Name:_____ Instructor:_____ ENGR 121 - Exam 1
Section:_____ January 20, 2015

Allowed Materials: *F.E. approved calculator(s) see syllabus; pencils and/or pens.*

ExamForm := 11

Honor Statement: *On my honor, I promise that I have not received any unauthorized assistance on this exam (I didn't look at another student's paper, I didn't view any unauthorized written materials, I didn't talk or listen to another student, I didn't use an unauthorized calculator, I didn't use any electronic device, any visual or auditory signals, or any other techniques of exchanging information with others.) I have maintained the highest standards of academic integrity while completing this exam.*

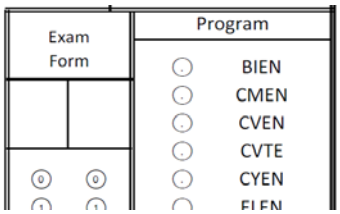
*Signed:*_____

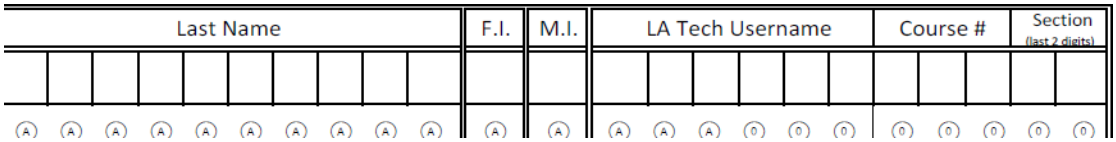
0. *(5 point deduction for failure to complete this problem!)*

- Write in all of the indicated information in the boxes of your response form.
- Darken the appropriate circles to encode the corresponding information.
- Write your name on this exam and sign the Honor Statement.

Bubble:	For Course Section:	
91	H01 - Evans	TR 8-9:50
92	H02 - Moller	TR 2-3:50
93	H03 - Cronk	MW 2-3:50
94	H04 - Harbour	MW 10-11:50
95	H05 - Swanbom	TR10-11:50
96	H06 - Hall	TR12-1:50
01	001 - Reis	MW 8-9:50
02	002 - Swanbom	MW 10-11:50
03	003 - Moller	TR 10-11:50
04	004 - Crittenden	TR 12-1:50
05	005 - Reis	MW 12-1:50

Notes:
- If your last name is too long, just write the first 10 letters.
- "**F.I.**" and "**M.I.**" are your first and middle initials, respectively
- Your **"Username"** is the first part of your LATech email address
- For **"Section"** use the guide provided to the right
- Your **"Exam Form"** is printed on the upper right corner of this page.
- Indicate "ENGR" as the **"Program"**





1. (3 points) According to our class notes, the purpose of a flyback diode in our relay circuit is to:

Choices =

"A"	"increase the voltage supplied to the relay circuit"
"B"	"increase the current supplied to the relay circuit"
"C"	"allow the magnetic energy in the relay coil to safely dissipate"
"D"	"smooth out voltage fluctuations in the voltage supply to the relay coil"
"E"	"act as a light to indicate when the circuit is energized"
"F"	"no reason, really; it just makes the circuit more complicated"
"G"	"make certain that conditions of Kirchoff's Voltage Law are met"
"H"	"prevent the energy in the relay coil from being wasted"

2. (3 points) I want to use a relay to control an alarm system. The system powers only one light at a time: a green light when everything is OK, and a red light when an alarm condition is met. The best type of relay for this would be:

Choices =

"A"	"SPDT"
"B"	"SPST"
"C"	"DPDT"
"D"	"A single relay won't work; two seperate relays would be needed for this circuit"
"E"	"DPST"

3. (3 points) The control volume chambers of the fishtank systems we built in class are made of:

Choices =

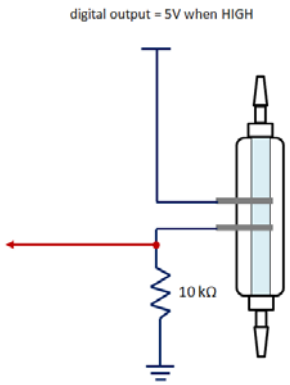
"A"	"Polyethylene"
"B"	"Stainless Steel"
"C"	"Nylon"
"D"	"Aluminum"
"E"	"Polypropylene"
"F"	"PVC"
"G"	"Copper"
"H"	"Duct Tape"

