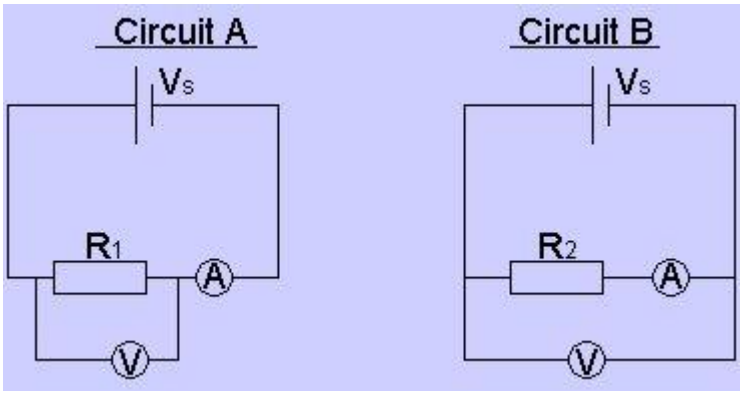
Higher Wheatstone Bridges Questions

1. The following circuits **A** and **B** are used to calculate the resistance of resistors $\mathbf{R_1}$ and $\mathbf{R_2}$.



a) **Explain in detail** which circuit is used to measure:

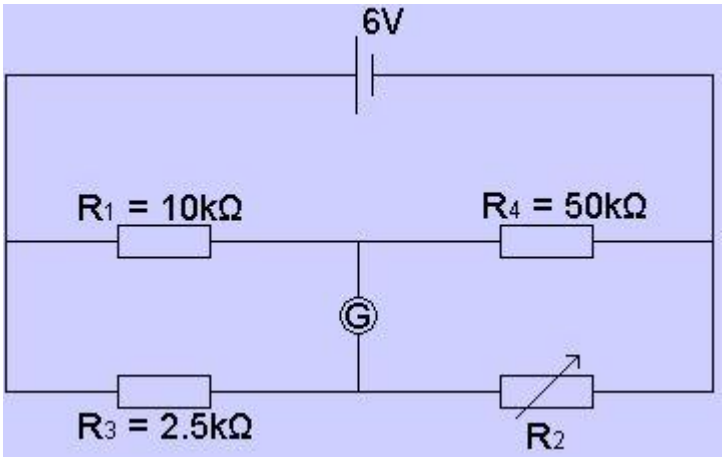
i) **Very low resistance** accurately.

ii) **Very high resistance** accurately.

(HINT-> Ammeters have a very low resistance and voltmeters have a very high resistance**!!!)**

b) Why are **Wheatstone Bridge circuits** very important in **measuring resistance accurately**?

2.

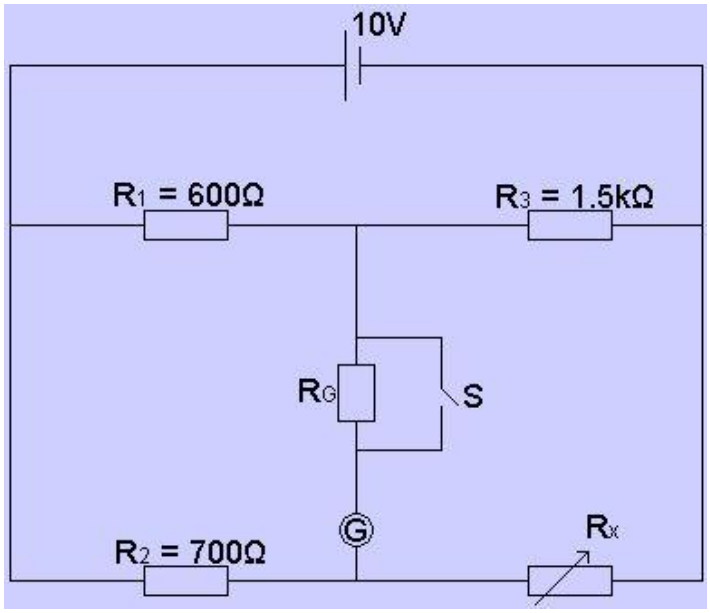


a) What does the instrument labelled **G** stand for and what type of meter is used for it in a Wheatstone Bridge circuit?

b) **Calculate the variable resistor $\mathbf{R_2}$** required to **balance** the Wheatstone Bridge **circuit**.

c) **What reading** is displayed on **G** when the Wheatstone Bridge is **balanced**?

3.

