eam Team # _____ School _____

1. (20.00 pts) **Identify the following components from the image (2.5 each)**

1. **LED**
2. **CFL**
3. **Filament Bulb**
4. **Thermocouple**
5. **Thermistor**
6. **Thermometer**
7. **IR Temperature**
8. **Thermostat**

Expected Answer: D. A. G. E. F. C. B. H.

2. (10.00 pts)

During the Covid19 pandemic, the temperture taking is one of the key tools for diagnostic for health care. Please demonstrate your capability of quick turn around to help the sociaty to provide a temperture measurement device. Please answer the following questions.

a. Design for the mass production, you need to select the cheapest temperature sensor, which one you would use? (2.5pt)

b. If this device is plug in to the USB cable (5V), and you use a CPU have a A/D of 8bit. What is your voltage sensitivity on measurement. (2.5pt)

c. If you use an Arduino type CPU for your design and want to save money without utilize a series resistor. What kind of pin of the output you would select? (2.5pt)

d. What happen if you make mistaken and bias too much current to your sensor? (suppose the sensor have not reach the current limit) (2.5pt)

Expected Answer: a. Thermistor NTC b. 0.019V c. PWM pin or Analog output pin d. Self heating and temperature accuracy will be bad

3. (6.00 pts)

Many places utilize a non-contact temperature-measuring device to avoid corona virus spread. Please describe what is the technology such device was using.

Expected Answer: It use infrared and a thermal couple to detect the bounded back temperature in reference to the room temperature. * Answer with Infrared or thermocouple will earn full score.

4. (20.00 pts) **Steinhart-Hart is the major method to calibrate the non-linear of the thermo sensor**

Steinhart - Hart Equation $1/T = A+B(LnR)+C(LnR)^3$

Where T = Temperature in degrees Kelvin, LnR is the Natural Log of the measured resistance of the thermistor, A, B and C are constants.

$10^{O}C$ = 40.000K Oh

$20^{O}C$ = 27.000K Oh

$30^{O}C$ = 18.000K Oh

Coefficient A = ? (4pt)

Coefficient B = ? (4pt)

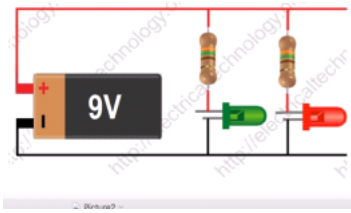
Coefficient C = ? (4pt)

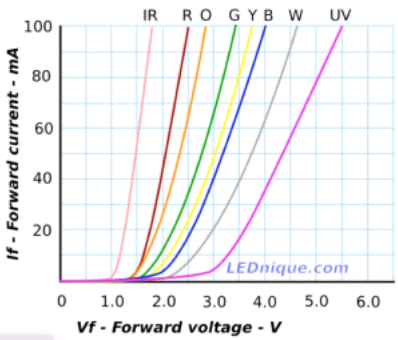
This Thermistor is NTC or PTC ? (4pt)

Measured 25.000K Ohm will be _____ ^{O}C (4pt)

Expected Answer: A = 0.0029524 or 2.952e-3 B = - 0.0000786 or - 0.786e-4 C = 0.0000011866 or 11.866e-7 NTC 21.925 degree C

5. (20.00 pts) **Design the circuit as following and answer questions**





a. For a 5mm LED, typical current used for general design is ? mA (4pt)

b. Design the resistors for the LED in the above circuit with 40 mA. What is the resistor value for Red and Green (4pt, 4pt)

c. What happen if you reverse the green LED connection? which color will not (light up)/(no light)/(burn) (4pt)

d. What is the wattage requirement for the resistor on the Red LED (4pt)

Expected Answer: 4 pt each. Total 5 answer a. 20mA b. (9-1.9V) /40mA = 177.5 Ohm (~175 Ohm is fine) for red (9-2.6)/40mA = 160 Ohm for green c green have no light, red light up d. 0.28W (score if it is close)

6. (3.00 pts) The first NTC thermistor was discovered in 1833 by whom?

- A) Olive Heaviside
- B) Michael Faraday
- C) Joseph Henry
- D) André-Marie Ampère

7. (3.00 pts) Which of the following symbol is Thermistor

a.  b.  c.  d. 

- A) Diagram a
- B) Diagram b
- C) Diagram c
- D) Diagram d

8. (3.00 pts) Thermal couple temperature sensor requires electronic circuit to measure

- A) Current
- B) Resistance
- C) Voltage
- D) Mass

9. (3.00 pts)
A student designs a thermometer, with 8 bit ADC on 5V reference voltage. He/She would need to meet the 0-400^{o}C requirements. This digital system is capable of ?

- A) +/- 0.4^{o}C
- B) +/- 0.8^{o}C
- C) +/- 1.0^{o}C
- D) +/- 1.6^{o}C

10. (3.00 pts) A “K-type” sensor must be which of the following temperature sensor

- A) Negative Temperature Coefficient (NTC)
- B) Resistance Temperature Detector (RTD)
- C) Thermocouple

D) Semiconductor-based sensor

11. (3.00 pts) NTC means?

- A) Negative Temperature Coefficient
- B) Negative Time Constant
- C) Numerical Transform Coefficient
- D) Numerical Temperature Constant
- E) New Talented Coach

12. (3.00 pts) A LED is a diode, which may be used as other sensor function. Which function is not commonly reported?

- A) LED can produce Light
- B) LED can sense light
- C) LED can sense temperature
- D) LED can sense acid levels

13. (3.00 pts) ^{o}K is what unit?

- A) Kevin
- B) Kelvin
- C) Kevan
- D) Kevyn