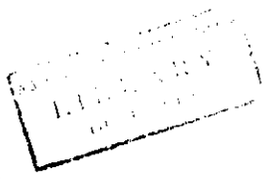
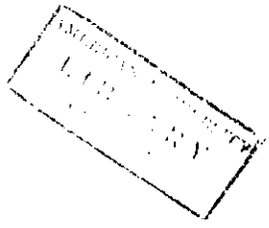
Physics Department | **Physics 205** **Final Exam** **Summer Course** | **August 23, 1999** **Time: 2 hours**



Christidis El-Eid



Name:_____

I.D. No. _____

- No make up of this exam without legal reason.
- Only one answer is allowed for multiple choice questions

Grade

Multiple Choice ...

P1) .....

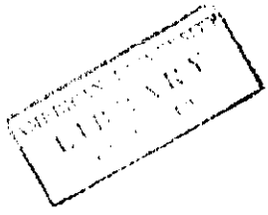
P2) .....

P3) .....

P4) .....

P5) .....

P6) .....



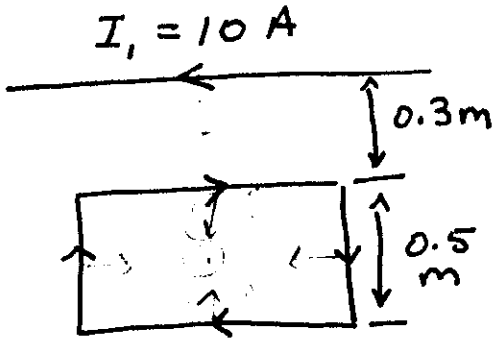
Total :

Physical Constants

$h = 6.626 \times 10^{-34}$ J.s	Planck Constant
$c = 3 \times 10^{8}$ m/s	Speed of light
$\mu_o = 4\pi \times 10^{-7}$ T. m /A	Permeability of free space
$K = 9 \times 10^{9}$ N.m^2/C^2	Coulomb Constant
$e = 1.6 \times 10^{-19}$ C	Elementary charge
$\lambda_c = 2.43 \times 10^{-12}$ m	Electron Compton wavelength
$R = 1.1 \times 10^{7}$ 1/m	Rydberg constant
1 eV = 1.6×10^{-19} J	

Multiple Choice Questions

- A long straight wire as shown in the Figure carries a current $I_1 = 10A$.
The current in the rectangular loop is $I_2 = 20$ A.
Select the right statement:
  a) The net magnetic force that acts on the current loop is zero.
  b) The net magnetic force on the rectangular loop is directed upward
  c) The net magnetic force on the loop is directed downward.
  d) The net magnetic force on the loop is directed to the right.
  e) none of the above, my answer is:_____



- A proton moving with a velocity $v = 6 \times 10^6$ m/s toward north, enters a region where the magnetic field of a magnitude B = 1.5 T points out of the page.
If the proton is to pass the magnetic field undeviated, an electric field is required, such that:
  a) $E = 3 \times 10^6$ V/m , to the right b) $E = 3 \times 10^6$ V/m, to the left
  c) $E = 9 \times 10^6$ V/m, to the left d) $E = 9 \times 10^9$ V/m, to the right

- Incident x-rays of wavelength 7.4×10^{-12} m are scattered through 180^0 by free electrons. The recoil energy of an electron is about (in keV):

  a) zero b) 41 c) 126 d) 167 e) 510

- A radioactive source has an activity of 500 μCi at time t = 0 .
After 32 days the activity is reduced to 125 μCi. The half-life time of this radioactive source is about (in days)

  a) 8 b) 4 c) 16

  d) None of the above, my answer is :_____days.

- A 3-Ω and a 1.5-Ω resistor are connected in parallel and this combination is wired in series to a 4-Ω resistor and a 10-V emf device. The current in the 3-Ω resistor is:

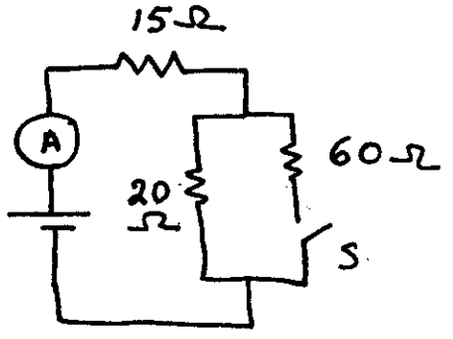
  a) 0.33 A b) 0.67 A c) 2.0 A d) 3.3 A e) 6.7 A

- A 2-μF and a 1-μF capacitor are connected in series and charged from a battery. They store charges P and Q, respectively. When disconnected and charged separately using the same battery, they have charges R and S, respectively. Then:

  a) R > S > Q = P
  b) P > Q > R = S
  c) R > P = Q > S
  d) R = P > S = Q
  e) R > P > S = Q
  f) None of the above

- When switch S is open, the ammeter in the circuit shown reads 2.0A. When S is closed, the ammeter reading:

  a) increases slightly
  b) remains the same
  c) decreases slightly
  d) doubles
  e) halves



