UNIVERSITY OF CALIFORNIA AT BERKELEY

DEPARTMENT OF MECHANICAL ENGINEERING

ME102A MIDTERM

FALL 2015

1a. (0.5 pts) YOUR NAME:

QUESTION	1	2	3	4	TOTAL
MAX GRADE	5	20	20	5	50
YOUR GRADE					

Open book and open notes exam.

No Computers, tablet, phones, or any Internet enabled device.

Equations you may or **may not need**:

Inverting Amplifier:

$$V_{out} = -\frac{R_f}{R_{in}} V_{in}$$

Non-inverting amplifier:

$$V_{out} = (\frac{R_f}{R_{in}} + 1) V_{in}$$

Propagation of Error:

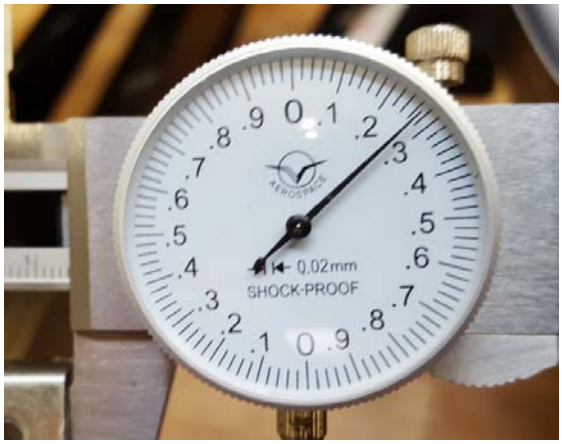
Given $X = f(A, B, C, \ldots)$

$$\sigma_X^2 = \left(\frac{\partial f}{\partial A}\sigma_A\right)^2 + \left(\frac{\partial f}{\partial B}\sigma_B\right)^2 + \left(\frac{\partial f}{\partial C}\sigma_C\right)^2 + \cdots$$

1. (5.0)
    a. (0.5) You already did this (hopefully) by filling out your name properly.

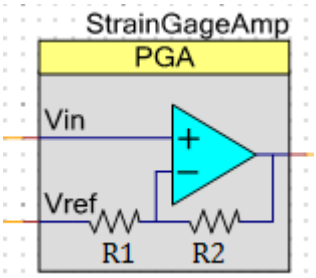
    b. (0.5) What is ‘triggering’ in the context of using the LabVIEW scope?

    c. (2.0)

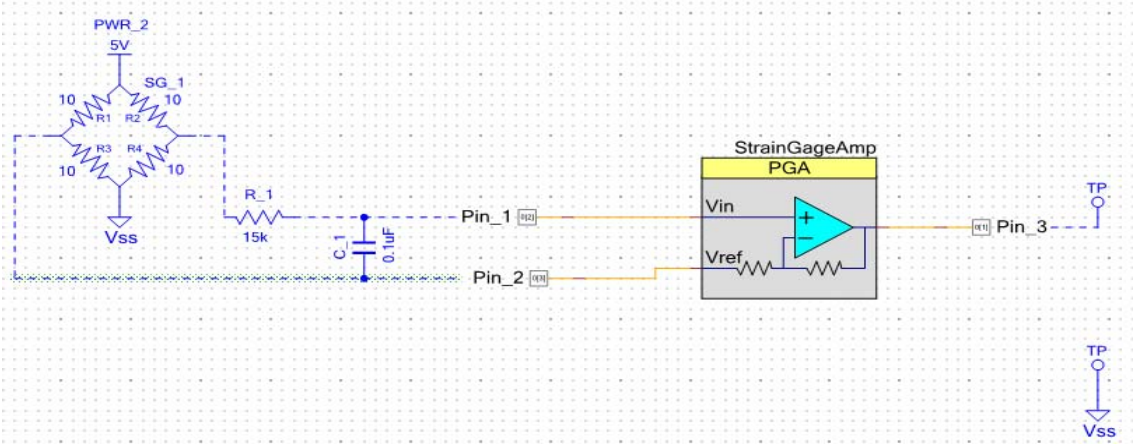


A student measured a mechanical piece 30 times, each time the indicator fell between the marks as shown in the picture above. Specify the standard deviation of the measurement.

d. (1.0) What is the value of R2, for a unity gain amplifier if R1 is 40000 ohms?



e. (2.0)



In the figure above, list the C statements needed to be included in main.c for the above circuit to work. Use proper C syntax as you did in your last lab.

