

Physics 107: Ideas of Modern Physics

Exam 2
March 14, 2007

Name _____

ID # _____

Section # _____

On the Scantron sheet,

- 1) Fill in your name
- 2) Fill in your student ID # (not your social security #)
- 3) Fill in your section # (under ABC of special codes)

Useful constants:

$c = \text{speed of light} = 3 \times 10^8 \text{ m/s}$

$\text{sound speed in air} = 340 \text{ m/s}$

$k = \text{electric constant} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$

$g = \text{accel. of gravity on Earth} = 10 \text{ m/s}^2$

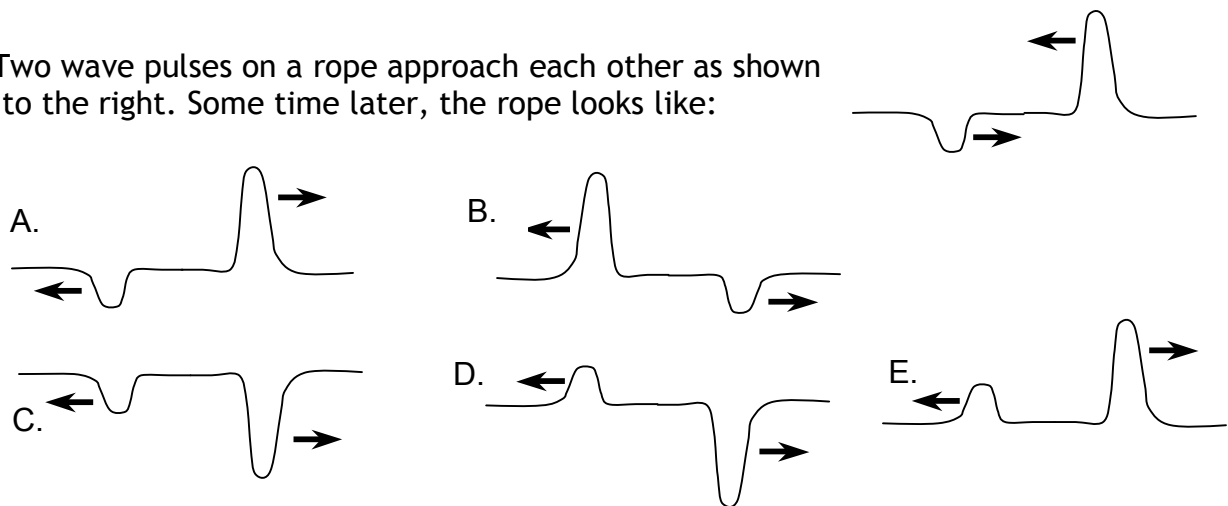
$G = \text{gravitational constant} = 6.7 \times 10^{-11} \text{ N-m}^2/\text{kg}^2$

1. c
2. A 1020 Hz tone is generated by a speaker. What is the wavelength of the sound wave?
 - a. 3.0 m
 - b. 0.10 m
 - c. 0.50 m
 - d. 1.0 m
 - e. 0.33 m

3. An example of a longitudinal wave is

- a. a sound wave.
- b. a water wave.
- c. a wave on a rope.
- d. an electromagnetic wave.
- e. a frequency wave.

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



5. In your room you have two speakers in different corners. At your desk you used to be exactly 1 meter from each, so that there is no interference. But now your roommate moved one of your speakers 0.2 m further away from your desk. At what frequency will you hear destructive interference?
 - a. 1360 Hz
 - b. 1700 Hz
 - c. 680 Hz
 - d. 850 Hz
 - e. 136 Hz

6. A car blowing its horn drives directly towards me at constant velocity, then passes and drives directly away from me at the same constant velocity. I hear
- A pitch rising in time as the car approaches, and a pitch falling in time after the car has passed.
 - A constant pitch as the car approaches, and a lower constant pitch after the car has passed me.
 - A pitch falling in time as the car approaches, and a pitch rising in time after the car has passed.
 - A constant pitch as the car approaches, and a higher constant pitch after the car has passed me.
 - A constant pitch as the car approaches, and a pitch falling in time after the car has passed.
7. Your Badger radio network broadcasts on AM 1310. This frequency is 1,310 kHz (1 kHz = 1000 Hz). What is the wavelength of this wave?
- 385 meters
 - 75 meters
 - 230 meters
 - 2.3 meters
 - 3.85 meters
8. An observed source of magnetic fields is:
- magnetic currents
 - magnetic monopoles
 - voltage currents
 - electric charges
 - electric currents
9. The force between two electrically charged particles 0.4 m apart is found to be attractive, with magnitude 2×10^{-10} N. What is the force when the separation is increased to 0.8 m?
- 4.0×10^{-10} N, repulsive
 - 4.0×10^{-10} N, attractive.
 - 0.5×10^{-10} N, attractive.
 - 8.0×10^{-10} N, repulsive
 - 1.0×10^{-10} N, repulsive

