Problem Set 11: Circuits and Ohms Law

11.1 [a] V = 2.55 V
I = 0.12A
V = IR
R = 2.55/0.12
= 21.3 Ohms

[b] V = 3.42 V
R = 147 kΩ
V = IR
I = 3.42/147000
= 2.33×10^{-5} Amps

[c] P = 1.60 W
R = 2 kΩ
$P = I^2R$
I = sqrt((1.60)/2000)
= 2.83×10^{-2}A

11.2 $R = 8.00 \times 10^{3}$ Ω
$I = 7.00 \times 10^{-3}$ A
V = IR
$= 7.00 \times 10^{-3} \times 8.00 \times 10^{3}$
= 56 V

11.3 V = 14 V
$I = 5.00 \times 10^{-1}$ A
V = IR
$R = (14)/(5.00 \times 10^{-1})$
= 28 Ω

11.4 I = 0.32 A
R = 4.7 Ω
V = IR
= 0.32 x 4.7
= 1.5 V

11.5 [a] As the resistance of the metal increases, the current through the metal will decrease according to ohms law.
V = IR

[b] As current passes through a heating element/resistor, energy is lost (P = I^2R). The lost energy heats up the material, increasing the average kinetic energy of the atoms inside the material. The higher the kinetic energy, the harder it is for electrons to pass through which results in a higher electrical resistance

[c] V = 240 V
I = 10 A
R = 240/10
= 24 Ω

[d] P = IV
= 10 x 240
= 2400 W

[e] During a brownout the supplied voltage drops below a certain voltage value (in this case 170v) while appliances continue to try and operate on the same amount of power. This leads to an increased current draw to maintain the power being supplied to the appliance. The resistance will change but only temporarily; as more current is drawn, material within the circuit heats up (11.5[a]).

11.6 [a] 1km = 18.1 ohms
R_T = (36/1000) x 18.1
= 6.50×10^{-1} Ω

[b] I = 1A
V = IR
= 1 x 6.50×10^{-1}
= 6.50×10^{-1} V

11.7 [a] 0 – 6 Amps

[b] R = 2/3
= 6.70×10^{-1} Ω

[c] The resistance of the component increases exponentially

[d] An increase in the power dissipated over the resistor (higher current)

11.8 When a bird perches on a single power line, the wire acts as a short circuit resulting in only a minute amount of current flow through the bird. This is because the resistance from one bird's foot to the other is very high compared to the low resistance of the power line which is designed to carry current.

11.9 [a] The lie detector should detect a decrease in resistance as a sign of lying. This is because sweat is more conductive than the human body because of the ionic salts that it's formulated of.

[b] As the resistance decreases, the amount of current drawn would increase

[c] V = 12 V
I = 3.50×10^{-2} A
R = 12/0.035
= 343 Ω