68

TEST # 1. PHYS 204. SPRING 2011. 02/23/11

NAME: Krystal Garcia

1. One of the harmonics on a string 1.30m long has a frequency of 20.6 Hz. The next higher harmonic has a frequency of 25.75 Hz. Find (a) the fundamental frequency, and (b) the speed of waves on this string. (c) Find the order of the harmonic corresponding to the 20.6 Hz frequency. (d) Suppose that the tension in the string is changed until the speed of the waves is 22 m/s. What are the frequencies of the first three harmonics in this case?

$r = 1.30m$.
$f_1 = 20.6Hz$.
$f_2 = 25.75Hz$.

a) fundamental frequency = ?
b) V = ?

② $f_{req} = 25.75Hz$..

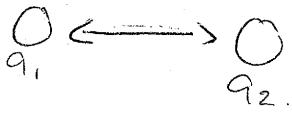
a) Fundamental frequency:
$25.75Hz - 20.6Hz = 5.15Hz$. ✓

b) speed $= V = \frac{\lambda}{T} = f\lambda$.
$V = 5.15Hz(1.30m)$ X
$V = 6.695 m/s$. X

c) Order of the Harmonic X

d) $V = \sqrt{\frac{F}{m/L}}$ X ?

2. Electric Field. Consider two charges on the x axis. One charge $q_1 = 8.5\mu C$ is at $x_1 = 3.0$ cm and the other $q_2 = -21\mu C$ is at $x_2 = 9.0$ cm. Evaluate the electric field at $x = 6$ cm. Show that between 3cm $< x <$ 9cm the total electric field cannot be zero.



$q_1 = 8.5\mu C$.

$x_1 = 3.0cm\,(r) \rightarrow .03m$.

$q_2 = -21\mu C$.

$x_2 = 9.0cm \rightarrow$

$9.0cm \frac{1\,m}{100cm} = .09m$.

$E_1 = \frac{K|8.5\mu C|}{(.03m)^2} =$

$E_2 = \frac{K|-21\mu C|}{(.09m)^2} =$

$E = K\frac{|q_1|}{r^2}$

$F = K\frac{|q_1||q_2|}{r^2}$

$F = \frac{(8.99\times10^9\,N\cdot m^2/C^2)|8.5\mu C||-21\mu C|}{(.06m)^2}$

$F = 4.44\times10^{20}$.

$E = \frac{F}{q_0} =$

$E = \frac{K|q|}{r^2} = \frac{8.99\times10^9\,N\cdot m^2/C^2\,|8.5\mu C|}{(.06m)^2}$.

$E = 2.12\times10^{16}$

Last part?

3. Electric potential. Charges of $-q$ and $+2q$ are fixed at a distance 2m between them. A dashed line is drawn through the negative charge, perpendicular to the line between the charges. On the dashed line, at a distance ℓ from the negative charge, there is at least one spot where the total potential is zero. Find ℓ.

Electric Potential

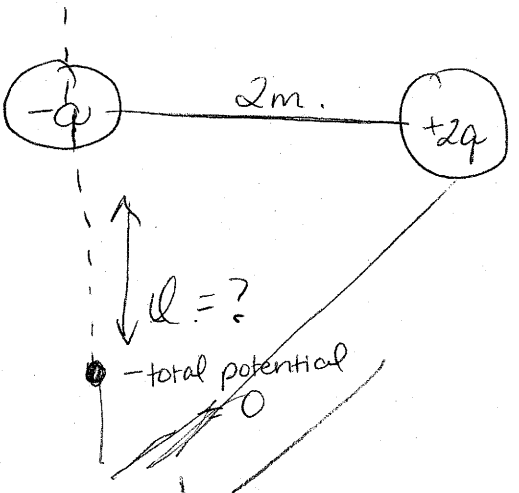
Charges:
$-q$ and $+2q$

$x = 2m$

$V = \frac{kq}{r}$

$0 = \frac{8.99 \times 10^9 (1.60 \times 10^{-19})}{r}$

0



Work?