10. Complete destructive interference of two waves occurs when
- troughs of both waves line up with each other
 - crests of both waves line up with each other
 - crests of one wave alternate with troughs of other
 - crests of one wave line up with troughs of other
 - the two waves have only crests
11. Your microwave oven beams electromagnetic radiation at the food inside, and the food warms by absorbing the radiation. To increase the efficiency, the oven is approximately a resonant cavity, with one wavelength of microwave radiation fitting inside the length. If the oven has a length of 15 cm (0.15 m), find the operating frequency. (1 Giga-Hertz= 10^9 Hz)
- 1.0 Giga-Hertz
 - 2.0 Giga-Hertz
 - 0.2 Giga-Hertz
 - 0.1 Giga-Hertz
 - 20 Giga-Hertz
12. An electron moves continuously up and down in one corner of room. An experimenter in the opposite corner of the room finds out that in *his* corner there is
- an unchanging electric field.
 - an electromagnetic wave.
 - a charge.
 - an unchanging magnetic field.
 - a current.
13. The first transatlantic radio broadcast was made in 1895 from Cornwall, England and detected in St. John's, Newfoundland, a distance of 2,100 miles (3,400 km, 1 km=1000 m). To cover this distance, it took the radio signal
- 0.011 seconds
 - 0.007 seconds
 - 3.2 seconds
 - 0.83 seconds
 - 88 seconds

14. Einstein's special theory of relativity is valid in inertial reference frames. An inertial reference frame is defined to be one that
- moves as constant speed.
 - is stationary.
 - moves at constant acceleration.
 - moves at constant velocity.
 - shows no gravitational force.
15. One space ship is catching up to and passing another on the same trip between two stars. The passing ship moves at $0.9c$ and the other ship at $0.45c$. The passing ship flashes its headlights before passing. An observer on the slower ship measures the light from the headlights to be moving at what speed relative to the slower ship?
- $0.45c$
 - $1.0c$
 - $1.45c$
 - $0.0c$
 - $1.67c$
16. A man on a fast motorcycle moving at $0.5c$ relative to an observer on the ground throws a baseball forwards in the motorcycle reference frame. Who measures the proper time interval between the ball being thrown, and passing the front wheel of the motorcycle 1 meter away?
- The ground observer
 - The motorcycle rider
 - Neither
 - Both
 - Depends on speed of ball
17. An astronaut travels by the Earth at $0.6c$. Someone stationary on Earth holds a meter stick. The astronaut measures the length of this meter stick to be.
- More than one meter.
 - Less than one meter.
 - Need to know Earth velocity.
 - Exactly one meter.
 - Depends on Earth reference frame.

18. An astronaut moves at a constant velocity of $0.5c$ relative to a person on Earth. The astronaut watches the Earth observer through a telescope and sees that
- the earthling ages more quickly.
 - the earthling ages more slowly
 - aging depends on whether velocity is positive or negative.
 - the earthling ages at the same rate.
 - the earthling has brown eyes
19. An astronaut in a spaceship moves relative to an Earth observer. The Earth observer measures the time interval between heart beats of the astronaut. As the speed of the astronaut gets closer and closer to the speed of light (assume the astronaut does not get excited!), the earth observer sees that the time interval between the astronaut's heart beats
- decreases, getting arbitrarily close to zero.
 - increases without bound
 - decreases, approaching $c/10$.
 - increases, but never exceeds c , the speed of light.
 - increases for positive speeds, decreases for negative speeds.
20. An average person requires 3000 Calories of energy per day, usually ingested as food. This is 1.25×10^7 Joules. So the entire population of the Earth (~6.5 billion people) requires about 9×10^{16} Joules of energy per day. If this could be provided by mass energy, how much mass per day would be required?
- 0.5 gm
 - 0.3 gm
 - 0.3 kg
 - 30 gm
 - 1 kg
21. As the speed of a massive particle approaches the speed of light, the relativistic mass of the particle
- does not change.
 - approaches the rest mass.
 - increases slightly.
 - increases without bound.
 - decreases to zero.