

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.

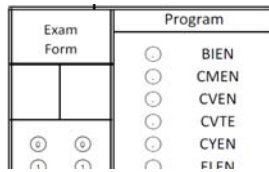
Signed: _____

1. (2 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.

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"



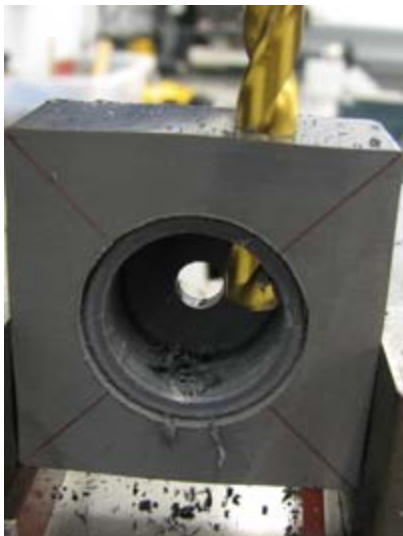
Bubble: For Course Section:

91	H01 - Harbour	MW 12-1:50
92	H02 - Long	TR 12-1:50
93	H03 - Cronk	MW 2-3:50
94	H04 - Scoggin	MW 4-5:50
95	H05 - Reeves	TR10-11:50
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05	005 - Hartmann	TR 4-5:50
06	006 - Corbett	TR 12-1:50
07	007 - Pathak	MW 12-1:50
08	008 - Easley	TR 8-9:50
09	009 - Cronk	MW 4-5:50
10	189c - Crittenden	MWF 8-9:50

Last Name	F.I.	M.I.	LA Tech Username	Course #	Section (last 2 digits)
(A) (A) (A) (A) (A) (A) (A) (A) (A) (A)	(A)	(A)	(A) (A) (A) (A) (A) (A) (A)	(A) (A) (A) (A) (A)	(A) (A)

Choices = ("A" "I properly completed all required items in problem 1, so I will not lose these points")
 ("B" "I did not properly complete problem 1 because I am fine with losing these points.")

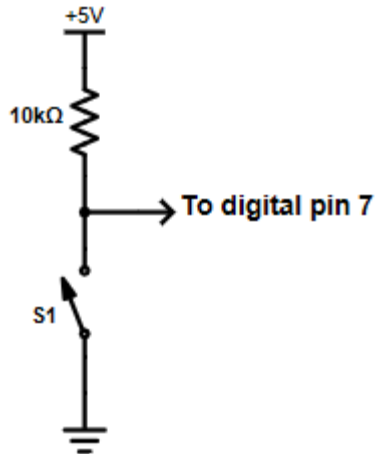
2. (3 points) In the picture shown below, the purpose of the hole being drilled is:



Choices = ("A" "mount the O-ring"
 "B" "mount the impeller"
 "C" "screw in the face plate"
 "D" "mount the DC pump motor"
 "E" "barbed fitting for the outlet"
 "F" "zip tie the dc motor"
 "G" "alignment mark for the pump body and face plate"
 "H" "barbed fitting for the inlet")



3. (3 points) Examine the schematic and the sketch shown below. If the switch, S1, is closed, the value of the variable **switch_status** is:



```
void setup() {
  pinMode (7, INPUT);
}
void loop() {
  int switch_status;
  switch_status = digitalRead(7);
}
```

- Choices =
- "A" "10"
 - "B" "315"
 - "C" "100"
 - "D" "450"
 - "E" "0"
 - "F" "1"
 - "G" "512"
 - "H" "1023"



4. (3 points) Water is pumped from the ocean (at sea level) to a bucket sitting on top of a high mountain. Here, there is an increase in the _____ of the water in the bucket due to the _____ that passes through the wires that power the pump.

- Choices =
- "A" "kinetic energy, force of gravity"
 - "B" "potential energy, mechanical energy"
 - "C" "mass of the water, potential energy "
 - "D" "potential energy, electrical energy"
 - "E" "potential energy, mass of water "
 - "F" "potential energy, velocity of water"
 - "G" "kinetic energy, velocity of water "
 - "H" "kinetic energy, mass of the water"



5. (3 points) If the voltage output of a circuit is 2.2V, then what is the best programming function to measure this **voltage** value?