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.

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

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

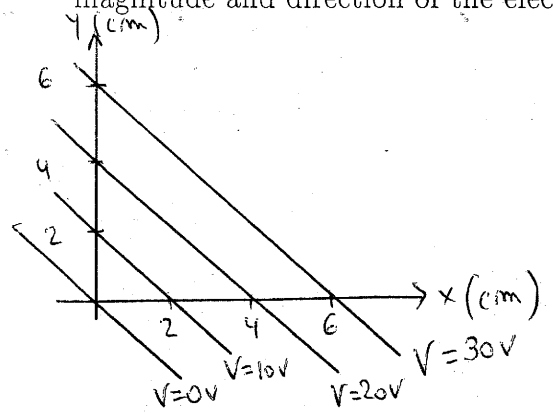
(d) The tension on the string is kept the same as before, but the length of the string is increased by a factor of 2:

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

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

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.

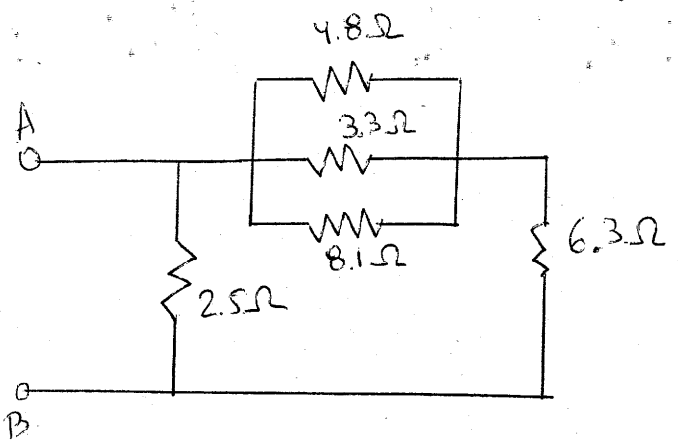
4. (a) A given system has the equipotential lines shown in the figure. What are the magnitude and direction of the electric field?



(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 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.

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

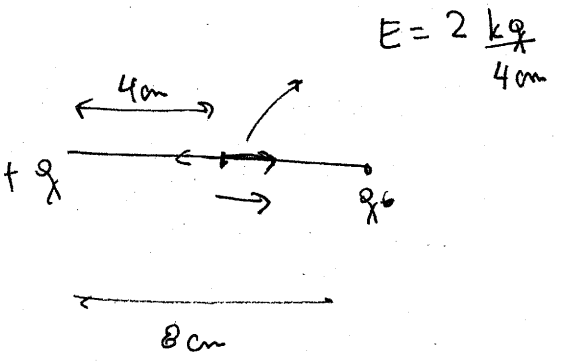
(c) Obtain the wave's intensity level if the wave's intensity is 10^{-11} W/m^2.

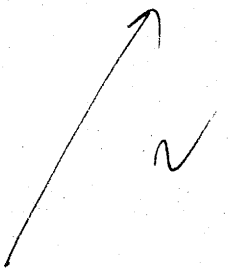
(d) The tension on the string is kept the same as before, but the length of the string is increased by a factor of 2:

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

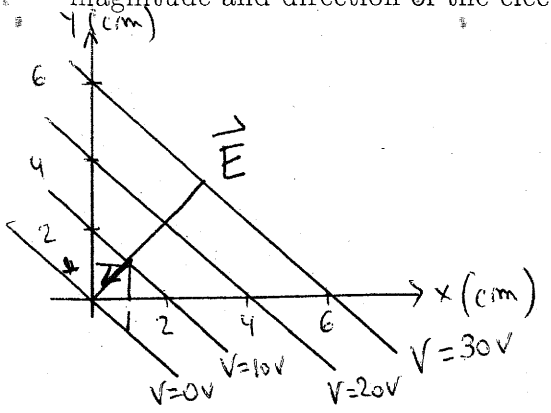
(d2) Calculate the new fundamental frequency of the string.

