2024 Sec 4 Physics Assignment 15
Current of Electricity (Sample Solutions)

Reminders:

1. Use subscripts for similar quantities belonging to different components, e.g. R_1, R_2.
2. Write down the **basic formulae** before substitution.
3. Show all key mathematical steps clearly.
4. Evaluate your final answer!

AS 15

1 $I = Q / t$
Current in lightning = 120 C / 0.20 s = 600 A

2   (a)   Current through Resistor A = 2 × 0.5 A = 1.0 A
Same p.d. = $I_1 R_1 = I_2 R_2$

Note: Resistor A is connected in parallel to the path where point X lies.
Point X lies along a path with 2 resistors.
Therefore, the current through Resistor A will be twice that at X.

(b)   Current through Resistor B = 0.5 A + 1.0 A = 1.5 A
Resistor B is in series with the battery, where the two paths (one with Resistor A and one with point X) converge.

3   R $= \rho L / A = \rho L / \pi r^2$ $= (7.0 \times 10^{-7} \, \Omega \, \text{m} \times 600 \, \text{m}) / \pi (5.0 \times 10^{-4})^2 \, \text{m}^2$
$= 534.76 \, \Omega$
$= 530 \, \Omega$ (2 sf)

4   R $= \rho L / A = \rho L / \pi r^2$

R_x $= \rho L / A = \rho L / \pi r^2$ $= \rho L / \pi(d/2)^2$ $= 10 \, \Omega$

R_y $= \rho \, 2L / \pi \, (2d/2)^2 = \frac{2}{4} (\rho L / \pi(d/2)^2) = \frac{1}{2}(10 \, \Omega) = 5.0 \, \Omega$

5   Given $L_x : L_y = 4 : 1 => \frac{L_x}{L_y} = \frac{4}{1}$ and $D_x : D_y = 1 : 2 => \frac{D_x}{D_y} = \frac{1}{2}$

$R_x : R_y = \frac{R_x}{R_y} = \frac{\rho \frac{L_x}{A_x}}{\rho \frac{L_y}{A_y}} = \frac{L_x}{L_y} \times \frac{A_y}{A_x} = \frac{4}{1} \times \frac{\pi r_y^2}{\pi r_x^2} = \frac{4}{1} \times \frac{\pi(\frac{D_y}{2})^2}{\pi(\frac{D_x}{2})^2} = \frac{4}{1} \times \frac{(2)^2}{1} = 16$

6   (a)   Rheostat or variable resistor

(b)   (i) 0.053 A   OR   0.052 A

(ii) $R = V / I = 2.5 \, \text{V} / 0.053 \, \text{A} = 47 \, \Omega$ (2 sf)

(iii) $I = V / R = 2.5 \, \text{V} / 200 \, \Omega = 0.0125 \, \text{A} = 0.013 \, \text{A}$ (2 sf)

(iv) $I = 0.053 \, \text{A} + 0.0125 \, \text{A} = 0.066 \, \text{A}$ (3 d.p, not 3sf)