Mathematical Exercises Name:_____

Do not round answers.

Show your work!

The problems below will be covered during the Balance Calibration Seminar and are Recommended to be completed prior to the seminar.
If you wish feedback on your preparedness for these topics submit the problems in either hand written or MSExcel workbook (any version) form. MSExcel is preferred. Title the workbook file:{Your name} Balance Math Exercises Recommended {Date}.
Return the completed exercises by e-mail with the subject line
"Balance Math Exercises Recommended" to aid in tracking your message.

Metrology-Related Examples

Given the following values:
100, 100.5, 100.4, 99.9, 99.8, 100.1, 99.6, 99.9, 100.3, 100.2,

Calculate

R1. Mean ($\bar{x}$): _____

R2. Range: _____

R3. Standard Deviation: _____

R4. Average: _____
Identify your choice of method for computing the average. Circle the one that applies:
Mean, Mode, Median, Other (explain)_____

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R5: Given:

Old mean ($\bar{x}_0$) (n_O=10): 99.5

New mean ($\bar{x}_n$) (n_N=15): 100.07

Old standard deviation (s_O): 0.09954

New standard deviation (s_N): 0.283039

Calculate the value of the t-test using: $$t = \left| \frac{\bar{x}_0 - \bar{x}_n}{\sqrt{\frac{s_O^2}{n_O} + \frac{s_N^2}{n_N}}} \right|$$

***t* =**_____

R6: Given:

New value (x_i): 100.5

Reference value (μ_{ref}): 100.2

New uncertainty (U_i) (k=2): 0.2

Reference value uncertainty (U_{ref}) (k=2): 0.16

Find the E-normal value for the data using the equation: $$E_n = \left| \frac{\left(x_i - \mu_{ref}\right)}{\sqrt{\left(U_i^2 + U_{ref}^2\right)}} \right| .$$

***E*$_n$ =**_____

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R7:Given:
Old standard deviation (s_O): 0.09954
New standard deviation (s_N): 0.283039

Calculate the F value using the equation: $F = \frac{(s_O)^2}{(s_n)^2}$

F = _____

R8:Given:
Tolerance: 2.3 g
Measurement uncertainty ($U_{k=2}$) : 150 mg

Calculate the Pn value using the equation: $P_n = \frac{U_{k=2}}{\frac{1}{3}Tolerance}$

P_n = _____

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R9:Given:
Uncertainty of standard (*Us* k=2): 0.01 mg
Standard deviation of process (s_p): 0.05 mg

Calculate the expanded uncertainty (*U*) using the equation: $U = 2\sqrt{\left(\frac{U_s}{2}\right)^2 + \left(s_P\right)^2}$

***U* =**_____

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Units, Conversions, and Related Problems

Use units instructions from NIST Special Publication 811 (attached).

R10: Select the correct form of the abbreviation for the unit: grams

☐ gms ☐ g ☐ gm ☐ gns ☐ gr ☐ G

R11: Select the correct form of the abbreviation for the unit: micro-grams

☐ mg ☐ µg ☐ Mg ☐ mgr ☐ mgrs ☐ mcgs.

R12: Select the correct form of the abbreviation for the unit: kilograms

☐ KG ☐ Kg ☐ Kgr ☐ kg ☐ KGs ☐ kgs

R13: Select the correct form of the abbreviation for the unit: liters

☐ L ☐ ls ☐ Ls ☐ ltr ☐ ltrs ☐ l

R14: Select the correct form of the abbreviation for the unit: milligrams

☐ Mgs ☐ Mg ☐ mG ☐ µg ☐ µgs ☐ mg

R15: Select the correct form of the abbreviation for the unit: milliliters

☐ µL ☐ µl ☐ mL ☐ ml. ☐ cc ☐ ml

R16: Select the acceptable forms for writing the value: ¼

☐ .25 ☐ 0.25 ☐ ¼

Rounding values

Rounding instructions can be found in NISTIR 6969 GLP 9 found at
http://www.nist.gov/pml/wmd/labmetrology/upload/GLP_9_20140911.pdf

R17: Round the value 4.9459 g to two significant digits: _____ g

R18: Round the value 0.2 kg to two significant digits: _____ kg

R19: Round the value 1059 mg to two significant digits: _____ mg

Time taken to complete these RECOMMENDED math exercises: _____ minutes