4. (3 points) The reason that we always perform mass balance analyses on systems instead of volume balance analyses is:

Choices =

"A"	"volume is harder to spell than mass"
"B"	"mass is always conserved, but volume for a constant mass can change due to changes in density"
"C"	"it doesn't matter; if a mass balance can be performed for a system, so can a volume balance"
"D"	"volume is harder to measure than mass"
"E"	"unit conversions are more complicated for volumes because they involve length units to the 3rd power"
"F"	"volume is harder to calculate than mass"
"G"	"we haven't yet covered the principles of volume balance analyses"
"H"	"no reason, really, other than to make certain calculations more complicated"

5. (3 points) When we analyze the circuit for the conductivity sensor, we analyze it using Kirchoff's Voltage Law as what type of circuit?



Choices =

"A"	"salinity"
"B"	"impossible"
"C"	"semiconductor"
"D"	"infinite impedance"
"E"	"electrochemical"
"F"	"mass balance"
"G"	"voltage divider"
"H"	"current divider"
"I"	"short"

6. (3 points) The difference between the salinity measured by the fishtank system and the setpoint is called:

Choices =

"A"	"system lag"
"B"	"deadtime compensation"
"C"	"hysteresis"
"D"	"offset"
"E"	"error"
"F"	"lower control limit"
"G"	"upper control limit"
"H"	"system status"

7. (3 points) When we add water to the fishtank, we keep the level of water in the tank relatively constant by:

Choices =

"A"	"draining the extra water through the conductivity sensor"
"B"	"routing the water to the salty water reservoir"
"C"	"draining the water onto the floor"
"D"	"routing the water to the fresh water reservoir"
"E"	"evaporating the extra water"
"F"	"routing the water to both the frsh and salty water reservoirs"
"G"	"draining the water into an overflow reservoir"
"H"	"using the pump in the system to pump water to an overflow reservoir"

8. (3 points) In a programming flowchart, diamond shapes like the one shown are used to:

Choices =

"A"	"show the direction of the flow of the program"
"B"	"represent 'for' loops"
"C"	"show decision points (what the program will do when a value is too large, for example)"
"D"	"show a function call (such as OpenSaltySolenoid());"
"E"	"show the start or end of a flowchart"
"F"	"show a point where the program will halt if there is an error"
"G"	"we don't use diamond shapes like this in flow charts"
"H"	"show that an operation is being performed (such as computing a certain value)"

9. (3 points) The inverted calibration equation for conductivity sensor used in the ENGR 121 class is as shown. Which of the given choices depicts how you would type teh equation into an Arduino sketch such that the value of salinity is properly calculated? Note: val in the equation is the analog value read from the conductivity circuit

$$salinity := 3.8138 \cdot 10^{-24} \cdot val^{7.5408}$$

Choices =

"A"	"salinity = 3.8138*10*-24*val*7.5408;"
"B"	"salinity = 3.8138*pow(10,-24)*pow(val,7.5408);"
"C"	"salinity = 3.8138*pow(10)^-24*pow(val)^7.5408;"
"D"	"salinity = 3.8138*10^pow(-24)*val^pow(7.5408);"
"E"	"none of these"
"F"	"salinity = 3.8138*power(10,-24)*power(val,7.5408);"
"G"	"salinity = 3.8138*exp(10,-24)*exp(val,7.5408);"
"H"	"salinity = 3.8138*10^-24*val^7.5408;"

10. (3 points) When we prepared a plot and fit a curve to create a calibration equation for the conductivity sensor, which of the following was considered the independent variable for the resulting equation?

