VI-1

Unknown Resistor	l1 (cm)	l2 (cm)	$\sigma_l(cm)$	R3 (Ω)	Rm (DMM) (Ω)
A	50	50	0.05	149	148.78
B	50	50	0.05	215	213
C	50	50	0.05	385	383
D	50	50	0.05	981	982

To calculate Rx and its uncertainty, we use the formula:

Rx=R3(l2/l1)
Rx=R3(50cm/50cm)
Rx=R3.

$$\sigma_{R_x}=R3\left(\frac{1}{l1}+\frac{l2}{l1^2}\right)\sigma_l=R3\left(\frac{1}{50}+\frac{50}{50^2}\right)*0.05=R3(0.002)$$

For resistor A, Rx=R3=149Ω and $\sigma_{R_x}=R3(0.002)=149*0.002=0.298\,\Omega$
$R_x\pm\sigma_{R_x}=149\pm0.3\,\Omega$
Rm = 148.78Ω

For resistor B, Rx=R3=215Ω and $\sigma_{R_x}=R3(0.002)=215*0.002=0.43\,\Omega$
$R_x\pm\sigma_{R_x}=215\pm0.4\,\Omega$

Rm = 213Ω

For resistor C, Rx=R3=385Ω and $\sigma_{R_x}=R3(0.002)=385*0.002=0.77\,\Omega$
$R_x\pm\sigma_{R_x}=385\pm0.8\,\Omega$

Rm = 383Ω

For resistor D, Rx=R3=981Ω and $\sigma_{R_x}=R3(0.002)=981*0.002=1.962\,\Omega$
$R_x\pm\sigma_{R_x}=980\pm2\,\Omega$

Rm = 982Ω

As we can see, for each resistor, A, B, C, D, Rm and $R_x \pm \sigma_{R_x}$ lie <u>almost</u> in the same range. There is a slight discrepancy in the values, which causes Rm and $R_x \pm \sigma_{R_x}$ to be different by 1 or 2 Ω. This is because of manual errors during measurement. Also, another reason for discrepancies is because we considered the resistance of the Wheatstone bridge wire to be zero, but in reality that wire has some resistance. The lengths are not 100% accurate because we used a ruler to measure the lengths. Since it is not digital, it is accurate only up to 1mm. <u>The least calibration on the ruler is 1mm and therefore, we assumed</u> σ_l <u>to be 1mm/2, that is, 0.5mm. This could be another reason for the discrepancy in the resistances.</u>

VI-2

Unknown Resistor	l1 (cm)	l2 (cm)	$\sigma_l(cm)$	R3 (Ω)	Rm (DMM) (Ω)
A	50	50	0.05	147	148.78
B	50	50	0.05	214	213
C	50	50	0.05	380	383
D	50	50	0.05	980	982

To calculate Rx and its uncertainty, we use the formula:

Rx=R3(l2/l1)
Rx=R3(50cm/50cm)
<u>Rx=R3.</u>

$$\sigma_{R_x} = R3\left(\frac{1}{l1} + \frac{l2}{l1^2}\right)\sigma_l = R3\left(\frac{1}{50} + \frac{50}{50^2}\right) * 0.05 = R3(0.002)$$

<u>For resistor A</u>, Rx=R3=147Ω and $\sigma_{R_x} = R3(0.002) = 147 * 0.002 = 0.294\,\Omega$
$R_x \pm \sigma_{R_x} = 147 \pm 0.3\,\Omega$
Rm = 148.78Ω

<u>For resistor B</u>, Rx=R3=214Ω and $\sigma_{R_x} = R3(0.002) = 214 * 0.002 = 0.428\,\Omega$
$R_x \pm \sigma_{R_x} = 214 \pm 0.4\,\Omega$

Rm = 213Ω

For resistor C, Rx=R3=380Ω and $\sigma_{R_x} = R3(0.002) = 380 * 0.002 = 0.76\,\Omega$

$R_x \pm \sigma_{R_x} = 380 \pm 0.8\,\Omega$

Rm = 383Ω

For resistor D, Rx=R3=980Ω and $\sigma_{R_x} = R3(0.002) = 980 * 0.002 = 1.96\,\Omega$

$R_x \pm \sigma_{R_x} = 980 \pm 2\,\Omega$

Rm = 982Ω

Just like, VI-1, for each resistor, A, B, C, D, Rm and $R_x \pm \sigma_{R_x}$ lie almost in the same range. There is a slight discrepancy in the values, which causes Rm and $R_x \pm \sigma_{R_x}$ to be different by 1 or 2 Ω. This is because of manual errors during measurement. Also, another reason for discrepancies is because we considered the resistance of the Wheatstone bridge wire to be zero, but in reality that wire has some resistance. The lengths are not 100% accurate because we used a ruler to measure the lengths. Since it is not digital, it is accurate only up to 1mm. The least calibration on the ruler is 1mm and therefore, we assumed σ_l to be 1mm/2, that is, 0.5mm. This could be another reason for the discrepancy in the resistances.

Comparison table between DC and AC values:

Unknown Resistor	$R_x \pm \sigma_{R_x}\,\Omega$ For DC	$R_x \pm \sigma_{R_x}\,\Omega$ for AC
A	$149 \pm 0.3\,\Omega$	$147 \pm 0.3\,\Omega$
B	$215 \pm 0.4\,\Omega$	$214 \pm 0.4\,\Omega$
C	$385 \pm 0.8\,\Omega$	$380 \pm 0.8\,\Omega$
D	$980 \pm 2\,\Omega$	$980 \pm 2\,\Omega$

Clearly, the uncertainties for Rx, that is σ_{R_x} for both DC and AC values is the same. The Rx, for both DC and AC is almost similar.