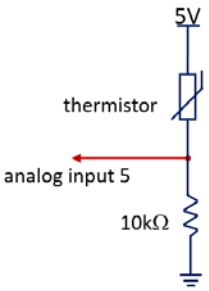
Exam Practice Problems (5 Point Questions)

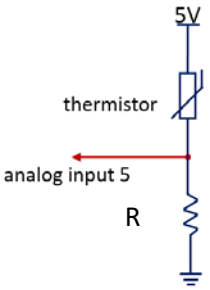
Below are practice problems for the five-point questions found on the exam. These questions come from past exams as well additional questions created by faculty. Please note that these are just examples of questions and may not cover all concepts that could be asked in the 5-point section on your exam.

Thermistor

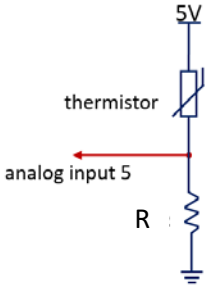
1. Given the voltage divider circuit below (where Thermistor Resistance = 2190Ω), if the Arduino function analogRead(5) is used, the analog input reading would be closest to…
    a. 789
    b. 564
    c. 889
    d. 839
    e. 630
    f. 904
    g. 711



2. Suppose Thermistor Resistance = 110Ω. What value should the unknown resistor, R, be so that the voltage drop across R is 1.1V for the given circuit?
    a. 20Ω
    b. 31Ω
    c. 43Ω
    d. 51Ω
    e. 62Ω
    f. 75Ω



3. Consider the circuit shown below where the resistance of the thermistor = 100Ω. If **analogRead(5)** has been called and the value of the analog input displayed on is 600, then the resistance, R, is closest to . . .
    a. 154.8 Ω
    b. 146.2Ω
    c. 130.1Ω
    d. 141.5Ω
    e. 127.3Ω
    f. 149.1Ω



LCD

4. When the code below is executed on an Arduino board connected to the serial LCD referenced in the course notes, the output that appears on the LCD is closest to . . .

```
void setup() {
Serial.begin(9600); delay(500);
mySerial.write(254); mySerial.write(1);
mySerial.write(254); mySerial.write(131);
Serial.write("Louisiana Tech");
mySerial.write(254); mySerial.write(197);
mySerial.write("University");
mySerial.write(254); mySerial.write(149);
mySerial.write("ENGR 121 Mid Term");
mySerial.write(254); mySerial.write(218);
mySerial.write("x=");
}
void loop() {
float x=0.0;
mySerial.write(254); mySerial.write(220);
x = 1.2345;
mySerial.print(x,3);
mySerial.write(254); mySerial.write(160);
mySerial.write(16);
mySerial.write(" ");
mySerial.write(" ");
mySerial.write(8);
delay(1000);
}
```

a.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0				L	o	u	i	s	i	a	n	a		T	e	c	h			
1						U	n	i	v	e	r	s	i	t	y					
2		E	N	G	R		1	2	1			M	i	d		T	e	r	m	
3							x	=	1	.	2	3	4	5						

b.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0				L	o	u	i	s	i	a	n	a		T	e	c	h			
1						U	n	i	v	e	r	s	i	t	y					
2		E	N	G	R		1	2	1			M	i	d		T	e	r	m	
3							x	=	1	.	2	3								

c.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0				L	o	u	i	s	i	a	n	a		T	e	c	h			
1						U	n	i	v	e	r	s	i	t	y					
2		E	N	G	R		1	2	1			M	i	d		T	e	r	m	
3							x	=	1	.	2	3	4							

d.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0				L	o	u	i	s	i	a	n	a		T	e	c	h			
1						U	n	i	v	e	r	s	i	t	y					
2							x	=	1	.	2	3	4							
3		E	N	G	R		1	2	1			M	i	d		T	e	r	m	

5. Write a program that ***(You will not need to program on the LCD for the test)***
   a. makes your first LED come on when the whisker is pressed.
   b. makes the first character of your first name scroll across the 2nd line of the LCD screen, moving one character to the right every 500 milliseconds. For example if your name is “Dusty”, then the letter “D” should start at position 192 and move through position 211 repeatedly; The character “D” should be the only thing that shows up on the LCD at any given time.
   c. Make the LED to come on AND the first letter of your first name to scroll across the 2nd line of the LCD screen when the whisker is pressed.
   d. Write a program that makes the first five characters of your first name scroll across the 2nd line of the LCD repeatedly. If your name is “Dusty”, then “Dust” should be displayed in 208, 209, 210 and 211 when the “y” scrolls back around to “192”. You must get this completely right to get any credit, with no stray characters present on the LCD. If your first name is shorter than 5 characters, then use some of the letters in your last name.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147
1	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211
2	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167
3	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231

