Physics Department _ **Physics 205** June 25, 1999

Final Exam Time: 2 hours

Name:_____

I.D. No._____

Instructor's Name: [ ] El Eid [ ] Klushin

- No make up of this exam without a legal reason
- Only one answer is valid for multiple choice questions
- All questions are obligatory

Natural Constants:

Electron rest mass: $m_e = 0.511\ \text{MeV}/c^2 = 9.11\times10^{-31}\text{kg}$
Planck constant: $h = 6.626\ 10^{-34}$ J.s
Speed of light : $c = 3.0\ 10^{8}$ m/s
Electron charge: $e = 1.60\ 10^{-19}$ C
Permeability : $\mu_0 = 4\pi\ 10^{-7}$ T.m/A
Ionization energy of the H-Atom: $E_0 = 13.60$ eV

List of some elements

$_{36}$**Kr** , $_{37}$**Rb**, $_{38}$**Sr**
$_{39}$**Y**, $_{40}$**Zr**

Page	Grade	Page	Grade
2.		7.	
3.		8.	
4.		9.	
5.		10.	
6.		11.	

TOTAL

Part A: Multiple Choice Questions

1. A non-relativistic electron has a kinetic energy of 30 eV. What is the de Broglie wavelength of this electron?
(4 points)

Answer: _____

2. A proton is moving along a circular trajectory of radius R under the action of a uniform magnetic field B. The speed of the proton is $v = \frac{eBR}{m_p}$.

The work done by the magnetic field on the proton per one revolution is :
(4 points)

a) mv^2 b) zero c) $\frac{(eBR)^2}{2m_p}$

d) $2\pi R\, evB$ e) none of the above, my answer is _____

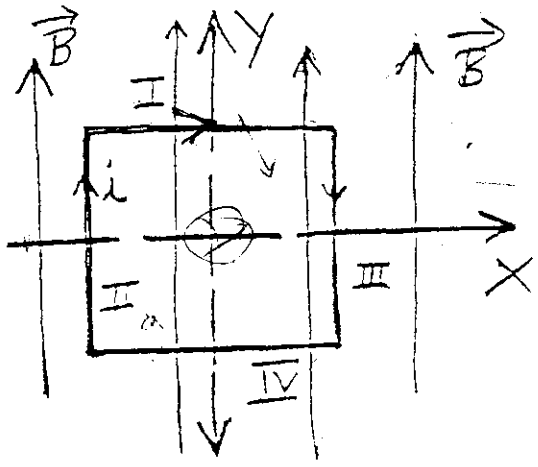
3. What is the number of electrons that can be accommodated in a 4f subshell :
(3 points)

(a) 5 (b) 8 (c) 14 (d) 18

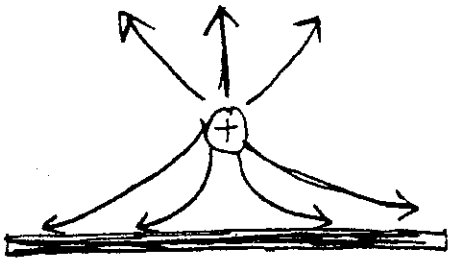
(e) none of the above, the answer is :_____

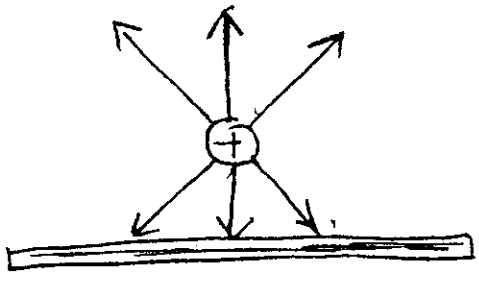
4) A square loop lies in the plane of the page and carries a clockwise current. The loop is placed in a uniform magnetic field $\vec{B}$ directed along the Y axis.
The loop will tend to rotate:
(3 points)

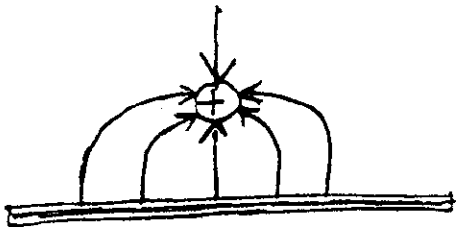
a) about the Y- axis with edge II going into the plane
b) about the Y- axis with edge II coming out of the plane
c) about the X- axis with edge I coming out of the plane
d) about the X- axis with edge I going into the plane
e) about the Z axis perpendicular to the plane of the page

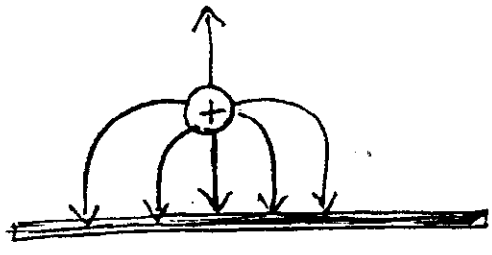


5. A positive point charge is placed near a very large conducting planar sheet carrying zero net charge.
Which of the following figures represents correctly the picture of the electric field lines (shown in cross-sectional view) ?
(4 points)

