**PHYS-115(x) (Kaldon-xxxxx)** **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

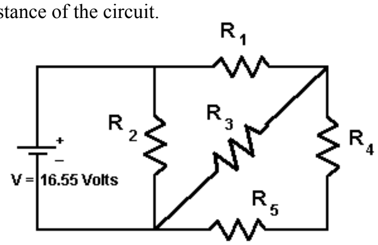
Sample Exam 01/23/2001•Rev.5

**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**

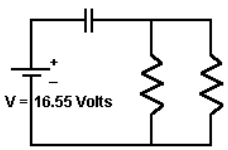
### Resistance to Physics Tyranny! (50,000 pts.)

1.) (a) The following circuit can be reduced to a single equivalent resistor by network reduction. At each step in the reduction, circle the resistors you are going to reduce, mark them as SERIES or PARALLEL, then draw the next equivalent circuit down to (and including) the final circuit.

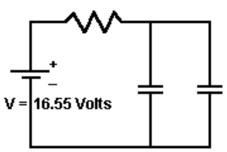
(b) If each of the resistors is 100. Ω, find the equivalent resistance of the circuit.




Consider the following two RC circuits marked (I) and (II). In each case the resistors are 155Ω and the capacitors are 155 µF. (c) Calculate the time constant $\tau$ for each circuit and circle the circuit which has the LARGER time constant.




(I)




(II)

(d) Which of the RC circuits (I) or (II) has the larger initial current $i_0$ ? Which has the larger maximum charge $Q_0$ ?

(e) You are given two square metal plates with sides $a = 10.0\ cm$. Design an air filled capacitor, such that when hooked up to a 12.0 volt car battery and fully charged, it will spark across the gap and discharge. What is the capacitance $C$ of this badly designed capacitor? *Do not say that the answer is zero… (grin).*

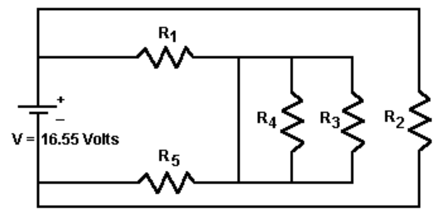


### Misdirection in Circuit Diagrams (50,000 points)

2.) (a) A circuit dissipates 125 W of power. Find the current $I$ that comes out of the 16.55 volt battery and the resistance $R$ of the entire circuit.

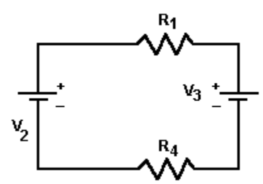
(b) The real battery $V = 16.55$ *volts* consists of a perfect battery with emf $\mathcal{E}$ and an internal resistance $r = 1.00\ \Omega$. Find the electromotive force $\mathcal{E}$ .

(c) The first two questions did *not* require you to solve this circuit – but now you will have to. This circuit can be reduced to a single equivalent resistance, which we know above is $R$. If each of the resistors $R_1$ through $R_5$ has a resistance $A$, then find $A$. *If you did not get an answer to (a), use R = 100. Ω.*



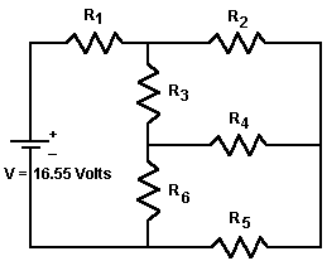

(d) Since all the resistors are identical, which one(s) is/are the most vulnerable to burning out? And why?

(e) The following circuit cannot be reduced by network reduction. There are two equations you would use to solve this. Identify the currents and then write down *BUT DO NOT SOLVE* the Kirchhoff loop equation and the one other equation you would need to solve this circuit.