- Choices =
- "A" "micros()"
 - "B" "analogRead()"
 - "C" "delay()"
 - "D" "digitalWrite()"
 - "E" "analogWrite()"
 - "F" "millis()"
 - "G" "digitalRead()"



6. (3 points) Which combination does not constitute units of energy?

- Choices =
- "A" "kg*[meters/(seconds^2)]*meters"
 - "B" "(Amps^2)*Ohms*Minutes"
 - "C" "kg*(meters^2)/seconds"
 - "D" "Newtons*meters"
 - "E" "Joules"
 - "F" "Pounds*Feet"
 - "G" "Watts*Days"
 - "H" "Volts*Amps*Hours "



7. (3 points) If the state of an Arduino pin will either be 0V or 5V, what is the best programming function to use to determine the state of the pin?

- Choices =
- "A" "analogRead()"
 - "B" "digitalRead()"
 - "C" "analogWrite()"
 - "D" "millis()"
 - "E" "delay()"
 - "F" "digitalWrite()"
 - "G" "micros()"



8. (3 points) In SolidWorks, before a 3-dimensional feature is created, the user must first draw a 2 dimensional...

choose the term that most closely aligns with SolidWorks' terminology

- Choices =
- "A" "plane"
 - "B" "doodle"
 - "C" "drawing"
 - "D" "feature"
 - "E" "sketch"
 - "F" "profile"
 - "G" "loop"
 - "H" "figure"



9. (3 points) It is possible to use pre-programmed collections of techniques on your Arduino that other people have created and published. The formal name of these collections of pre-programmed techniques that you can include in your Arduino programs is...

- Choices =
- "A" "calls"
 - "B" "libraries"
 - "C" "functions"
 - "D" "memories"
 - "E" "references"
 - "F" "resources"
 - "G" "collections"
 - "H" "inputs"



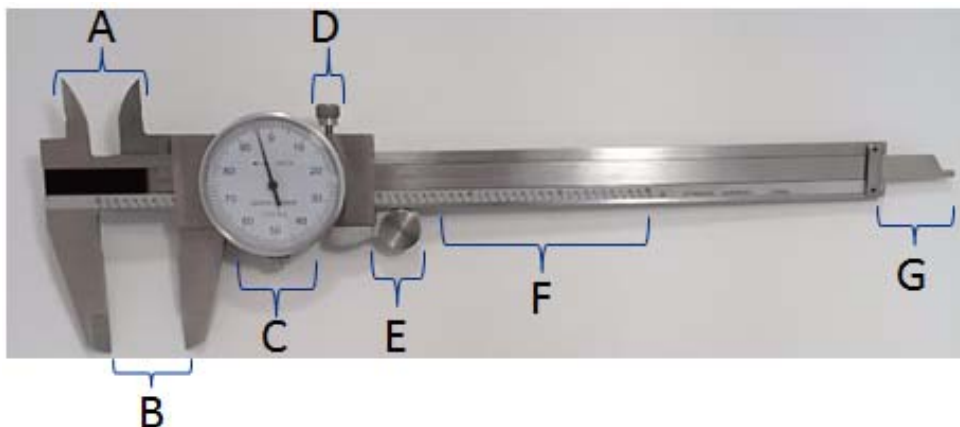
10-12. (1 point each) For the multimeter shown, choose the best setting to accomplish each item in the following list of tasks:



Questions =	"QUESTION"	"TASK"
	10	"measuring the equivalent resistance of a resistor network you have built"
	11	"measuring the voltage applied to an arduino input from a sensor"
	12	"measuring the current supplied to the pumps built in this class"

