**ELECTRICAL AND ELECTRONIC TECHNOLOGY**

**RESISTIVITY PROBLEM SOLVING EXERCISES**

{**R = ρ L}**

**A**

**NOTE: This worksheet follows from the power-point lesson on Physical factors that**

 **affects the resistance of a conductor. It is recommended that the following**

 **problem solving questions be attempted.**

1. Calculate the length of copper wire, 1.5mm diameter, to have a resistance of 0.3Ω, given that the resistivity of the copper is 0.017µΩm.
2. The resistance of 7.7m of manganin wire, of uniform cross-section, 1.3mm2, is 2.6 Ω. Calculate the resistivity of manganin in ohmmeters.
3. In a test on a 100mm strip of copper, the resistance was found to be 171µΩ. The cross-sectional area is 9.92mm2. Calculate the resistivity of the copper.
4. A heating coil of power rating 10W is required when the p.d. across it is 20 V. Calculate the length of nichrome wire needed to make the coil of cross-sectional area of the wire used is 1 x 10-7m2 and the resistivity of nichrome is 1 x 10-6 Ωm.

**SOLUTION**

1. Calculate the length of copper wire, 1.5mm diameter, to have a resistance of 0.3Ω, given that the resistivity of the copper is 0.017µΩm.

Outline Info:

R = 0.3Ω L =?

ρ = 0.017 µΩm = .017 X 10-6 Ωm A =?

* since, d = 1.5mm = 1.5 x 10-3 m, we can find A
* A= πd2 = 3.14 x (1.5 x 10-3)2 = 3.14 x 2.25 10-6 = 7.065 x 10-6

 4 4 4 4

 **A = 1.77 x 10-6 m2**

**To find length, L**

**L = RA** = 0.3 x 1.77 x 10-6 0.3 x 1.77 x 10-6  **0.531**

 **Ρ** .017 X 10-6  **=** .017 X 10-6  = **0.017 = 31.2m**

Therefore, length, **L =** **31.2m**

**SOLUTION**

1. The resistance of 7.7m of manganin wire, of uniform cross-section, 1.3mm2, is 2.6 Ω. Calculate the resistivity of manganin in ohmmeters

Outline Info:

R = 2.6Ω L = 7.7 m

ρ =? A = 1.3mm2 = 1.3 x (10-3)2m

 Hence, **A = 1.3 X 10-6 m**

**ρ = RA**

 **L**

**ρ =** 2.6 X 1.3 X 10-6 = 3.38 X 10-6 = 0.44 X 10-6 Ωm = 0.44 µΩm

 7.77.7

Therefore , Resistivity**, ρ = 0.44 µΩm**

**SOLUTION**

1. In a test on a 100mm strip of copper, the resistance was found to be 171µΩ. The cross-sectional area is 9.92mm2. Calculate the resistivity of the copper.

Outline Info:

R = 171µΩ = 171 x 10-6Ω L = 100mm = 100 x 10-3m

ρ =? A = 9.92mm2 = 9.92 x (10-3)2m

 Hence, **A = 9.92 X 10-6 m**

**ρ = RA**

 **L**

**ρ = 171** x 10-6X 9.92 X 10-6 = 1696 X 10-12 = 16.96 X 10-12 =16.96 X 10**(-12- -3)** = 16.96 x 10-9 Ωm

 100 x 10-3 **100 x** 10-3  10-3

**Therefore, Resistivity**, **ρ = 16.96 x 10-9 Ωm**

**SOLUTION**

1. A heating coil of power rating 10W is required when the p.d. across it is 20 V. Calculate the length of nichrome wire needed to make the coil of cross-sectional area of the wire used is 1 x 10-7m2 and the resistivity of nichrome is 1 x 10-6 Ωm.

Outline Info:

P = 10 W; V = 20V; hence to find R;

P = V2/R: **R = V2/P** = (20)2/10 = 400/10 = 40Ω

Now:

ρ = 1 x 10-6 Ωm: A = 1 x 10-7m2 and R = 40 Ω

**To find length, L**

**L = RA** = 40 x 1.0 x 10-7 40 x 1.0 x 10-7  **40 x 10-1**

 **Ρ** 1.0 X 10-6  **=** 1.0 X 10-6  = **1 = 4m**

Therefore, length, **L =** **4 m**