Choices =

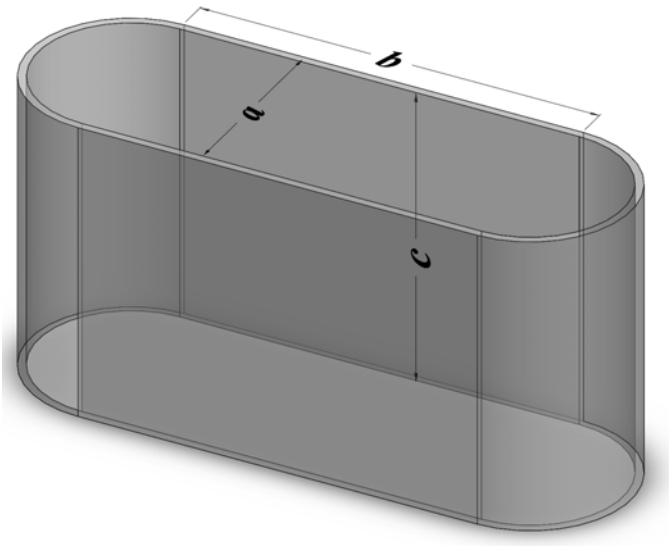
"A"	"the analogRead value corresponding to the voltage across the probes of the conductivity sensor"
"B"	"none of these"
"C"	"the mass of water in the system"
"D"	"the voltage across the 10kΩ resistor"
"E"	"the analogRead value corresponding to voltage across the 10kΩ resistor"
"F"	"the % weight of salt in the solution"
"G"	"the mass of salt in the system"
"H"	"the voltage across the conductivity sensor probes"

11. (5 points) If the chamber shown (see dimensions given below) is completely filled with water, then the mass of the water will be closest to:

$a = 0.5 \cdot m$

$b = 1.2 \cdot m$

$c = 0.75 \cdot m$



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 446 \\ \text{"B"} & 476 \\ \text{"C"} & 506 \\ \text{"D"} & 536 \\ \text{"E"} & 567 \\ \text{"F"} & 597 \\ \text{"G"} & 628 \\ \text{"H"} & 658 \end{pmatrix} \text{kg}$$

12. (5 points) The amount of DI water that you need to add to $m = 97.5 \cdot \text{grams}$ of NaCl to achieve a solution that has a $\text{wt\%}_{\text{NaCl}} = 0.123\%$ is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 63.15 \\ \text{"B"} & 67.07 \\ \text{"C"} & 71.14 \\ \text{"D"} & 75.15 \\ \text{"E"} & 79.17 \\ \text{"F"} & 83.21 \\ \text{"G"} & 87.23 \\ \text{"H"} & 91.19 \\ \text{"I"} & 95.22 \\ \text{"J"} & 99.25 \end{pmatrix} \text{kg}$$

13. (5 points) You measure the current draw of your salinity sensor to be the value shown below. If you were to leave the sensor on for 30 seconds you would produce closest to how many mols of hydrogen gas molecules?

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 2.11 \\ \text{"B"} & 2.49 \\ \text{"C"} & 2.86 \\ \text{"D"} & 3.24 \\ \text{"E"} & 3.61 \\ \text{"F"} & 3.99 \\ \text{"G"} & 4.36 \\ \text{"H"} & 4.74 \end{pmatrix} \quad \text{micromols} \qquad \text{current\_draw} = 16 \cdot \text{mA}$$

14. (5 points) A student presents you with a salt water solution that needs to be duplicated. All that is written on the side of the container is that it holds a $\text{volume} = 0.41 \cdot \text{m}^3$ of DI water, in which salt has been dissolved to yield a number of Na^+ $\text{ions} = 3.9 \times 10^{22}$. The mass of salt you would need to add to a $\text{volume} = 0.41 \cdot \text{m}^3$ of DI water to duplicate this solution is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 3.02 \\ \text{"B"} & 3.21 \\ \text{"C"} & 3.40 \\ \text{"D"} & 3.60 \\ \text{"E"} & 3.79 \\ \text{"F"} & 3.98 \\ \text{"G"} & 4.17 \\ \text{"H"} & 4.36 \\ \text{"I"} & 4.56 \\ \text{"J"} & 4.75 \end{pmatrix} \cdot \text{grams}$$

15. (5 points) A $\text{mass} = 850 \cdot \text{grams}$ of NaCl is dissolved in a $\text{volume} = 2.5 \cdot \text{gallons}$ of DI water. The %wt NaCl in this mixture is closest to:

