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Physics 1C Sample Tests and Problems

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Physics 1C Test 1

1. BALANCE
You wish to use gravity and electrostatic fields to trap an electron. As a first step in your calculations how many coulombs should you put on a point .016 m below the electron to just cancel out gravity? q electron = 1.6 E-19 coulombs, m electron = 9.11 E-31 kg, k=9 E9 n m square/clb squared

9.11E-31*9.8*.016*.016/9E9/1.6E-19

A. 6.29 E23, B. 5.19 E-24, C. 1.59 E-21,
D. (1.59 E-24), E. 7.95 E-25

2. LINE CHARGE
Find the electric field at the origin due to a line of charge along the x axis from x=4.7 m to x=10 m. The charge density is 1.1 E-10 clb/m.

— 9E9*1.1 E-10*(1/4.7-1/10)

A. .0396, B. .0755, C. (.112), D. .166, E. .44

3. G TO C
Show how Cooulomb's Law follows from Gauss' Law. Explain carefully.

4. SPHERE CHARGE
Find the electric field 2.5 m from the center of a region of space with a charge density given by ro=5.5 E-15 R**(2.3).

5.5 E-15*2.5**(2.3+1)/(8.85E-12*(2.3+3))

A. .000605, B. .0013, C. .00182, D. (.00241), E. .00828

5. E FROM PLANE
Show that the electric field produced by an infinite conducting plane is given by sigma/epslon zero where sigma is the charge per unit area. Explain VERY carefully.

6. CAVITY
A spherical region carries a uniform charge per unit volume ro. Let r be the vector from the center of the sphere to a point P within e sphere. (a) Show that the electric field at P is given by E=ro x r / x epslon zero). (b) A spherical cavity is created in the above sphere. Show that the electric field at all points within the cavity is E=ro x a / (3 x epslon zero), where a is the vector connecting the center of the sphere with the center of the cavity.

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Physics 1C Test 2

1. LINE POTENTIAL
Find the potential due to a charged line of charge density lambda. The point of interest is on the axis of the line, and a distance a from the near end of the line. The line is of length b. The potential is: k lambda ln((a+b)/a)

2. V VS R
Show that for two spheres connected by a conductar the ratio of the fields at the surfaces is given by E/e=r/R where one sphere has a radius R and field E and the other sphere has a radius r and field e.

3. SPHERE APPROXIMATION
Find the capacatence of two concentric spheres separated by a distance, d, small compared to their radius. Show that the capacatance is approximatly the same as the capacatance of two parallel plates with the same area and separation: ~~C=A/d~~. Use only C=q/V, Gauss' Law, and dV=E dx.

$C = A\varepsilon_0/d$

4. SHUFFLE C
Two capacitors (7.1 E-6 farads and .000036 farads) are connected in series and 10 volts is applied to the pair. The voltage is removed and the capacitors are connected in parallel, plus to plus. What is the new voltage?

20*7.1 E-6*.000036/(7.1 E-6+.000036)**2

A. 1.37, B. 1.67, C. (2.75), D. 4.93, E. 7.61

5. PARALLEL
Durive the equivelent resistance of two resistors connected in parallel.

6. R V CIRCUIT
A circuit has three parts, in series. Part 1 is a 130 volt battery, 12 ohms internal resistance. Part 2 is two resisters in parallel, 120 and 200 ohms. Part 3 has a 76 ohm resister in parallel with a 36 volt battery, reversed, 25 ohms internal resistance. How many amps of current flow through the 130 volt battery? Consider the plus direction to be the direction the 130 volt battery pushes current.

(130-36*76/(76+25))/(12+120*200/(120+200)+25*76/(76+25))

A. .448, B. .771, C. (.973), D. 1.07, E. 2.62

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Physics 1C Test 3

1. RC DERIVATION

Show that the charge on a capacitor C connected in series with a resistor R is given by Q=Q(initial) EXP(-t/RC)

2. CYCLETRON

You plan to build a large, cheap cycletron using the Earth's magnetic fiels (1 E -4 T) and orbiting just above the Earth's autmosphere (radius 5.9 E6 m). What energy, in volts, should protons be given to just circle the earth? q=1.6 E -19 clb, m = 1.67 E -27 kg.

1.6E-19*1E-8*5.9 E6*5.9 E6/2/1.67E-27

A. (1.67 E13), B. 1.93 E13, C. 3.26 E13, D. 5.35 E13, E. 7.1 E13

3. B FIELD OF LOOP

A circular loop of radius .15m is carring a current of 11 amps. Find the magnetic field on the axis of the loop at a distance of .63 meters. Start from dB=mu * i * dl * r /(4 * pi * r**3). mu=1.26 E-6

1.26E-6*11*.15*.15/(2*(.15*.15+.63*.63)**1.5)

A. (5.74 E-7), B. 9.91 E-7, C. 1.52 E-6, D. 1.68 E-6, E. 2.34 E-6

4. FLYING RING

Remember the demonstration with a magnetic coil connected to AC power and an aluminum ring. The ring was placed on top of the coil and, although aluminum is non magnetic, the ring was thrown to the ceiling. Explain 1. Why was there any force on the ring? 2. Why the ring went UP? Use clear diagrams and Faraday's Law.

