PY106 Fall 2022 Quiz 3

Yang Jeong Yong

TOTAL POINTS

20 / 20

QUESTION 1

Problem 1 5 pts

1.1 1a 1 / 1

✓ **+ 1 pts** **Correct: t=5 s (maximum magnitude slope of flux graph)**

+ 0 pts Incorrect

1.2 1b 1.5 / 1.5

✓ **+ 1.5 pts** **Correct: $$|\epsilon|=|-N \Delta\Phi/\Delta t |=|-50 (-3 Tm^2)/(2 s)| = 75 V$$**

+ 0.3 pts Used correct equation (Faraday's Law)

+ 0 pts Incorrect

1.3 1c 1.5 / 1.5

✓ **+ 1.5 pts** **Correct: $$\epsilon=\Delta V = IR$$. At 5.5 seconds, change of flux is same as part (a). Thus $$I=(75 V)/(10 \Omega) = 7.5 A$$**

+ 1.5 pts Correct equation, but carryover from emf determined in (a), full credit

+ 0.3 pts Correct equation, but incorrect flux

+ 0 pts Incorrect

1.4 1d 1 / 1

✓ **+ 1 pts** **Correct: Counter-clockwise. At 1.0 sec, slope of flux graph is negative and flux is positive. Before: (xx) After (x) Oppose (x) = clockwise. At 6.5 s slope is positive and flux is negative: Before: (...) After (.) Oppose: (.) = counter-clockwise**

+ 0 pts Incorrect

QUESTION 2

Problem 2 4 pts

2.1 2a 1 / 1

✓ **+ 1 pts** **Correct: Look at graph of motion. 7 cycles in 1 sec, thus 7 Hz**

+ 0.3 pts Calculated a proper answer, but did not take into account full plot was 1 second total.

+ 0 pts Incorrect

2.2 2b 1 / 1

✓ **+ 1 pts** **Correct: Look at photograph of wave: $$3/2 \lambda = 10 m$$. Thus $$\lambda = 20/3 m = 6.66 m$$. Estimated a wavelength of 6.5 m by inspection is not full credit.**

+ 0.3 pts Guesstimated 6.5

+ 0 pts Incorrect

2.3 2c 1 / 1

✓ **+ 1 pts** **Correct: $$v=f \lambda = (7 Hz)(20/3 m) = 140/3 m/s = 46.66 m/s$$.**

+ 1 pts Carryover from previous problems; full credit

+ 0 pts Incorrect

2.4 2d 1 / 1

✓ **+ 1 pts** **Correct: -x direction.**
Look at graph of the motion. At next instance of time, y will become positive. Now look at the photograph of the wave. For next y to become positive at the next moment in time, the wave must be moving to the left (which is in the -x direction)

+ 0 pts Incorrect

QUESTION 3

Problem 3 4 pts

3.1 3a 2 / 2

✓ **+ 2 pts** **Correct: 750 Hz.**

$$f' = f(\frac{v+v_0}{v}) = f(\frac{v+0.25 v} {v})=(600 Hz)(1.25)=750 Hz$$

+ **0.4 pts** Math error or incorrect use of doppler equation, leading to incorrect result

+ **0 pts** Incorrect

3.2 3b 2 / 2

✓ **+ 2 pts** **Correct: 800 Hz**

$$f' = f(\frac{v}{v-v_s}) = f(\frac{v} {v-0.25v})=(600 Hz)(1/0.75)=800 Hz$$

+ **0.4 pts** Math error or incorrect use of doppler equation leading to incorrect result

+ **0 pts** Incorrect

QUESTION 4

Problem 4 7 pts

4.1 4a 1 / 1

✓ **+ 1 pts** **Correct: String fixed at both ends. Standing wave for the fundamental has $$\lambda = 2L = 2(0.4 m) = 0.8 m$$**