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.



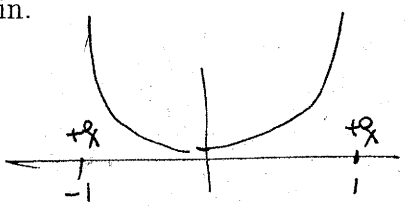


4. (a) A given system has the equipotential lines shown in the figure. What are the magnitude and direction of the electric field?

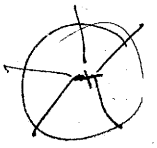


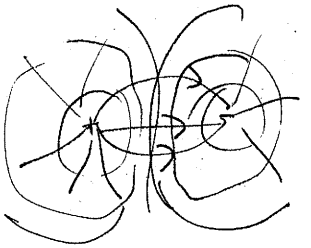
$$E = \frac{10V}{\sqrt{2}\,cm}$$

(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.

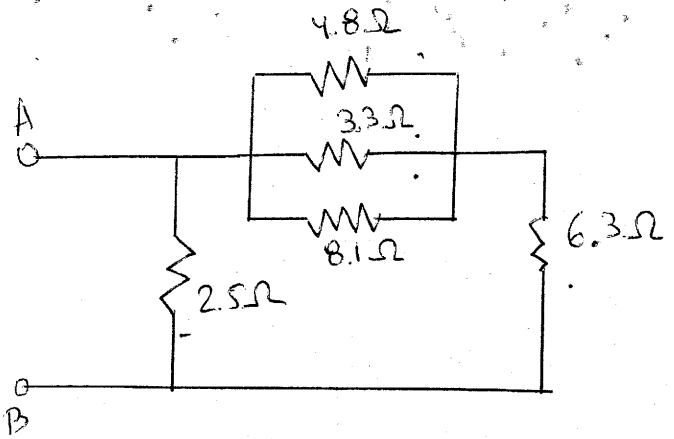


(c) Make a qualitative sketch of the equipotential lines produced by a point positive charge, for a dipole and for a parallel plate capacitor.





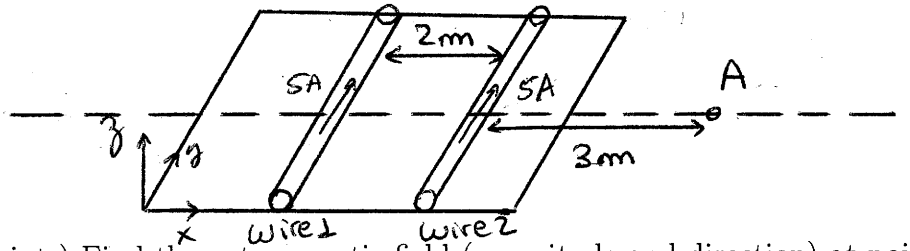
5. Find the equivalent resistance between points a and B shown in the figure.



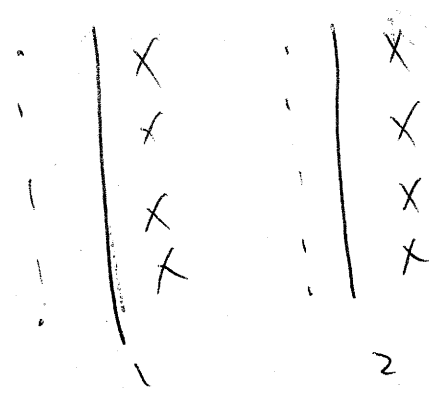
TEST #2. PHYS 204. SPRING 2003. 04/10/03

NAME:

1. Consider two long straight wires separated by a distance of 2 m as in the figure. The wires carry currents of 5 A in the same direction as shown.



(a) (15 points) Find the net magnetic field (magnitude and direction) at point A. Show the direction of the magnetic field of both wires and the total magnetic field in the diagram.

