Quiz 10

Due Nov 23 at 10am **Points** 71 **Questions** 9
Available Nov 22 at 10am - Nov 23 at 10am 1 day **Time Limit** 30 Minutes
Allowed Attempts 2

Instructions

This quiz covers the material from class up to and including Nov 19.

You have 30 minutes to take the quiz and you can take it twice if you like.

Come to office hours on Monday at 9-9:45pm to ask quiz (or other) questions.

Henriette

Take the Quiz Again

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	29 minutes	41 out of 71 *

* Some questions not yet graded

Correct answers are hidden.

Score for this attempt: **41** out of 71 *
Submitted Nov 23 at 1:47am
This attempt took 29 minutes.

Question 1 — 1 / 1 pts

I certify that I am me and that I am taking this quiz on my own, without help from others. Between my two attempts, I know I can Henriette questions ask in office hours and via Piazza if I need clarification. My answers will reflect my own understanding and I will not copy answers from others.

Yes, and happy Thanksgiving!

Question 2

10 / 10 pts

Which of the following functions solve the wave equation with *some* speed?

(1) $\text{Exp}[-(2kx - \omega t)^2]$

(2) $\text{Exp}[-2kx]\text{Exp}[-\omega^2 t^2]$

(3) $\cos^2(3kx + \omega t)$

(4) $\cos(3kx)\sin(\omega t)$

(5) $k^2x^2 + 4\omega^2t^2 - 4k\omega tx$

(6) $\sin(kx + \omega t) + x\cos(kx + \omega t)$

- ○ (1), (3), (5)
- ○ (1), (3) , (4), (6)
- ○ None of them
- ○ (3) , (4), (5)
- ○ (4)
- ○ (1), (2), (3), (4)
- ● (1), (3) , (4), (5)
- ○ (1), (2), (4)
- ○ (1), (3), (4)
- ○ (3) , (5)
- ○ (3), (4)
- ○ All of them

Question 3

10 / 10 pts

Which of the following waves can be superimposed?

(1) $\cos(2kx - 2\omega t)$

(2) $-3\sin(kx + \omega t)$

(3) $111\sin(kx - \omega t)$

(4) $\sin(kx)\cos(\omega t + \varphi)$

(5) $5\sin(6kx + \varphi - 6\omega t)$

- (2), (3), (4)
- (1), (3), (5)
- (1), (3)
- (2), (4)
- (2), (3)
- (1), (2), (3)
- All of the them
- (4), (5)
- None of them

Question 4

Not yet graded / 10 pts

Consider a violin string. We have learned that when a string is plucked, the fundamental tone and the overtones superimpose. What guarantees that different waves on a particular string can be described by wave-solutions that can be superimposed?

Your Answer:

Given a wave equation (the second order wave PDE), all solutions to this equation have the same wave speed. The wave equation (the second order PED) that describes the fundamental tone and the overtones of a string on a violin is the same. In other words, the equations (the solutions to the PDE) that describe the fundamental and the overtones of a string are the solution to the same wave equation (the second order wave PDE). That is, we know that the fundamental tone and the overtones of a string have the same speed, so they can be superimposed.

This agrees with what we discussed during class. For standing waves, if the frequency doubles, the wavelength is halved, so the speed of the wave remains unchanged, so the wave of all overtones (and the fundamental) have the same speed, and hence they can be superimposed.

Question 5

5 / 5 pts

When a wave is transmitted from one medium to another (say string to air / EM wave in air to glass), which is true?

- ○ None of the these
- ◉ The frequency of the wave is the same in the two media
- ○ The speed of the wave is the same in the two media
- ○ All of the these
- ○ The wavelength of the wave is the same in the two media

Question 6

Not yet graded / 10 pts

On a cold winter day, I tune my ukulele indoors, then go outside to play for whoever walks by (hoping that they are not carrying rotten tomatoes...). But when I start to play, something is amiss (and it is not just my skills). The ukulele sounds out of tune. What happened? Explain.

Your Answer:

When we go from indoors (warm) to outdoors (cold), the length of the ukulele and the length of the strings on the ukulele will become shorter due to the thermal expansion effect (or maybe we should say thermal contraction in this case). Since the lengths of the strings are now shorter, the wavelength of the standing waves will become shorter. Given that the tension on the strings does not a lot, and the speed of the wave is unchanged, the frequency of the standing waves has to be changed. So the ukulele sounds out of tune.

Question 7

5 / 5 pts

The index of refraction of a material is typically a real number greater than one. Does that mean that light moves faster or slower or at the same speed in glass compared to in air?

- slower
- the same
- faster

Question 8

10 / 10 pts

Using the *complex* index of refraction has which of the following consequences:

- The speed of light in the material becomes complex valued

- [x] The frequency of light is unaffected by the index of refraction
- [ ] The real part of the index of refraction changes the amplitude of the wave
- [ ] The imaginary part of the index of refraction changes the frequency of the light
- [x] The imaginary part of the index of refraction is related to attenuation of the wave
- [x] The speed of light in the material is still real, but the amplitude is affected by the imaginary part of the index of refraction
- [ ] The wavelength of light is unaffected by the index of refraction
- [x] The real part of the index of refraction determines the speed of light

Question 9

Not yet graded / 10 pts

The punchline of the physical effect of the imaginary part of the index of refraction is that... [description in your own words]

Your Answer:

The imaginary part of the index of refraction affects the amplitude of the wave as we derived in Friday's discussion, and as the distance (travelled by the wave) increases, the amplitude decreases. We know that the power of the wave is proportional to the (amplitude)^2 of the wave. Hence when amplitude of the wave decreases, the power of the wave decreases, so the wave loses energy to the material that it is travelling through. We conclude that the imaginary part of the index of refraction causes the attenuation of the wave.

Quiz Score: **41** out of 71