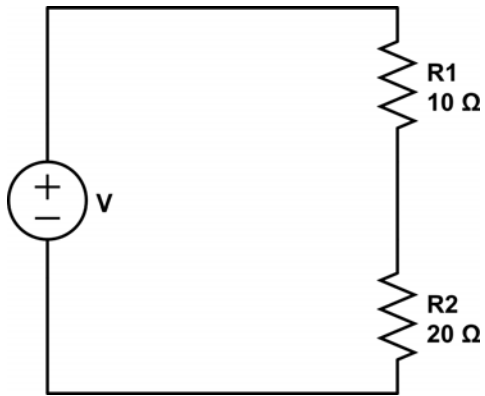


13-15. (1 point each) For the dial caliper shown, choose the letter on the figure that best matches the purposes in the list.



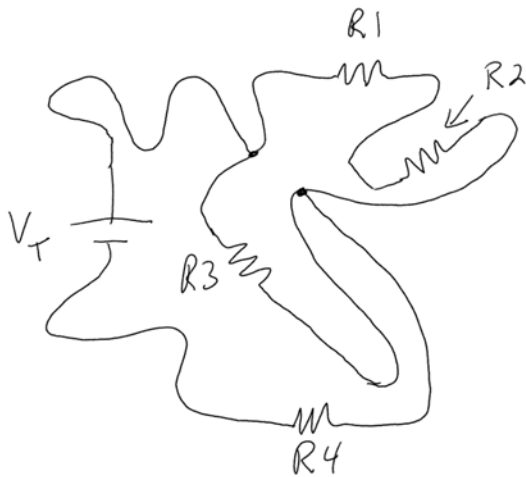
Questions =	"QUESTION"	"PURPOSE"
	13	"measures depth"
	14	"provides additional measurement resolution"
	15	"measures internal dimensions"

16. (5 points) Given that the voltage $V = 7\text{ V}$, then the power consumed by R_2 is closest to ...



- Choices =
- | | |
|-----|------|
| "A" | 0.65 |
| "B" | 0.74 |
| "C" | 0.82 |
| "D" | 0.91 |
| "E" | 1.00 |
| "F" | 1.09 |
| "G" | 1.18 |
| "H" | 1.26 |
- W

17. (5 points) Given the listed values for voltage and resistance, the voltage drop across R_4 is closest to ...

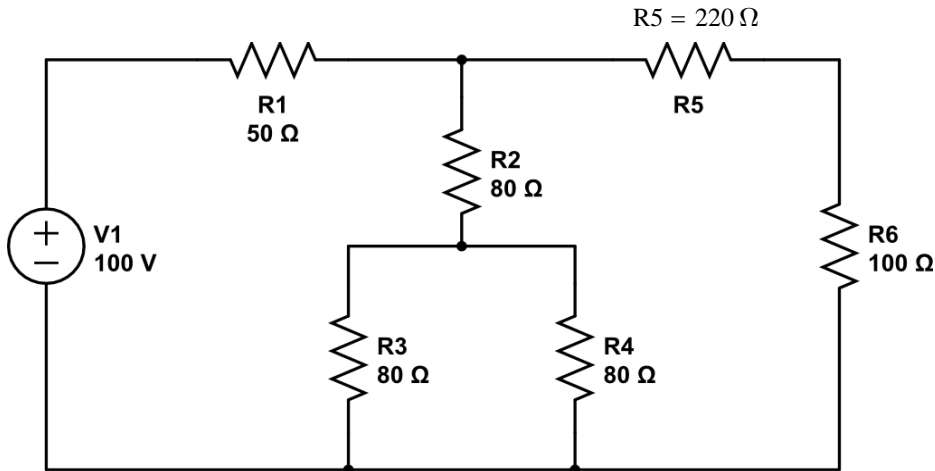


- $V_T = 2\text{ V}$ $R_3 = 20\ \Omega$
 $R_1 = 50\ \Omega$ $R_4 = 100\ \Omega$
 $R_2 = 30\ \Omega$

- Choices =
- | | |
|-----|------|
| "A" | 1.62 |
| "B" | 1.72 |
| "C" | 1.83 |
| "D" | 1.93 |
| "E" | 2.04 |
| "F" | 2.14 |
| "G" | 2.25 |
| "H" | 2.35 |
- V



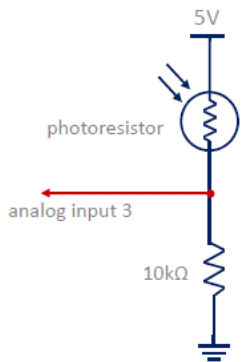
18. (5 points) For the circuit shown, the voltage drop across R5 is closest to...