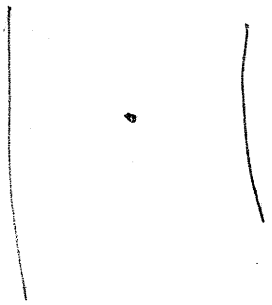


$$\frac{\mu_0 I_1}{2\pi r_1} + \frac{\mu_0 I_2}{2\pi r_2}$$

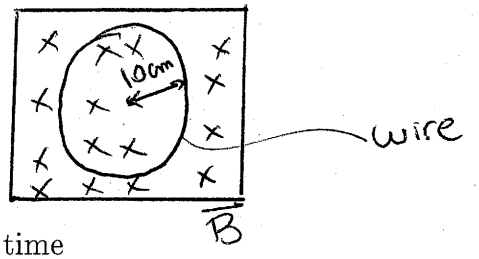
$$\frac{\mu_0}{2\pi} - \frac{9\times10^{-7}}{2\pi} = 2\times10^{-7}$$

$$2\times10^{-7}\left(\frac{5}{5} + \frac{5}{3}\right)$$

(b) (10 points) Relative to the wire 1, locate a point on the dashed line in the figure where the total magnetic field is zero.



2. A circular loop of wire is in a region of spatially uniform magnetic field as shown in the figure. The magnetic field is directed into the plane of the figure. Determine the direction (clock or counterclockwise or no current) of the induced current in the loop when (explain your reasoning):



(a) (5 points) B is increasing in time

(b) (5 points) B is decreasing in time

(c) (5 points) B is constant with value B_0

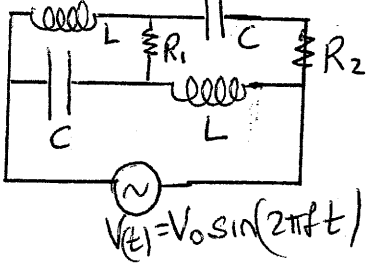
0

(d) (10 points) In the case of increasing magnetic field, calculate the magnitude of the induced emf if the loop has a radius of 10 cm, and the magnetic field goes from an initial value of 0T to a final value of 3T in a time interval of 0.1s.

$A = \pi \times (0.1)^2$ $\mathcal{E} =$

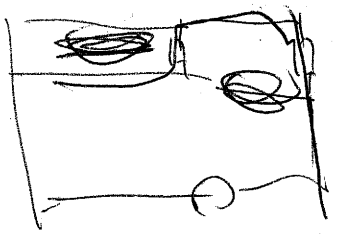
$\mathcal{E} = -N \frac{\Delta \Phi}{\Delta t} = 3 - N \frac{\pi (0.1)^2 \cdot 3}{0.1}$

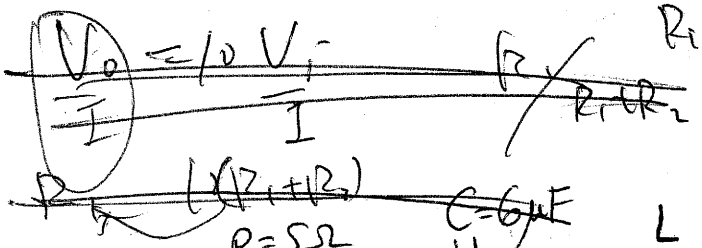
3.1 (16 points) In the circuit below, the generator delivers 10 times as much current at very low frequencies than it does at very high frequencies. Find the ratio $R_1/(R_1+R_2)$.