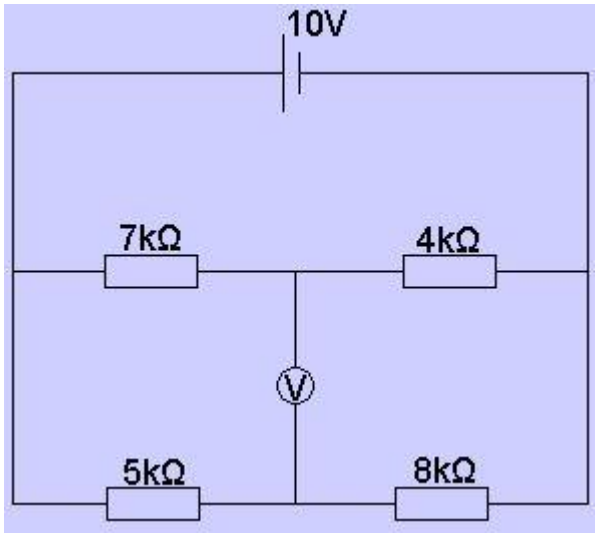


a) Why is the **resistor R_G** placed in series with the galvanometer?

b) i) Why is the **switch S** placed **in parallel with R_G** and under what circumstances is it used?
ii) What effect will the **switch closing** have on the galvanometer?

c) **Calculate** what the **variable resistor R_X** must be set at to **balance** the Wheatstone **Bridge**.

4.

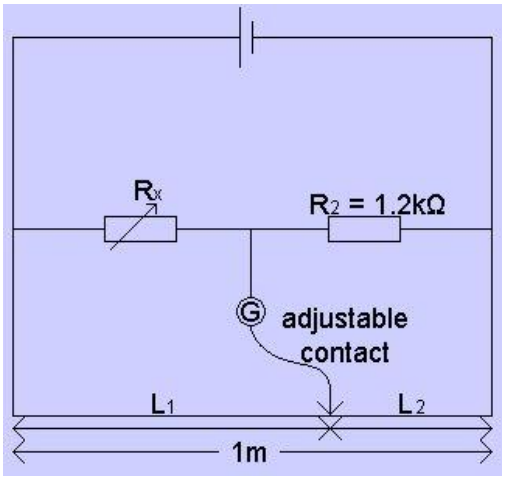


a) **How can you tell** that this Wheatstone Bridge circuit is **out of balance**?

b) **Calculate the reading on the voltmeter** in this out of balance Wheatstone bridge circuit?

c) **How could** the Wheatstone Bridge be **adjusted** to become **balanced**?

5.



In the **Metre Bridge circuit** above, the bridge **balances** when the variable resistor $\mathbf{R_X = 1.8k\Omega}$.

a) **Find** the lengths $\mathbf{L_1}$ **and** $\mathbf{L_2}$ at **balance point**.

The **variable resistor** $\mathbf{R_X}$ **is varied** from the balance point with current readings from the galvonometer and shown in the table below.

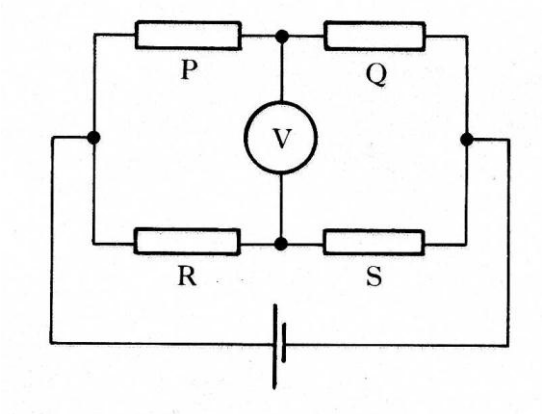
R_X (kΩ)	1.6	1.7	1.8	1.9	2.0
I (mA)		- 0.4			+ 0.8

b) i) **Fill in the missing entries** for current in the table.

ii) Plot a graph on **graph paper** of **current** against **change in resistance** R_X.

iii) **Explain the relationship** between Current and change in resistance **from the graph**.

