

Homework 1

ME 240: Fundamentals of Instrumentation & Measurement

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1. (4 points) You attempt to determine the validity of a bathroom scale by repeatedly placing 20.0 lb 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 lb. Estimate the systematic error and the maximum random error of the measurements.
2. (4 points) A bourdon gage (a mechanical device to measure gage pressure, the pressure relative to atmospheric pressure), which has a range of 0 to 50 psi, reads +0.5 psi when measuring atmospheric pressure. It is claimed to have an accuracy of $\pm 0.2\%$ of full-scale reading. What is the expected error in the measurement of 20 psi in psi and in percent of reading? How can you reduce the error produced by this gage?
3. (4 points) A thermometer, initially at a temperature of 20°C , is suddenly immersed in a tank of water with a temperature of 80°C . The time constant of the thermometer is 2 s. What temperature will the thermometer read after 5 s?
4. (4 points) A thermometer, initially at a temperature of 75°F , is suddenly immersed into a tank of water with a temperature of 180°F . The time constant of the thermometer is 4 s. What are the values of its rise time and 90% response time?