5. LENS AND MIRROR, REAL

An object is 18 m to the left of a lens of 7.1 m focal length. A mirror of 13 m focal length is 110 m to the right of the lens. How far from the mirror is the image it forms?

13/(1-13/(110-7.1*18/(18-7.1)))

A. 5.83, B. 8.25, C. 12.2, D. (15), E. 32.5

J CROSS B GENERATOR

An ionized gas (a plasma) has a tempeture of 5,700 K. 11,000 K is about equal to 1ev of energy (1 electron charge times 1 volt). The plasma flows down a chanel of width .76 m with a velocity due to its energy (1/2 mv squared). There is a magnetic field of 2.4 T perpendicular to the flow of the plasma. The v cross B force will push electrons toward the wall. This motion charges the wall and produces an electric field opposing the v cross B force. What is the equilbrium voltage when the forces are equal? electron mass = 9.11 E -31 kg, electron charge= 1.6 E -19 clb.

.76*2.4*SQR(2*5,700*1.6E-19/9.11E-31/11000)

A. (778,000), B. 857,000, C. 1.81 E6, D. 2.32 E6, E. 3.43 E6

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Physics 1C Test 4

1. INDUCTANCE TWO

Show that the inductance of two parallel wires (radius a, separation of centers d, length L) carrying equal but opposite currents, is given by:

L = ((mu zero) 1/PI) LN((d-a)/a)

OR

Use the energy density of a magnetic field B*B/(2 (mu zero)) to show that the self inductance of a length l of a long wire due to the magnetic flux inside the wire is (mu zero) l / (8 PI). Assume the current distribution is uniform across the wire.

E=-L (di/dt)

2. LC OSCILLATION

Find the inductance required to oscillate at 1.3 E6 Hz with a .0011 farad capacitor. Derive the equation needed starting from the definitions of capacitors, etc. or from the definitions of reactance.

1/((1.3 E6*PIX(2))**2*.0011)

A. 5.49 E-12, B. 7.9 E-12, C. (1.36 E-11), D. 1.5 E-11, E. 4.16 E-11

3. PHASER

For an RC phaser diagram: Sketch and explain the diagram. Include the maximum and observed voltages. Use the diagram to find Z and delta for the power supply voltage in V=(i sub zero) SIN(omega t + delta).

4. LRC DRIVEN

A LRC circuit is driven by a source of 110 volts rms at 770 Hz. If L=.00088 henries and C=.000025 farads, what is the power delivered to a 9.2 ohm resister?

9.2*110*110/(9.2*9.2+(PIX(2*770*.00088)-1/PIX(2*770*.000025))**2)

A. (1,110), B. 1,300, C. 2,910, D. 3,150, E. 4,610

5. WAVE EQUATION

Show that E=E(x-vt) solves the wave equation "Del squared E = (mu zero) (epson zero) (the second derivitive of E with respect to time). Also show that v=the square root of one over (mu zero)(epson zero).

6. DURIVE DOPPLER

Durive the Doppler Effect for light starting from the relativistic

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Physics 1C Fifth Sample Test

1. C DIVIDER
A LRC circuit has an input voltage of 120 volts. R=7,100 ohms, L=7.7 E-6 Henries, and C=.00093 Farads. What is the voltage across the capacator for an input frequency of 7,900 HZ?

120/PIX(2*7,900)/.00093/SQR(7,100*7,100+(PIX(2*7,900)*7.7 E-6-1/PIX(2*7,900)/.00093)**2)
A. 9.43 E-6, B. .000183, C. (.000366), D. 2.97 E9, E. 6.63 E9

2. FORM OF A TRAVELING WAVE
Show that E=E(x-vt) is a traveling wave and satisifies the wave equation: del squared E=(mu zero)(epslen zero) second partial of E/second partial of t.

3. E, B, AND C
Given that del cross E=- partial B / partial t and that E(x-ct), B=B(x-ct) show that E, B, and c are mutually perpendiculer for electromagnetic waves.

OYNTING'S VECTOR
Show that the power entering a resister is given by i*i*R according to Poynting's vector. V=iR, E=V/L, Integral(B dl)=mu i

5. WAVE GUIDE, SHORT
Show how to construct a wave that satisifies the boundry conditions of a wave guide and satisifies the wave equation: Del squared E =(1/c squared)(second partial E/second partial t).