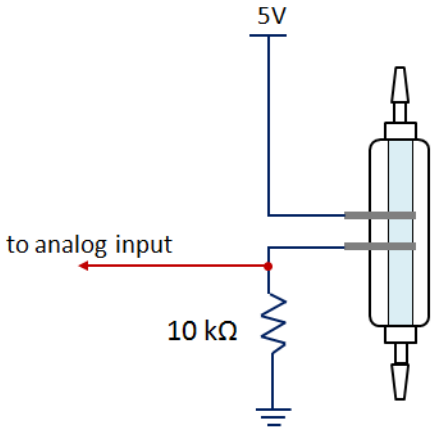
$$\text{Choices} = \begin{pmatrix} \text{"A"} & 7.41 \\ \text{"B"} & 7.82 \\ \text{"C"} & 8.24 \\ \text{"D"} & 8.66 \\ \text{"E"} & 9.08 \\ \text{"F"} & 9.50 \\ \text{"G"} & 9.92 \\ \text{"H"} & 10.33 \\ \text{"I"} & 10.75 \\ \text{"J"} & 11.17 \end{pmatrix} \cdot \%$$

16. (5 points) During the cold winter months in Ruston, an Engineering 121 student thinks back to time spent at the beach last summer. To recreate that time, she buys a kiddie pool at Walmart and wants to fill it with a %wt saltwater solution of 3.5%, roughly the salinity of the saltwater in the Gulf. If the pool holds a $\text{volume} = 7.8 \cdot \text{ft}^3$ of DI water, the number of pounds of salt she should add is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 14.1 \\ \text{"B"} & 15.0 \\ \text{"C"} & 15.9 \\ \text{"D"} & 16.8 \\ \text{"E"} & 17.7 \\ \text{"F"} & 18.6 \\ \text{"G"} & 19.5 \\ \text{"H"} & 20.4 \\ \text{"I"} & 21.2 \\ \text{"J"} & 22.1 \end{pmatrix} \cdot \text{lb}$$

17. (5 points) Given the schematic shown below where the salinity sensor has an effective resistance between its probes as shown, the rate at which water molecules are broken down in the sensor is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 10.02 \\ \text{"B"} & 12.19 \\ \text{"C"} & 14.35 \\ \text{"D"} & 16.51 \\ \text{"E"} & 18.68 \\ \text{"F"} & 20.83 \\ \text{"G"} & 22.99 \\ \text{"H"} & 25.17 \end{pmatrix} \frac{\text{micromol}}{\text{hour}}$$



$\text{probe\_resistance} = 3000\,\Omega$

18. (5 points) You are aware that Hydroxide is one of the products of the reduction reaction at the cathode in your salinity sensor. You also know that it is possible for the Hydroxide to combine with Sodium to make Sodium Hydroxide (NaOH), which is a very useful compound. You think there may be a business opportunity in the production of Sodium Hydroxide, but first you need to run some numbers. Assume that all Hydroxide molecules that you produce end up combining with Sodium to make Sodium Hydroxide, and your goal is to produce a given $\text{amount} = 2.4 \cdot \text{grams}$ of the compound. If your salinity sensor is drawing the maximum 40mA from a digital pin on your Arduino, the amount of time that you will need to energize the sensor is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 28.0 \\ \text{"B"} & 32.1 \\ \text{"C"} & 36.2 \\ \text{"D"} & 40.2 \\ \text{"E"} & 44.3 \\ \text{"F"} & 48.3 \\ \text{"G"} & 52.4 \\ \text{"H"} & 56.5 \end{pmatrix} \text{hours}$$

Na = 22.99 grams/mol
O = 15.999 grams/mol
H = 1.008 grams/mol

19. (5 points) A civil engineer examining the makeup of soil places a sample of moist soil with $\text{mass} = 505 \cdot \text{grams}$ in a high temperature oven. The high-temperature oven evaporates all water and organic matter in the soil. The mass of the sample when removed from the $\text{oven} = 408 \cdot \text{grams}$. In a separate test, the engineer places another sample of the original moist soil with a $\text{mass} = 310 \cdot \text{grams}$ in a microwave oven where all the water is evaporated, but the organic matter is not evaporated. The mass of this sample when it is removed from the $\text{microwave} = 290 \cdot \text{grams}$. The weight percent of organic matter in the original moist soil is closest to:

Hint: you may assume soil is composed of a mixture of water, organic matter, and minerals.

