

Physics 107: Ideas of Modern Physics

Practice Exam 2 Oct. 25, 2006

Useful constants:

c = speed of light = 3×10^8 m/s

sound speed in air = 340 m/s

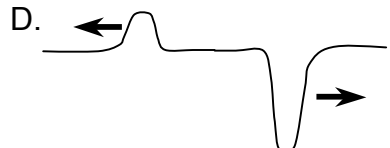
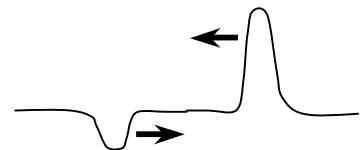
k = electric constant = 9×10^9 Nm²/C²

g = accel. of gravity on Earth = 10 m/s²

G = gravitational constant = 6.7×10^{-11} N-m²/kg²

1. Why will a transverse wave on a rope speed up if the rope tapers down?
- $v = \lambda f$, since the wavelength gets bigger the velocity increases
 - Conservation of energy, since the mass is smaller the velocity must be bigger
 - The wave actually slows down.
 - It doesn't speed up, Einstein's theory of special relativity says that all waves propagate at exactly c .
 - none of the above.
2. In your room you have two speakers in different corners. You learned about interference in Physics 107, and positioned the speakers so that at your desk you are exactly 2 meters from each. Your roommate moved one of your speakers: you now hear a cancellation of sound at 680 Hz. How far did your roommate move your speaker toward your desk?
- 0.25 m
 - 0.5 m
 - 0.12 m
 - 1.0 m
 - 0.1 m
3. An magnitude 10.0 earthquake occurs 200km away. After the p wave reaches you how long to you have to get to a safe place before the s wave arrives
- they arrive at the same time
 - about half a minute
 - about one minute
 - about two minutes
 - the s wave arrived first because it's faster

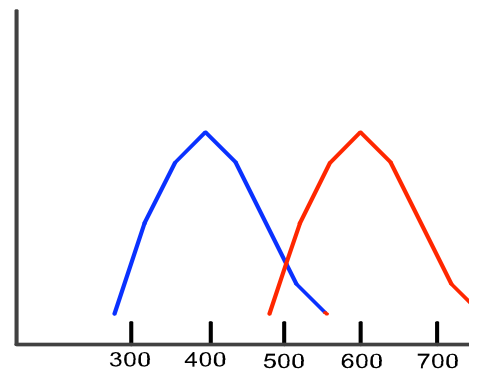
4. Two wave pulses on a rope approach each other as shown to the right. Some time later, the rope looks like:



5. An electric field:
- always appears in conjunction with a magnetic field.
 - cannot change in time.
 - cannot cause a force on a charged particle.
 - can arise from electric charges.
 - can arise from stationary magnets.
6. The force between two charged particles 0.4 m apart is found to be repulsive, with magnitude 2×10^{-10} N. What is the force after the charge on *each* particle is doubled, with the particles still 0.4 m apart?
- 4.0×10^{-10} N, attractive.
 - 4.0×10^{-10} N, repulsive
 - 8.0×10^{-10} N, repulsive
 - 0.5×10^{-10} N, attractive.
 - 1.0×10^{-10} N, repulsive

7. Suppose an eye has only two cones with spectral sensitivities shown here. It is stimulated by equal intensities of 300 and 700 nm pure spectral light. Which single wavelength might produce a similar color perception?

- 330 nm
- 430 nm
- 500 nm
- 530 nm
- 630 nm



8. A continuous beam of electrons moving at a constant velocity is near one corner of an otherwise empty room. At a particular location in the opposite corner of the room, an experimenter measures
- an electromagnetic wave.
 - an changing electric field.
 - an unchanging magnetic field.
 - a charge.
 - a current.
9. A radio transmission from an astronaut on the moon will be received how much later on the Earth? (The moon is 380 million meters from the Earth).
- 0.12 s
 - 0.25 s
 - 0.38 s
 - 1.27 s
 - 0.80 s
10. The conclusions of special relativity arise primarily from the assumption that
- nothing can exceed the speed of light.
 - the speed of light is constant in all inertial reference frames.
 - the ether provides a relative inertial reference frame.
 - only relative velocities between inertial reference frames are important.
 - space-time has a relative curvature.
11. An astronaut on a spaceship traveling from earth to mars at $0.6c$ has a perfect atomic clock. She uses her clock to measure the time it takes her to travel from the earth to mars and finds 10 minutes. An observer on the Earth also times the spaceship and finds a trip time of:
- 12.5 min
 - 10.0 min
 - 8.0 min
 - 6.4 min
 - 25 min

12. A car is 6 meters long when it is at rest. It drives by at $0.6c$ relative to an observer on the street corner. The street corner observer measures the car to have a length of:
- 4.8 m
 - 7.5 m
 - 0.6 m
 - 5.7 m
 - 2.1 m
13. Two astronauts, Joe and Jane, are playing catch on a spaceship traveling at $0.4c$ relative to an Earth observer. Joe, Jane, and the Earth observer measure the time for the ball to travel from Joe to Jane and then back to Joe again. Who measures the shortest time?
- Joe.
 - Jane.
 - Both Joe and Jane.
 - The Earth observer.
 - All of them measure the same time.
14. As a particle of rest mass m_o approaches the speed of light, its total energy
- approaches $m_o c^2$.
 - approaches zero.
 - increases without bound.
 - becomes entirely kinetic.
 - is trapped in a black hole.
15. The first atomic bomb exploded with an energy of 15 kilotons (15,000 tons of TNT). (1 kiloton = 4.184×10^{12} Joules). If this were accomplished by converting mass directly into energy, how much mass would have been required (1000 gram = 1 kilo-gram)?
- 1400 kg
 - 310,000 kg
 - 700 gm
 - 0.7 gm
 - 0.005 gm

16. General relativity would say a dropped ball accelerates toward the Earth because

- a. the speed of light is same in all reference frames.
- b. of the gravitational force from Earth.
- c. only the relative velocity of the earth and ball matters.
- d. the ball follows the shortest path in spacetime.
- e. relativistic momentum is different than Newtonian momentum.

Also see questions from review lecture!