Saladin 7E
Answer Key
Chapter 24, Water, Electrolyte, and Acid-Base Balance

Testing Your Comprehension

1. Blood loss results in a drop in blood volume and pressure. The drop in blood pressure stimulates the production of angiotensin II, which stimulates the thirst center.

2. In this case from *Morbidity and Mortality Weekly Reports* (9 September 1994), the baby was suffering from hypotonic hydration and hyponatremia because it was losing sodium and other electrolytes in the ordinary course of urination, while the mother was replacing this with sodium-free water. The situation is complicated by the fact that an infant's kidneys also are less able to conserve sodium than adult kidneys are. Volume excess resulted in the infant's edema, and the seizures from cerebral edema in particular. The volume excess also produced a state of acidosis, because with less Na^+ reabsorption by the renal tubules, less H^+ is secreted and more H^+ is retained in the body (these are linked by the Na^+–H^+ antiport).

3. At the pH of the extracellular fluid, the carbonic acid reaction $HCO_3^- + H^+ \rightarrow H_2CO_3 \rightarrow H_2O + CO_2$ would not proceed very far to the right in vitro, and would not buffer very much acid. In vivo, however, the respiratory and urinary systems continually eliminate CO_2. By the law of mass action, this keeps the reaction moving to the right and neutralizing more acid.

4. Chronic diarrhea caused by pathogens in contaminated drinking water (in cholera, for example) can result in hypovolemia and hypotension, which in turn can lead to cardiac arrest. Hypokalemia also develops as diarrhea flushes potassium from the body, especially if there is an inadequate dietary intake of potassium to compensate for it. Hypokalemia can also be a contributing factor in heart failure.

5.

	Cause	Effect	Reason
a.	$\uparrow H_2O$	$\downarrow Na^+$	Water dilutes the ECF, causing relative hyponatremia.
b.	$\uparrow Na^+$	$\uparrow Cl^-$	Cl^- passively follows Na^+ when Na^+ is reabsorbed or retained in the ECF.
c.	$\downarrow K^+$	$\downarrow H^+$	Hypokalemia causes excess K^+ to diffuse out of cells into the ECF. This alters the electrical gradient across the plasma membrane and induces H^+ to diffuse into the cells. Thus, the H^+ concentration of the ECF drops.
d.	$\uparrow H^+$	$\uparrow K^+$	In acidosis, H^+ diffuses into cells and displaces K^+. The K^+ diffuses out of the cells into the ECF, thus causing hyperkalemia.
e.	$\downarrow Ca^{2+}$	$\downarrow PO_4^{3-}$	Hypocalcemia stimulates parathyroid hormone (PTH) secretion. PTH induces increased calcium reabsorption by the kidneys, while promoting phosphate excretion, ensuring that the calcium remains dissolved in the ECF rather than combining with phosphate and being deposited in the bones.