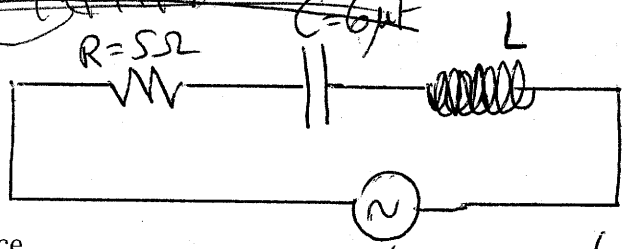


$f \to 0$, R_1 $\quad I_0 = 10\, I_\infty$

$f \to \infty$, $R_1 + R_2$ $\quad \frac{V_0}{I_0} = 0.1\,\frac{V_0}{I_\infty}$







3.2 (9 points) In the following circuit:

$V(t) = 10V \sin(2\pi f t)$

(a) (3 points) Find the impedance at resonance.

$X_C = \frac{1}{2\pi f C}$, $X_L = 2\pi f L$, $Z = \sqrt{R^2 + (X_L - X_C)^2}$

(b) (3 points) Find the value of L if the resonance frequency is $f_0 = 100$ Hz.

$f_0 = \frac{1}{2\pi}\frac{1}{\sqrt{CL}}$

(c) (3 points) Find the I_{rms} at resonance.

$I_{rms} = \frac{V_{rms}}{Z} = \frac{5\sqrt{2}}{\sqrt{2}\,Z}$

4.1 Consider a concave spherical mirror of focal distance 2m. An upright object of height 1.5 m is located at 2.5 m to the left of the mirror. Calculate:

(a) (5 points) The image distance

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \Rightarrow d_i = \frac{1}{\frac{1}{2} - \frac{1}{2.5}} = \frac{1}{0.5 - 0.4} = 10$$

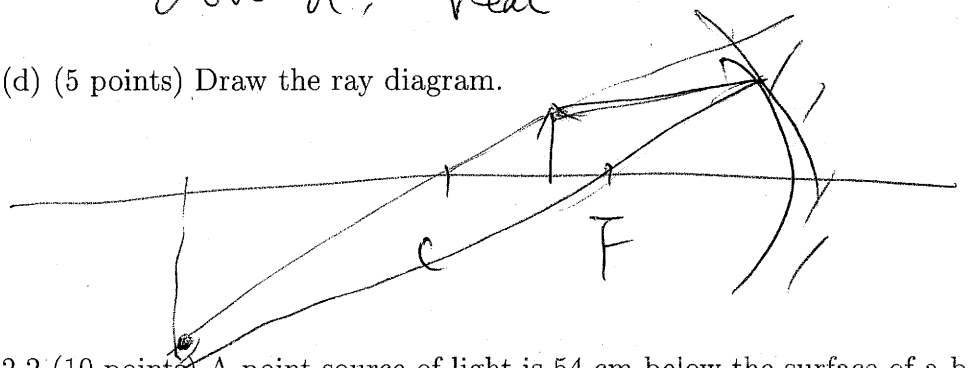
(b) (3 points) The magnification

$$m = -\frac{d_i}{d_o} = -\frac{10}{2.5} = -4$$

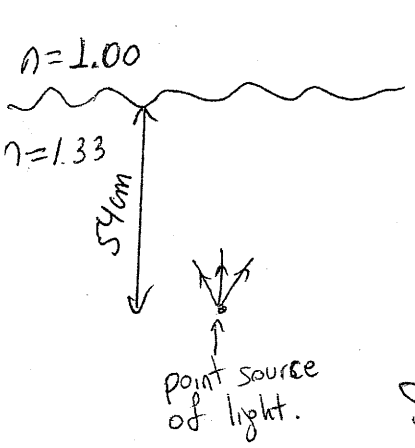
(c) (2 points) Is the image upright or downright, virtual or real?

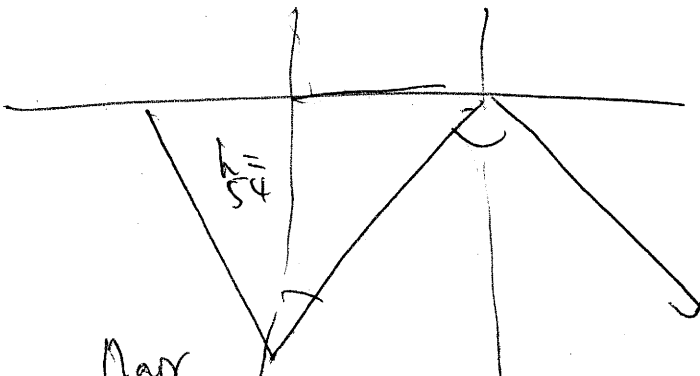
down n, real

(d) (5 points) Draw the ray diagram.