Mass

6. A fishtank with a diameter of 1.6 inches and a depth of 2.4 inches contains a mass of water closest to
    a. 56 grams
    b. 70 grams
    c. 79 grams
    d. 88 grams
    e. 94 grams

7. A fishtank reservoir has an inside diameter of 1.75 inches. The water level inside the reservoir is 2.25 inches high. The mass of water in the reservoir is closest to…
    a. 54 g
    b. 0.089 g
    c. 5.4 g
    d. 88,685 g
    e. 543 g
    f. 88.7 g
    g. 50.7 g
    h. 5.0 g

8. A cylindrical "fishtank" with an inner diameter of 1.8 inches and a water depth of 2.5 inches. The density of this water is 1000 kg/m^3. Find: The mass of the water in the tank is closest to:
    a. 82.4 grams
    b. 92.4 grams
    c. 104 grams
    d. 112 grams
    e. 122 grams
    f. 132 grams

Salt Water Chemistry

9. The mass of NaCl that you would need to add to 5 kg of water to create a concentration of 0.15% NaCl is closest to
    a. 1.8 g
    b. 7.5 g
    c. 43 g
    d. 94 g

e. 107 g
f. 521 g

10. Two (2) kilograms of deionized water is mixed with 225 grams of NaCl. The percent weight of NaCl for this mixture is closest to…
    a. 1.13 %
    b. 14.6 %
    c. 1.01 %
    d. 9.9 %
    e. 11.25 %
    f. 8.9 %
    g. 10.1 %
    h. 12.4 %

11. A mixture whose % weight of NaCl is 14.25% is required for a project. The amount of NaCl that must be added to 5 liters of deionized water in order to achieve this % weight is closest to…
    a. 5.83 kg
    b. 0.83 kg
    c. 4.29 kg
    d. 0.7125 kg
    e. 0.021 kg
    f. 2.15 kg
    g. 3.109 kg
    h. 0.413 kg

12. salt water mixture contains 1 gram of NaCland 10 grams of water. The percent weight of NaCl in this solution is closest to . . .
    a. 0.100%
    b. 0.110%
    c. 1.11%
    d. 8.31%
    e. 9.09%
    f. 10.0%
    g. 11.0%
    h. 14.2%
    i. 21.0%
    j. 21.3%

13. A mass of 400g of salt is poured into 1 gallon of water. The resulting salinity of the water in % wt NaCl is closest to
    a. 5.8% wt NaCl
    b. 9.4% wt NaCl
    c. 11.7% wt NaCl
    d. 13.2% wt NaCl
    e. 15.9% wt NaCl

14. Salt is mixed with 3 liters of pure water. The mass of salt in grams needed to produce salt water with a concentration of 2.5% NaCl by weight (or mass) is closest to . . .
    a. 0.5 g
    b. 38.2 g
    c. 39.9 g
    d. 75.0 g
    e. 76.9 g

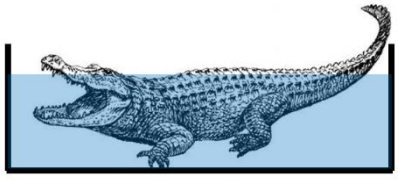
Conservation of Energy

15. A 12VDC power supply powers a 24-ohm resistance heater. Select the smallest power supply below that will sufficiently power the heater.
    a. 12V, 0.2A
    b. 12V, 0.6A
    c. 12 V, 0.8A
    d. 12V, 1A
    e. 12V, 2A

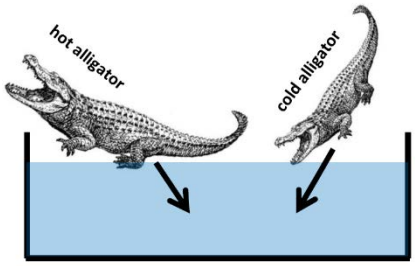
16. A small chamber of water with a 5 cm inside diameter and a depth of 5 cm is heated by an 18 ohm resistor which is powered by a 12VDC power supply. If the heater stays on for a 30 second period, the temperature increase of the water will be closest to . . .
    a. 0.146 °C
    b. 0.585 °C
    c. 1.000 °C
    d. 14.6 °C
    e. 21.96 °C

17. A 10 watt heater that remains on for 10 seconds and heats a small volume of water. If the water temperature increases by 10°C, then the volume of water in m^3 is closest to . . .
    a. $2.39 \times (10)^{-6}\ m^3$
    b. $23.9 \times (10)^{-6}\ m^3$
    c. $0.0042\ m^3$
    d. $0.0500\ m^3$
    e. $0.176\ m^3$

