Statistics Problem Set - modified July 25, 2014

$$\bar{x} = \frac{\sum_i x_i}{n} \qquad s = \sqrt{\frac{\sum_i \left(x_i - \bar{x}\right)^2}{n-1}} \qquad \mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}} \qquad Q = \frac{d}{w}$$

Table 4-1 Ordinate and area for the normal (Gaussian) error curve,

$$y = \frac{1}{\sqrt{2\pi}} e^{-z^2/2}$$

$|z|^a$	y	$Area^b$	$|z|$	y	Area	$|z|$	y	Area
0.0	0.398 9	0.000 0	1.4	0.149 7	0.419 2	2.8	0.007 9	0.497 4
0.1	0.397 0	0.039 8	1.5	0.129 5	0.433 2	2.9	0.006 0	0.498 1
0.2	0.391 0	0.079 3	1.6	0.110 9	0.445 2	3.0	0.004 4	0.498 650
0.3	0.381 4	0.117 9	1.7	0.094 1	0.455 4	3.1	0.003 3	0.499 032
0.4	0.368 3	0.155 4	1.8	0.079 0	0.464 1	3.2	0.002 4	0.499 313
0.5	0.352 1	0.191 5	1.9	0.065 6	0.471 3	3.3	0.001 7	0.499 517
0.6	0.333 2	0.225 8	2.0	0.054 0	0.477 3	3.4	0.001 2	0.499 663
0.7	0.312 3	0.258 0	2.1	0.044 0	0.482 1	3.5	0.000 9	0.499 767
0.8	0.289 7	0.288 1	2.2	0.035 5	0.486 1	3.6	0.000 6	0.499 841
0.9	0.266 1	0.315 9	2.3	0.028 3	0.489 3	3.7	0.000 4	0.499 904
1.0	0.242 0	0.341 3	2.4	0.022 4	0.491 8	3.8	0.000 3	0.499 928
1.1	0.217 9	0.364 3	2.5	0.017 5	0.493 8	3.9	0.000 2	0.499 952
1.2	0.194 2	0.384 9	2.6	0.013 6	0.495 3	4.0	0.000 1	0.499 968
1.3	0.171 4	0.403 2	2.7	0.010 4	0.496 5			

a. $z = (x - \mu)/\sigma$.

b. The area refers to the area between $z = 0$ and $z = $ the value in the table. Thus the area from $z = 0$ to $z = 1.4$ is 0.419 2. The area from $z = -0.7$ to $z = 0$ is the same as from $z = 0$ to $z = 0.7$. The area from $z = -0.5$ to $z = +0.3$ is $(0.191\ 5 + 0.117\ 9) = 0.309\ 4$. The total area between $z = -\infty$ and $z = +\infty$ is unity.

Table 4-6 Values of Q for rejection of data

Q (90% confidence)^a	Number of observations
0.76	4
0.64	5
0.56	6
0.51	7
0.47	8
0.44	9
0.41	10

a. Q = gap/range. If $Q_{calculated} > Q_{table}$, the value in question can be rejected with 90% confidence.

source: R. B. Dean and W. J. Dixon, *Anal. Chem.* **1951**, *23*, 636; see also D. R. Rorabacher, *Anal. Chem.* **1991**, *63*, 139.