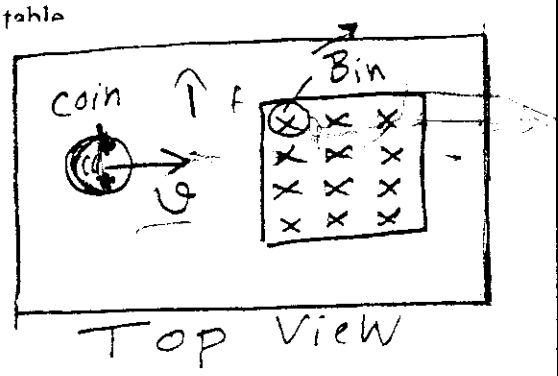








6. An <u>uncharged</u> copper coin slides on a horizontal frictionless table. On its way, it passes through a region of magnetic field oriented perpendicular to the surface of the table. After leaving the region of the magnetic field, the coin will : (4 points)



a) be deviated to the left
b) be deviated to the right
c) move with the same speed in the same direction
d) move in the same direction, but with a larger speed
e) move in the same direction, but with a smaller speed

7. A monochromatic light source radiates 30 W at a wavelength λ=480nm. The number of photons that are emitted by this light source per second is about: (4 points)

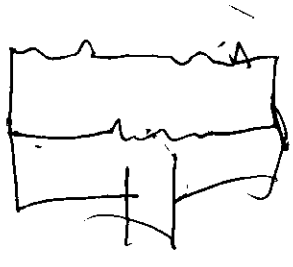
a) $4.8\ 10^{28}$ b) $2.4\ 10^{20}$ c) $4.8\ 10^{19}$

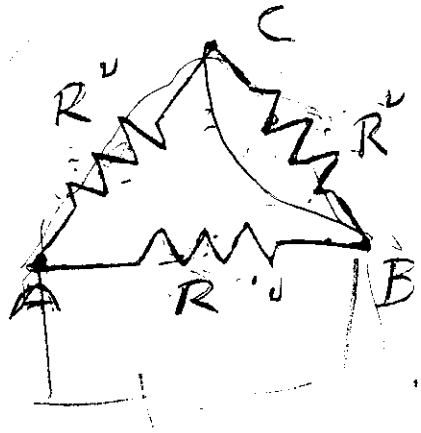
e) none of the above, my answer is _____

8. In the arrangement shown the resistances are identical R = 2 Ω. The resistance between the points A and B, R_{AB} is (in Ω): (4 points)

a) 1/3 b) 3 c) 2/3 d) 4/3

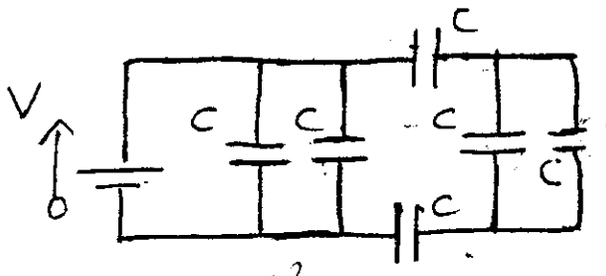
e) none of the above, my answer is : 3/4





9. Six identical capacitors C = 2 mF (mF=millifarad) are connected as shown in the Figure on the right and charged by a battery with V = 5.0 V.
The total energy stored by the capacitors is:
(4 points)

