The electrical power dissipated by a resistor is given by P = I^2 R. It is also given by P = (Δ V)^2/R. So is the power really proportional to R or to 1/R or is neither really true? Discuss thoroughly.

Good discussion of relationships

These given equations describing electrical power dissipated by a resistor are neither really true. P=I^2R can be derived from the relationship determined in lab P=(I) delta V, where delta V= IR. Therefore, P= I^2 R. The equation for voltage can be manipulated so that the current (I) is equal to the voltage divided by the resistance. Using this value for I in the equation for power, P=(delta V/ R)(delta V) or (delta V)^2 /R. **The current and the change in voltage are referring to two separate entities**. Therefore the quantities [(delta V)^2/R] and (I^2R) are two separate entities as well. **So, it is not really true to say that P is either proportional or inversely proportional to R because it is ignoring the differences between electric potential and current**.

Truth is a practical issue here:

Neither is really true. When we set these two expressions equal to each other we get

I^2 R = (dV^2)/R From this we can then get I^2 R^2 = dV^2

If we then take the square root of each side, we get

dV = IR which is Ohms Law

As a result, **the power dissipated is not necessarily proportional or inversely proportional but is dependent upon the practicality and ease of use for the equation**.

Key question to ask always practically: what remains constant?

Power can be proportional to either R or 1/R depending on the situation. **If the current (I) is a constant value**, then P will be proportional to R as I^2 will stay the same. **If the potential difference (delta-V) is held constant**, then power would be proportional to 1/R as the numerator would stay the same.

Unlike the new, compact fluorescent bulbs, an ordinary light bulb is basically a thin wire filament that acts as a simple resistor. Estimate the resistance of such a bulb using some common numbers from ordinary household experience that previously may not have meant much to you. And look at the equations I gave you in the first question.

Straightforward application of the relevant formulas, clear algebra

Lets say an ordinary bulb is P=80 W, ΔV= 120 V
P=(ΔV)^2 /R

R=(ΔV)^2/P

=(120V)^2/80 W

=14400 V^2 / 80 W

appr. =less than 200 ohms=175 ohms

dp - note easier way to do math

R=(ΔV)^2/P

=(120V)^2/80 W

=(120V/80W) 120V

=(1.5V/W) 120V = 180 ohm

But what about the units?

One of the lightbulbs I use for a lamp is **70 watts** (or something like that, it doesn't really matter). This is powered by an outlet that provides a **110 V potential drop**. As power P = (delta V)^2/R, then R = (delta V)^2/P. So:

R = (deltaV)^2/P = (110 V)^2/(70 W) = (10000/70) V^2/W

So, approximately,
R = (10000/50) V^2/W
= (1000/5) (J/C)^2/(J/s)
= 200 (J*s)/(C^2)
= 200 V/A = 200 ohms

So, the wire filament has a resistance of around 200 ohms or so.

Charge is for a capacitor as what is for a resistor?
a. energy
b. power
c. current
d. potential