Q1- a) What is the resistance of a light bulb that uses 75 Watts at 115 Volts?
b) What is the current in the bulb in this situation?

The power dissipated P in a resistance R when a current I flowing through it by applying a voltage V is given by

$P = VI = I^2R = V^2/R$

Here the power of the bulb P = 75 Watt
The voltage across the bulb V = 115 V
Thus the current in the circuit is given by

$P = V^2/R$

Gives $R = V^2/P = 115^2/75 =$ **176.33 Ω**
And the current is given by

$P = VI$

Or $75 = 115*I$
Gives $I = 75/115 =$ **0.6522 A**

Q2- An electric heater is designed to consume 600 W when connected to a 120 V line. How much power is actually used if line voltage is only 110 V?

The resistance of the heater coil is given by the rated power as

$P = V^2/R$

Or $R = 120^2/600 = 24\ \Omega$
Now as the voltage is less, the power consumed at this voltage 110 V will be

$P' = V^2/R = 110^2/24 =$ **504.2 W**

Q3- A 6V, 3W light bulb connected across a 6 V battery draws a current of 0.480 A. Find the battery's internal resistance.

The resistance of the light bulb is given by its ratings as

$P = V^2/R$

Or $R = V^2/P = 6^2/3 = 12\ \Omega$
The internal resistance of the battery always comes in series with the battery. If the internal resistance of the battery is r then total resistance in the circuit will be R + r where R is the external resistance. Thus the current in the circuit is given by using Ohm's law as

$I = \mathcal{E}/(R + r)$

Or $0.480 = 6/(R + r)$
Gives $R + r = 6/0.480 = 12.5\ \Omega$
Substituting value of resistance of the bulb we get

$r = 12.5 - 12 = 0.5\ \Omega$

Thus the internal resistance of the battery is **0.5 Ω**

Q4- A 9 volt battery has 5 W internal resistance and is supplying current to a 25 W load. Find: a) the current. b) the terminal voltage of the battery. c) the power delivered to the load.

(a) The current in the circuit is given by

$$I = \frac{\varepsilon}{R+r} = \frac{9}{25+5} = 0.30\ \text{A}$$

(b) the terminal voltage of the battery is the same as the voltage across the external resistance, given by

$$V = IR = \frac{\varepsilon R}{R+r} = \frac{9*25}{25+5} = \mathbf{7.5\ V}$$

The power delivered to the load is given by

$P_L = V*I = 7.5*0.3 =$ **2.25 W**