- Two large parallel conducting plates are separated by a distance d, placed in a vacuum, and connected to a source of potential difference V. An oxygen ion, with charge 2e, starts from rest on the surface of one plate and accelerates to the other. The final kinetic energy of this ion is (e denotes the electron charge):

  a) eV/2 b) eV/d c) eVd d) Vd/e e) 2eV

- Charges q_1 and q_2 are on the x-axis, with q_1 at x = a and q_2 at x = 2a. For the net a force on a another charge at the origin to be zero, q_1 and q_2 must be related by q_2 = :

  a) $2q_1$ b) $4q_1$ c) $-2q_1$ d) $-4q_1$ e) $-q_1/4$

- For a singly ionized helium, the wavelength associated with a transition from n = 2 to n = 1 state is about (in nm):

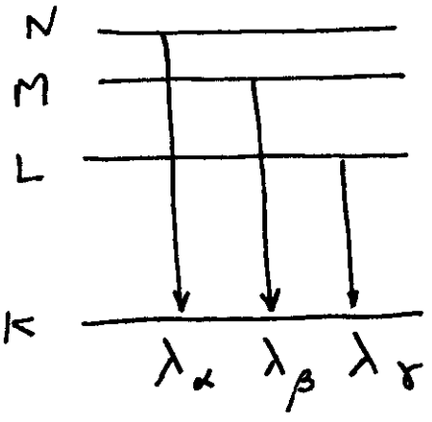
  a) 20 b) 30 c) 121 d) 61

  f) none of the above, my answer is:_____

- The x-ray line spectrum of the element Tungsten (Z = 74) contains wavelength of $\lambda_\alpha = 0.0185$ nm, $\lambda_\beta = 0.0209$ nm, and $\lambda_\gamma = 0.0215$ nm.
  The ionization energy of the K-shell is 69.50 keV.
  The ionization energy of the M-shell is about (in KeV):

  a) 27.2 b) 13.5 c) 11.8 d) 10.1

  e) None of the above, my answer is: _____



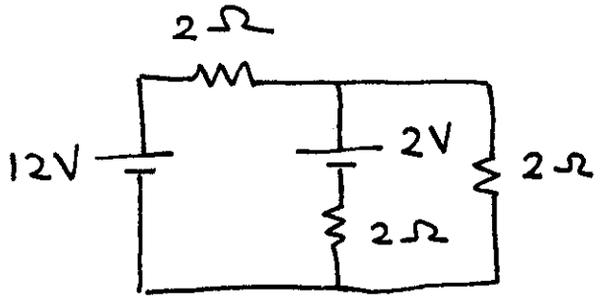
- A Sodium nucleus ($^{22}_{11}Na$) undergoes a β^+–decay.
  Write down the decay formula: $(_{12}Mg, _{10}Ne)$

  $^{22}_{11}Na \rightarrow$

Problems

P1) (10 P) In the circuit shown the batteries have negligible internal resistance. Find:

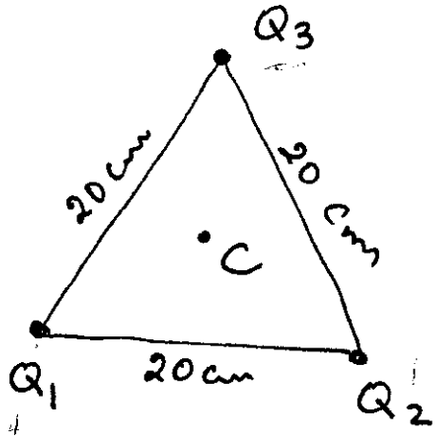
a) The power delivered by each battery
b) The Joule power produced in the resistors
c) Show that energy is conserved.



P2) (10 P) Three charges $Q_1 = +6.0\ \mu C$, $Q_2 = -6.0\ \mu C$ and $Q_3 = +6.0\ \mu C$ are located as shown

a) Find the force on Q_1
b) Find the electric field at C, (the center of the equilateral triangle).

c) Is there anywhere where the electric field is zero?



P3) (10 P) Two identical 4 μF parallel -plate capacitors are connected in series across a 24 V battery

a) What is the charge on each capacitor ?
b) What is the total energy stored in the capacitors?.

If a dielectric having a dielectric constant k = 5 is inserted between the plates of one the capacitors while the battery is still connected.

c) What is then the charge on each capacitor and the total energy stored in the capacitors.

P4) (10 P) The electron in a hydrogen atom makes a transition between two orbits $n_i \rightarrow n_f$, where n is the principle quantum number. The emitted photon strikes a metal surface whose work function is $\phi = 4.58$ eV, and his stopping potential is 7.51 V.
a) What is the value of n_f ? **(No grade if you don't show your work).**
b)What is the value of n_i ? **(No grade if you don't show your work)**

P5) (10 p) A 100 μF capacitor is charged to a potential of 100 V. At t = 0 it is discharged by Connecting a wire of resistance R = 0.04 Ω to its terminal.
a) Determine the time at which the voltage across the capacitor terminals will be 50 V.
b) What is the value of the initial current in the circuit after the connection has been established?

P6) (10 P) Two long straight parallel wires separated by a distance D = 2 m carry currents I_1 and $I_2 = 2I_1$ flowing in the same direction

a) At what distance from the wire I_1 is the magnetic field zero between the wires ?

c) Are there other points where the magnetic field is zero? (Justify your answer to get a grade)