Table 4-2 Values of Student's t

Degrees of freedom	Confidence level (%)						
	50	90	95	98	99	99.5	99.9
1	1.000	6.314	12.706	31.821	63.657	127.32	636.619
2	0.816	2.920	4.303	6.965	9.925	14.089	31.598
3	0.765	2.353	3.182	4.541	5.841	7.453	12.924
4	0.741	2.132	2.776	3.747	4.604	5.598	8.610
5	0.727	2.015	2.571	3.365	4.032	4.773	6.869
6	0.718	1.943	2.447	3.143	3.707	4.317	5.959
7	0.711	1.895	2.365	2.998	3.500	4.029	5.408
8	0.706	1.860	2.306	2.896	3.355	3.832	5.041
9	0.703	1.833	2.262	2.821	3.250	3.690	4.781
10	0.700	1.812	2.228	2.764	3.169	3.581	4.587
15	0.691	1.753	2.131	2.602	2.947	3.252	4.073
20	0.687	1.725	2.086	2.528	2.845	3.153	3.850
25	0.684	1.708	2.060	2.485	2.787	3.078	3.725
30	0.683	1.697	2.042	2.457	2.750	3.030	3.646
40	0.681	1.684	2.021	2.423	2.704	2.971	3.551
60	0.679	1.671	2.000	2.390	2.660	2.915	3.460
120	0.677	1.658	1.980	2.358	2.617	2.860	3.373
∞	0.674	1.645	1.960	2.326	2.576	2.807	3.291

NOTE: In calculating confidence intervals, σ may be substituted for s in Equation 4-6 if you have a great deal of experience with a particular method and have therefore determined its "true" population standard deviation. If σ is used instead of s, the value of t to use in Equation 4-6 comes from the bottom row of Table 4-2.

$$F = \frac{s_1^2}{s_2^2}$$

Table 4-5 Critical values of $F = s_1^2/s_2^2$ at 95% confidence level

Degrees of freedom for s_2	Degrees of freedom for s_1													
	2	3	4	5	6	7	8	9	10	12	15	20	30	∞
2	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5
3	9.55	9.28	9.12	9.01	8.94	8.89	8.84	8.81	8.79	8.74	8.70	8.66	8.62	8.53
4	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.75	5.63
5	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.50	4.36
6	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.81	3.67
7	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.58	3.51	3.44	3.38	3.23
8	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.08	2.93
9	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.86	2.71
10	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.84	2.77	2.70	2.54
11	3.98	3.59	3.36	3.20	3.10	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.57	2.40
12	3.88	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.47	2.30
13	3.81	3.41	3.18	3.02	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.38	2.21
14	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.31	2.13
15	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.25	2.07
16	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.19	2.01
17	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.15	1.96
18	3.56	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.11	1.92
19	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.07	1.88
20	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.04	1.84
30	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.84	1.62
∞	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.46	1.00

$$t_{calculated} = \frac{|\bar{x}_1 - \bar{x}_2|}{s_{pooled}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}} \qquad s_{pooled} = \sqrt{\frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}} \qquad d.f = n_1 + n_2 - 2$$

$$t_{calculated} = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad d.f. = \left(\frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{(s_1^2/n_1)^2}{n_1 + 1} + \frac{(s_2^2/n_2)^2}{n_2 + 1}} \right) - 2$$

Know concepts of

- Gaussian Curve
- Systematic Error
- Indeterminate Error
- t-test
- q-test
- Propagation of Uncertainty

The answers are attached to this document.

1] What is the molar concentration of 0.78 % (w/v) NaCl(aq) (MW = 58.4 g/mol). [1]

2] How many milliliters of 0.1000 M HCl are required to make 100.0 mL of 25.00 mM HCl? (5 points) [2]

3] The mass of 37.1% (m/m) HCl(aq) (d = 1.19 g/mL, MW_{HCl} = 36.46) required to make 2.00 L of 1.00 M HCl is _____ [3]

4] A 100.0 mL sample was diluted to 2.00 L. A subsequent analysis revealed that the concentration of analyte revealed in the *diluted* sample was 1.00×10^{-3} M. What is the concentration of this analyte in the original undiluted sample? [4]

5] The concentrated HCl(aq) is 37.1% (m/m) HCl(aq) (d = 1.19 g/mL, MW_{HCl} = 36.46). What is the molarity of this solution? [5]

6] What volume of 0.800 M K_2SO_4 is required to make 250-mL of 0.0500 M solution? [6]

7] What is the volume of 0.233 M HCl(aq) required to make a solution of 500.0-mL of 0.0840 M HCl(aq)? [7]

8] The Fe content of a meteorite was found to be: [8]

      12.6% 11.9% 13.0% 12.7% 12.5%

- Find the 50% and 95% confidence limit for the Fe analysis.
- Describe in words what the confidence interval concept means.

