1. Recall that a normal person has a GFR (glomerular filtration rate) of about 120 ml/min, reabsorbs about 119 mls of water per minute, and produces 1 ml urine per minute.
   a. If the GFR increases to 124 ml/min and reabsorption increases to 123 ml/min, what will the urine production rate become?  
      still 1 ml/min
   b. If the GFR becomes 124 ml/min and the reabsorption becomes 119 ml/min, what will the urine production rate be?  
      5 ml/min

2. If you have a normal GFR and your plasma sodium concentration is 140 mM, how much sodium will you have to re-absorb during this morning's one-hour conference? (Assume that you are in perfect sodium and water balance, and that you stay that way.)

   Normal GFR = 120 ml/min = 0.120 liter/min

   FL_{Na^+} = GFR \times [Na^+]_{plasma} = 0.120 L/min \times 140 mmols/L = 16.8 mmols/min

   16.8 mmols/min \times 60 min/hr = 1,008 mmols/hr (about 59 grams)

3. Which is greater, the filtered load of Na\textsuperscript{+} or the filtered load of K\textsuperscript{+}?

   Filtered Load of any solute is the GFR x plasma concentration. Since the plasma concentration of sodium (140 mM) is greater than that of potassium (4 mM), the filtered load of sodium will be greater than the filtered load of potassium.

4. If your GFR is 110 ml/min, and your plasma glucose concentration is 1.5 mg/ml, and there is no glucose present in your urine, what is your glucose reabsorption rate, in mg/min?

   1. Glucose is filtered and reabsorbed, but not secreted.
   2. Therefore, excretion of glucose = filtered load - reabsorption.
   3. We are told there is no glucose in the urine, so excretion = 0,
   4. so 0 = filtered load - reabsorption
   5. and reabsorption = filtered load.
   6. Calculate the filtered load of glucose = 110 ml/min \times 1.5 mg/ml = 165 mg/min.
   7. The reabsorption = the filtered load= 165 mg/min

Under these conditions, could your glucose reabsorption rate increase to 300 mg/min?

No. You can’t reabsorb 300 mg/min because there’s only 165 mg/min entering the tubule.
5. A condition called **SIADH** (syndrome of inappropriate ADH secretion) results from inappropriately high levels of secretion of ADH (sometimes by cancer cells). For a person with this condition, would the following be high, low, or normal?

- plasma [ADH] concentration: **High**
- plasma osmolarity: **Low**
- plasma [Na+] : **Low**
- intracellular fluid volume: **High**
- urine flow rate: **Low**
- urine osmolarity: **High**

6. **Diabetes insipidus** is a condition where the ADH mechanism for regulating osmolarity is ineffective. This can happen because ADH is not secreted when it should be (central diabetes insipidus) or because ADH is secreted but the kidneys do not respond to it (nephrogenic diabetes insipidus).

Predict what you think the consequences of central diabetes insipidus would be for the following:

- plasma [ADH] concentration: **Low**
- plasma osmolarity: **High**
- plasma [Na+] : **High**
- intracellular fluid volume: **Low**
- urine flow rate: **High**
- urine osmolarity: **Low**

7. One characteristic of **diabetes mellitus** (what people generally mean by “diabetes”) is an elevated plasma glucose concentration.

What effect do you think diabetes mellitus and a high plasma glucose concentration would have on the following?

- filtered load of glucose: **High**
- glucose concentration of the glomerular filtrate: **High**
- glucose concentration in the tubular fluid in the descending loop of Henle: **High (should be zero)**
- glucose concentration of the urine: **High (should be zero)**
- urine flow rate: **High (osmotic diuresis)**
- extracellular fluid volume: **gets Low**
- plasma osmolarity: **can be high or normal** *
- thirst: **more than normal**
- plasma [Na+] : **can be normal or low** *

* If plasma osmolarity is normal and plasma [glucose] is high, plasma [Na+] will be low.