- Choices =
- | | |
|-----|-------|
| "A" | 35.71 |
| "B" | 38.40 |
| "C" | 41.06 |
| "D" | 43.71 |
| "E" | 46.37 |
| "F" | 49.04 |
| "G" | 51.71 |
| "H" | 54.34 |
- V



19. (5 points) If a current $=0.00021\text{A}$ passes through the photoresistor in the circuit diagram below, then the integer value returned by the analogRead(3) function is closest to...



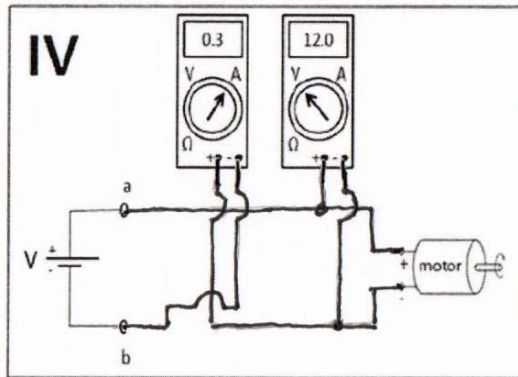
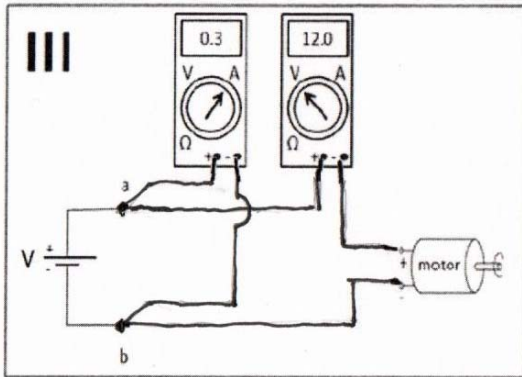
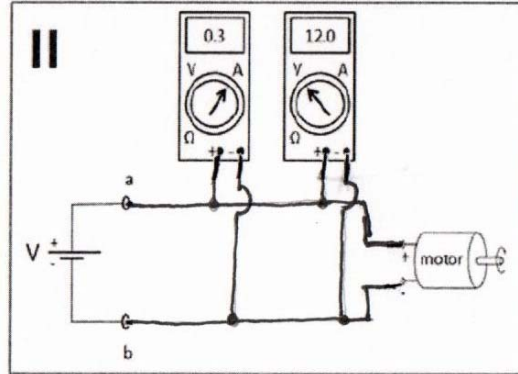
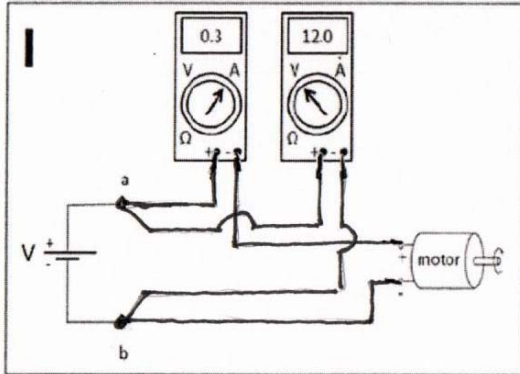
- Choices =
- | | |
|-----|-----|
| "A" | 429 |
| "B" | 464 |
| "C" | 498 |
| "D" | 533 |
| "E" | 568 |
| "F" | 602 |
| "G" | 636 |
| "H" | 672 |



20. (5 points) Using the experience from the centrifugal water pump testing you did in class and/or at helpdesk hours, the setup for determining the power input to your pump can be shown by