9] Decide whether any of the following values can be rejected at the 90% confidence level: [9]

      0.217, 0.224, 0.195, 0.221, 0.221, 0.223

10] Express the answer for the following operation the proper number of significant digits and absolute uncertainty: $(36.2 \pm 0.4)/(27.1 \pm 0.6)$ = _____ [10]

11] Express the following operation in the correct number of significant figures

      1.222e-3 + 5.2 e-4 = _____ [11]

12] What is the propagated error from the following operation?

$(3.56e\text{-}6 \pm 2e\text{-}8) \times (9.223e\text{-}6 \pm 4e\text{-}9) = 3.28e\text{-}11 \pm \underline{\hspace{1cm}}$ [12]

13] You have obtained the following values for the analysis of Cu in an ore sample.

2.53% 2.47% 2.51% 2.99% 2.49% 2.54%

Using valid statistical methods show how one of the values can be rejected. [13]

14] The analysis of phosphate in fertilizer was made using a reliable method. Seven measurements were conducted. The mean value of phosphate in the sample is 1.72 mg/g with a standard deviation, s of 0.17. Express the sample concentration (with uncertainty) assuming a 95% confidence level. [14]

15] Using the information from problem 5 estimate the chance that the true mean will be 2.20 mg/g or greater. Hint – you will need to calculate "z" for this one, and think about the light bulb example from lecture. [15]

16] A blood sample was sent to two different labs for cholesterol analysis. The results are:

Lab 1 $\bar{x}$ = 221 mg/dL   s = 11   n = 10

Lab 2 $\bar{x}$ = 233 mg/dL   s = 14   n = 10

Are the two standard deviations different significantly different at the 95% confidence limit? [16]

17] You have carefully followed an analytical procedure with n = 6 and found a mean of 6.37 mM with s = 0.37. Meanwhile, Joe Cutcorners used a modified procedure with n = 4, $\bar{x}$ = 6.87 mM with s = 0.22. Assuming that the **standard deviations** are **not** statistically different from each other, does Joe's method have a systematic error, i.e. statistically different at the 95% confidence limit? [17]

18] Express the answer for the following calculation the proper number of significant figures:
$(2.772 \pm 0.002 + 8.27 \pm 0.05) =$ [18]

19] Standard deviation is expression of [19]
 a) precision   b) background   c) sensitivity   d) accuracy   e) dynamic range

20] The analysis of Mn (m/m) was conducted on a Martian rock sample. The following values were obtained: [20]
    4.77% 4.82% 5.22% 4.92% 5.82% 4.99%

    Which of the values can be discarded?

21] The analysis of Pb in a drinking water was repeated 6 times and yielded a mean of 0.245 ppm with a standard deviation of 0.011 ppm. What are the limits for the concentration assuming a 95% confidence level? [21]

22] The Rope-A-Dope fishing line company guarantees that their "Jaws-Max" nylon line will haul in at least an 80 lbs gilled monster. Their chief statistician, Myron Knumbers has 200 samples of the Jaws-Max line tested and finds that the mean weight for line breakage is 120 lbs with a standard deviation of 60 lbs. What are the chances that the hooked 80 pounder will get away if you were using Jaws-Max and end up being another fishing story? [22]

23] Express the answer for the following calculation the proper number of significant figures: (5 points)

$$(2.75 \text{cm} \pm 0.03 \text{ cm} \times 4.28 \text{cm} \pm 0.05 \text{ cm}) = \underline{\hspace{4cm}}$$ [23]

24] What is the 95% confidence interval for 5 measurements whose average is 3.44 and with a standard deviation of 0.04? [24]

25] What is the relative population that lies above the value of 55.1 for a Gaussian distribution whose mean is 33.8 and with a standard deviation of 11.8? [25]

26] Which of the following values may be discarded with 90% confidence? [26]

    9.11   8.89   9.01   9.77   9.05

20] Which of the following data points can be discard based on sound statistical principles? [27]