2.2 (10 points) A point source of light is 54 cm below the surface of a body water. Find the diameter of the largest circle at the surface through which light can emerge from the water. (Hint: think in terms of total internal reflection. $n_{water} = 1.33$).



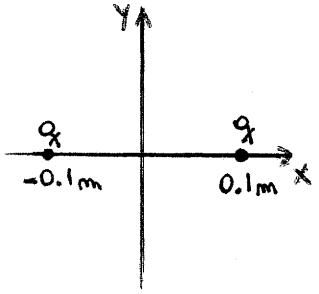


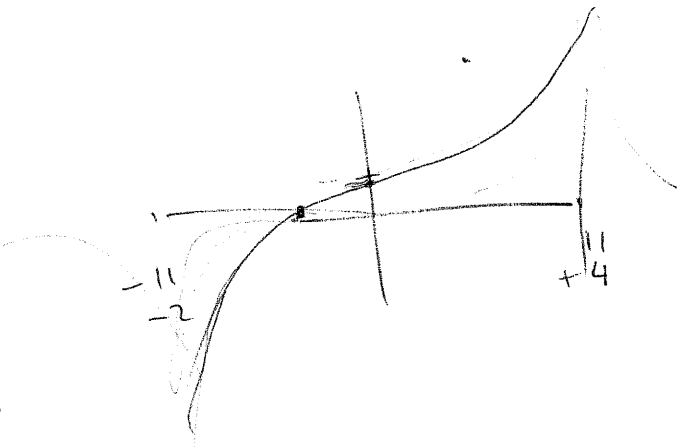
$$\sin\theta = \frac{n_{air}}{n_{water}} \Rightarrow \theta = \arcsin\frac{1}{n_{water}}$$

$$r = h\tan\theta = h\frac{\sin\theta}{\cos\theta} = h\frac{\sin\theta}{\sqrt{1-\sin^2\theta}} = h\frac{1}{\sqrt{\frac{1}{\sin^2\theta}-1}} = h\frac{1}{\sqrt{(1.33)^2-1}}$$

1a. 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 point 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.



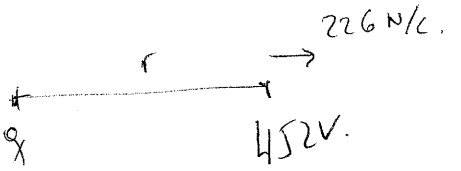


(1)

1b. 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?

(3)



$\frac{q}{r^2} = 226$

$\frac{q}{r} = 452$

$q = 452r$

$\frac{452r}{r^2} = 226$

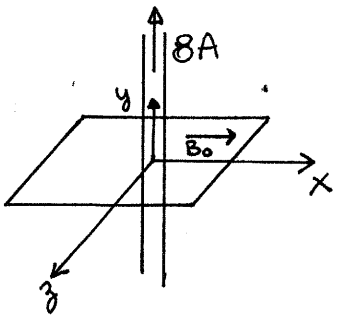
(4) Sketch of a dipole.

parallel plate.

2a. Magnetic force on a wire, and magnetic field.

A long straight, vertical wire carries a current of 8 A upward in a region with a horizontal and constant external magnetic field $B_0 = 6$ T in the $x-$direction as seen in the figure.

(i) What are the magnitude and direction of the magnetic force on a 1 cm section of the wire that is in this uniform magnetic field.