- "A" "II and III"
- "B" "II only"
- "C" "II and IV"
- "D" "I and IV"
- "E" "III and IV"
- "F" "I only"
- "G" "III only"
- "H" "I and III"
- "I" "IV only"

Choices =



21. (5 points) Consider the following data, and assume the unidentified 'x' coordinate is as shown below. When using a linear model, the value of 'm' is closest to:

X	Y
100	125
	172
147	195

Xcoordinate = 133

- "A" 1.060
- "B" 1.164
- "C" 1.268
- "D" 1.373
- "E" 1.478
- "F" 1.582
- "G" 1.687
- "H" 1.791

Choices =

22. (5 points) Consider a linear model with the slope shown below (based on a collection of four data points). Given the sum of the dependent data points is 1174 and the sum of the independent data points is 314, the y-intercept value is closest to:

$$\text{Slope} = 4.45$$

- Choices =
- "A" -32.083
 - "B" -36.069
 - "C" -40.045
 - "D" -43.985
 - "E" -47.913
 - "F" -51.886
 - "G" -55.825
 - "H" -59.780

23. (5 points) In class, we discussed that the coefficient of determination may be calculated using the equation shown below. Consider a linear model with the r^2 value given below. If the value computed for the denominator in the r^2 equation is 144.5, the sum of the squared error terms is closest to:

$$r^2 = 1 - \frac{\sum (y_i^{\text{fit}} - y_i)^2}{\sum (\bar{y} - y_i)^2}$$

$$\text{Coefficient of Determination} = 0.9897$$

- Choices =
- "A" 0.89
 - "B" 1.04
 - "C" 1.19
 - "D" 1.34
 - "E" 1.49
 - "F" 1.64
 - "G" 1.79
 - "H" 1.94



24. (5 points) A pump is connected to an electric motor that is supplied with current $=2.1\text{A}$ from a 12VDC source. The apparatus runs steadily for 60s and a mass $=2.75\text{kg}$ is collected from a height $=0.8\text{m}$. If the velocity of the water at the exit can be neglected ($v = 0\text{ m/s}$), then the efficiency of the pump is closest to...

- Choices = $\left(\begin{array}{l} \text{"A"} \ 0.85 \\ \text{"B"} \ 1.00 \\ \text{"C"} \ 1.14 \\ \text{"D"} \ 1.28 \\ \text{"E"} \ 1.43 \\ \text{"F"} \ 1.57 \\ \text{"G"} \ 1.71 \\ \text{"H"} \ 1.86 \end{array} \right) \cdot \%$



25. (5 points) A pump moves water with a mass $= 56\text{kg}$ over a duration $= 24\text{s}$ to a height $= 2.5\text{m}$. If the average velocity of the fluid was 3.5 m/s and the pump efficiency is known to be 21% , then the power required to move the water in Watts is closest to...

- Choices = $\left(\begin{array}{l} \text{"A"} \ 237.60 \\ \text{"B"} \ 271.70 \\ \text{"C"} \ 306.14 \\ \text{"D"} \ 340.46 \\ \text{"E"} \ 374.73 \\ \text{"F"} \ 408.93 \\ \text{"G"} \ 443.28 \\ \text{"H"} \ 477.75 \end{array} \right) \cdot \text{W}$



26. (5 points) Every Saturday morning, Jack uses a pipe with inner diameter of 3 inches to fill a mini pool of volume 5,000 gallons. He then goes for a walk and comes back precisely at the instant when the pool fills up. One day, a thief enters Jack's house immediately after he leaves. For the average velocity of water in the hose given below, the maximum time in minutes the thief can stay in the house without getting caught is closest to ...

$$\text{Velo}_{\text{hose}} = 5 \cdot \frac{\text{ft}}{\text{s}}$$

- Choices = $\left(\begin{array}{l} \text{"A"} \quad 37.98 \\ \text{"B"} \quad 39.82 \\ \text{"C"} \quad 41.71 \\ \text{"D"} \quad 43.54 \\ \text{"E"} \quad 45.39 \\ \text{"F"} \quad 47.23 \\ \text{"G"} \quad 49.09 \\ \text{"H"} \quad 50.92 \\ \text{"I"} \quad 52.80 \\ \text{"J"} \quad 54.62 \end{array} \right) \cdot \text{min}$



