## Table 4-1 Ordinate and area for the normal (Gaussian) error curve, $y = \frac{1}{\sqrt{2\pi}} e^{-z^2/2}$

| $\lvert z\rvert$[a] | $y$ | Area[b] | $\lvert z\rvert$ | $y$ | Area | $\lvert z\rvert$ | $y$ | 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.

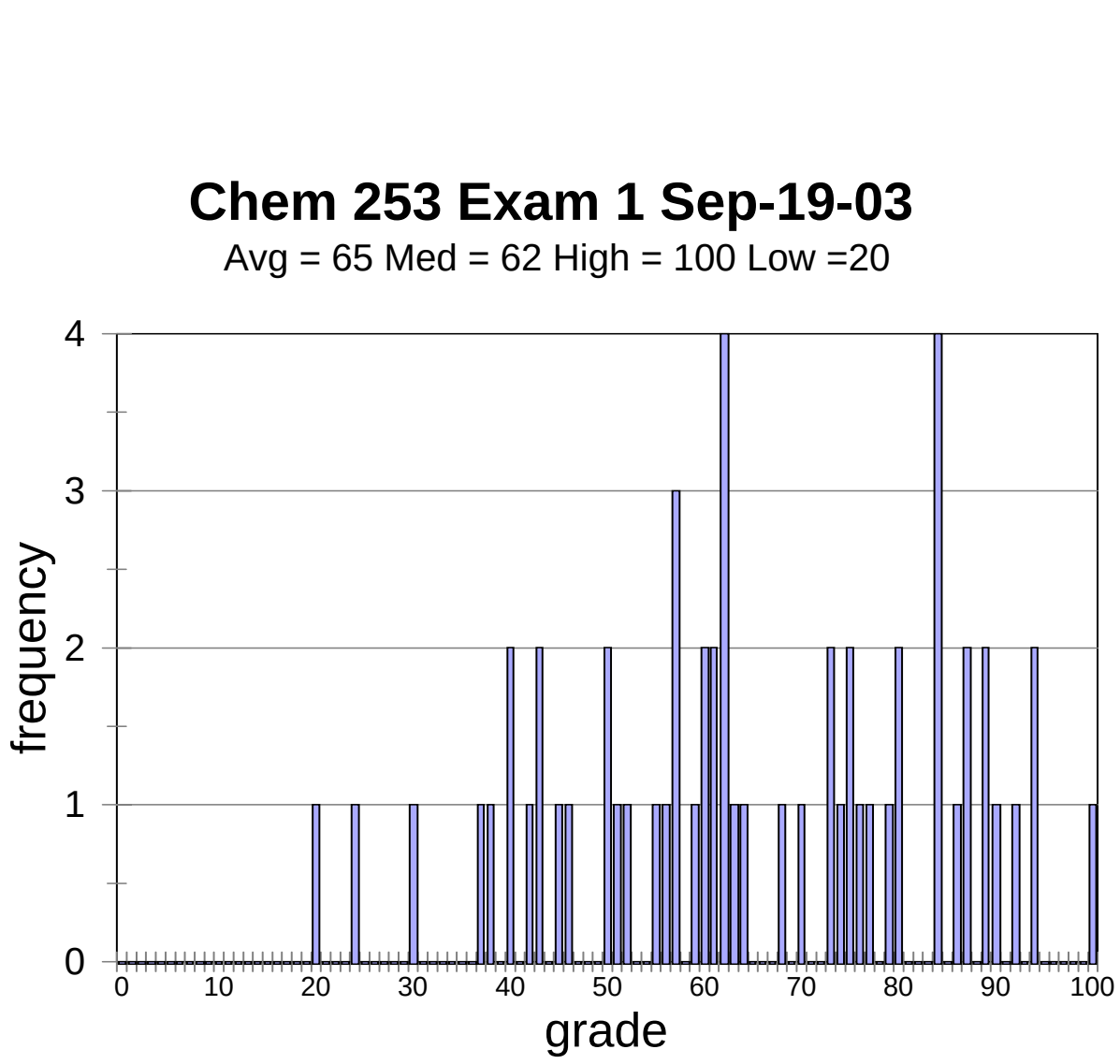
## Table 4-2 Values of Student's $t$

| | Confidence level (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| Degrees of freedom | 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 |
| $\infty$ | 0.674 | 1.645 | 1.960 | 2.326 | 2.576 | 2.807 | 3.291 |