+ **0 pts** Incorrect

4.2 4b 2 / 2

✓ **+ 2 pts** **Correct: 144 N.**

$$f=v/\lambda$$.
Thus $$v=(300 Hz)(0.8 m) = 240 m/s$$ (wave speed)
$$F_T = v^2 m/L = (240 m/s)^2 (0.0025 kg/m) = 144 N$$

+ **2 pts** Carryover from prior part, which led to incorrect result, otherwise correct

+ **1.5 pts** Incorrectly converted SI units for mass per unit length, which led to an incorrect result, otherwise correct

+ **1 pts** Did not convert to SI units for mass per unit length, which led to an incorrect result, otherwise correct

+ **0.4 pts** Math error leading to incorrect result plus possibly other errors, but otherwise had the correct approach

+ **0 pts** Incorrect

4.3 4c 2 / 2

✓ **+ 2 pts** **Correct: 1.1 m.**

$$\lambda_{air} = v_{air}/f = (330 m/s)/(300 Hz) = 1.1 m$$

+ **2 pts** Correct, but due to a carryover error from prior

+ **0.4 pts** Math error, but correct approach

+ **0 pts** Incorrect

4.4 4d 2 / 2

✓ **+ 2 pts** **Correct: 37.5 cm**

$$f' = \frac{nv}{2L}$$ with n=1 (it's the fundamental)
Thus, 320 Hz = (1)(240 m/s)/2L
Solve for L = (240 m/s)/[2(320 Hz)] = 0.375 m = 37.5 cm

+ **2 pts** Correct but due to a carryover error from prior part

+ **1.5 pts** Incorrect Units

+ **0.4 pts** Incorrect answer, but correct approach

+ **0 pts** Click here to replace this description.

PY106 Quiz 3 November 9, 2022

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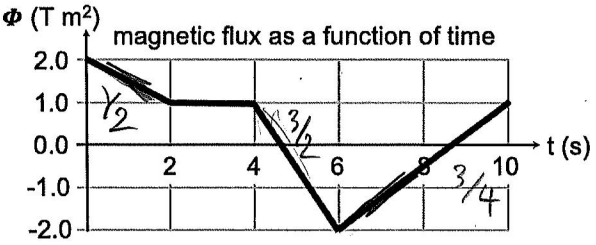
Show your work and put final answers in the boxes provided. You must show work to earn credit.

PROBLEM 1 – 5 points

You have a coil with N = 50 turns. The graph shows the magnetic flux passing through the coil as a function of time, between t = 0 s and t = 10 s.



[1 point] (a) At which of the following times is the magnitude of the induced current in the coil the largest?

[ ] t = 1 s [ ] t = 3 s [✓] t = 5 s [ ] t = 7 s [ ] t = 9 s

[1.5 points] (b) At t=4.5 seconds, determine the magnitude of the induced voltage in the coil.

$\mathcal{E} = -N\left(\frac{d\Phi}{dt}\right) = -50\left(\frac{3}{2}\right) = -75$

$|\varepsilon| =$ 75 V

Ω

[1.5 points] (c) The coil has a resistance of 10.0 Ω. Determine the magnitude of the induced current in the coil at t = 5.5 s.

$V = IR \quad I = \frac{V}{R} = \frac{75}{10} = 7.5$

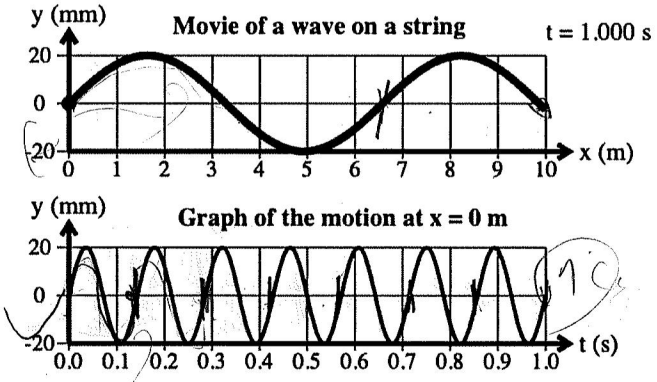
I = 7.5 A

[1 point] (d) If the induced current goes clockwise around the coil at t = 1.0 s, which direction is the induced current at t = 6.5 s?

