\boxed{0.75\,m}$ at the open end of the pipe since there is a pressure node at y-antinode, so there is minimum pressure.

d. $I = \frac{P_{max}^2}{2\rho v_s}$

$I = \frac{(1\ N/m^2)^2}{2(1.225\ kg/m^3)(343\ m/s)} = 1.19 \times 10^{-3}\ W/m^2$

$\beta = (10\ dB)\log\left(\frac{I}{I_0}\right)$

$\beta = (10\ dB)\log\left(\frac{1.19 \times 10^{-3}\ W/m^2}{1 \times 10^{-12}\ W/m^2}\right)$

$\boxed{\beta = 90.755\ dB}$

e. 3rd harmonic:

$\lambda_3 = \frac{4L}{3}$, $\lambda_1 = \frac{4L}{1}$, $\lambda_3 = \frac{1}{3}\lambda_1$

$f_3 = \frac{3v}{4L}$, $f_1 = \frac{v}{4L}$, $f_3 = 3f_1$

$\boxed{\begin{array}{l}\text{Wavelength decreases by factor of } \frac{1}{3} \\ \text{Frequency increases by factor of 3}\end{array}}$ for 3rd harmonic

$\lambda_3 = 1m$, $\lambda_1 = 3m$

$f_3 = 343\ Hz$, $f_1 = 114.\bar{3}\ Hz$

2.1 Part a 3 / 3

✓ **+ 3 pts** **Correct**

+ 2 pts Math error

+ 1 pts $$\lambda$$ = 4L

+ 0 pts No credit

Nathan Lin

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2.2 Part b 3 / 3

✓ **+ 3 pts** **Correct**

+ 2 pts Partial credit

+ 0 pts No credit

Nathan Lin

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$\boxed{\begin{array}{l}\text{Wavelength decreases by factor of } \frac{1}{3} \\ \text{Frequency increases by factor of 3}\end{array}}$ for 3rd harmonic

$\lambda_3 = 1m$, $\lambda_1 = 3m$

$f_3 = 343\ Hz$, $f_1 = 114.\bar{3}\ Hz$

2.3 Part c 3 / 3

✓ **+ 3 pts Correct**

+ 2 pts Partial credit

+ 0 pts No credit

+ 3 pts Correct by above

+ 1 pts Partial credit

Nathan Lin

Quiz 2

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$\lambda_3 = 1m$, $\lambda_1 = 3m$

$f_3 = 343\ Hz$, $f_1 = 114.\bar{3}\ Hz$

2.4 Part d **5 / 5**

✓ **+ 5 pts** **Correct**

+ 4 pts Math error

+ 2 pts Intensity

+ 2 pts Convert to decibels

+ 0 pts No credit

Nathan Lin

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$\lambda_3 = 1m$, $\lambda_1 = 3m$

$f_3 = 343\ Hz$, $f_1 = 114.\bar{3}\ Hz$

2.5 Part e **6 / 6**

- ✓ **+ 6 pts** **Correct**
- **+ 5 pts** Math error
- **+ 2 pts** Wavelength
- **+ 3 pts** Frequency
- **+ 0 pts** No credit
- **+ 2 pts** Partial credit
- **+ 4 pts** Wrong harmonic

