Voltmeters And Ammeters

Theoretical Resistance of Ammeters and Voltmeters:

In hypothetical circuits we assume that adding an ammeter in series or a voltmeter in parallel will have no change to the potential difference or current in the rest of the circuit, what does this imply?

In ammeters: since (in theory) the change in the potential difference is 0 this implies (as potential difference of components is shared in a series circuit) that the potential difference across the ammeter is 0. Therefore, since $R = V/I$ and V is 0, $R = 0/R$ so $R = 0$.

In Voltmeters: since (in theory) the current in the other branch connected to the voltmeter is the same as it would be without the voltmeter this implies that the current in the voltmeter branch is 0. Therefore, since $R = V/I$ and $I = 0$, $R = V/0$ so (since anything divided by 0 approaches $\pm\infty$) $R = \pm\infty$ however since its not possible to have a negative resistance R must be ∞.

Practical Resistance of Ammeters and Voltmeters:

In practise however, while ammeters are supposed to have as small a resistance as possible and voltmeters as high as possible, the resistances are as follows:

Voltmeters: Range from 10 Megaohms to 1 Gigaohms depending on the precision (higher resistance = higher precision)

Ammeters: Range from 10 Milliohms to 100 Ohms depending on the precision (similar to voltmeters but inverse, lower resistance = higher precision)