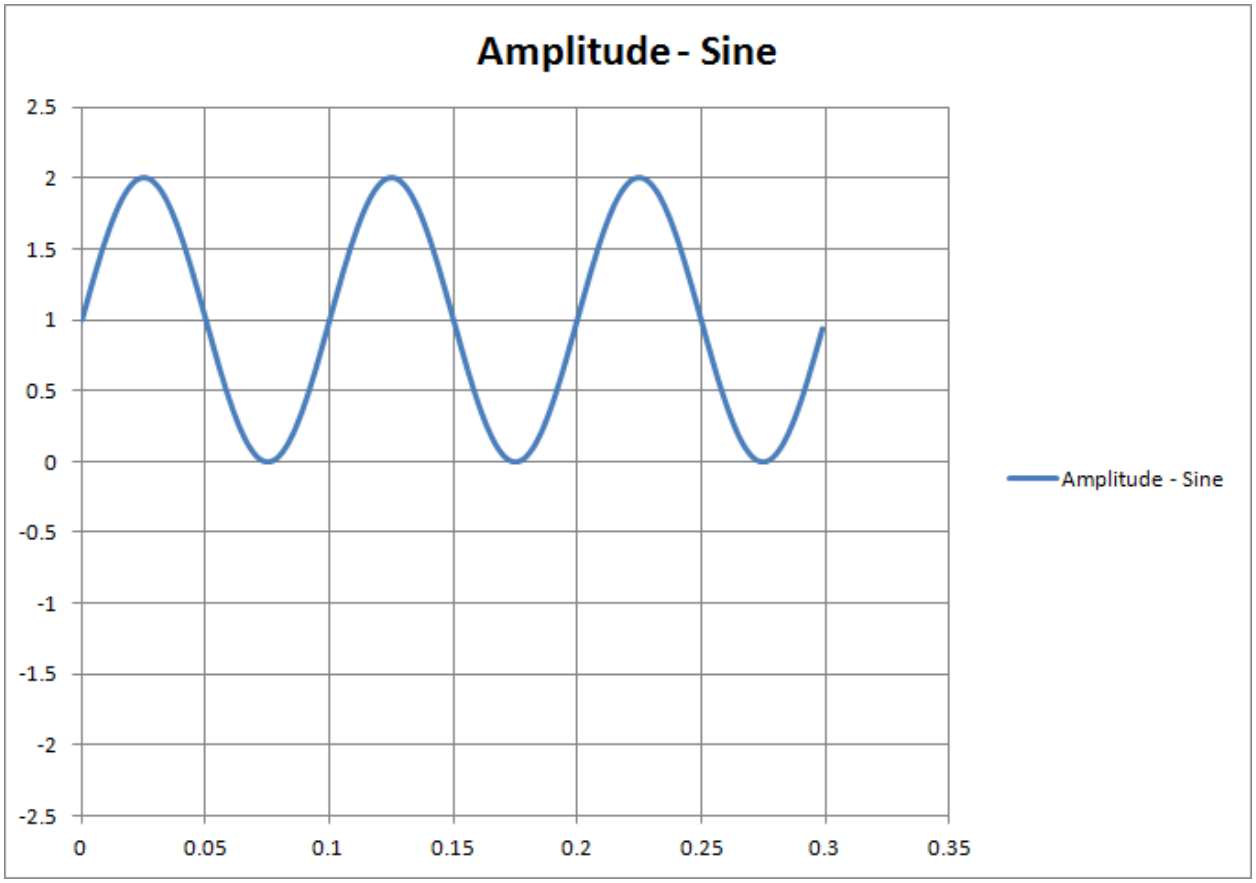
2. (20 pts) You have been employed by Boeing to develop a scale to count bolts issued for their assembly line. You decide to count the bolts, by weighing 30 bolts. How precise does your weight scale have to be for you to be able to count up to10,000 bolts accurately.

3. For some reason, your VP of Engineering want you to confirm the numerical value for π out to the 8^{th} decimal place with 95% C.L. $(3.14159265)^{*}$.
    a. (10 pts) Since you are mechanical, you decide no problem, I will take a Frisbee disk measure the diameter D, and Circumference C. Specify the precision of the measurement in order for you to accomplish your task.

b. (10 pts) You did such a spectacular job on the previous assignment (hopefully you did), your VP decided he wanted you to help the electrical department to do the same. It turns out he assigned the electrical group to confirm π out to the 10^{th} place with 99.99% C.L. $(3.1415926536)^{*}$. Using a DMM, that can measure frequency, resistance, and capacitance, what precision would each measurement need to be if you decided to use 10kHz for your base frequency, and 1Mohm for your resistor. You also decided that each measurement should have the same precision when expressed as a percentage.

*http://www.factmonster.com/ipka/A0876705.html. According to the site π has been calculated to the 1.24 trillionth place by Tokyo University.

4.



a) (3pts) Sketch the LabVIEW output above, if the signal was AC coupled. The LabVIEW scope high pass corner frequency is at 10 Hz.

b)(2pts) Sketch the original DC coupled signal if the LabVIEW express VI was changed to negative triggered.

Extra Credit: (5 pts) Design an active non-inverting amplifier with a gain of 0.5.