18. Cold blooded creatures (like alligators and engineering professors) take on the temperature of their surroundings and generally do not use their own energy to regulate the temperature of their bodies. A 450 kg alligator (Cp=3300$J/(kg\cdot℃)$) is placed in a pool of water that is 4.4m long, 0.5m deep, and 1m wide (volume of water before adding alligator). We wish to heat the water and the alligator from a beginning temperature of 5°C up to 24°C using the fishtank heaters (which have a resistance of 20Ω and operate on 12VDC) over a 12 hour span. Assuming 70% of the energy provided to the heaters is used to heat the water and the alligator (30% is lost due to heat loss to the environment), then the number of heaters required is closest to . . .
    a. 308
    b. 501
    c. 585
    d. 653
    e. 933
    f. 1207



19. A hot alligator weighing 300kg at 37°C is placed in a bath of water with a cold alligator weighing 200kg at 5°C. If the water before adding the alligators has a volume of 1.5m^3 with an initial temperature of 15°C, then the final temperature of the alligators and water, assuming no heat loss and Cp=3300$J/(kg\cdot℃)$ for both alligators, is closest to . . .
    a. 13.8°C
    b. 15.4°C
    c. 16.9°C
    d. 21.9°C
    e. 36.1°C



20. After you finish this final exam, you would like to have a hot bath. You know that your bathtub holds 180 liters of water. The cold water line to your apartment will supply water at a temperature of 15° C, and the hot water heater will supply water at a temperature of 60° C. If you want the bath water to have a temperature of 40 ° C, then how much hot water and how much cold water will you need to draw into the tub?
    a. 40 L hot water; 140 L cold water
    b. 50 L hot water; 130 L cold water
    c. 60 L hot water; 120 L cold water
    d. 70 L hot water; 110 L cold water
    e. 80 L hot water; 100 L cold water
    f. 90 L hot water; 90 L cold water
    g. 100 L hot water; 80 L cold water
    h. 110L hot water; 70 L cold water
    i. 120 L hot water; 60 L cold water

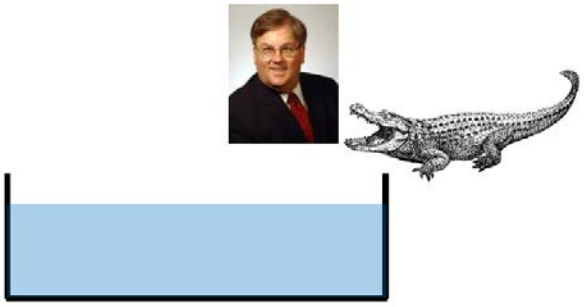
21. A cow has an average specific heat (Cp) of 3550 J / (kg-°C). Normally, the cow has an average body temperature of 39 °C. Suppose the cow becomes overheated during a hot summer day, and his body temperature rises to 43 ° C. The cow has a body mass of 800 kg. To bring the cow's temperature back to his normal value, the farmer decides to submerse the cow in a bath of water which is at room temperature (22 ° C). Assume that the cow's physiological (metabolic) processes are not contributing to the raising or lowering of his body temperature. The amount of water required to reduce the cow's temperature back to 39 ° C is closest to…
    a. 20 kg
    b. 40 kg
    c. 60 kg
    d. 80 kg
    e. 100 kg
    f. 120 kg
    g. 140 kg
    h. 160 kg
    i. 180 kg
    j. 200 kg

22. You are heating a 10 gallon freshwater fish tank with a store bought fish tank heater. You want to heat the water over the next 24 hours from room temperature (20 degrees Celsius) to 26 degrees Celsius. If you are using a 110 Volt heater, the current required will be closest to: Assume: no heat loss from the tank
    a. 0.026 A
    b. 0.1 A
    c. 0.5 A
    d. 0.6 A
    e. 1.0 A
    f. 2.4 A

23. You just made a nice cup (0.237 Liters) of green tea, but it is too hot to drink. You measured the temperature and it was 70 degrees Celsius. You prefer to drink your tea at 60 degrees Celsius. You plan to cool your tea by submerging two-thirds (2/3) of a number of stainless steel spoons in the tea. These spoons are at room temperature (20 degrees Celsius). Only the submerged portion of the spoons will change temperature. How many of these spoons will be required to accomplish this? Assume: Cp for tea = 4185 J/(kg-°C), Cp for stainless steel = 502 J/(kg- °C), density of tea= 1000 kg/m^3 no heat loss from the cup mass of entire spoon = 75 grams
    a. 2 spoons
    b. 4 spoons
    c. 6 spoons
    d. 8 spoons
    e. 10 spoons
    f. 12 spoons

