PSC-4012 **Resistivity**

Answer all questions by referring to the appropriate formula/s.

1. What has greater resistance, a short fat wire, or a long skinny one?

A long skinny wire has more resistance.

$R = \frac{\rho L}{A}$ $\uparrow L \therefore \uparrow R$; $\downarrow A \therefore \uparrow R$

2. If we triple the length of a wire, how will this affect the resistance of the wire?

$R = \frac{\rho L}{A}$ $\uparrow L\ 3X \therefore \uparrow R\ 3X$

3. If we triple the cross-sectional area of the wire, how will this affect the resistance of the wire?

$R = \frac{\rho L}{A}$ $\uparrow A\ 3X \therefore \downarrow R\ \frac{1}{3}X$

4. If the radius of a wire is reduced by one half, then how is resistance affected?

$R = \frac{\rho L}{\pi r^2}$ $\downarrow r\ \frac{1}{2}X \therefore \uparrow R\ 4X$

5. What happens to a wire's resistance if its length is cut in half?

$R = \frac{\rho L}{A}$ $\downarrow L\ \frac{1}{2}X \therefore \downarrow R\ \frac{1}{2}X$

6. If the cross-sectional area of a wire is doubled, then how is the wire's resistance affected?

$R = \frac{\rho L}{A}$ $\uparrow A\ 2X \therefore \downarrow R\ \frac{1}{2}X$

7. If the diameter of a wire is doubled, then what happens to the resistance of the wire?

↑ d 2X ∴ ↑ r $\frac{1}{2}$X

$R = \frac{\rho L}{\pi r^2}$ ↑ r 2X ∴ ↓ R $\frac{1}{4}$X

8. If the length of a wire is reduced from 9m to 3m, then how is the wire's resistance affected?

9m → 3m
before after

↓ L $\frac{1}{3}$X ∴ ↓ R $\frac{1}{3}$X

$\frac{\text{after}}{\text{before}} = \frac{3}{9} = \frac{1}{3}$X

$R = \frac{\rho L}{A}$

9. Industrial machines require a great deal of **current**. To obtain this, do the industrial circuit wires need to be thicker or thinner than those in residential circuits? (hint… you will need to refer to the resistivity formula, and to Ohm's law)

$I = \frac{V}{R}$ For ↑ I need ↓ R

$R = \frac{\rho L}{A}$ For ↓ R need ↑ A

The industrial wires must be thicker.

10. Given that you need to use an extension cord for your lawn mower, should the cord be as long as possible, or as long as is necessary (i.e. as short as possible)?

It should be only as long as is necessary.

$R = \frac{\rho L}{A}$ For ↓ R need ↓ L

11. A space heater is plugged in using an extension cord which is one-third the thickness (⅓ the diameter) that it should be. Is the resistance of the cord used greater or less than the resistance of the recommended cord? By how much? How will this impact on the current drawn by the heater?

↓ d $\frac{1}{3}$X ∴ ↓ r $\frac{1}{3}$X

$I = \frac{V}{R}$

$R = \frac{\rho L}{\pi r^2}$ ↓ r $\frac{1}{3}$X ∴ ↑ R 9X → ↑ R 9X ∴ ↓ I $\frac{1}{9}$X

The current will be reduced by $\frac{1}{9}$X

12. Why is it important to use the recommended gauge wire in a circuit?

If you use a gauge that is thinner than recommended, then there will be too much resistance and the current will be less than what is required,