DC Circuits Introductory Self Test

(answers on second page)

1. A flashlight uses two 1.5 volt batteries in series with a single bulb. If the current drawn by the bulb is 50 mA, determine:
A. The effective resistance of the bulb
B. The power dissipated by the bulb
C. The life of the batteries if they are rated at 1 amp-hour

2. I like toasted bagels. It takes about 4 minutes to properly toast a bagel in my toaster oven. The oven is rated at 1500 watts. If NiMo charges me 11 cents per KWH, determine:
A. The energy used to toast the bagel (in KWH)
B. The yearly energy cost to toast one bagel per day.
C. The current drawn by the oven.

3. A certain chunk of material has a resistance of 100 Ohms. Determine the new resistance if:
A. The length is doubled.
B. The area is doubled.
C. The length and area are both tripled.
D. The material is altered so that its resistivity is increased ten fold.

4. An audio amplifier has an efficiency of 50%. The loudspeaker it drives has an efficiency of 10%.
A. What is the net efficiency?
B. For a loudspeaker output of 2 watts, what power must be drawn by the amplifier?

5. A 60 volt source feeds four series connected resistors. R1 is 100 Ohms, R3 is 500 Ohms, R4 is 200 Ohms. R4 also dissipates .5 watts. Determine:
A. The value of R2.
B. The voltage drop across each resistor.
C. The total power dissipated in the circuit resistors.

DC Circuits Introductory Self Test Answers

1. A. R=V/I 3 V/50 mA = 60 Ohms
B. P=I*V 50 mA * 3 V = 150 mW
C. 1 Ah/50 mA = 20 hours

2. 4 minutes = 4/60 = .0667 hours
A. .0667 hours * 1500 W = 100 wH (.1KWH)
B. 365 days/year * .1 KWH/day = 36.5 KWH/year. At $.11/KWH, cost = $4.01
C. I=P/V 1500 W/120 V = 12.5 amps

3. Remember: $R=\rho * \text{length/area}$
A. R is doubled to 200 Ohms.
B. R is halved to 50 Ohms
C. No change, still 100 Ohms
D. R is 1k Ohms

4. A. $\eta_{net} = \eta_1 * \eta_2$ $\eta_{net} = .5 * .1 = .05$ (i.e., 5%)
B. In other words, 2 watts is 5% of what?
$P_{in} = 2\ W * 1/\eta$ $P_{in} = 2\ W * 1/.05$ $P_{in}=40\ W$

5. Knowing R_4 and P_{R5}, you can find I: $P=I^2R$, or $I=\sqrt{P/R}$
$I=\sqrt{.5\ W/200\ Ohms}$ I=50 mA You can now find the drops on R1, R3, R4.
$V_{R1}=I*R1$ $V_{R1}=50\ mA * 100\ Ohms$ $V_{R1}=5V$
$V_{R3}=I*R3$ $V_{R3}=50\ mA * 500\ Ohms$ $V_{R3}=25V$
$V_{R4}=I*R4$ $V_{R4}=50\ mA * 200\ Ohms$ $V_{R4}=10V$

From KVL, sum of rises must equal sum of drops, so
$V_{R2}=E - V_{R4} - V_{R4} - V_{R4}$ $V_{R2}=60V – 5V – 25V – 10V$ $V_{R2}=20V$

You now know the drop across R2 and the current through it, so
$R2= V_{R2}/I$ R2 = 20 V/50 mA R2 = 400 Ohms

The total power is found using the total voltage applied and the total current drawn:
P = I*V P = 50 mA * 60V P = 3 W