# DEPARTMENT OF MECHANICAL ENGINEERING
CONCORDIA UNIVERSITY
MECH 373: Instrumentation and Measurements
Problem Set # 1

1. Determine if the following errors are of precision or bias-type. Justify your response.
    a) A digital scale which always shows 0.216 when no weight is applied.
    b) Vibration of the needle of an automobile speedometer.
    c) Consistent temperature difference between two sensors.

2. You attempt to determine the validity of a bathroom scale by repeatedly placing 20 kg of accurate weights on it. Ten readings were obtained with values of 20.2, 20.2, 20.6, 20.0, 20.4, 20.2, 20.0, 20.6, 20.0 and 20.2 kg. Estimate the bias error and the precision error of the measurements.

3. A linear device converts an input force into an output displacement. The ideal sensitivity of this device is 0.1 cm/N, and the input span is 200 N. What will be the ideal output span? What will be the output span if the actual sensitivity is 0.015 cm/N? What will be the % error in the output span?

4. A digital output voltmeter has an input range of 0 to 30V and displays three significant figures (XX.X). The manufacturer claims on accuracy of $\pm 2\%$ of full scale. With a voltage reading of 5V, what are the percent uncertainties of the reading due to accuracy and re solution?

5. The following figure shows the variation of the output of a sensor with respect to its input.
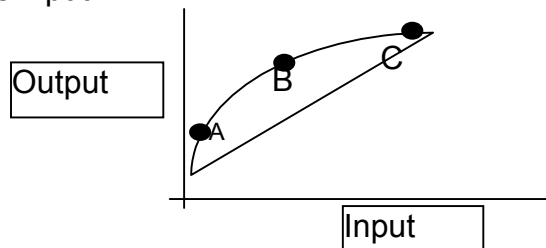
    a) How does the sensitivity of the sensor vary from A to C?
    b) Would you recommend using this device in the A-B or B-C range.

6. A bourdon tube pressure gage (a mechanical device used to measure gage pressure relative to atmospheric pressure) with a range of 0 to 50 psi, reads +0.5 psi when measuring atmospheric pressure. The gage is pecified with an accuracy of $\pm 0.2\%$ of the full scale reading. What is the expected error when a 20 psi signal is measured? Express the error in absolute terms, and in percent of the reading. How can you reduce the error?