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 11.46 \\ \text{"B"} & 12.11 \\ \text{"C"} & 12.76 \\ \text{"D"} & 13.40 \\ \text{"E"} & 14.05 \\ \text{"F"} & 14.69 \\ \text{"G"} & 15.33 \\ \text{"H"} & 15.99 \\ \text{"I"} & 16.65 \\ \text{"J"} & 17.28 \end{pmatrix} \cdot \%$$

20. (5 points) To reduce the fat content in whole milk and make skim milk, a processing plant siphons off some of the fat. The mixture that is removed from the whole milk has a $\text{fat\%} = 88 \cdot \%$ and the rest of what is siphoned is water (assume no other nutrients are siphoned). In order to keep the weight percent of the other nutrients unchanged, the processing plant then adds water to the milk. For both the skim and the whole milk, the percentage of other $\text{nutrients} = 7.7 \cdot \%$. The original weight percent of fat in $\text{whole\_milk} = 3.6 \cdot \%$ and the new weight percent of fat in the $\text{skim\_milk} = 1.3 \cdot \%$. If the processing plant operates 24 hours/day and produces skim milk at a $\text{flowrate} = 1060 \frac{\text{kg}}{\text{hr}}$, the amount of water that must be supplied to the process per day is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 496 \\ \text{"B"} & 530 \\ \text{"C"} & 564 \\ \text{"D"} & 597 \\ \text{"E"} & 631 \\ \text{"F"} & 665 \\ \text{"G"} & 698 \\ \text{"H"} & 732 \\ \text{"I"} & 766 \\ \text{"J"} & 799 \end{pmatrix} \cdot \frac{\text{kg}}{\text{day}}$$

21. (5 points) A well-insulated container holds 15 liters of water which have an initial temperature of 21°C. A $\text{mass} = 2570\text{gram}$ block of unknown material with a temperature of 98°C is added to the container, the lid is closed, and the system reaches an equilibrium temperature of 28°C. The specific heat capacity value for the block of material is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 1819 \\ \text{"B"} & 1946 \\ \text{"C"} & 2067 \\ \text{"D"} & 2191 \\ \text{"E"} & 2316 \\ \text{"F"} & 2440 \\ \text{"G"} & 2564 \\ \text{"H"} & 2687 \\ \text{"I"} & 2811 \\ \text{"J"} & 2936 \end{pmatrix} \cdot \frac{\text{J}}{\text{kg}\cdot\text{°C}}$$

22. (5 points) Each of the 1.5 million engineers in the USA decide to power up a 20Ω fishtank heaters in a symbol of unity for the beauty of science. Each engineer makes a pilgrimage to Ruston to place their heater in the Lady of the Mist water fountain. Knowing that this is a lot of heaters, President Guice wisely decides to expand the fountain to a $\text{diameter} = 11\text{m}$ with a water depth of 1m. The heaters are then uniformly placed in the water (adding the heaters causes the water to rise, but the volume of the water doesn't change). If all heaters are turned on simultaneously, the time required to increase the temperature of the water to 99˚C is closest to . . .

- •Heaters weigh 50 grams and with an average specific heat of 910 J/kg*degC)
- •Initial temperature of water and heaters is 15˚C
- •Voltage for each heater is 12V

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 3436.5 \\ \text{"B"} & 3620.5 \\ \text{"C"} & 3803.8 \\ \text{"D"} & 3988.1 \\ \text{"E"} & 4170.6 \\ \text{"F"} & 4356.4 \\ \text{"G"} & 4542.3 \\ \text{"H"} & 4719.5 \\ \text{"I"} & 4906 \\ \text{"J"} & 5089.7 \end{pmatrix} \text{s}$$

23. (5 points) An aquarium has an outside exhibit where a tank holds a $\text{volume} = 1.1 \cdot \text{million}\,\text{gallons}$ of salt water with a salt weight percent of 3.5%. In hot, sunny weather, the amount of water that the tank loses to $\text{evaporation} = 21000\,\text{gallons}$ per day of pure water. On average, the amount of water that the aquarium loses each day because of animals $\text{splashing} = 50000\,\text{gallons}$. This water lost due to splashing is 3.5% salt by weight. At night, aquarium workers add saltwater with a salt $\text{concentration} = 5 \cdot \%$ by weight as well as pure water in order to restore the water level to the original volume and the desired 3.5% salt concentration. Assume the density of pure water is 8.33 lb/gal, the density of 3.5% salt water is 8.54 lb/gal, and the density of 5% salt water is 8.63 lb/gal. The volume of pure water that must be added to the tank each night is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 29005 \\ \text{"B"} & 30480 \\ \text{"C"} & 31929 \\ \text{"D"} & 33419 \\ \text{"E"} & 34899 \\ \text{"F"} & 36378 \\ \text{"G"} & 37852 \\ \text{"H"} & 39354 \\ \text{"I"} & 40803 \\ \text{"J"} & 42273 \end{pmatrix} \cdot \text{gallons}$$