2. a. $d_1 = x$, $d_2 = L - x$

$\Delta d = L - 2x$

$\Delta d = n\lambda$ for constructive interference

$\Delta d = \frac{nv}{f} = L - 2x$

$x = \frac{L}{2} - \frac{nv}{2f}$

$n=0$: $x = \frac{10m}{2} - 0 = 5m$

$n=1$: $x = \frac{10m}{2} - \frac{1.343 m/s}{2(110\ Hz)} = 3.441 m$

$n=2$: $x = \frac{10m}{2} - \frac{2.343 m/s}{2(110\ Hz)} = 1.882 m$

$n=3$: $x = \frac{10m}{2} - \frac{3.343 m/s}{2(110\ Hz)} = 0.323 m$

$n=-1$: $x = \frac{10m}{2} - \frac{(-1).343 m/s}{2(110\ Hz)} = 6.559 m$

$n=-2$: $x = \frac{10m}{2} - \frac{(-2).343 m/s}{2(110\ Hz)} = 8.118 m$

$n=-3$: $x = \frac{10m}{2} - \frac{(-3).343 m/s}{2(110\ Hz)} = 9.677 m$

$n = \pm 4, \pm 5, \ldots$ outside bands of $0 < x < 10m$

$x_{cons} = 0.323m, 1.882m, 3.441m, 5m, 6.559m, 8.118m, 9.677m$

b. $\Delta d = \left(\frac{2n+1}{2}\right)\lambda$ for destructive interference

$\Delta d = L - 2x$

$x = \frac{L}{2} - \frac{(2n+1)v}{4f}$, * plug in same values

$n=0$:	$x = 4.220\ m$
$n=1$:	$x = 2.661\ m$
$n=2$:	$x = 1.102\ m$
$n=-1$:	$x = 5.78m$
$n=-2$:	$x = 7.339m$
$n=-3$:	$x = 8.898m$

$n = 3, n = \pm 4, \pm 5, \ldots$ outside bands of $0 < x < 10m$

3.1 Part a 7 / 7

✓ **+ 7 pts** **Correct**

+ 5 pts mistake

+ 3 pts wrong

+ 2 pts incomplete

+ 1 pts no work

2. a. $d_1 = x$, $d_2 = L - x$

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$\Delta d = n\lambda$ for constructive interference

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$n=-3$:	$x = 8.898m$

$n = 3, n = \pm 4, \pm 5, \ldots$ outside bands of $0 < x < 10m$

3.2 Part b **7 / 7**

✓ **+ 7 pts Correct**

+ 6 pts mistake

+ 4 pts wrong

+ 3 pts incomplete

+ 1 pts no work

c. $f_1' = \frac{V \pm V_o}{V \pm V_s} f$

$f_1' = \frac{V - V_o}{V} f$

$f_1' = \frac{343\ m/s - 3\ m/s}{343\ m/s} (110\ Hz) = 109.038\ Hz$

$f_2' = \frac{V + V_o}{V} f$

$f_2' = \frac{343\ m/s + 3 m/s}{343\ m/s} (110\ Hz) = 110.962\ Hz$

$f_{beat} = |f_1' - f_2'|$

$\boxed{f_{beat} = 1.924\ Hz}$

d. $\Delta\beta = (65 - s)\,dB = 10 \log\left(\frac{I_2}{I_1}\right)$

$\frac{I_2}{I_1} = \frac{r_1^2}{r_2^2}$ since $P = \text{constant} = I_2 \cdot 4\pi r_2^2$, $r_2^2 I_2 = r_1^2 I_1$

$\frac{I_2}{I_1} = \frac{(5m)^2}{(1m)^2} = 25$

$65 - s = 10 \log(25)$

$s = 51.02\ dB$ from 1 speaker

@ $x = 5m$, interference is constructive, so we double dB level from 1 speaker

$2s = \boxed{102.04\ dB}$

3.3 Part c **8 / 8**

✓ **+ 8 pts Correct**

+ 5 pts mistake

+ 3 pts wrong

+ 2 pts incomplete

+ 1 pts no work

c. $f_1' = \frac{V \pm V_o}{V \pm V_s} f$

$f_1' = \frac{V - V_o}{V} f$

$f_1' = \frac{343\ m/s - 3\ m/s}{343\ m/s} (110\ Hz) = 109.038\ Hz$

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@ $x = 5m$, interference is constructive, so we double dB level from 1 speaker

$2s = \boxed{102.04\ dB}$

3.4 Part d **4 / 8**

+ **8 pts** Correct
+ **6 pts** mistake
✓ **+ 4 pts wrong**
+ **1 pts** no work