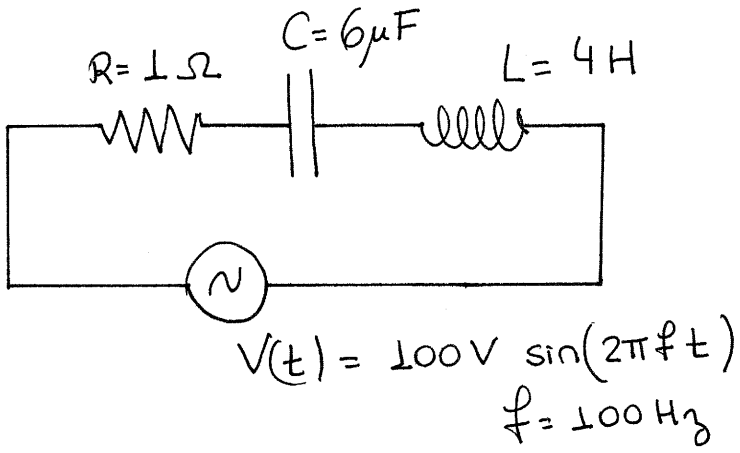


(ii) What is the **total** magnetic field (magnitude and direction) at the point $x = 2$ cm, $z = 0$, $y = 0$.

2b. Can a charged particle move through a magnetic field without experiencing a magnetic force? Explain

3. AC Circuits.

In the circuit shown bellow,



3a. Find the impedance

3b. The rms current

3c. The resonance frequency

4a. Diffraction from a single slit.

Monochromatic light from a distance source is incident on a slit 0.8 mm wide. On a screen 3 m away, the distance from the central maximum of the diffraction pattern to the first minimum is measured to be 1.25 mm. Calculate the wavelength of the light.

4b. Diffraction and interference.

An interference pattern is produced by two identical parallel slits of width a and separation (between centers) $d = 3a$. Which interference maxima m_i will be missing in the pattern.

4c. If a two-slit experiment were done with white light, what would be seen?

5. Relativity.

A spacecraft of rest-length 100m (as measured by a person on the spacecraft) travels away from earth with speed $0.7c$ relative to the earth.

5a. Calculate the length of the spacecraft as observed by a person in the earth.

5b. If a person in the spacecraft measures a time interval of 8s, calculate the measurement of the time interval for the observer in earth.

5c. The spacecraft fires a rocket towards the earth. The earth-based observer measures that the rocket is approaching with a speed of $0.2c$. Calculate the speed of the rocket relative to the spacecraft. At which velocity do the observer in Earth see the rocket move away from the spacecraft?

6a. The Bohr model.

(i) A hydrogen atom that is initially in the ground level absorbs a photon, which excites it to the $n = 3$ level. Determine the wavelength and frequency of the photon.

(ii) How much energy in electron volts does it take to ionize an electron in the hydrogen atom from the ground level?

(iii) A 12.09 eV photon is absorbed by the hydrogen atom. When the electron returns to the ground level ($n = 1$), what possible energies can the emitted photons have?

6b. Atomic structure. Quantum mechanics.

According to the atomic model in quantum mechanics, write down the 18 possible sets of the 4 quantum numbers (n, l, m_l, m_s) of the hydrogen atom with $n = 3$.

7a. Nuclear Physics.

The only two stable nuclides with more proton than neutrons are ${}_1^1H$ and ${}_2^3He$. Why is $Z > N$ so uncommon?

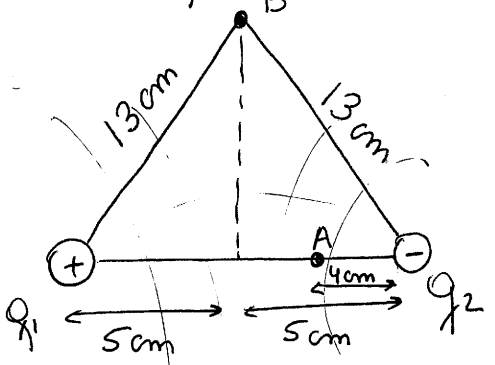
7b. Radioactive decay.