a) 30 mJ b) 20 mJ c) 60 mJ d) 120 mJ
e) none of the above, my answer is:_____



$E = \frac{1}{2} C \Delta V^2$

10. An electron travelling with a speed v in a circle of radius R is equivalent to a current of :
(3 points)

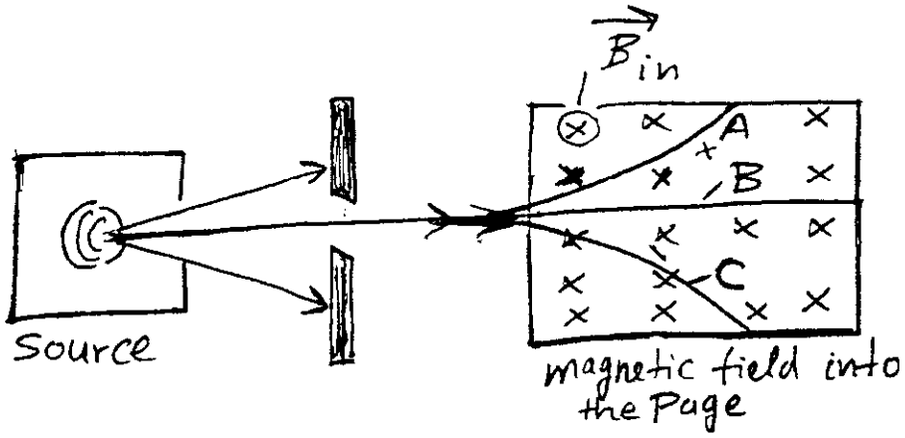
$F = BIl = \frac{mv^2}{r}$

a) $ev/2$ b) R/ev c) ev/R d) $ev/2\pi R$

(e) none of the above, my answer is:_____

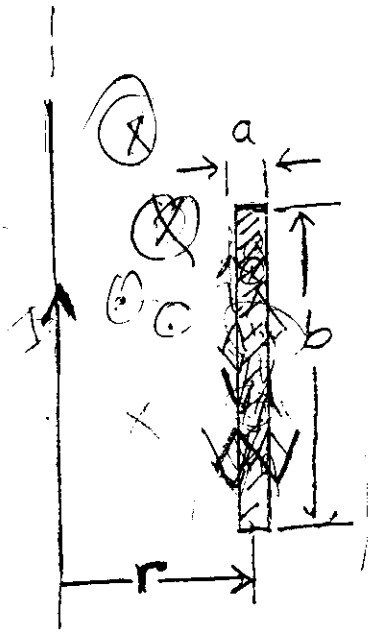
11. A radioactive source produces α, β^- and γ emissions simultaneously. They are distinguished by their behavior in a magnetic field as shown in the figure.
For each of the paths shown, identify the emission
(specify whether it is α, β^-, or γ)
(3 points)

Path A: _____
Path B: _____
Path C: _____



Part B: Subjective Problems

1. A very long straight wire and a rectangular loop are situated as shown in the Figure on the right, the distances are given as:



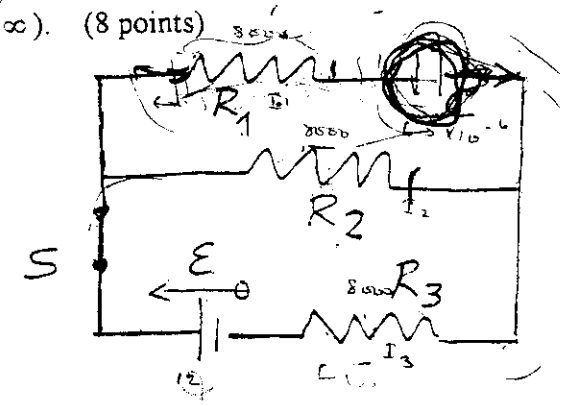
a = 1.0 cm; b = 20 cm; r = 10 cm.

The current in the wire increases at a constant rate $\frac{\Delta I}{\Delta t} = 5.0$ A/s. Assume that the width of the loop is small enough so that the magnetic field is the same at any point inside the loop. (8 points)

A. Find the magnitude of the induced emf in the loop

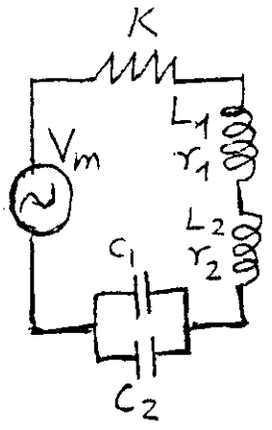
B. What is the direction (sense) of the induced current in the loop ?

2. In the circuit shown, $\mathcal{E} = 12$ V, $C = 6.5\ \mu$F, $R_1 = R_2 = R_3 = 8000\ \Omega$. The capacitor is initially uncharged. Consider the situation where the switch has been closed for a very long time ($t \to \infty$). (8 points)



A. Find the currents through each of the resistors I_1, I_2, and I_3:

B. Find the charge on the capacitor (in the same limit of $t \to \infty$).



$V_m = 250V$
$f = 1000\ Hz$
$C_1 = C_2 = 0.5\mu F$
$L_1 = 40\ mH$
$r_1 = 20\ \Omega$
$L_2 = 5.0\ mH$
$r_2 = 10\ \Omega$
$R = 60\ \Omega$

3. For the circuit shown in the Figure (12 points)

A. Find the **rms** current in the circuit

B. Find the average power dissipation in the circuit

C. Find the resonance frequency f_r for this circuit.

4. A sample of soil is contaminated by 2.5×10^{-12} g of radioactive strontium $^{85}_{38}Sr$. The activity of the sample is measured to be 2.2×10^{3} Bq.
(10 points)

A. Find the half-life for the decay of $^{85}_{38}Sr$

B. How long one would have to wait for the activity of this sample to drop by a factor of four ?

C. The radioactivity of $^{85}_{38}Sr$ is due to β^{+} decay. Write down the equation for this decay.