24. (5 points) To grow cells used for cancer research, a biologist prepares a stock solution of serum with a $\text{volume} = 5 \cdot \text{L}$ and a density = 1.05 kg/L. The serum is primarily composed of water, along with growth $\text{factors} = 3.5 \cdot \%$ by weight, and $\text{antibiotics} = 5 \cdot \%$ by weight. Wanting to speed up the cell growth, the biologist adds a $\text{volume} = 2 \cdot \text{L}$ of a solution that contains growth $\text{factors} = 6 \cdot \%$ by weight and water. This solution has a density = 1.08 kg/L, and contains no antibiotics.

For the growth to proceed properly, the final mixture must contain at least 4% antibiotics by weight. The mass of pure antibiotics that must be added to make the final mixture have at least 4% antibiotics (by weight) is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 31.7 \\ \text{"B"} & 33.5 \\ \text{"C"} & 35.3 \\ \text{"D"} & 37.1 \\ \text{"E"} & 38.9 \\ \text{"F"} & 40.7 \\ \text{"G"} & 42.5 \\ \text{"H"} & 44.3 \\ \text{"I"} & 46.0 \\ \text{"J"} & \text{"no antibiotics need to be added"} \end{pmatrix} \cdot \text{grams}$$

25. (5 points) Teamwork can sometimes be a challenge. Just before salinity testing, your partner was goofing off and poured a $\text{volume} = 30 \cdot \text{mL}$ of Diet Dr. Pepper into your fishtank (which had been at the required setpoint of 0.1 wt% NaCl). If your system is set to have a $\text{gain} = 70 \cdot \%$, then the new target salinity after adding the Diet Dr. Pepper will be closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 0.0682 \\ \text{"B"} & 0.0709 \\ \text{"C"} & 0.0738 \\ \text{"D"} & 0.0766 \\ \text{"E"} & 0.0793 \\ \text{"F"} & 0.0820 \\ \text{"G"} & 0.0848 \\ \text{"H"} & 0.0876 \\ \text{"I"} & 0.0904 \\ \text{"J"} & 0.0931 \end{pmatrix} \cdot \%$$

Assumptions:

- A 20 fl. oz. bottle of Diet Dr. Pepper has 100 milligrams of NaCl (and nothing else to influence salinity)
- 1 fl. oz. = 29.57 milliliters
- Diet Dr. Pepper as well as DI and the salt water used here all have a density of 1 kg/L
- 15% of the overflow water comes from the correction water and 85% comes from the initial water in the tank (0.1 wt%)
- The effective control volume is 0.0659L (including hoses, pump, conductivity sensor, etc.)

26. (5 points) You are interested in trying to make Dr. Moller's famous alligator broth recipe. The goal of the recipe is to produce a $\text{mass} = 15 \cdot \text{lb}$ of broth that has a salt $\text{concentration} = 1.9 \cdot \%$ and has a percentage pure $\text{water} = 85 \cdot \%$. The recipe begins with filling a large pot with a $\text{volume} = 3.3 \cdot \text{gallons}$ of 1.5% saltwater (by weight) that has a density of 8.42 lb/gal. You will add an unknown quantity of salted alligator bones and scraps to the saltwater. These bones and scraps are expected to be 3.3% salt, 66.4% water, 21.2% protein, and 9.1% fat (all by weight). You will boil the bones and scraps while covered to prevent evaporation of water. When the boiling process is finished, you will remove the solid material left in the pot. This solid material will have the same salt concentration as the final broth and a fat concentration of 1.2% (by weight). The mass of salted alligator bones and scraps that you must add to achieve the goal of the recipe is closest to:

Hint: you can set the problem up in terms of four types of material: water, salt, fat, and protein