NOTE: In calculating confidence intervals, $\sigma$ 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 $\sigma$ is used instead of $s$, the value of $t$ to use in Equation 4-6 comes from the bottom row of Table 4-2.

**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 |




**Chem 253 – Exam 1 – September 19, 2003**

Please note that the appendix to this exam may be of help.

100 total points.

1] Express the answer for the following operation the proper number of significant digits and absolute uncertainty: (5 points)

$(36.2 \pm 0.4)/(27.1 \pm 0.6) =$ ____

a) $1.34 \pm 0.12$ b) $1.34 \pm 0.07$ c) $1.34 \pm 0.03$ d) $1.34 \pm 0.22$ e) $1.34 \pm 0.06$

2] What is the molar concentration of 0.78 % (w/v) NaCl(aq) (MW = 58.4 g/mol). (5 points)

a) 0.26 b) 0.13 c) 1.3 d) 2.6 e) 5.2

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

a) 0.025 b) 250 c) 2.50 d) 25.0 e) 12.5

4] You have obtained the following values for the analysis of Cu in an ore sample. (10 points)

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.

5] 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. (10 points)

6] 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. (10 points)

7] 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? (10 points)

8] 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 <u>not</u> statistically different from each other, does Joe's method have a systematic error, i.e. statistically different at the 95% confidence limit? (10 points)

9] What is the pH of a solution of 0.100 M HCl? (5 points)

a) 1.00 b) 1.000 c) 1.0000 d) 0.1000 e) 1.0

10) Calculate the pH of a solution of 0.025 M acetic acid, $K_a = 1.8 \times 10^{-5}$. (5 points)

a) 2.37 b) 3.02 c) 3.17 d) 3.33 e) 3.28

11) Calculate the pH of a solution of 0.025 M acetic acid and 0.025 M sodium acetate. (5 points)

a) 3.17 b) 4.00 c) 4.17 d) 5.22 e) 4.74

12) Calculate the $K_{sp}$ of barium sulfate (MW 233) if its solubility is measured as 0.0023 mg/mL. (5 points)

a) $9.7 \times 10^{-11}$ b) $9.9 \times 10^{-6}$ c) $1.0 \times 10^{-5}$ d) $1.1 \times 10^{-9}$ e) $2.9 \times 10^{-7}$

13) Part of the labeling of a class "A" pipet is the letters TD. What does this mean? (5 points)

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.

14) Calculate the solubility of $PbCl_2$ ($K_{sp} = 1.7 \times 10^{-5}$) in the presence of 0.122 M NaCl. (10 points)

