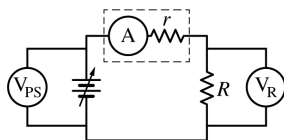


Circuit 1



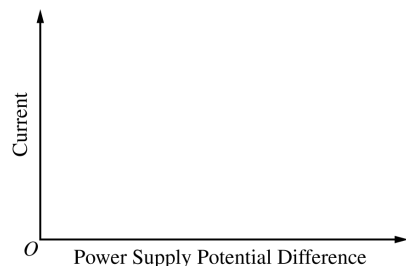
Circuit 2

2. (12 points, suggested time 25 minutes)

The two circuits shown above contain an ideal variable power supply, an ohmic resistor of resistance R , an ammeter A , and two voltmeters V_{PS} and V_R . In circuit 1 the ammeter has negligible resistance, and in circuit 2 the ammeter has significant internal ohmic resistance r . The potential difference of the power supply is varied, and measurements of current and potential difference are recorded.

(a) The axes below can be used to graph the current measured by the ammeter as a function of the potential difference measured across the power supply. On the axes, do the following.

- Sketch a possible graph for circuit 1 and label it 1.
- Sketch a possible graph for circuit 2 and label it 2.

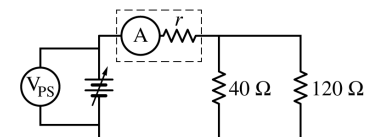


(b) Let ΔV_{PS} be the potential difference measured by voltmeter V_{PS} across the power supply, and let I be the current measured by the ammeter A . For each circuit, write an equation that satisfies conservation of energy, in terms of ΔV_{PS} , I , R , and r , as appropriate.

Circuit 1

Circuit 2

- (c) Explain how your equations in part (b) account for any differences between graphs 1 and 2 in part (a).
- (d) In circuit 2, $R = 40\ \Omega$. When voltmeter V_{PS} reads 3.0 V, voltmeter V_R reads 2.5 V. Calculate the internal resistance r of the ammeter.
- (e) Voltmeter V_R in circuit 2 is replaced by a resistor with resistance $120\ \Omega$ to create circuit 3 shown below. Voltmeter V_{PS} still reads 3.0 V.



Circuit 3

- Calculate the equivalent resistance R_{eq} of the circuit.
- Calculate the current in each of the resistors that are in parallel.