1st Mid-Term Exam

Class: B.E. Chemical 2nd Semester

Subject: Material and Energy Balance

Duration: 1 hour

Total marks: 20

Instruction:

- Answer all questions.
- Draw diagram for questions, wherever required.
- In case of conversions, write conversion factor.

1. Convert the following   (8)
   a. 500nm to cm
   b. 39.8 kg of NaCl per 100 kg water to kilogram moles of NaCl per kilogram mole of water
   c. 0.4g/ (min m³) to lb$_m$/ (hr ft³)
   d. 1 horsepower to Watt.

2. Check dimensional consistency of following equation: (4)

$$q = 0.415(L - 0.2h_0)h_0^{1.5}\sqrt{2g}$$

Where q= volumetric flow rate (ft³/s)

   L= crest height (ft)

   h$_0$= weir height (ft)

   g= acceleration due to gravity (32.2 ft/s²)

3. The diagram shows a sketch of an artificial kidney, a medical device used to remove waste metabolites from the blood in case of kidney malfunction. The dialyzing fluid passes across a hollow membrane and the waste products diffuse from the blood into the dialyzing fluid.
   If the blood entering the unit flows at the rate of 220mL/min and the blood exiting the unit flows at the rate of 215mL/min, how much water and urea (the main waste products) pass into the dialysate if the entering concentration of urea is 2.3 mg/mL and the exit concentration of urea is 1.7mg/mL?
   If the dialyzing fluid flows into the unit at the rate of 1500 mL/min, what is the concentration of the urea in the dialysate?   (8)