[ ] clockwise [✓] counterclockwise [ ] there is no induced current at t = 6.5 s

PROBLEM 2 – 4 points

The picture gives two representations of a wave on a string. The top shows a photograph of 10 meters of the string, taken at t = 1.000 s. The bottom representation is a record of the motion of the point at x = 0 m, showing the motion between t = 0 s and t = 1.000 s.



[1 point] (a) Determine the frequency of the wave.

7 Cycles in 1s → 1 cycle is 1/7 = 0.143

$f = \frac{1}{T} = \frac{1}{1/7} = 7$

f = 0.7 Hz

[1 point] (b) Determine the wavelength of the wave.

1.5 Cycle in 10m → 1 cycle in $\frac{10}{1.5}$

λ = 6.67 m

[1 point] (c) Determine the speed of the wave.

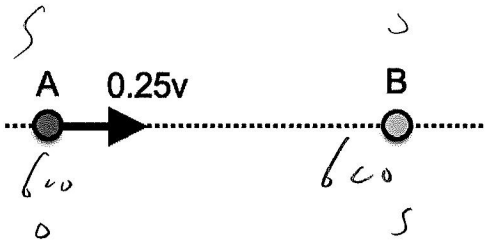
$v = \lambda f = (6.67)(7)$

v = 46.69 m/s

[1 point] (d) The direction the wave is moving is [ ] +x [✓] -x

PROBLEM 3 – 4 points

The picture shows two sources of sound. Each source emits sound at a frequency of 600 Hz, and v represents the speed of sound. Source A moves at 0.25v to the right, and source B is at rest. Let's investigate which source, A or B, observes the lowest frequency.



[2 points] (a) Determine the frequency that A observes from source B.

$f' = f\left(\frac{v + 0.25v}{v}\right) = 600\left(\frac{5}{4}\right)$

$f_A' =$ 750 Hz

[2 points] (b) Determine the frequency that B observes from source A.

$f' = f\left(\frac{v}{v - 0.25v}\right) = 600\left(\frac{1}{0.75}\right)$

$f_B' =$ 800 Hz

PROBLEM 4 – 7 points

One of the strings of a violin has a length of 40 cm and a mass per unit length of 2.5 grams/meter.

[1 point] (a) What is the wavelength of the fundamental standing wave on the string?

$v = \sqrt{\frac{F_T}{2.5g/L}}$ $\lambda = 2L$, $\lambda = 0.4$ $f = \frac{v}{\lambda}$ $\lambda = 2L$

$= 2(0.4)$

$\lambda =$ 0.8 m

[2 points] (b) The fundamental frequency of the string is 300 Hz. What is the tension in the string?

$v = f\lambda$

$= 300(0.8)$

$= 240$

$v = \sqrt{\frac{F_T}{2.5g/L}} = \sqrt{\frac{F_T}{2.5\times10^{-3}kg/L}}$

$F_T = v^2 \cdot \frac{2.5g}{L}\left(\frac{1kg}{1000g}\right)$

$F_T =$ 144 N

[2 points] (c) If the speed of sound in air is 330 m/s, what is the wavelength of the sound wave that is produced by this string's fundamental vibration?

$v = f\lambda$ $\lambda = \frac{330}{300} = 1.1$

$330 = (300)\lambda$

$\lambda =$ 1.1 m

[2 points] (d) If we want to increase the fundamental frequency in (b) to 320 Hz by changing the length of the string, what should be the new effective length of the string?

$v = 240$ $240 = f\lambda$ $\lambda = 2L$

$= 320(\lambda)$ $\frac{.75}{2} = L$

$\lambda = 0.75$

$L =$ 37.5 cm