standard known resistance S. The jockey is connected to some point D on the wire, a distance l cm from the end A. The jockey can be moved along the wire. The portion AD of the wire has a resistance $R_{cm}l$, where R_{cm} is the resistance of the wire per unit centimetre. The portion DC of the wire similarly has a resistance R_{cm} (100-l).

The four arms AB, BC, DA and CD [with resistances R, S, $R_{cm}\,l$ and $R_{cm}(100\text{-}l)$] obviously form a Wheatstone bridge with AC as the battery arm and BD the galvanometer arm. If the jockey is moved along the wire, then there will be one position where the galvanometer will show no current. Let the distance of the jockey from the end A at the balance point be $l = l_1$. The four resistances of the bridge at the balance point then are R, S, $R_{cm}\,l_1$ and $R_{cm}(100–l_1)$. The balance condition, Eq. [3.83(a)] gives

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$$\boxed{\frac{R}{S}=\frac{R_{cm}\,l_1}{R_{cm}\,(100-l_1)}=\frac{l_1}{100-l_1}} \tag{3.85}$$

Thus, once we have found out l_1, the unknown resistance R is known in terms of the standard known resistance S by

$$\boxed{R=S\,\frac{l_1}{100-l_1}} \tag{3.86}$$

A wheatstone bridge is in its most sensitive condition only when all the four resistances are of same value.
This condition is achived in case of Meter Bridge when the null point is almost at the centre of the wire i.e for $l_1 = 50$cm

By choosing various values of S, we would get various values of l_1, and calculate R each time. An error in measurement of l_1 would naturally result in an error in R. It can be shown that the percentage error in R can be minimised by adjusting the balance point near the middle of the bridge, i.e., when l_1 is close to 50 cm. (This requires a suitable choice of S.)

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Example 3.9 In a meter bridge (Fig. 3.27), the null point is found at a distance of 33.7 cm from A. If now a resistance of 12Ω is connected in parallel with S, the null point occurs at 51.9 cm. Determine the values of R and S.

Solution From the first balance point, we get

$$\frac{R}{S}=\frac{33.7}{66.3} \tag{3.87}$$

After S is connected in parallel with a resistance of 12Ω , the resistance across the gap changes from S to S_{eq}, where

$$S_{eq}=\frac{12S}{S+12}$$

and hence the new balance condition now gives

$$\frac{51.9}{48.1}=\frac{R}{S_{eq}}=\frac{R(S+12)}{12\,S} \tag{3.88}$$

Substituting the value of R/S from Eq. (3.87), we get

$$\frac{51.9}{48.1}=\frac{S+12}{12}\cdot\frac{33.7}{66.3}$$

which gives S = 13.5Ω. Using the value of R/S above, we get R = 6.86 Ω.

EXAMPLE 3.9