Instructions:

1. CLOSED BOOK AND OPEN NOTES.

2. Show all work on the paper provided with exception to the matching problems.

3. Do not discuss test with anyone other than the instructor.

4. There are a total of 9 problems plus a 10 point bonus problem. Points associated with each problem are denoted.

5. Not necessary to show work for the matching problems.

6. The instructor subscribes to and supports the Mercer Honor Code.

Name: _______________________________ Date: ________________
Your services have been acquired to prepare the preliminary design of a water treatment facility that services a suburb of New Orleans, Louisiana. The source of the water is the mighty Mississippi River. Typical raw water characteristics include high turbidity, high bacterial counts, low alkalinity and high color.

1. (10 pts) Draw a schematic diagram of the proposed water treatment plant, labeling all unit operations and/or unit processes, influent and effluent flow, and chemicals added along with addition points.

2. (10 pts) Explain how the unit operations and/or unit processes selected will reduce turbidity, bacteria, color, etc.
Given the following bar graph (meq/L):

Find: Calculate the following:

3. (10 pts) Total hardness of the raw water in mg/L as CaCO$_3$.

4. (10 pts) Lime requirement (1b/MG) assuming a 90% purity for CaO and excess lime treatment is utilized.

5. (10 pts) Soda ash requirement (1b/MG) assuming 88% purity for Na$_2$CO$_3$. 
The settling velocity of alum floc is approximately 0.0014 fps in water at 10°C.

6. (10 pts) What is the minimum detention time in hours to settle out the floc in an ideal basin with a depth of 10 ft?

7. (10 pts) Determine the length (ft) and width (ft) of the settling basin for a flow of 0.927 MGD assuming a Length to Width Ratio = 4 to 1

8. (20 pts) Matching: Fill in the appropriate letter. **Use only once!**
(2 pts each)

   ______ BOD  a) Primary and secondary drinking water standards
   ______ Indicator Organism  b) Oxygen required to oxidize organics
   ______ Flocculation  c) Volume divided by flow
   ______ MLVSS  d) Coagulation
   ______ MCL  e) Softening
   ______ Turbidity  f) Volatile content
   ______ RO  g) Oxygen required by bacteria to oxidize organics
   ______ Destabilization  h) Slow stirring
   ______ COD  i) JTU
   ______ Detention time  j) Coliform bacteria
9. (10 pts) Discuss some of the sub-disciplines and or jobs that environmental engineers are involved. Describe at least 5 different areas.

Bonus (10 pts)

Express 60.0 mg/L of $\text{CO}_3^{2-}$ in terms of mg/L as CaCO$_3$. 