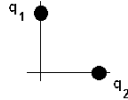


**State Any Assumptions You Need to Make -- Show All Work -- Circle Any Final Answers**  
**Use Your Time Wisely - Work on What You Can - Be Sure to Write Down Equations**  
**BOLDFACE Variables Are Vectors - Feel Free to Ask Any Questions**

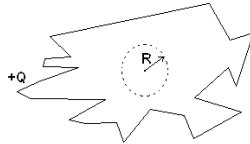
**It's Game Show Physics Time! Jeopardy? Family Feud? No... it's... (50,000 points)**

1.) Two charges,  $q_1 = q_2 = +0.500 \text{ C}$ , are located at  $y = +2.00 \text{ m}$  and  $x = +2.00 \text{ m}$  respectively. (a) Find the net Electric field,  $\vec{E}$ , at the origin ( $x = y = 0$ ).



(b) Find the magnitude of the force of  $q_1$  on  $q_2$ .

(c) Consider a solid hunk of metal that is very irregularly shaped. A charge  $+Q = 5.00 \text{ C}$  is placed on the metal. Use Gauss' Law to find the magnitude of the electric field,  $E$ , on a Gaussian sphere of  $r = R$ , as shown.

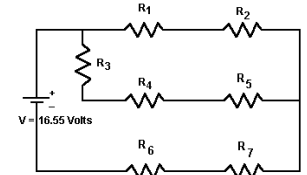


(d) Use Gauss' Law to find the magnitude of the electric field,  $E$ , of the hunk of metal at a point  $r = 100 R$  from the center.

(e) How do you make a charge of  $+Q = 5.00 \text{ C}$  on a hunk of metal?

**Who Wants to Win a Million Dollars? (50,000 points)**

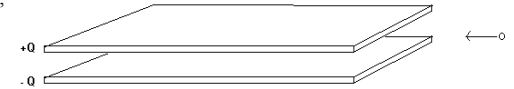
2.) All of the resistors in the circuit shown are  $R = 100. \Omega$ . Consider the three resistors along the right hand side ( $R_2, R_5, R_7$ ) which, for the record, are *not* in parallel with each other. (a) Which of the three resistors sees the largest current? Why?



(b) Which of these three resistors generates the most heat? Why?

(c) Find the equivalent resistance of this circuit. *Note: you don't have to do part (c) first to answer (a) or (b). If you want more room, use the back of page 7.*

(d) A parallel plate capacitor consists of plates that are  $0.100 \text{ m} \times 0.275 \text{ m}$ , separated by  $0.0350 \text{ m}$ . If this capacitor is charged up with a  $12.0 \text{ V}$  car battery, what is the charge on the plates,  $\pm Q$ ?



(e) An electron is shot in between the plates as shown, moving to the left. Find the magnitude of the electric force,  $F_E$ , and tell whether the electron is accelerated *Left, Right, Up, Down, Front* or *Back*.



This Michigan geek won \$2,180,000 last week. Yeah, you can win big, too, if you have no life. Have a great summer, everyone!

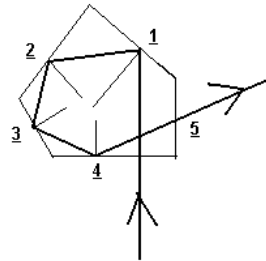
- Dr. Phil



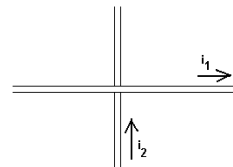
**“The Tribe Has Spoken” (50,000 points)**



3.) (a) A light ray in the air comes down the perpendicular at the bottom of the five-sided glass prism ( $n = 1.53$ ). The reflection angles are approximately as follows: 1.  $43^\circ$  2.  $47^\circ$  3.  $52^\circ$  4.  $65^\circ$ . Which of those four surfaces requires a silver mirror on the surface to force the reflection (circle them) and which don't need to be silvered (X them)?



(b) There's something wrong with the drawing at 5. Correctly describe the problem for 5000 pts. Show the correct direction of the ray for 8000 pts. Or calculate the correct angle in air for 10,000 points. *If you assume that the lower right corner of the prism is a right-angle, you have enough information to solve the puzzle, Pat.*



(c) Two 1.25 m long segments of wire cross over each other as shown, separated by a distance  $d = 0.0250$  m (about an inch). If  $i_1 = 1.25$  A and  $i_2 = 2.50$  A, then find the magnitude of the magnetic force of wire 1 on wire 2.

(d) A thin film of oil ( $n = 1.47$ ) is sitting on water ( $n = 1.33$ ), above the oil is air. If the thin film is a “half-wave” thickness, then if you were directly above the surface looking down ( $\theta = 0^\circ$ ), then do you see glare or no reflection?



Amber uses sling shot to try to win the Immunity Challenge. Didn't work. She got voted off.

(e) A microwave has a wavelength  $\lambda = 20.0$  cm = 0.200 m. Find the frequency  $f$  of this wave.



**“You Are The Weakest Link – Goodbye.” (50,000 points)**



4.) (a) Most calculators work display ten digits. If your calculator does so, then  $\gamma = 1.000\ 000\ 001$  is the smallest *gamma* you can use to make any sort of a relativistic calculation. Solve the  $\gamma$  equation for  $\beta$ , and find the speed  $v$  that  $\gamma = 1.000\ 000\ 001$  corresponds to.

(b) If  $\gamma = 1.000\ 000\ 001$ , and the proper length  $L_p =$  one meter exactly then the Lorentz length contraction of the improper length would result in a change of length on the order of: a football field, a meter stick, the width of this dot •, the width of an atom or the width of the nucleus of an atom. Pick one and defend your answer.

(c) An electron in the helium ion  $\text{He}^+$  jumps from the  $n = 2$  orbit to the  $n = 3$  orbit. Find the radius of the new orbit and indicate whether a photon of light was ABSORBED or EMITTED by the electron to make the jump.

24
Cr
Chromium
51.9961

(d) Given the information from the Periodic Table shown here, what isotope of chromium is likely to be the most common? Write the isotope's complete symbol down, then indicate how many electrons, protons and neutrons that an atom of that isotope should have.

(e) The kinetic energy of a hydrogenic electron is  $KE = +\frac{Z^2}{n^2} E_0$ , where  $E_0 = 2.18 \times 10^{-18}$  J. For what element, with what  $Z$ , is the innermost electron ( $n = 1$ ) have a  $KE$  that is just relativistic? (Use  $KE = \frac{1}{2}mv^2$ .)



Host Anne Robinson – the rudest personality on TV, U.S. or U.K. tonight on NBC.



The smash U.K. game show hit *The Weakest Link* is on again