6. The diagram below shows a balanced Wheatstone Bridge circuit with four resistors P,Q,R and S.



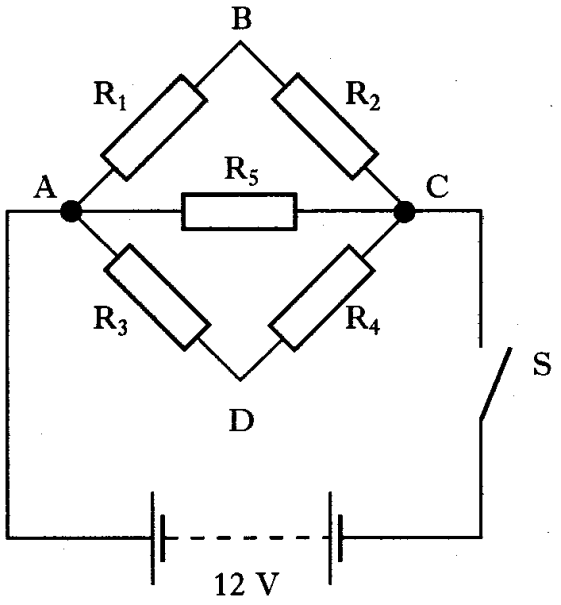
a) **Explain what is meant by** a balanced Wheatstone Bridge circuit.

b) After a period of use the **pd** across the battery in the circuit **decreases** to half of its original value.

Explain what **effect** this will have on the **reading on the voltmeter**.

7.

Four 10 Ω resistors R_1, R_2, R_3 and R_4 are connected in the form of a square ABCD. A fifth resistor R_5 of the same value is connected between A and C. This arrangement of resistors is connected in a circuit as shown below. The battery in the circuit has negligible internal resistance.



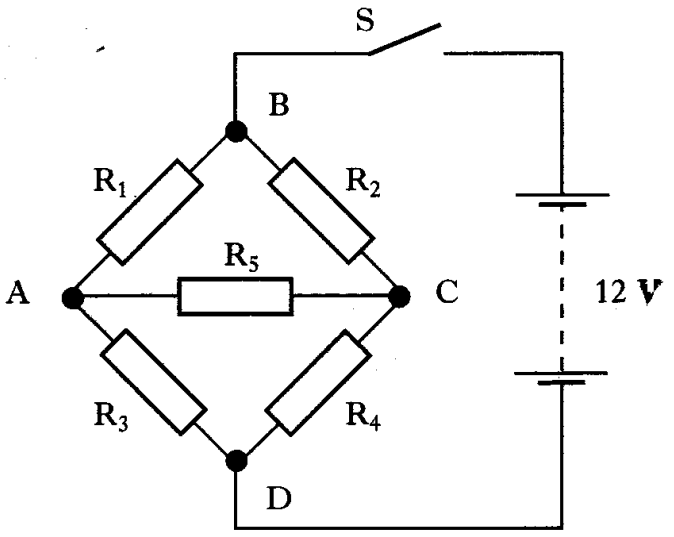
(*a*) Determine the total resistance between A and C.

(*b*) The switch S is now closed.

(i) In which of the resistors is the greatest power developed?

(ii) Calculate the value of **this** power.

(*c*) In a second experiment with the same resistors, the battery is connected across BD.



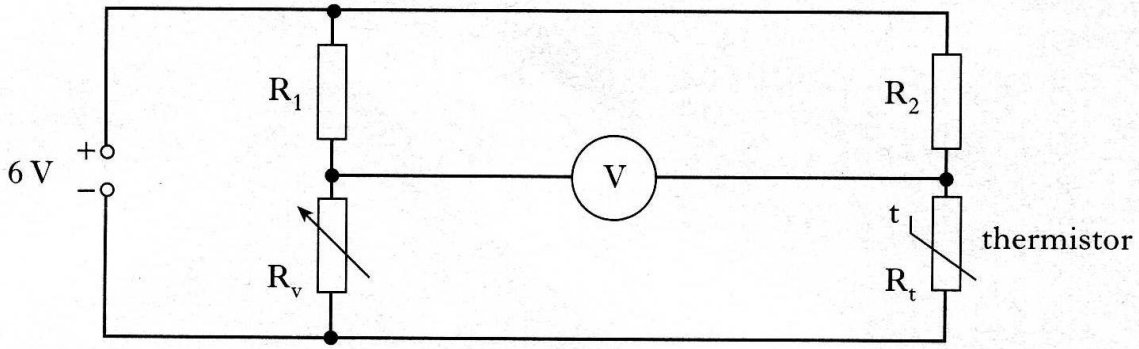
The switch S is now closed.

(i) Explain why there is no current in resistor R_5.

(ii) Calculate the current drawn from the battery.

