

ARCH 631. Essay Model for Sample Exam

2) *Worth ~20% (~20 points)*

Compose a response to the following series of questions with no more than 2/3 of a page of text. The content will be graded in terms of the accuracy, completeness, and relevance of the ideas expressed. The form will be evaluated for clarity, organization, correct spelling and grammar, and legibility. Content will have higher worth than form. *Poor format will likely result in unrecognizable content.*

21. Three resistors $R_1 = 25$ ohms, $R_2 = 50$ ohms, and $R_3 = 75$ ohms each obey Ohm's law. These three resistors are connected in series to a battery that has negligible internal resistance. How do the currents, voltages and electrical power dissipated compare for the three resistors? How do the currents and voltages for the individual resistors compare to the battery voltage and to the current through the battery.

If the same resistors are connected in parallel to the battery, how do the currents, voltages and electrical power dissipated compare for the three resistors? How do the currents and voltages for the individual resistors compare to the battery voltage and to the current through the battery.

In which case, series or parallel, does the battery deliver the greater electrical power to the circuit? Give the reasoning behind your answer.

TEXT

Electrical circuits are looped pathways for electrons to flow. The battery provides stored energy to the circuit. If the resistors obey Ohms Law then the current, which is net charge over the time, is a linear function of the voltage. When there is a negligible internal resistance for the battery r , is 0 and can be excluded from the difference in potential so that the potential, V is equal to the voltage, ϵ . When there is a single loop with resistors connected in series, the current remains constant in the loop and will be related to the battery voltage divided by the sum of the resistance; in this case $i = \epsilon / (250 \text{ ohms})$. The power is defined as the product of i and ϵ , which would result in $P = \epsilon^2 / 250$.

When considering the individual resistors, the voltage for each resistor is $i25$, $i50$ and $i75$ with constant current, which are each less than the battery voltage of $i250$ (total)

When the resistors are connected in parallel, the current for each resistor is not identical, but is related to the voltage divided by the resistance: $i_1 = V / R_1$ so that the total

$i = V \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)$ results in a voltage of $i12$, when $i_1 = V/25$, $i_2 = V/50$ and $i_3 = V/75$ and

the voltage for each resistor is identical. The power dissipated for the three resistors will be $\epsilon^2/25$, $\epsilon^2/50$ and $\epsilon^2/75$, and not identical. The currents (V/R) of the individual resistors are all smaller than the current of the battery, while the voltages are all larger for the individual resistors than $i12$ through the battery.

The circuit with the resistors in parallel will deliver more power of $\epsilon^2/12$ than the circuit with the resistors in series of $\epsilon^2/250$.

COMMENTARY (or what knowledge I was thinking to myself to help me compose)

We know that resistors have a potential difference (V) with respect to the current (i) in the form of $R = V/i$. Ohms Law states that there is a linear relationship for a metallic conductor between potential (V) and current (i). Connecting the resistors in series means one after another so there is only one conducting path, and the current will be related to the battery voltage (ϵ) divided by the sum of the resistances: $i = \frac{\epsilon}{R_1 + R_2 + R_3}$. Power is defined as the current times the voltage:

$P = i\epsilon$. When there is no internal resistance in the battery, the voltage is the same as the potential, $V = \epsilon$. When the resistors are connected in parallel, the current will change with time for each resistor, so the equivalent resistance can be found with $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$