2.5510, 2.4913, 2.5766, 2.5317, 2.6229

28] The method of least squares fits a line (L) to a set of x,y data by [28]

a) maximizing	b) minimizing	c) minimizing	d) maximizing	e) minimizing
$\Sigma (x_i - x_L)$	$\Sigma (x_i - x_L)^2$	$\Sigma (y_i - y_L)^2$	$\Sigma (y_i - y_L)^2$	$\Sigma (y_i - y_L)$

29] Detection limit of any instrumental method is defined as _____ [29]

30] Sketch a plot of a calibration curve. Label the axes and the following: [30]

    a) background
    b) dynamic range
    c) sensitivity

31] Express the answer for the following calculation the proper number of significant figures: [31]

$$(2.75\text{cm} \pm 0.03 \text{ cm} \times 4.28\text{cm} \pm 0.05 \text{ cm}) = \text{_____}$$

29] Part of the labeling of a class "A" pipet is the letters TD. What does this mean? [32]

   a) The correct liquid delivery process should have entire
       contents of the pipet should be blown out with the pipet blub.

   b) The pipet should be acid washed between usages.
   c) The pipet is defective and only semi-quantitative
   d) The pipet is coated with an inert agent.
   e) The solution delivery process will leave behind a small amount of liquid in the tip.

33] After rounding the correct representation of the following is [33]

   627.12 + 3.445 =

34] The relative errors for each measured value in the following operation are represented below. What is the relative error in the in final calculated value? [34]
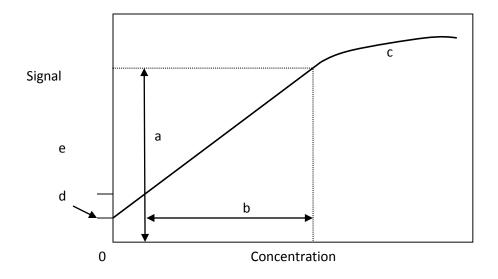
   $(1.2 \pm 0.2\%) \times (71.2 \pm 0.3\%)$

35] The standard deviation for the mean value of the following is [35]

   36.78, 36.82, 36.75

36] A method for the determination of iron in drinking water was conducted 5 times and mean value was found to be 11.7 ppm with a standard deviation of 0.7 ppm. What is the 95% confidence interval that expresses likelihood that true mean lies within the calculated one? [36]

37] The detection limit of any instrumental method is best expressed as _____ [37]

38] Which of the labeled features in the curve above best represents the nonlinear region? [38]

39] Which of the labeled features in the curve above best represents the linear range? [39]

40] Which of the labeled features in the curve above best represents the background? [40]

41] Precision can is best described as which of the following? [41]

    a) control
    b) q-test
    c) accuracy
    d) mean
    e) reproducibility

42] Which of the following values may be discarded based on sound statistical principles? [42]

    8.55   9.32   7.19   9.06   8.37

43] The class average for the 2005 UI Chem 253 class on the American Chemical Society final exam was 22.4 out of 60 correct with a standard deviation of 8.0. The national average is 19.5/60 with a standard deviation of 6.3. Assuming that Gaussian statistics are observed for the UI grade distribution, what is the percentage of UI students scoring above the national average? [43]

44] The analysis for Ni in a meteorite sample was conducted by two different methods yielding the following: [44]

$\bar{x}$ standard deviation   n

Method A	6.898	0.110	6
Method B	7.095	0.197	4

If s_{pooled} is 0.149 do the methods yield the same result to the 95% confidence limit?