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 6.73 \\ \text{"B"} & 7.13 \\ \text{"C"} & 7.54 \\ \text{"D"} & 7.94 \\ \text{"E"} & 8.34 \\ \text{"F"} & 8.75 \\ \text{"G"} & 9.15 \\ \text{"H"} & 9.55 \\ \text{"I"} & 9.96 \\ \text{"J"} & 10.34 \end{pmatrix} \cdot \text{lb}$$

27. (5 points) For the previous problem, the weight percent of protein in the final broth is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 8.93 \\ \text{"B"} & 9.44 \\ \text{"C"} & 9.94 \\ \text{"D"} & 10.44 \\ \text{"E"} & 10.95 \\ \text{"F"} & 11.46 \\ \text{"G"} & 11.95 \\ \text{"H"} & 12.46 \\ \text{"I"} & 12.96 \\ \text{"J"} & 13.48 \end{pmatrix} \cdot \%$$

1 coulomb = $6.24(10)^{18}$ electrons Avogadro's Number: $6.022(10)^{23}$

Density of water at 4°C (maximum density) = 1 g/mL = 1g/cm³ = 1000 kg/m³ = 8.33 lbs/gal

$$C_{p\,H_2O} = 4180\,\frac{J}{kg \cdot C}$$

1L = 0.001m³ = 1.0567quarts = 0.264gal = 61.02in³ 1 gal = 0.1337 ft³ = 3.785 L

1 pound = 16 ounces = 453.592 grams 1 inch = 25.4 mm 1 foot = 12 inches

Conductivity Sensor Reactions:

$2Cl^-_{(aq)} \longrightarrow Cl_{2\,(g)} + 2e^-$ and $2H_20_{(l)} + 2e^- \longrightarrow H_{2\,(g)} + 2OH^-_{(aq)}$

Atomic Weights:

Na = 23.0 g/mol, Cl = 35.5 g/mol, C = 12.0 g/mol, H = 1.0 g/mol, O = 16.0 g/mol

$$R = \frac{\rho \cdot L}{A} \qquad \alpha = \frac{R_2 - R_1}{R_1(T_2 - T_1)} \qquad V \cdot I \cdot t = \rho \cdot Vol \cdot C_p \cdot \Delta T$$

Volume of Cylinder = $\frac{\pi \cdot diameter^2}{4} \cdot height$ $\Delta E = Q - W$

```
/* mySerial.write(254) - control command must be sent before commands below  */
/*                                                                           */
/* mySerial.write(1)   - clear display and move cursor to top left           */
/* mySerial.write(8)   - turn display off                                    */
/* mySerial.write(12)  - turn display on / hide cursor                       */
/* mySerial.write(13)  - blinking cursor on                                  */
/* mySerial.write(14)  - underline cursor on                                 */
/* mySerial.write(16)  - move cursor left one space                          */
/* mySerial.write(20)  - move cursor right one space                         */
/* mySerial.write(24)  - scroll left one space                               */
/* mySerial.write(28)  - scroll right one space                              */
/*                                                                           */
/* mySerial.write(124) - control command must be sent before commands below  */
/*                                                                           */
/* mySerial.write(128) - backlight off                                       */
/* mySerial.write(157) - backlight fully on                                  */
/*                                                                           */
/* row and position commands are shown below for all 80 character positions  */
/*    ROW 0:   128=(0,0)  129=(0,1)  130=(0,2)  131=(0,3)  132=(0,4)         */
/*             133=(0,5)  134=(0,6)  135=(0,7)  136=(0,8)  137=(0,9)         */
/*             138=(0,10) 139=(0,11) 140=(0,12) 141=(0,13) 142=(0,14)        */
/*             143=(0,15) 144=(0,16) 145=(0,17) 146=(0,18) 147=(0,19)        */
/*    ROW 1:   192=(2,0)  193=(2,1)  194=(2,2)  195=(2,3)  196=(2,4)         */
/*             197=(2,5)  198=(2,6)  199=(2,7)  200=(2,8)  201=(2,9)         */
/*             202=(2,10) 203=(2,11) 204=(2,12) 205=(2,13) 206=(2,14)        */
/*             207=(2,15) 208=(2,16) 209=(2,17) 210=(2,18) 211=(2,19)        */
/*    ROW 2:   148=(1,0)  149=(1,1)  150=(1,2)  151=(1,3)  152=(1,4)         */
/*             153=(1,5)  154=(1,6)  155=(1,7)  156=(1,8)  157=(1,9)         */
/*             158=(1,10) 159=(1,11) 160=(1,12) 161=(1,13) 162=(1,14)        */
/*             163=(1,15) 164=(1,16) 165=(1,17) 166=(1,18) 167=(1,19)        */
/*    ROW 3:   212=(3,0)  213=(3,1)  214=(3,2)  215=(3,3)  216=(3,4)         */
/*             217=(3,5)  218=(3,6)  219=(3,7)  220=(3,8)  221=(3,9)         */
/*             222=(3,10) 223=(3,11) 224=(3,12) 225=(3,13) 226=(3,14)        */
/*             227=(3,15) 228=(3,16) 229=(3,17) 230=(3,18) 231=(3,19)
```