The number of radioactive nuclei present at the start of an experiment is 5×10^{10}. The number of nuclei 20 days later is 2×10^9. What is the half-live (in days) of the nuclei?

Quiz 4 Chapter 19 and 20

NAME:

1) An electric dipole consists of two point charges $q_1 = 12\,\mu C$ and $q_2 = -12\,\mu C$, placed 10 cm apart.



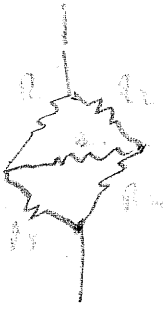
Compute the potentials at points A and B by adding the potentials due to either charge.

at B $V = 0$.

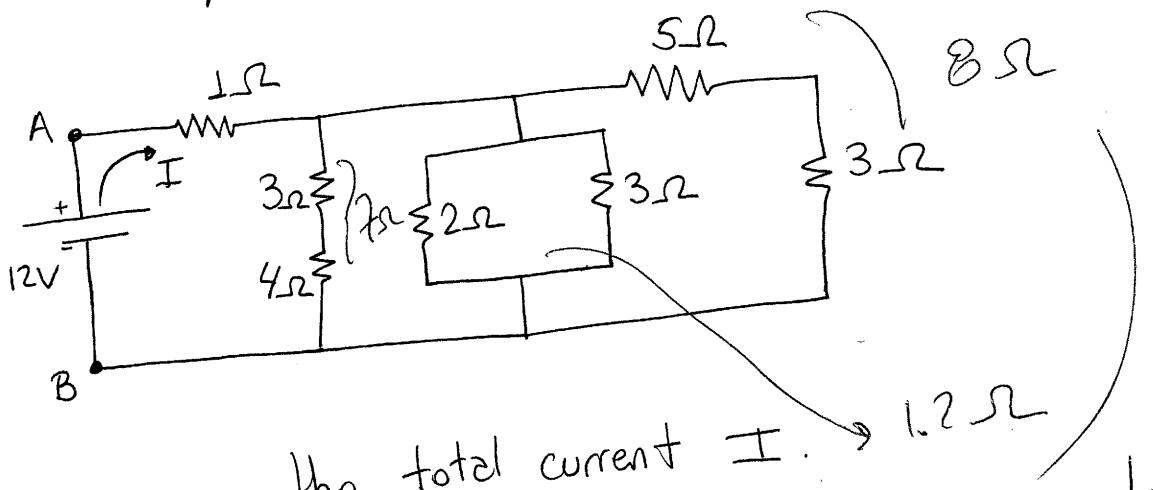
at A $V = \frac{8.9\,10^9\,\frac{Nm^2}{C^2}\;12\,10^{-6}\,C}{6\,10^{-2}\,m} \times \oplus - \frac{8.9\,10^9\,\frac{Nm^2}{C^2}\;12\,10^{-6}\,C}{4\,10^{-2}\,m}$

$- 6.7 \times 10^7$

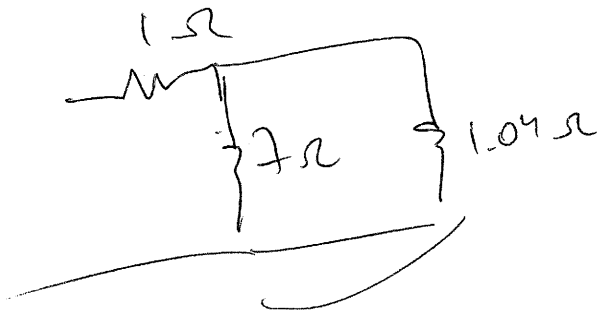
$V = -890{,}000\ V$



2)(a) Determine the equivalent resistance between the points A and B :



(b) Determine the total current I.



0.9Ω

1.9Ω

$V = IR$

$I = \frac{12}{1.9\Omega} = 6.28A$