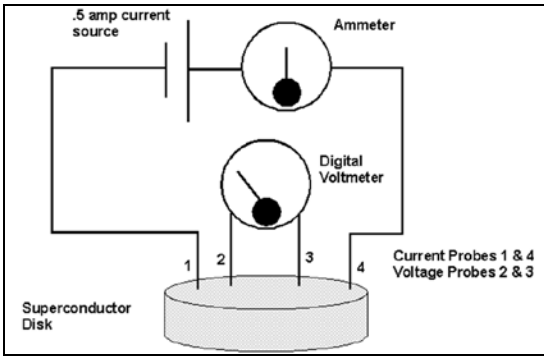
Physics 3950 (F18) Final Exam-a, Name_____, ID#_____, Score_____

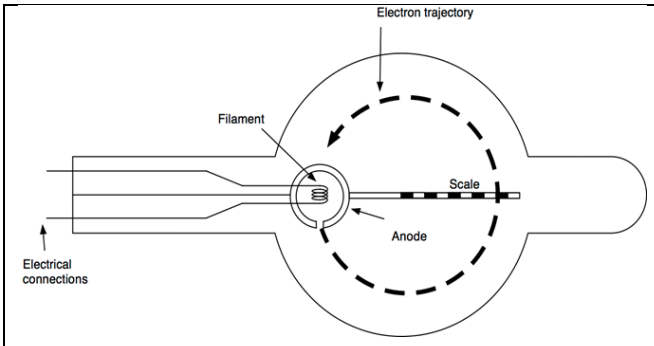
1. (**Superconductivity, 25%**)



a. As shown in left, a four probe arrangement was used in our superconductivity experiment. Indicate the current-source, voltage-meter, and ampere-meter in the diagram.

b. If 0.5 A current is injected into the superconductor under superconducting state, how many cooper pairs are been transported per second from the terminal "1" to "4"?
Ans. _____1.56 x 10^{18}_____

2. (**Charge-mass ratio of an electron 25%**)

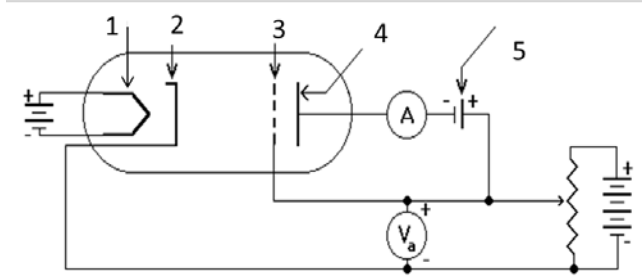


a. Indicate the direction of magnetic field either into or out from the paper based on the electron trajectory as shown in the left diagram.
Ans. B out from the paper

b. Estimate value for the error δR due to the fuzziness of the measured radius, δr = 0.001 m, with the assumptions of V = 100 volt, r = 0.01 m, and B = 0.5 T.

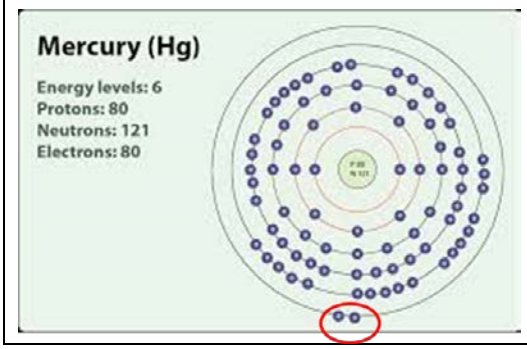
Ans. _____- 3.2 x 10^{6} C/kg _____

3. **(Frank-Hertz, Hg excited by energetic e-, 25%)**



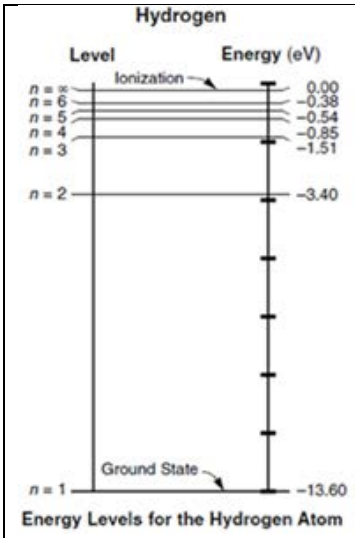
a. Identify the parts of 2 to 5 in the schematic diagram shown in left, used for our Frank-Hertz experiment:
   1. _heating filament___
   2. ___Cathode_____
   3. ___Anode (grid)_____
   4. ____Collector_____
   5. _____Retarding bias (voltage)_____

