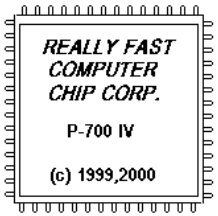
PHYS-115(3) (Kaldon-16406) **Name** _____
WMU - Winter 2001
Exam 2 - 100,000 points **Book Title** _____

Section: **3a** A to F **3b** G to M **3c** N to S **3d** T to Z 02/21/2001•Rev.3

State Any Assumptions You Need To Make -- Show All Work -- Circle Any Final Answers
Use Your Time Wisely - Work on What You Can - Be Sure to Write Down Equations
BOLDFACE Variables Are Vectors - Feel Free to Ask Any Questions

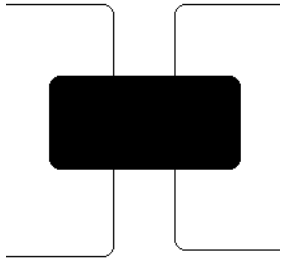
This 700 MHz Computer is Really *HOT! Yowch!* (50,000 points)



1.) One of the problems of modern computer chips is that the faster they run, the hotter they tend to get. Consider a chip that dissipates *12.5 W* of power when it is connected to a *5.00 V* battery. We don't really care exactly what is going on inside the chip – that's why we call computers "black boxes" – but we can treat the chip as a single device like a resistor as far as the battery is concerned. (a) What is the resistance, *R*, of the chip?

(b) Four of these chips are connected up to the *5.00 V* battery in parallel. Draw the circuit. What is the effective resistance, R_{1234}, of this circuit? *If you did not get an answer to (a), use R = 7.00 Ω for each resistor.*

(c) The resistivity of silicon is 640. Ω·m. One little structure is *3.00 μm long × 1.00 μm wide × 0.250 μm thick* (3.00×10^{-6} m long × 1.00×10^{-6} m wide × 0.250×10^{-6} m thick) – the current flows across this little "silicon bridge" from left to right. Find the resistance of this structure.



(d) Inside computer chips there are both resistors and capacitors. Assume that the chip consists of a resistor *R* in series with a capacitor *C*, and has a time constant $\tau = 1.423$ *nanoseconds* $= 1.423\times10^{-9}$ *sec*. What is the value of the capacitor, *C* ? *If you did not get an answer to (a), use R = 7.00 Ω.*

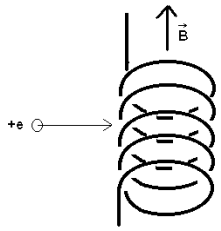
(e) For a capacitor in an RC circuit with a time constant $\tau = 1.423$ *nanoseconds* $= 1.423\times10^{-9}$ *sec*, at time *t=0* the capacitor is fully charged with ±125,000,000 electrons on the two plates. Find the time it takes for the charge on the plates to reduce to ±12,500,000 (or 10% of the original value).

"Coil, Coil, Magnet and Trouble" WITH APOLOGIES TO WILLIAM SHAKESPEARE (50,000 points)

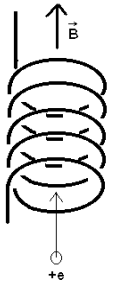
2.) A solenoid has its magnetic field in the center, $\vec{B}$, heading straight up. (a) Use Right Hand Rule to determine whether the current in the coil comes out the wire at the top or out the wire at the bottom.

The magnetic field points in the positive *y*-direction with a magnitude $B_y = +1.45\ T$. A proton, $q = +e$ and mass $m = 1.67\times10^{-27}\ kg$, is moving at a speed $v = 1550\ m/s$. Find the force on the proton for the two cases where:

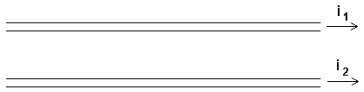
(b) the proton is moving in the positive *x*-direction and …



… (c) the proton is moving in the positive *y*-direction.



(d) Two current carrying wires are 1.55 m long and separated by a distance of 0.375 m. Find the magnitude and direction of the magnetic force <u>of wire 1</u>, $i_1 = 2.33\ A$, <u>on wire 2</u>, $i_2 = 3.73\ A$.



(e) Remember Dr. Megaohm? He was the evil villain trying to kill James Bond in one of the sample exam problems. He had a resistance of 1,000,000 Ω and was connected to a voltage source of 100,000 V. Suppose we want to measure the voltage drop across Dr. Megaohm. Using the galvanometer (generic meter) shown here, how would we hook up the meter so that it will read full-scale deflection? Draw the appropriate circuit either in series or parallel with the galvanometer, G, using all the components below. Then find R.

The galvanometer has a full-scale deflection current of 4.72×10^{-4} A.