24. Dr. Hall loves coffee. He loves it the best when it has a temperature of 93°C. He wants to make a resistance heater (similar to the one we used in the fish tank project) using a 12V car battery as the energy source that will heat his 12oz. (355mL) coffee from 86°C to 93°C in exactly 5 seconds. Assuming his coffee has the same properties as water, the resistance that he needs for his resistance heater is closest to . . .
    a. 0.02936 Ω
    b. 0.03692 Ω
    c. 0.05923 Ω
    d. 0.06932 Ω
    e. 0.07236 Ω
    f. 0.09263 Ω

25. Alligators are cold-blooded, meaning they assume the temperature of their surroundings. Suppose a 340 kg alligator whose tissue has a specific heat of 3300 J/(kg°C) sits for a long time in the sun, until his average temperature reaches 50°C. Feeling lucky, Dr. Cronk (Cp = 3470 J/(kg°C); mass = 100 kg; Temperature = 37°C) runs up to the alligator to pull his tail. Not being so lucky, he gets snatched by the alligator and killed (may he rest in peace). The alligator then takes Dr. Cronk's lifeless corpse and slips into a perfectly insulated 800 gallon pond nearby. If the initial temperature of the pond was 20°C, then the final temperature of the alligator-Dr. Cronk-pond system after a long period of time is closest to . . . *(Assume the alligator does not generate thermal energy over time, i.e. exothermic chemical reactions are not taking place within the alligator.)*
    a. 20.008 °C
    b. 20.08 °C
    c. 20.80 °C
    d. 22.80 °C
    e. 24.08 °C
    f. 26.08 °C
    g. 28.80 °C
    h. 30.80 °C

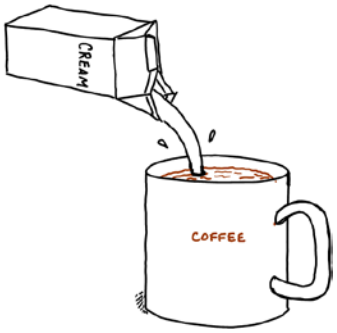


26. You are selecting a resistor to serve as a heater for the new and improved fishtank that you are designing. You are upgrading to a 16 VDC power supply and want the water to heat at a rate of 3°C per minute. The fishtank is 1.5 inches in diameter and the water level is 1.3 inches deep. The resistance value of the heater needed is closest to . . .
    a. 16.3 Ω
    b. 18.3 Ω
    c. 20.3 Ω
    d. 22.3 Ω
    e. 24.3 Ω
    f. 26.3 Ω
    g. 28.3 Ω
    h. 32.5 Ω

27. A 20 Ω resistor connected to a 18VDC power supply will be used to heat the water in an aquarium with a volume of 0.01m^3. The time it will take to heat the water from 22°C to 27°C is closest to . . .
    a. 8,043 s
    b. 10,731 s
    c. 12,901 s
    d. 15,915 s
    e. 18,241 s
    f. 25,891 s

28. A 50 Ω resistor is used to heat 100 mL of water. It takes 30 seconds for the temperature of the water to raise 1 degree Celsius. The power drawn by the heater is closest to . . .
    a. 10 Watts
    b. 12 Watts
    c. 14 Watts
    d. 16 Watts
    e. 18 Watts
    f. 20 Watts

29. Nine grams of cream (Cp= 3770 J/(kg°C)) at 4°C is added to 420 grams of coffee (Cp= 4180 J/(kg°C)) at 96°C. Assuming no heat loss out of the cup, the equilibrium temperature of the mixture is closest to:
    a. 86.5°C
    b. 87.6°C
    c. 88.7°C
    d. 89.8°C
    e. 91.0°C
    f. 92.1°C
    g. 93.2°C
    h. 94.3°C
    i. 95.4°C



30. Dr. Harbour is trying a new method of making his famous alligator soup. He has an immersible110V, 6.7A resistive heater that he places into in an insulated pot containing 4kg of salty water (Cp= 3983 J/(kg°C)). He heats the salty water to a temperature of 62°C and then adds 2kg of alligator meat (Cp= 3120 J/(kg°C)) that has an initial temperature of 10°C. Three minutes later, the salty water and the alligator meat have equalized in temperature. This temperature is closest to: *(Notes: The heater heats during the entire process. Assume zero heat loss from the pot, and uniform temperatures inside the pot at the end of the three minutes.)*
    a. 51.1 °C
    b. 53.3 °C
    c. 55.5 °C
    d. 57.7 °C
    e. 59.9 °C
    f. 62.2 °C
    g. 64.4 °C
    h. 66.6 °C
    i. 68.8 °C
    j. 70.0 °C