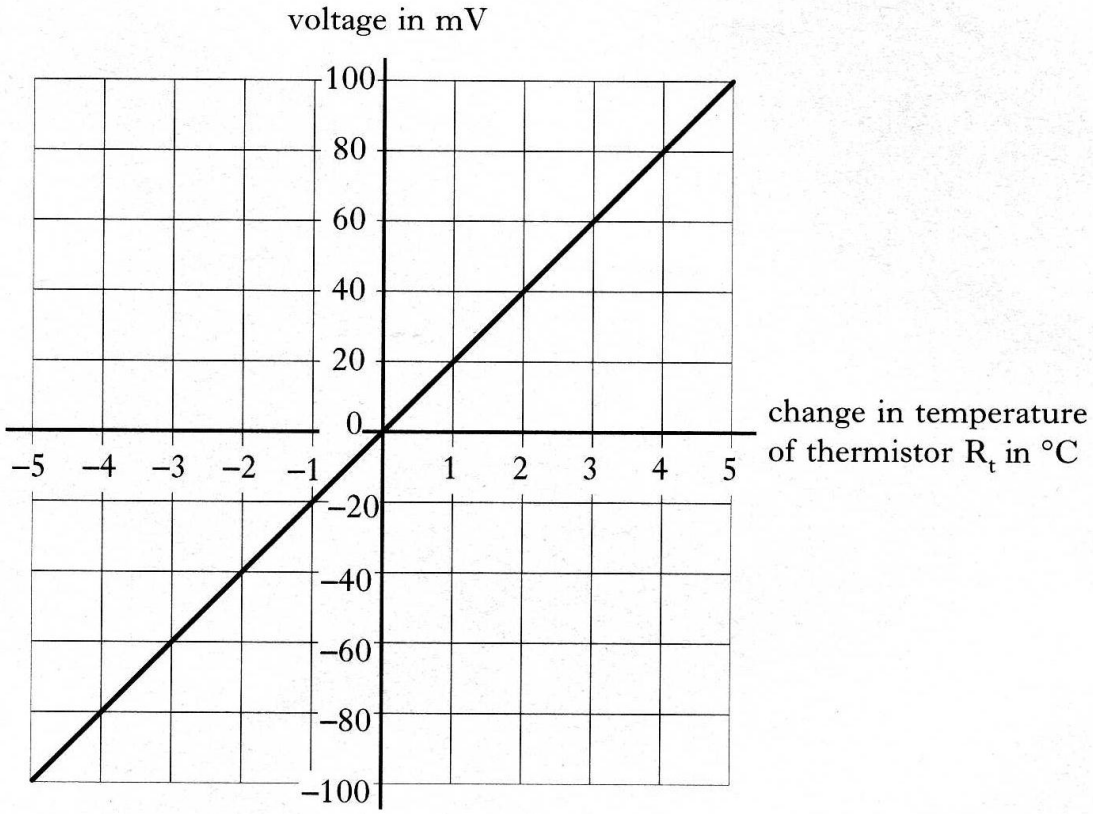
8.

The Wheatstone bridge shown below is balanced.



(*a*) R_1 has a resistance of 3·3 kΩ, R_2 has a resistance of 2·2 kΩ and the variable resistor R_v is set at 225 Ω. Calculate the resistance of the thermistor R_t.

(*b*) The graph below shows what happens to the reading on the voltmeter as the temperature of thermistor R_t is changed.

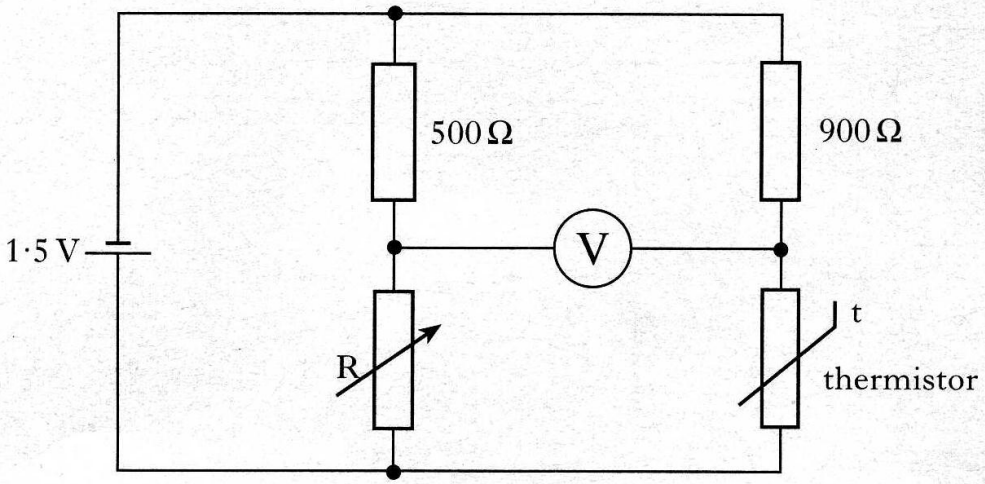


The bridge was initially balanced at 20 °C.