27. (5 points) The Electrical Engineering department has a new motor in the power lab that is liquid cooled. They are storing this fluid with a density = $1023 \frac{\text{kg}}{\text{m}^3}$ in a tank on the roof of Nethken Hall and pumping it from the power lab to the roof using a hose with a diameter = 1.1-in. If the tank holds a mass = 2423-kg and if it takes $t = 2.5\text{-hr}$ to fill the tank, the velocity of the fluid as it enters the tank on the roof is closest to ...

- Choices = $\left(\begin{array}{l} \text{"A"} \quad 0.299 \\ \text{"B"} \quad 0.325 \\ \text{"C"} \quad 0.351 \\ \text{"D"} \quad 0.377 \\ \text{"E"} \quad 0.403 \\ \text{"F"} \quad 0.429 \\ \text{"G"} \quad 0.455 \\ \text{"H"} \quad 0.481 \\ \text{"I"} \quad 0.507 \\ \text{"J"} \quad 0.534 \end{array} \right) \cdot \frac{\text{m}}{\text{s}}$



28. (5 points) You have been asked to calculate the electrical power of a pump that is used to fill a water tower. The tower will hold $V_{ol} = 2 \times 10^6 \text{ L}$ of water. The water exits the hose connected to the pump at a height = 30m from the surface of the water supply. The pump can fill the tower in $t = 1.2 \text{ days}$. The kinetic energy associated with the velocity of the water at the exit can be neglected. If the pump is 55% efficient, then the electrical power used by the pump is closest to:

- Choices = $\left(\begin{array}{l} \text{"A"} \quad 10.32 \\ \text{"B"} \quad 10.95 \\ \text{"C"} \quad 11.57 \\ \text{"D"} \quad 12.2 \\ \text{"E"} \quad 12.82 \\ \text{"F"} \quad 13.45 \\ \text{"G"} \quad 14.08 \\ \text{"H"} \quad 14.71 \\ \text{"I"} \quad 15.33 \\ \text{"J"} \quad 15.95 \end{array} \right) \cdot \text{kW}$

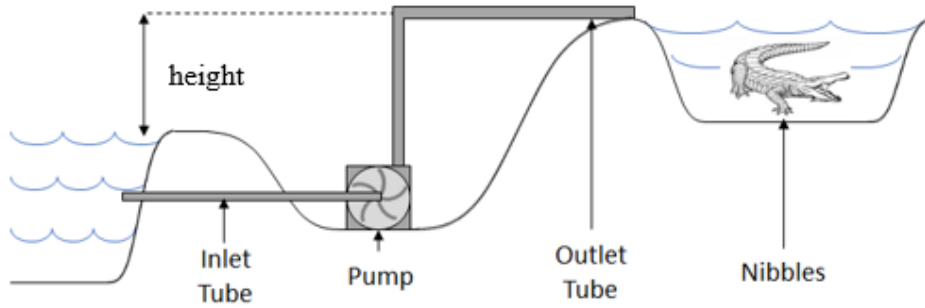


29. (5 points) You are filling your 20ft diameter swimming pool that is 5ft deep. The pool is on a hill where the water exits 105 ft above the surface of the reservoir feeding the pump. Your electric pump is $\eta = 25\%$ efficient. The water exits the hose connected to the pump at a speed of $\text{Velocity} = 2.8 \frac{\text{m}}{\text{s}}$. The cost of electricity at your location is \$0.12 per kWh (kilowatt-hour). The cost for powering your pump with electricity until the pool is filled is closest to:

- Choices = $\left(\begin{array}{l} \text{"A"} \quad 1.66 \\ \text{"B"} \quad 1.77 \\ \text{"C"} \quad 1.88 \\ \text{"D"} \quad 2.00 \\ \text{"E"} \quad 2.11 \\ \text{"F"} \quad 2.23 \\ \text{"G"} \quad 2.34 \\ \text{"H"} \quad 2.46 \\ \text{"I"} \quad 2.57 \\ \text{"J"} \quad 2.69 \end{array} \right) \cdot \$$



30. (5 points) Dr. Hartmann has recently acquired a pet alligator named "Nibbles" and has decided to create a small sanctuary in his back yard. He intends to transfer water into his pond that has a volume = 105-m^3 from a local reservoir using an electric pump which draws an energy = $1.52\text{-kW}\cdot\text{hr}$. The exit nozzle of the 1" inner diameter hose is located at an elevation = 3.4 ft above the reservoir surface. If the pump operates at efficiency = 25% , the time it take Dr. Hartmann to fill his pond is closest to...



- Choices =
- | | |
|-----|--------|
| "A" | 13.784 |
| "B" | 15.304 |
| "C" | 16.763 |
| "D" | 18.214 |
| "E" | 19.663 |
| "F" | 21.133 |
| "G" | 22.588 |
| "H" | 24.043 |
| "I" | 25.509 |
| "J" | 26.976 |
- hr

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

Notes:

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- 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"

Exam Form		Program	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	BIEN
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	CMEN
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	CVEN
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	CVTE
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	CYEN
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	FIEN

Bubble: For Course Section:

- | | | |
|----|-------------------|------------|
| 91 | H01 - Harbour | MW 12-1:50 |
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| 01 | 001 - Bhattarai | MW10-11:50 |
| 02 | 002 - Scoggin | MW 2-3:50 |
| 03 | 003 - Cronk | TR 2-3:50 |
| 04 | 004 - Scoggin | MW 8-9:50 |
| 05 | 005 - Hartmann | TR 4-5:50 |
| 06 | 006 - Corbett | TR 12-1:50 |
| 07 | 007 - Pathak | MW 12-1:50 |
| 08 | 008 - Easley | TR 8-9:50 |
| 09 | 009 - Cronk | MW 4-5:50 |
| 10 | 189c - Crittenden | MWF 8-9:50 |

Last Name										F.I.	M.I.	LA Tech Username						Course #	Section <small>(last 2 digits)</small>	
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Also Note:

- 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 (including smartwatches), 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 given below.
- 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.

Reference Information:

color	digit
black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
violet	7
gray	8
white	9

$$\eta = \frac{\frac{1}{2}mv^2 + Wh}{VIt}$$

$$m = \frac{W}{g}$$

$$Vol = \frac{W}{\rho g}$$

$$v = \frac{Vol}{At} = \frac{W}{\rho g At}$$

$$Q = v \cdot A$$

$$A = \frac{\pi}{4}d^2 = \pi r^2$$

$$m = \frac{n(\sum x_i y_i) - (\sum x_i)(\sum y_i)}{n(\sum x_i^2) - (\sum x_i)^2}$$

$$b = \frac{\sum y_i - m(\sum x_i)}{n}$$

$$r^2 = \left[\frac{n(\sum x_i y_i) - (\sum x_i)(\sum y_i)}{\sqrt{n(\sum x_i^2) - (\sum x_i)^2} \sqrt{n(\sum y_i^2) - (\sum y_i)^2}} \right]^2$$

- Density of water = 1000 kg/m³ = 1 g/cm³
- Density of water = 1 kg/L
- 1 kg = 1000 g
- 1 L = 0.001 m³
- g = 9.81 m/s²
- 1 gallon = 3.785 L
- 1 inch = 2.54 cm 1 foot = 12 in
- 1 coulomb = 6.24(10)¹⁸ electrons
- Avogadro's Number = 6.022(10)²³ per mol
- cylinder volume = $\frac{\pi \cdot \text{diameter}^2}{4} \cdot \text{height}$
- 1 mile = 5280-ft



ExamForm = 11
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181_ENGR120_E2
November 11, 2017

Key =

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

