Name: ______________________________________ Arr: _________

Chapter 21 ALL Written Problems Worksheet

Use this sheet to record your answers to the following Chapter 21 Challenge Problems.

21-8. Identify which of the Teensy 3.2's signal pins are analog pins and which are digital pins.

21-9. One bare lightbulb is lit in an otherwise dark room. Rascal and Honey point their identical VDB/photoresistor sensors (see page 791) directly at the bulb. Rascal's sensor returns a raw digital value of 900 and Honey's returns a value of 600. Who is closer to the lightbulb?

21-12. To determine who has the strongest grip, three brothers – Gy, Joey, and Douglas – each squeeze a force sensor (see page 797) between their thumb and index finger. The sensor is connected to a voltage divider board (VDB), which is connected to an analog pin on the Teensy 3.2. If Gy's sensor reading was 410, Joey's reading was 405, and Douglas' was 400, which brother has the strongest fingers?

21-13. Brett and Jimmy use identical DRV5053 Hall-effect sensors (see pages 799-802) to measure the magnetic field of the same magnet. Brett claims his sensor consistently returns raw digital values near 915, while Jimmy claims his sensor has readings near 72. Which one of them is not telling the truth, and how do you know?

21-14. Polly and Pacho use identical DRV5053 Hall-effect sensors (see pages 799-802) to measure two different magnetic fields. As good scientists do, they ensured that the sensor-magnet distance was the same for each as was their orientation. Polly's sensor returned raw digital values near 60, while Pacho's sensor output values near 560. Which magnet was stronger, Polly's or Pacho's?

21-15. The photoresistor sold by Patton Robotics (see page 804) is used by a scientist to measure the illuminance, E_v, on a sunny day. The sensor is connected to a voltage divider board (VDB), which is powered with 5V and is connected to an analog pin on the Teensy 3.2. If the sensor's digital reading is 25, determine the illuminance in lux units.

21-16. In the previous problem, a VDB/photoresistor recorded a raw digital value of 25, which you converted to illuminance, E_v, in lux units using the equation on page 804. Later, a new measurement is made with the same sensor and an output value of 50 (twice the original reading) is recorded. Calculate the new illuminance value in lux and compare the two E_v values.

21-19. A DRB5053 Hall-effect sensor (see pages 799-802) is connected to an analog pin of the Teensy 3.2 microcontroller and is powered with 5V. The sensor returns a raw digital value of 400. What is the strength of the magnetic field detected by the sensor? Give your answer in units of mT. What is the polarity of the magnet – north or south? You may want to consult the code and explanation for the "**quantitativeMagField.ino**" sketch, which begin on page 807.

21-21. Convert the following 10-bit digital readings from a Teensy 3.2 microcontroller into **analog voltages**. (For assistance answering this question, see *Section 5*, which begins on page 805.)

a. 0

b. 100

c. 777

d. 1023

21-22. Convert the following input analog voltages as read by a Teensy 3.2 microcontroller into **10-bit digital values**. (For assistance answering this question, see *Section 5*, which begins on page 805.)

a. 0 V

b. 1.0 V

c. 2.0 V

d. 3.0 V

21-26. As you know, the voltage divider board (VDB) from Patton Robotics has a fixed resistor, R_f, value of 10kΩ. A force sensor of unknown resistance, R_v, is inserted into the VDB's terminal block, and the board is powered with a voltage of 5V. If the sensor's output **voltage** is 1.6V, what is the resistance of the force sensor, R_v? Give your answer in ohms (Ω). Use the voltage divider equations from *Section 6* on pages 808-812 to answer this question.

Turn in this sheet to be graded.