The temperature of R_t is increased until the reading on the voltmeter is 80 mV. What is the new temperature of the thermistor R_t?

9.

A pupil uses a Wheatstone bridge to investigate how the resistance of a thermistor is affected by its temperature. The circuit is shown below.



(*a*) The thermistor is placed in water at a temperature of 20 °C and the resistance of the variable resistor, R, is adjusted to 450 Ω to balance the bridge.

Calculate the resistance of the thermistor at this temperature.

(*b*) Several pupils use the circuit to find the resistance of the thermistor when the water temperature is 30 °C. The values they obtain are as follows.

852 Ω 854 Ω 848 Ω 851 Ω 853 Ω

Calculate:

i) The **mean** of the values.

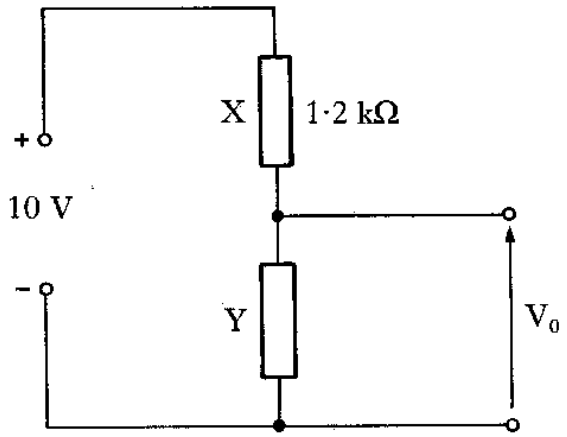
ii) The **random uncertainty** in the **mean**.

(c) Their teacher says that there may have been a systematic uncertainty in the investigation.

Describe what is meant by a **systematic uncertainty**.

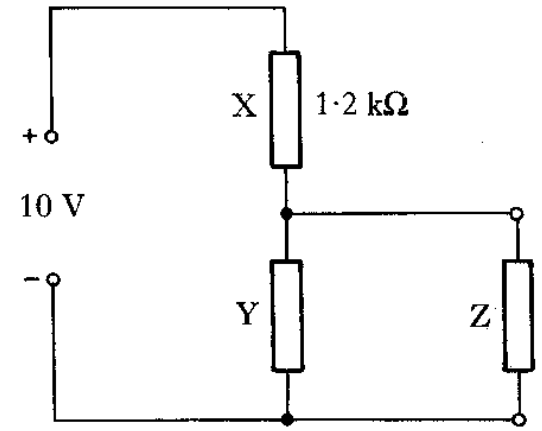
10.

(*a*) A potential divider is used to provide an output voltage V_0 from a 10 V supply as shown below. The supply has negligible internal resistance.



(i) The resistance of resistor X is 1·2 kΩ and the output voltage required is 6·0 V. Calculate the resistance of resistor Y.

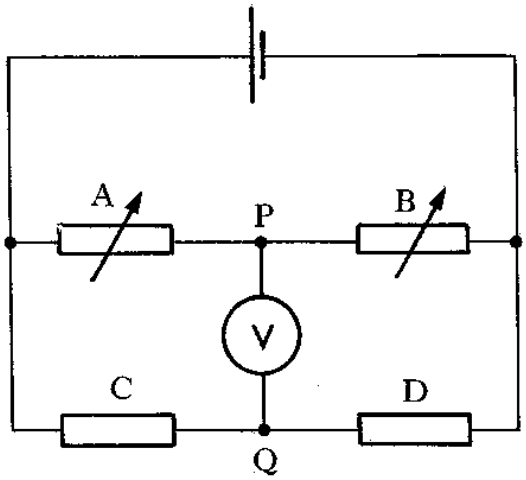
(ii) A load resistor Z is now connected across the output as shown below.



Explain why the voltage across Z is less than 6·0 V.

(iii) Calculate the voltage across resistor Z when its resistance is 4·7 kΩ.

(*b*) A Wheatstone bridge circuit is shown below.



(i) How are the resistances of A, B, C and D related when the bridge is balanced?

10. Continued

(ii) C and D are fixed resistors, each of value 120 Ω. The resistors A and B are variable and each is initially set at 120 Ω. The voltmeter is used to measure the p.d. between the points P and Q.

Small changes are made to the resistances of A and B, and the various values are shown in the table below.

Resistance of A/Ω	Resistance of B/Ω	Voltmeter reading/mV
120	120	
121	120	−21
121	121	
121	122	
121	119	

Copy and complete the last column of the table to show the voltmeter readings (including sign) that you would expect for each of the remaining sets of resistance values.