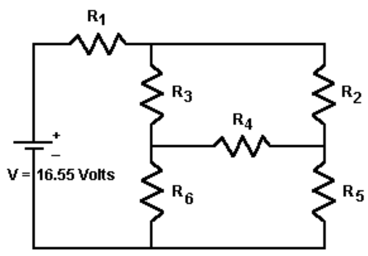


## Not Everything Is As It Seems (50,000 points)

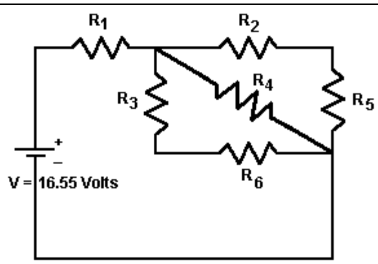
3.) (a) Consider the six circuits on this page (A - F). Which of these circuits are really the same?
(b) Which of these circuits can be solved with series/parallel network reduction? A B Ⓒ D E F



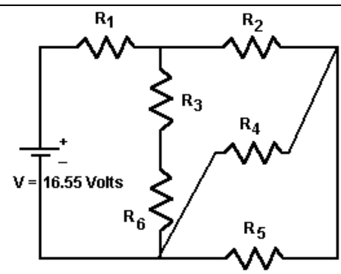

Circuit A




Circuit B

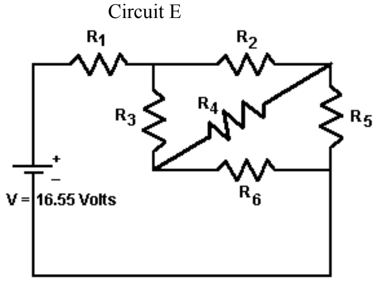



Circuit C

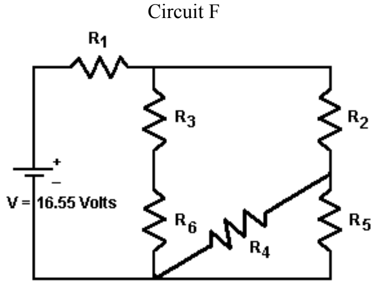



Circuit D

Circuit E




Circuit F




(c) If all the resistors are 100 W, find the current $I$ that the battery is delivering in Circuit C. *Show work either in margins on this page or on the Worksheet at end of exam.*
(d) Consider a box of 10,000. identical 1000. Ω resistors. Find the equivalent resistance if they first are all connected *in series*, or then if they are all connected *in parallel*.
(e) Two light bulbs connected in parallel dissipate energy when plugged into 115 volts of 60.0 W and 15.0 W respectively. Ignoring any change of their resistance due to temperature, what is the power of these two bulbs when connected in series to the 115 volts.



## *X-Men!* Mutants Rule… Courtesy of Hollywood and Marvel Comics (50,000 pts.)

4.) (a) Storm (one of the good guys) is fighting Toad (one of the bad guys). After zapping him with a lightning bolt, transferring a charge $q = -2.335 \times 10^{-4}\ C$, Toad (mass = 70.0 kg) is accelerated at 10.0 m/s² in the $+x$ direction. Find the magnitude and direction of the electric field $\vec{E}$ that Storm supplies to accelerate Toad.

(b) After 2.00 seconds, when Toad is moving at 20.0 m/s, Toad's boss Magneto (head bad guy) sends out a magnetic field, $\vec{B}$, to apply a magnetic force to cancel Storm's electric force on Toad. Find the magnitude and direction of this *B-field*.

(c) Can Magneto bring Toad to a stop in (b)? *Briefly explain. If you write a long paragraph you'll lose points.*


(d) Is the situation described in (b) a velocity selector for $\vec{v} = +20.0\,m/s\,\hat{i}$ as we described in class? *Briefly explain why or why not.*

(e) Storm stops the *E-field* and Magneto applies a new magnetic field of $\vec{B} = +4.00\,T\,\hat{k}$ on Toad moving at $\vec{v} = +20.0\,m/s\,\hat{i}$. Find the radius, $r$, of the turn that Toad makes and the time, $t$, that it takes for him to make a 180° turn. (And head good guy Professor Xavier smiles.)