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Voltmeters as EMF measurers?

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(Submitted 30-03-2020)

Abstract

In high school physics it is usually taught that Voltmeters (DC) can only measure potential differences by drawing some current and (Circuit) Potentiometers can measure the EMF (Electromotive Force) of a cell. In this paper, the author discusses about a setup involving a voltmeter such that the voltmeter measures the EMF of the cell exactly.

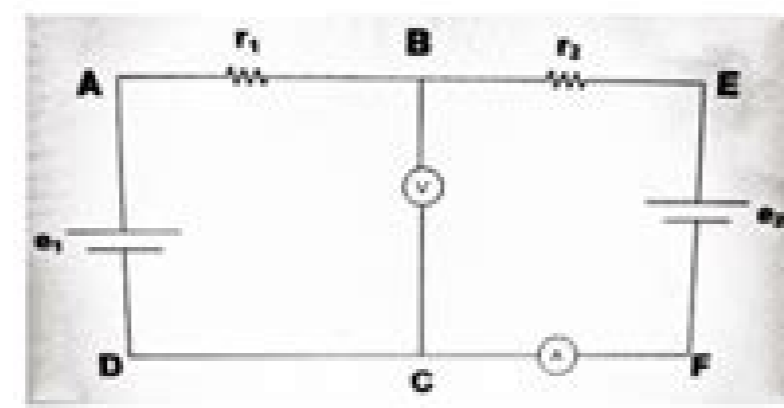
1. Introduction

Electrical devices like voltmeters (DC) and potentiometers are generally introduced in high school physics as electrical equipment that measure potential differences in DC circuits. A voltmeter needs some power for itself to consume for measuring the emf of the cell and hence it will always indicate a voltage reading less than the actual EMF. As the voltmeter itself draws some current so it can't be used for measuring the EMF of the cell. Note that, voltmeters referred to here are non-ideal; as if there were an ideal voltmeter, by directly connecting it across the terminals of the cell one cannot measure the EMF because there is no flow of charges (current) happening. Well, potentiometers get around with this by the null method. So, a potentiometer can give the exact value of potential difference across any two points in a circuit because it never draws any current from the circuit. Hence, potentiometers can measure the EMF of a cell exactly.

In the following section, the author discusses about a possible set up where the voltmeter measures the exact EMF of a cell by exploiting the null method.

2. Voltmeter as EMF-measurer

One should note at first, that a voltmeter and a potentiometer don't have much difference between them – they basically both consist of resistances and galvanometers. What really makes a potentiometer bit special from a voltmeter is that one can measure EMF of a cell and this is possible as one applies the null method to measure potential differences in a potentiometer. And by definition, no current gets drawn into the measuring apparatus in null method. Consider the following circuit [1]:



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Data Analysis Framework

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