TEST # 1. PHYS 204. SPRING 2003. 03/04/03

NAME:

1. A train on one track moves in the same direction as a second train on the adjacent track. The first train, which is ahead of the second train and moves with a speed of 32 m/s, blows a horn whose frequency is 125 Hz. If the frequency heard on the second train is 131 Hz, what is its speed?

2. A string, fixed at both ends, has a length of 4 m and a mass per unit length of 0.01 kg/m. The tension in the string is 0.25 N.

(a) Obtain the speed of a transverse wave traveling along the string.

$v = \sqrt{\frac{F}{\mu}}$

(b) The frequency, period and wavelength of the 3rd harmonic emitted by the string.

$f_3 = 3\,\frac{v}{2L}$

(c) Obtain the wave's intensity level if the wave's intensity is 10^{-11} W/m^2.

X

(d) The tension on the string is kept the same as before, but the length of the string is increased by a factor of 2: $L \rightarrow 2L$

(d1) Does the speed of the transverse wave change?

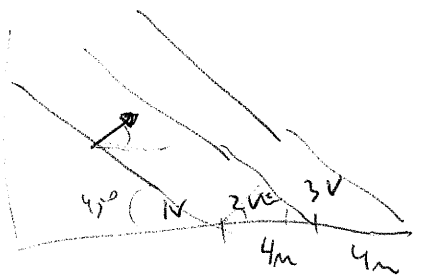
NO

(d2) Calculate the new fundamental frequency of the string.

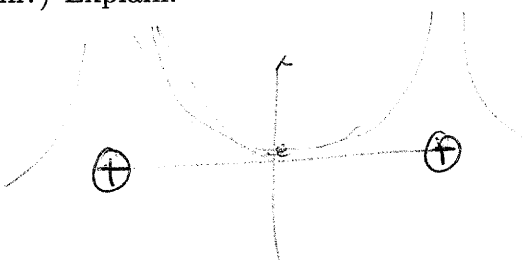
$f_0 = \frac{v}{2L} = \frac{v}{2 \times 2\,4m}$

3. Two point charges of equal magnitude are 8.0 cm apart. At the midpoint of the line connecting them, their combined electric field has a magnitude of 25 N/C. Find the magnitude and sign of the charges.

4. (a) A given system has the equipotential lines shown in the figure. What are the magnitude and direction of the electric field?



(b) Two point charges, each equal to $+q$, are placed on the x axis at $x = -1$ m and $x = +1$ m. As one moves along the $x-$axis, does the potential look like a peak or a valley near the origin? (i.e., does the potential has a maximum or a minimum— bottom of a valley— at the origin?) Explain.



(c) Make a qualitative sketch of the equipotential lines produced by a point positive charge, for a dipole and for a parallel plate capacitor.

5. Find the equivalent resistance between points a and B shown in the figure.

TEST # 1. PHYS 204. SPRING 2005. 03/08/05

NAME:

1. (20 points) One of the harmonics on a string 1.30m long has a frequency of 15.6 Hz. The next higher harmonic has a frequency of 23.4 Hz. Find (a) the fundamental frequency, and (b) the speed of waves on this string. (c) Supposed that the tension in the string is increased until the speed of the waves is 22 m/s. What are the frequencies of the first three harmonics in this case?

