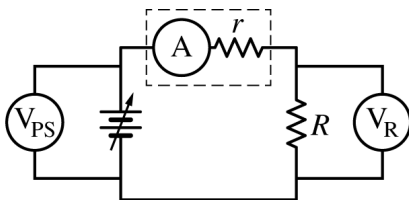


Circuit 1

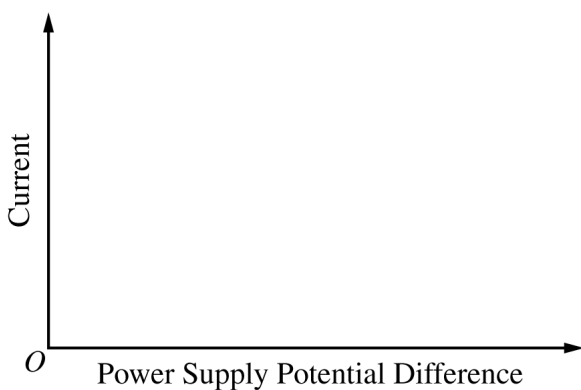


Circuit 2

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.

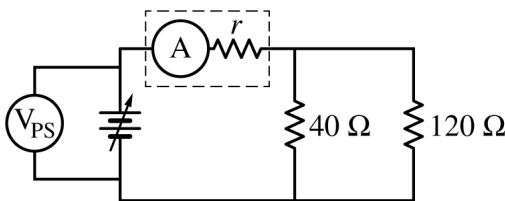


- (b) Let ΔV_{PS} be the potential difference measured by voltmeter V_{PS} across the power supply, and let I be the current measured by the ammeter A . For each circuit, write an equation that satisfies conservation of energy, in terms of ΔV_{PS} , I , R , and r , as appropriate.

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.