Case Scenario 1:

A 25 year old, 70 kg man was walking down the street, minding his own business at 2 o’clock Saturday morning heading to church (he wanted to get a good seat) when he sustained a gunshot wound to his abdomen. Upon paramedic arrival, he was in shock and was intubated and transferred to MUSC for Trauma evaluation. The paramedics were unable to obtain i.v access. Time from injury to the Trauma Bay was 10 minutes.

Questions:

1. What is this patients’ total body water?

2. What is his circulating plasma volume?

3. What are the main ions found in his extracellular fluid compartment (i.e. plasma and interstitial fluids)?

4. What are the main ions found in his intracellular fluid compartment?
5. His electrolyte panel reveals the following information:

\[
\begin{align*}
135 & \quad 107 & \quad 15 & \quad 218 \\
3.5 & \quad 21 & \quad 0.7 
\end{align*}
\]

Calculate his expected serum osmolality.

What is the range of a normal serum osmolality?

6. Three days prior to this injury, the patient underwent a physical examination for his job. Routine labs were drawn, including a CBC which revealed the
A CBC was sent early during the course of this patient’s resuscitation in the Trauma Bay. The FAST scan reveals approximately 1500 cc of blood in the abdomen. If you drew a serum hemoglobin level on this patient at this time what value would you expect and why?
Case Scenario 2:

A 68-year-old man with chronic renal failure was in the hospital in serious condition recovering from a heart attack. He had just undergone a CABG to his LAD and left circumflex arteries and was thus made "npo". He was receiving fluid through an intravenous line.

Late one night, a weary nurse who was on the 11th hour of a 12-hour shift came into the patient's room to replace the man's empty IV bag with a new one. Misreading the physician's orders, she hooked up a fresh bag of IV fluid that was "twice-normal" saline rather than "half-normal" saline.

This mistake was not noticed until the following morning. At that time, the man had marked pitting edema around his sacral region and had inspiratory rales at the bases of his lungs on each side. He complained that it was difficult to breathe as well. Blood was drawn, revealing the following:

\[
\begin{array}{c|c|c|c}
157 & 120 & 50 \\
4.7 & 3.5 & \\
\end{array}
\]

A chest X-ray revealed interstitial edema of the lungs.
Questions:

1. Most dissolved substances in the blood plasma can easily move out of the bloodstream and into the interstitial fluid surrounding the cells.
   
   A. Will the nurse's mistake increase or decrease the "saltiness" of the interstitial fluid?
   
   B. Given your knowledge of osmosis, will this cause the cells in the body to increase or decrease in size? Explain your answer.

2. Why does this patient have pitting edema and inspiratory rales?

3. How would this increase in salt load affect the patient's blood-aldosterone level? In your answer, explain the function of the hormone aldosterone.

4. Can you think of any other normal mechanisms that the body has to control salt and water balance? How might they react in this situation?

5. What symptoms might result from hypernatremia?

6. How is this patient's interstitial edema in the lungs affected by his already-weakened heart?
Case Scenario 3:

A 45 year old man with a previously known duodenal ulcer presents with complaints of persistent vomiting for the past 36 hours. The vomit is clear-looking and acidic in taste. He has no abdominal pain. Prior to vomiting, he had difficulty with solid foods causing a “fullness” in his stomach and he had been taking only liquids for the past one week. His heartburn had been aggravated at the time of the “fullness”, but antacids did not help and he did not seek medical attention until today. He complains of being dizzy when he stands up. His blood pressure changes from 120/70 when lying down to 105/55 when standing; his pulse changes from 100 to 130. An abdominal X-ray reveals the following:
Questions:

1. What do you think this patients’ volume status is?

2. What are the signs and symptoms of hypovolemia?

3. What is the most likely electrolyte and acid/base disturbance in this patient?

4. What is the most important ion to replace in order to reverse this disturbance?

   What i.v fluid should be used to replace gastric losses?
Case Scenario 4:

A 54 year old female who had just undergone an elective sigmoid resection and primary anastomosis was started on a dilaudid PCA with a continuous infusion by the orthopedic intern on your service postoperatively. The next morning, she was found to be obtunded by the nursing tech who was catching up on the vital signs that morning.

The MET team was called and a pre-intubation ABG was obtained and revealed the following:

\[ \begin{align*}
\text{pH} & = 7.30 \\
\text{PCO}_2 & = 50 \text{ mmHg} \\
\text{PaO}_2 & = 55 \text{ mmHg} \\
\text{HCO}_3 & = 24 \text{ meq/l} \\
\end{align*} \]

Questions:

1. How would you classify this patients’ acid-base status?

2. How would the kidneys try to compensate for the patients’ acid-base imbalance?

3. List some other causes of this type of acid-base disturbance.
Case Scenario 5:

An elderly gentleman is in a coma after suffering a severe Traumatic Brain Injury. He is in the intensive care unit and has been placed on a ventilator. Arterial blood gas measurements from the patient reveal the following:

\[
\begin{align*}
\text{pH} & = 7.50 \\
\text{PCO}_2 & = 30 \text{ mmHg} \\
\text{PaO}_2 & = 100 \text{ mmHg} \\
\text{HCO}_3 & = 24 \text{ meq/l}
\end{align*}
\]

Questions:

1. How would you classify this patient's acid-base status?

2. How does this patient's hyperventilation pattern raise the pH of the blood?

3. How might the kidneys respond to this acid-base disturbance?
A 26 year old man was involved in a MVC. He was the restrained driver who fell asleep and drove into a ditch and was entrapped in his vehicle. He was unresponsive at the scene and had a prolonged extrication time. He was intubated at the scene and arrived in the Trauma Bay approximately 2 hours after the crash.

He was hypotensive with a positive FAST scan and remained hemodynamically unstable despite aggressive volume resuscitation.

He was taken to the operating room for exploration. Intra-operative findings included a grade 4 liver injury that was packed off and a splenic injury requiring splenectomy. A damage-control laparotomy was performed as the patient was hypothermic, coagulopathic, and acidotic.

Arterial blood gas measurements from the patient reveal the following:

\[
\begin{align*}
\text{pH} &= 7.25 \\
\text{PCO}_2 &= 30 \text{ mmHg} \\
\text{PaO}_2 &= 100 \text{ mmHg} \\
\text{HCO}_3 &= 17 \text{ meq/l}
\end{align*}
\]
Questions:

1. How would you classify this patient's acid-base status?

2. The patients’ electrolyte panel is as follows:

   \[ \begin{array}{c|c|c}
   & 132 & 100 \\
   & 3.2  & 17 \\
   \hline
   9 & 0.6 & 210 \\
   \end{array} \]

   Calculate this patients Anion Gap.

2. What is the differential diagnosis of a patient with a “Gap” metabolic acidosis?

   What is the most likely cause of this patients “Gap” metabolic acidosis?

3. What is the differential diagnosis of a patient with a “Non-Gap” metabolic acidosis?