$f_n = 15.6\ Hz$

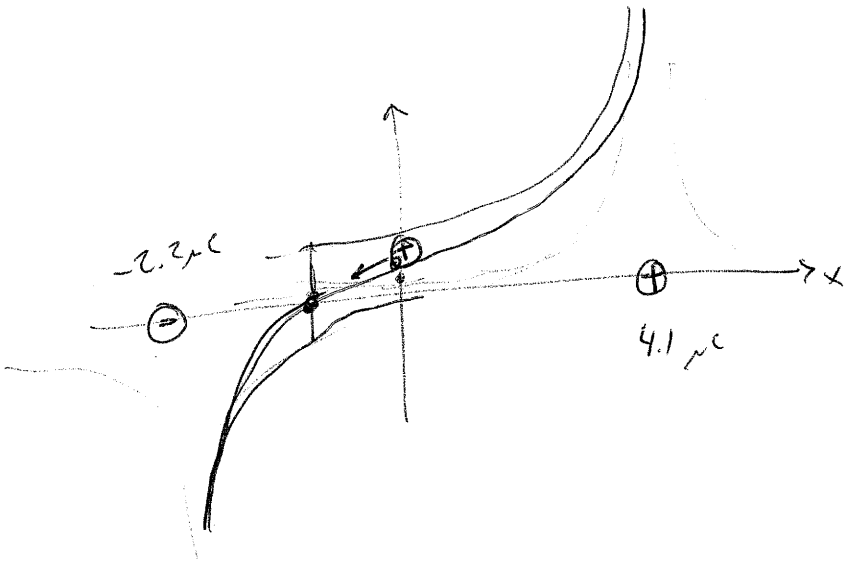
$f_{n+1} = 23.4\ Hz.$

$f_0 = 23.4\ Hz - 15.6\ Hz = \frac{v}{2L}$

$20 = v = \sqrt{\frac{F}{\mu}}$

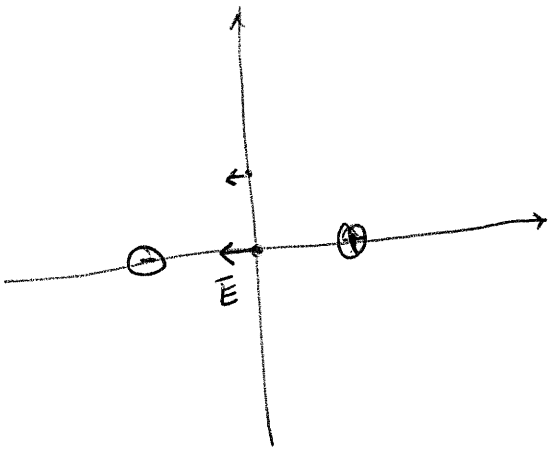
$21 = v' = \sqrt{\frac{F'}{\mu}}$

2. (30 points) Point charges of $+4.1\mu$C and -2.2μC are placed on the x axis at (11m,0) and (-11m,0), respectively. (a) Sketch the electric potential on the x axis for this system. (b) Your sketch should show one point on the x axis between the two charges where the potential vanishes. Is this point closer to the positive or negative charge? Explain. (c) Find the point referred to in part (b). (d) Supposed a small positive test charge is released from rest at $x = 0$. In which direction will it move? Explain.



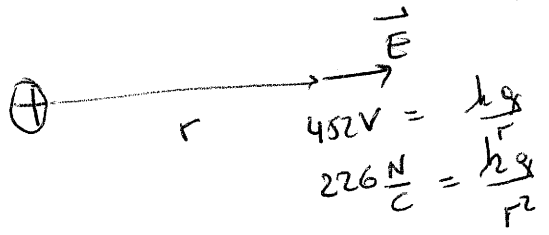
3. (30 points) Electric field.

In a (x, y) coordinate system a positive point charge $q = 2 \times 10^{-8}$C is placed at the point $x = 0.1$m, $y = 0$, and an identical charge is placed at $x = -0.1$m, $y = 0$. Find the magnitude and direction of the electric field at the origin and at $x = 0$, $y = 0.1$m.

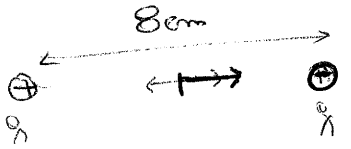


4. (20 points) Electric potential

The potential at a certain distance from a point charge is 452 V, with the potential taken to be zero at infinity, and the electric field is 226 N/C. Calculate the distance to the point charge, and the magnitude of the charge. Is the electric field directed toward or away from the point charge?



5a. (optional) Two point charges of equal magnitude are 8.0 cm apart. At the midpoint of the line connecting them, their combined electric field has a magnitude of 25 N/C. Find the magnitude and sign of the charges.



5b. (optional) Make a qualitative sketch of the electric field lines and equipotential lines produced by a point charge, a dipole, and a parallel capacitor.

TEST # 1. PHYS 204. SPRING 2001. 02/28/01

NAME:

1. A siren S1 emits a wave of frequency 680 Hz with a amplitude of 6cm. Assume that the speed of sound is 340 m/s

(a) (6 points) Find the sound's wavelength and the period if the siren is at rest.

$$v = \lambda f \Rightarrow \lambda = \frac{v}{f} = \frac{340 m/s}{680 \frac{1}{s}} = 0.5 m$$

$$T = \frac{1}{f} = \frac{1}{680 \frac{1}{s}} = 1.4 \, 10^{-3} s$$

(b) (6 points) Write down the mathematical expression describing this wave assuming that it propagates towards $+x$.

$$y(x,t) = A \sin\left(2\pi f t - \frac{2\pi}{\lambda} x\right)$$

$$y(x,t) = (6cm) \sin\left(\pi \frac{1360}{s} t - \frac{4\pi}{m} x\right)$$

(c) (8 points) If a listener L moves at 170 m/s towards S1, with S1 remaining at rest, find the frequency observed by L.

source
$f_s = 680 Hz$

L $\leftarrow v_o = 170 m/s$

$$f_o = f_s \left(1 + v_o/v\right) = 680 Hz \left(1 + \frac{170}{340}\right) = 1020 Hz.$$

(d) (10 points) Consider a second siren S2, identical with S1 (they are in phase and emit a wave with the same frequency), located 4 m to the right of an facing S1. If P is a point (on the line joining S1 and S2) 2.125 m to the right of S1, determine whether the interference at P is constructive or destructive.

$|l_1 - l_2| = 0.25\,m = \frac{\lambda}{2} \Rightarrow$ destructive

$\lambda = 0.5\,m$