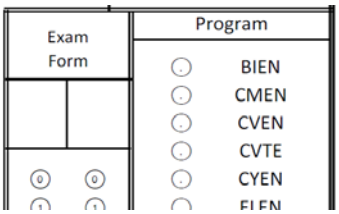
While you are waiting to begin your test:

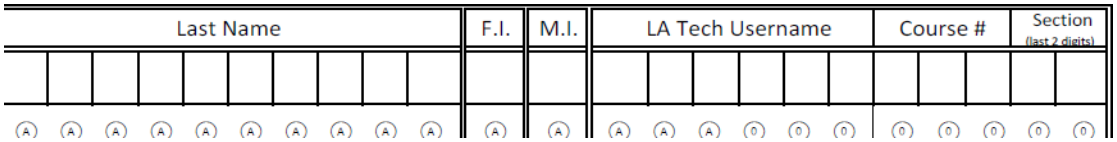
- Please write and bubble your name and initials on your response sheet
- Please write and bubble your LATech username (e.g. abc567) on your response sheet
- Please write and bubble your section number on your response sheet using the guide shown here
- Please write and bubble your ExamForm number. This is your ExamForm: ExamForm= 11

Bubble:	For Course Section:	
91	H01 - Evans	TR 8-9:50
92	H02 - Moller	TR 2-3:50
93	H03 - Cronk	MW 2-3:50
94	H04 - Harbour	MW 10-11:50
95	H05 - Swanbom	TR10-11:50
96	H06 - Hall	TR12-1:50
01	001 - Reis	MW 8-9:50
02	002 - Swanbom	MW 10-11:50
03	003 - Moller	TR 10-11:50
04	004 - Crittenden	TR 12-1:50
05	005 - Reis	MW 12-1:50

Notes:

- If your last name is too long, just write the first 10 letters.
- "**F.I.**" and "**M.I.**" are your first and middle initials, respectively
- Your **"Username"** is the first part of your LATech email address
- For **"Section"** use the guide provided to the right
- Indicate "ENGR" as the **"Program"**





Also Note:

- Points will be awarded as marked for the first 100 points you earn. Any additional points you earn on the exam will be credited to you as extra credit at a 1:5 ratio (i.e. if you earn 105 points on the exam, your score for the exam will be 101)
- Mobile phones or other electronic devices (other than FE-approved calculators and plain timepieces) are not allowed on this exam. If you have non-approved devices, please deposit them at the front of the room for the duration of the exam. Don't forget to retrieve them when you prepare to depart.
- Please deposit any bags you might have brought in the front of the room for the duration of the exam.
- There is a reference sheet on the other side of this page. You may rip it off when the exam begins if you wish. If you rip off this page, please turn it in with your exam.
- If you need additional scratch paper, please ask your proctor. Turn in any scratch paper with your exam, even if unused.
- If you have questions during the exam, please remain in your seat and raise your hand. A proctor will come to you.
- Please use a restroom now if you need it so as to minimize potential disruptions during the exam.

ExamForm = 11

Key =

	1
1	"C"
2	"A"
3	"F"
4	"B"
5	"G"
6	"E"
7	"G"
8	"C"
9	"B"
10	"E"
11	"F"
12	"E"
13	"B"
14	"E"
15	"C"
16	"E"
17	"C"
18	"D"
19	"C"
20	"F"
21	"F"
22	"B"
23	"F"
24	"C"
25	"I"
26	"D"
27	"C"