45] The molality of a solution of HX is 1.56. What is the molarity of that solution of the density is measured as 1.33 g/mL and the MW of the solute is 88.2 g/mol? [45]

46] Two methods of analyses were compared. Method A had a mean of 23.2 with a standard deviation of 4.4. Method B had a mean of 24.1 with a standard deviation of 4.8. Both sets of measurements were done 6 times. What is the F ratio and are the standard deviations significantly different from each other at the 95% confidence level? [46]

   a) 1.19, no   b) 1.19, yes   c) 0.840, no   d) 0.840, yes   e) 1.09, no

47] What is the molar concentration of 0.65% (w/w) KCl (74.55 g/mol)? Density = 1.00 g/mL [47]

Answers

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[1] 0.13 M

[2] 25.0 mL

[3] 2.00L*1.00 mol/L*36.46g/mol*1/0.371 = 197 g

[4] 1.00e-3 M * 2.00/0.1000 = 2.00e-2 M

[5] 12.1 M

[6] 0.250 L * 0.0500 mol/L * L / 0.800 mol = **15.6 mL**

[7] 180-mL

[8] First calculate $\bar{x}$ = 12.5%
          Then standard dev.   s = 0.4

          For n = 5 or df= 4 find the 50% confidence limit in table 4-2,

          0.741

          Plug into the t-test equation above

$$\mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}} = 12.5 \pm \frac{0.741(0.4)}{\sqrt{5}} = 12.5 \pm 0.1\%$$

- This calculation tells us that there is a 50% chance that the true mean, μ lies within the interval $12.5\% \pm 0.1\%$

Now find the 95% C.L. n = 5, d.f. = 4, 8.610

$$\mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}} = 12.5 \pm \frac{2.776(0.4)}{\sqrt{5}} = 12.5 \pm 0.5\%$$

- Note that the C.L. interval widens.

[9] $Q = \dfrac{d}{w} = \dfrac{0.217 - 0.195}{0.223 - 0.195} = 0.786$

n = 6   use Table 4-6 Q_{table} = 0.56

Q > Q_{table} so the point can be discarded

[10] 1.34 ± 0.03

[11] 1.222e-3 + 0.52e-3 = **1.74e-3**   use least number of decimal points

[12] For $\times/\div$ is $e_T = (\%e_1{}^2 + \%e_2{}^2)^{1/2}$ $\%e_1$ = 100*(2e-8/3.56e-6) = 0.6% $\%e_2$ = 100*(4e-9/9.223e-6) = 0.04%
$\%e_T = (0.6\%^2 + 0.04\%)^{1/2} = 0.6\%$ 0.6% of 3.28e-11 = **2e-13**

[13] Q = 2.99-2.54/2.99-2.47 = 0.865 Q_{table} = 0.56

Q > Q_{table} so it can be rejected

[14] $1.72 \pm (2.447*0.17/7^{1/2}) = 1.72 \pm 0.16$ mg/g

[15]   z=(2.20-1.72/0.17)=2.8   Table 4-1 z=2.8;area=.4974

chance = 0.5000-0.4974 = 0.0026, 0.26% chance

[16] $F = 14^2/11^2 = 1.62$ F-Table = 3.18 so they are not statistically different from each other

[17] $S_{pooled} = (0.37^2*5 + 0.22^2*3/6+4-2)^{1/2} = 0.332$

$t = (6.87 - 6.37/0.332)(6*4/6+4)^{1/2} = 2.41$

$t_{table}@95\% = 2.306$ so they are different from each other.

[18] 11.04 ± 0.05

[19] Precision

[20] $Q = (5.82 - 5.22)/(5.82 - 4.77) = 0.57$ $df = 5$ $Q_{table} = 0.56 < 0.57$ the number can be rejected.

[21] $0.245 +/- (2.571*0.011/6^{1/2}) = 0.245 +/- 0.0115$ ppm

[22] $z = [x - \text{x-bar}]/s = [80 - 120]/60 = 0.667$ $z \approx 0.7$ area $= 0.258$

     Area from 0 to 80 is $0.500 - 0.258 = 0.242$ $\approx 24\%$

[23] $(2.75 \text{ cm} \pm 0.03 \text{ cm} \times 4.28 \text{cm} \pm 0.05 \text{ cm})$

     $= (2.75 \text{ cm} \pm 1.1\% \times 4.28 \text{ cm} \pm 1.2\%)$

     $= 11.77 \pm (1.1\%^2 + 1,2\%^2)^{1/2} = 11.8 \text{ cm}^2 \pm 1.6\% = 11.8 \text{ cm}^2 \pm 0.2 \text{ cm}^2$