b. Can $|V_{4->5}| > |V_{3->2}|$ in your experiment? **Ans. Yes _____No____ X ___**

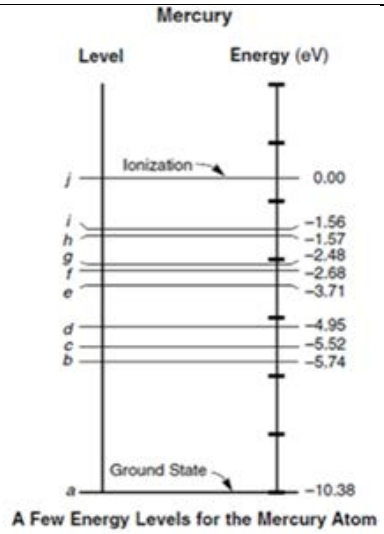


c. What is the value of principle quantum number, n?
Ans. _____6 _____

d. Circle the electrons involved in the inelastic scattering during your experiments in the schematic diagram shown in left.

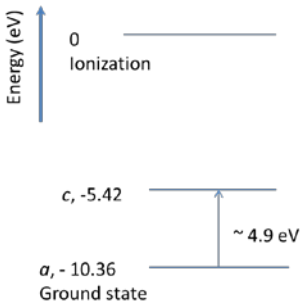


Energy Levels for the Hydrogen Atom

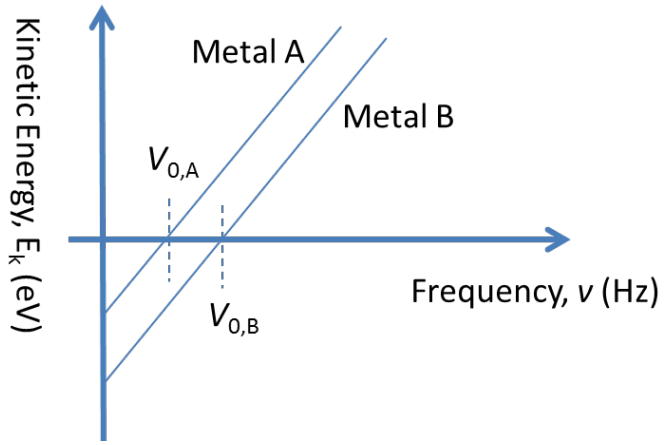


A Few Energy Levels for the Mercury Atom

e. Draw (below) an energy transition diagram for the electrons involved when Hg atoms are excited by energetic electrons based on the energy-diagram shown in left.



4. (**Photoelectric effect, 25%**)



Given:
$V_{0,A} = 5.3 \times 10^{14}$ Hz
$V_{0,B} = 5.6 \times 10^{14}$ Hz

Referring to the diagram shown in left as the measured photoelectric data (maximum kinetic energy vs. frequency) from the two metals (A and B), find:

a. the work-function for the metal A in eV,
Ans. ___2.2 eV ___

b. the work-function for the metal B in eV,
Ans. ___ 2.3 eV ___

Reference equations and constants:

Charge-mass ratio, *R*	R = e/m = 2V/(r^2B^2); The recommended value of R for an *electron* is $^{e}/_{m}$ =−1.758820024 (11) ×10^{11} C/kg.
Photoelectric effect	Planck constant, h = 6.626 x 10^{-34} J.s. 1 J = 6.242 x 10^{18} eV
Elementary charge value	e^- = - 1.6 ×10^{-19} C (coulombs)