

# Midterm 1: CST8227 Interfacing

Winter 2011

Time: 50 minutes; Total Marks available: 25 marks

(Allocation of marks is shown beside each question)

## Instructions:

1. **BEFORE** answering any questions, please check that your copy of the test has all pages (as indicated in the footer at the bottom of each page). Please read all questions carefully, then answer the question below first!
2. Be sure to **mark your name** on all pages of this midterm.
3. All work necessary for finding your answer should be shown on this test paper. If you do **not** show your work, **you will not get any marks!!**
4. No calculators are allowed. Numbers have been chosen to work out conveniently. Maybe you'd be better working in fractions instead of decimal values?
5. If you are uncertain what a question is asking, make reasonable assumptions, write those assumptions down on this test paper, and continue answering the question.

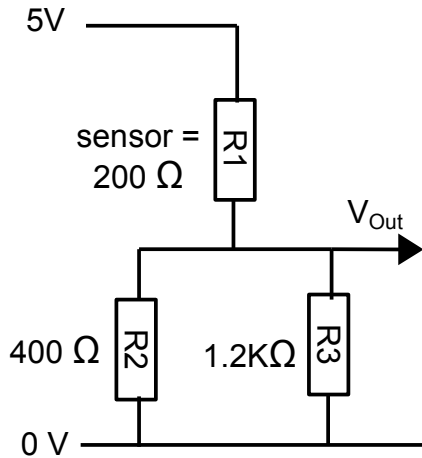
What is your:

NAME? \_\_\_\_\_

Student Id? \_\_\_\_\_

(Continued on next page)

1. [8 marks] Consider the following circuit where a sensor (R1) is combined with two additional resistors (R2, R3). Calculate all values for resistance, current and voltage; remember to give the correct units (ie. ohms, amps/milli-amps, or volts). **Show all your work** on the last page.



- Net resistance = \_\_\_\_\_ **500 ohms**
- Total current from 5V supply = \_\_\_\_\_ **10 mA**
- Voltage across R1 = \_\_\_\_\_ **2V**
- Current through R1 = \_\_\_\_\_ **10 mA**
- Voltage across R2 = \_\_\_\_\_ **3V**
- Current through R2 = \_\_\_\_\_ **7.5 mA**
- Voltage across R3 = \_\_\_\_\_ **3V**
- Current through R3 = \_\_\_\_\_ **2.5 mA**

Other convenient values:  $3//6 = 2$ ,  $4//12 = 3$ ,  $5//20 = 4$

2. [1 mark] What is the resistance, in ohms, of a resistor whose colour bands are: brown, orange, red, gold?

**1300 ohms**

3. [1 mark] What colour bands would appear on a 1.2KΩ resistor?

**brown, red, red**

4. [1 mark] The most recent version of Java Micro Edition (as of Jan 2011) is built around which version of Java?

**Java version 1.3**

5. [1 mark] During this course, we have examined and discussed the spectrum of capabilities and features found in embedded and mobile systems. The minimum hardware requirements specified for CLDC were also presented. Within the spectrum of embedded devices, **clearly** identify **all** categories that meet the requirements for CLDC.

**Mid to high end of the range; ie. everything but the lowest end**

6. [1 mark] Is the Arduino system a multi-tasking system?

**No**

7. [1 mark] The program listed below successfully compiles and loads onto an Arduino, but nothing appears in the serial monitor. **Clearly** identify the problem and/or fix the program.

```
void setup() {  
  pinMode(2, INPUT);  
}  
  
void loop() {  
  int sensorValue = digitalRead(2);  
  Serial.println(sensorValue, DEC);  
}
```

**The setup() function is missing Serial.begin(9600);**

8. [1 mark] Give a **clear** definition of the term "analog" when referring to electronic signals.

**A current or voltage that varies continuously with time and has no abrupt transitions between levels.**

9. [1 mark] Give a **clear** definition of the term "digital" when referring to electronic signals.

**A voltage or current that is produced at one of several finite levels, with a step-wise (abrupt) transition between levels.**

10. [1 mark] **Clearly** describe the type(s) of analog output available on the Arduino.

**Arduino boards only have Pulse Width Modulation (PWM), which approximates analog signals by varying the duty cycle of an output pulse between 0 – 100%.**

11. [1 mark] What is the largest value that can be stored in an `int` on the Arduino?

**2\*\*15 – 1 = 32767**

12. [2 marks] Write the essential Arduino code to display the size (in bytes) of `float` variables.

```
Serial.println( sizeof(float), DEC ); 1 mark for each bolded item
```

13. [2 marks] A student writes a test program which successfully compiles, loads, and is completely functional. The compiler correctly reports "Binary sketch size: 2248 bytes". A few lines of the program are reproduced below. Later the student increases the array of stored values to: `int sensorValues[500];` but notices that the compiler **still** reports "Binary sketch size: 2248 bytes". **Clearly** explain what the problem is, a suitable fix, or why this is not a problem.

```
/* ... additional program code goes here ... */  
  
void loop() {  
    int sensorValues[10];  
    ../* ... remainder of program ... */  
}
```

**This is correct and not a problem since variables are kept in RAM, not in the (flash) storage used for the program code (which is what the compiler reports)**

14. [3 marks] Do you remember the lab work? The voltage on a chip's output pin is measured as 5V with no load connected to it. With a  $20\Omega$  resistor attached, the output voltage is 4V. What is the value of the internal resistance of the output? **Show all your work** below.

**Current through external resistor =  $4V / 20\Omega = 0.2$  amps**

**Internal resistance =  $(5V - 4V) / 0.2$  amps =  $5\Omega$**

1 mark for knowing what to do, 1 mark for each calculation.

15. [1 mark] Consider the internal wiring of a 7-segment display. Is it possible to directly control each of the segments individually using less than 7 output pins? If so, how?

**No**

16. [1 mark] **Clearly** describe what is meant by the term "switch bounce".

**Any clear description of switch bounce is acceptable.** From Wikipedia: *Switch and relay contacts are usually made of springy metals that are forced into contact by an actuator. When the contacts strike together, their momentum and elasticity act together to cause bounce. The result is a rapidly pulsed electric current instead of a clean transition from zero to full current.*

17. [1 mark] **Clearly** describe the difference between the terms "flash" and EEPROM memory.

**The term "flash" refers to memory that is erased and programmed in blocks (eg. 512 bytes) The term "EEPROM" refers to memory that can erase and program individual bytes. Strictly speaking, flash is a type of EEPROM.**

18. [3 marks] List and **clearly** describe three different methods that could be used to remotely control (ie. interface to) an Arduino based rover robot. Include in your description of each method any sensor(s) required and whether the sensor(s) operates in an analog or digital mode.

**Light flashes to light sensor; analog  
Infrared; digital (pulses)  
WiFi shield; digital**

Repeat of Circuit for Q1

Name: \_\_\_\_\_

