not function reliably. More trials are required to investigate long-term reliability and the time it takes the thin wall of the aluminum can to disintegrate. The economics of the cell would depend largely on the cost of aluminum and the cell's ability to be recharged. Recycled aluminum would be a significant economic advantage. Certainly, there does not appear to be a shortage of empty aluminum cans. The cell is simple as it does not have any complex parts or technical design. Further trials are needed using a moist, basic electrolyte paste to obtain a cell that will not easily leak its contents.

LAB EXERCISE 9.4.1 CHARACTERISTICS OF A HYDROGEN FUEL CELL

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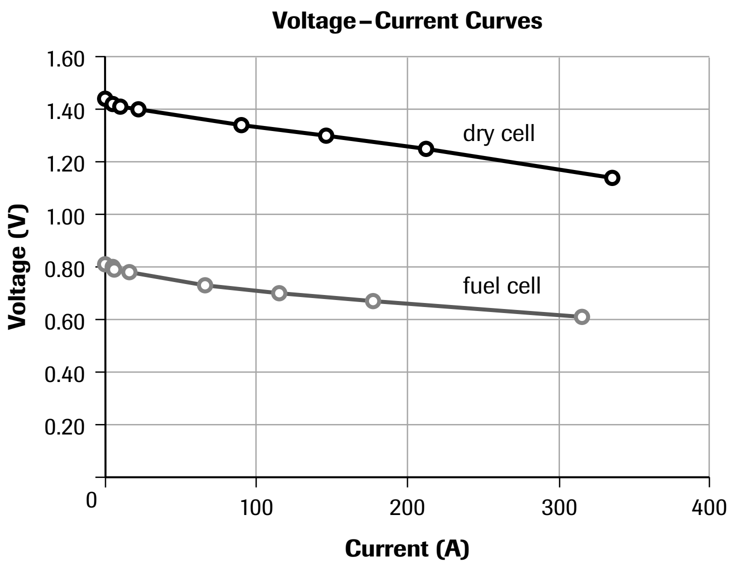
Analysis

(a)



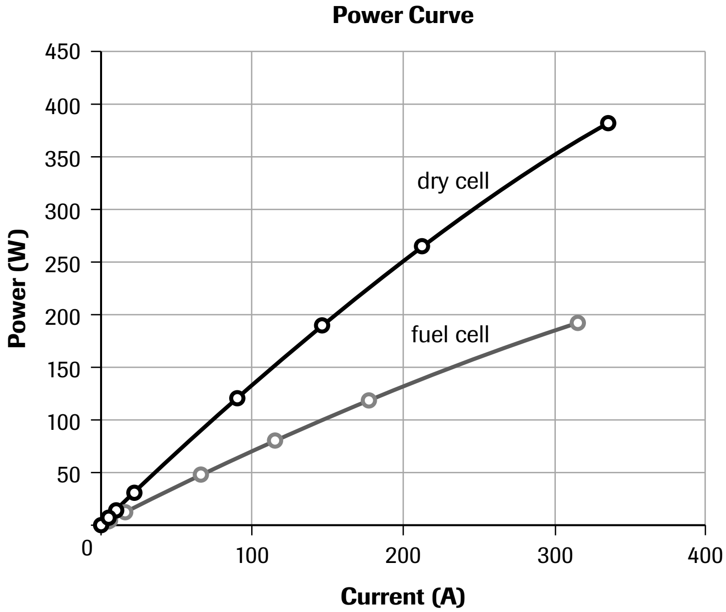
(b) For both cells, the voltage of the cell slowly decreases as the current increases. The behaviour of the hydrogen fuel cell appears similar, although it starts at a lower initial voltage.

(c)

Power Curve Comparison

Dry cell			Hydrogen fuel cell		
Voltage (V)	Current (mA)	Power (mW)	Voltage (V)	Current (mA)	Power (mW)
1.44	0	0	0.81	0	0
1.42	5	7	0.80	5	4
1.41	10	14	0.79	6	5
1.40	22	31	0.78	16	12
1.34	90	120	0.73	66	48
1.30	146	190	0.70	115	80
1.25	212	265	0.67	177	120
1.14	335	382	0.61	315	190

(d)



The power curve for the hydrogen fuel cell follows a similar pattern to that of the dry cell. However, the slope of the curve is noticeably less steep for the fuel cell. This means that, as the current increases, the power output of the fuel cell increases less rapidly than that of the dry cell.

(e) Based on the evidence collected, the trends of the voltage–current and power–current graphs are very similar for a hydrogen fuel cell compared to a typical dry cell.

Synthesis

(f) Both cells have two electrodes, an electrolyte, and chemicals that are consumed as the cell operates. In the case of the dry cell, there is a limited amount of reactant present and the cell will eventually stop producing electricity when the reactants are used up. In the fuel cell, the reactants are continuously supplied to the cell and the cell would only stop operating if the fuel is no longer provided.

(g) A fuel cell is like a gasoline motor; both operate using a continuous supply of fuel. As long as you keep fuel "in the tank," you can drive the car. Primary or even secondary cells have a limited quantity of "fuel" sealed inside their containers. The car can only travel a limited distance before the cell has to be recharged. (With present-day cells, this is not a very great distance unless a large battery — with unreasonable size and weight — of cells is present.)

ACTIVITY 9.5.1 GALVANIC CELL DESIGN

(Page 721)

(a) The first design with the single electrolyte is most like Volta's invention. All three designs have the same two metal electrodes and at least one electrolyte. Two of the cells have separate half-cells with the metal immersed in an electrolyte of its own ion and the half-cells separated by some porous boundary. The difference between these two designs is in the nature of the porous boundary. One has a salt bridge containing an inert electrolyte separating the two half-cell electrolytes and the other has a porous (porcelain) cup separating the electrolytes.

(b) In all cells, the silver metal is the cathode (positive electrode) and the copper metal is the anode (negative electrode). (Cell (a) had a voltage of 0.15 V; cell (b) was 0.45 V; and cell (c) was 0.46 V.)

(c) Each metal in contact with an electrolyte has a different electric potential determined by the nature of the metal atoms. As shown by a redox table, silver and copper have different strengths as reducing agents. Therefore, the answer to (a) should be the same if the two metals are the same.

(d) The two cells comprised of half-cells both contain the same oxidized and reduced species: e.g., $Cu_{(s)} \mid Cu^{2+}_{(aq)}$. The single electrolyte cell contains only an inert electrolyte.

(e) Removing one of the parts of the cell interrupts or breaks the electrical circuit. (Removing either electrode from the solution, removing the salt bridge, or removing the porous cup immediately produced a zero volt reading. Replacing the removed part restored the original voltmeter reading.)

(f) A common light switch also breaks or disconnects the electrical circuit.

