Higher Wheatstone Bridges Answers

1. a) i) **Circuit A – low resistances**

True value of current passing through the resistor R_1 as the voltmeter has a very high resistance and the voltage across the resistor R_1 is true.

ii) **Circuit B – high resistances**

True value of current through the resistor R_2 and the voltage across the resistor R_2 is true as the voltage across the ammeter is so small in relation to the voltage across the resistor.

b) It will measure the resistance accurately regardless of the magnitude of the resistance.

2. a) A **Galvonometer,** which a **sensitive ammeter or voltmeter** can be used in the circuit.

b) 12.5kΩ.

c) 0V or 0A.

3. a) To protect the galvonometer from high out of balance currents or voltages.

b) i) To **short circuit** the resistor R_G at or near the balance point.

ii) It will make the **galvonometer more sensitive** to very small variations in current or voltage.

c) 1.75kΩ.

4. a) The ratio of the resistors in each arm of the bridge are not equal.

7/5 does not equal 4/8.

b) 2.52V.

c) To change one of the resistors so that the ratio of the resistors in each arm of the bridge are the same.

You could change the 7kΩ resistor to 2.5kΩ. => **2.5/5 = 4/8**.

5. a) L_1 = 60cm and L_2 = 40cm.

b) i)

R_X (kΩ)	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**
I (mA)	-0.8	**- 0.4**	0	+0.4	**+ 0.8**

ii) Current **(I)** against Change in Resistance **(ΔR)** is a **SLTO**.

iii) The **current** is **directly proportional** to the **change in resistance** from the balance point.

6. a) The ratio of the resistors in each arm of the bridge is equal.

The ratio of the resistors P and R is equal to the ratio of resistors Q and S.

This gives a reading of 0V on the voltmeter.

b) The pd of the battery does not affect the ratio of the resistors, and so the bridge will remain balanced and read 0V on the voltmeter.

7. a) 5Ω.

b) i) In resistor R_5, as R_5 has the greatest current through it.

ii) 14.4W.

c) i) Since $R_1 = R_2 = R_3 = R_4$, this is a balanced Wheatstone Bridge and there is no pd between A and C.

Therefore no current can flow.

ii) 1.2A.

8. a) R_t = 150Ω.

b) 24^{o}C.

9. a) 810Ω.

b) (851.6 ± 1.2)Ω.

c) A systematic uncertainty is one that will make all measurements made either too small or too big.

The equipment may not be properly calibrated and zeroed properly.

10. a) i) 1.8kΩ.

ii) When resistor Z is placed in parallel with Y the combined resistance is less than Y alone.

The output voltage will fall as the resistance and voltage are in direct proportion.

iii) Resistance of the parallel combination = 1.3kΩ.

Voltage across Z = 5.2V

b) i) A/B = C/D **OR** A/C = B/D.

ii) Voltage reading is directly proportional to the change in resistance from the balance point.

A(Ω)	**B(Ω)**	**V(mV)**
120	120	**0**
121	120	- 21
121	121	**0**
121	122	**+ 21**
121	119	**- 42**