[24] $\pm 2.776 (0.04)/(5)^{1/2}$

[25] $z = (33.8 - 55.1)/11.8 \cong 1.80$ use table 4-1   area $= 0.4641$

     above $= 0.5000 - 0.04641 \cong 3.6\%$

[26] $Q = 9.77 - 9.11/9.77 - 8.89 = 0.75$ $Q_{table} = 0.64$ for $n = 5$ so 9.77 can be discarded

[27] $2.5510, 2.4913, 2.5766, 2.5317, 2.6229$

     $Q = 2.6229 - 2.5766 / 2.6229 - 2.4913 = 0.3518$

     $Q = 2.4913 - 2.5317 / 2.4913 - 2.6229 = 0.3070$

     {Q-table for $n = 5$} $= 0.64$ **all points must be retained.**

[28] Answer c

[29] $y_{d.l.} = y_{blank} + 3s$ where $s = $ std.dev. see discussion in the text. See also Figure 5-2 (8th ed.)

     For a calibration curve   min. detect. Conc. $= 3s/m$ where $m = $ slope

[30] see book and lecture notes

[31] (2.75 cm ±0.03 cm × 4.28cm ±0.05 cm)

     = (2.75 cm ±1.1% × 4.28 cm ± 1.2%)

     = 11.77 ± (1.1%² + 1,2%²)$^{1/2}$ = 11.8 cm² ± 1.6% = 11.8 cm² ± 0.2 cm²

[32] The solution delivery process will leave behind a small amount of liquid in the tip.

[33] 630.56

[34] $e = \sqrt{0.2\%^2 + 0.3\%^2} = 0.4\%$

[35] Mean value = 36.78

     $(x_i - \bar{x})^2$
     0
     0.0016
     <u>0.0009</u>

Σ   0.0025 $s = \sqrt{\dfrac{0.0025}{3-1}} = 0.04$

[36] $\mu = \bar{x} \pm \dfrac{ts}{\sqrt{n}} = 11.7 \pm \dfrac{2.776(0.7)}{\sqrt{5}} = 11.7 \pm 0.9\,ppm$

[37] See http://www.chem.utoronto.ca/coursenotes/analsci/StatsTutorial/LimDetect.html

$y_{d.l.} = y_{blank} + 3s$

[38] c
[39] b
[40] d
[41] e
[42] $Q_{calc} = \dfrac{7.19 - 8.37}{7.19 - 9.32} = 0.554$ $Q_{table} > Q_{calc}$ so we cannot discard any of the data.

first calculate z

z = x-u/s   in this case s = 8.0, x = 19.5 & u = 22.4

z = [19.5-22.4]/8.0 = 0.36 ≈ 0.4   (5 points)

from table 4-1 z = 0.4 corresponds to a relative area of 0.1554, this would mean that fraction of UI students scoring above the national average is

0.5000 + 0.1554 ≈ 0.65   or   about 65%

First calculate F value

F_{calc} = 0.197²/0.110² = 3.21   for s = 0.197 d.f. =3

for s = 0.110 d.f. = 5

F_{table} = 5.41

F-table > F-calc   Calculate t by

$$t_{calculated} = \frac{|\bar{x}_1 - \bar{x}_2|}{s_{pooled}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}} = \frac{|7.095 - 6.898|}{0.149} \sqrt{\frac{6*4}{6+4}} = 2.05$$

d.f = 6+4-2 = 8

use table 4-2   t-table = 2.306

therefore t-table > t-calc, we are sure the two results are the same with the 95% c.l.

1.56 mol * 88.2 g/mol HX = 137.5 g

1.56 mol HX/1137.5g soln * 1.33 g/mL * 1000 mL/L = 1.824 mol/L

A

Assume 1 g of solution 0.0065 * 1 g = 0.0065 g KCl

0.0065 g KCl * (mol / 74.55 g) * (1 / 0.00100 L) = 8.7e-2 M