**Answers**

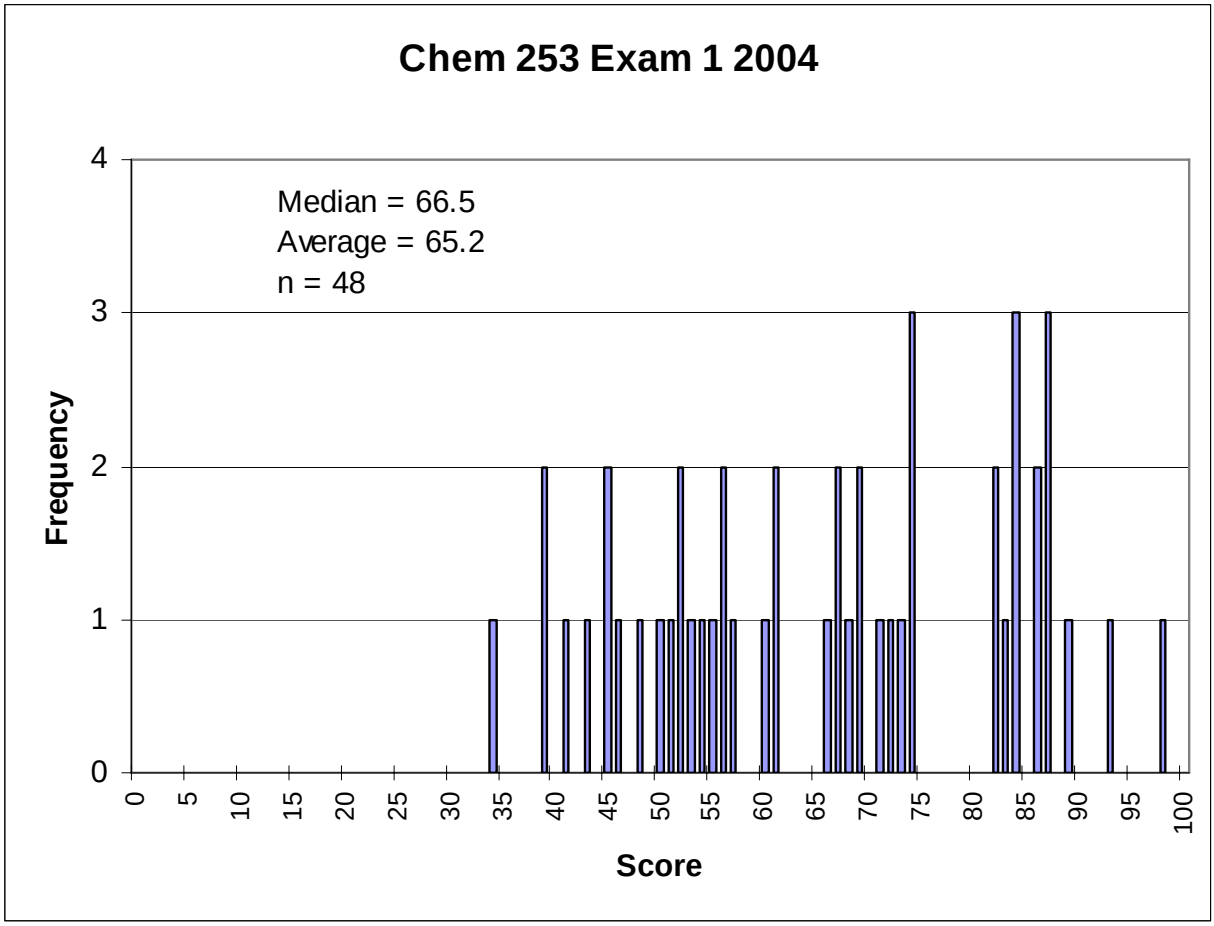
1] **c) 1.34 ± 0.03** 2] **b) 0.13** 3] **d) 25.0**
4] *Q = 2.99-2.54/2.99-2.47 = 0.865* $Q_{table}$ *= 0.56*
$Q > Q_{table}$ *so it can be rejected*
5] $1.72 \pm (2.447*0.17/7^{1/2}) = 1.72 \pm 0.16 mg/g$

6] *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*

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

8] $S_{pooled} = (0.37^2*5+0.22^2*3/6+4-2)^{1/2} = 0.33\underline{2}$
$t = (6.87-6.37/0.332)(6*4/6+4)^{1/2} = 2.41$
$t_{table}$*@95%=2.306* *so they are different from each other.*

9] b) 1.000 10) c) 3.17 11) **e) 4.74** 12) **a) 9.7 x $10^{-11}$**
13) **The solution delivery process will leave behind a small amount of liquid in the tip**.
14) $x(0.122+2x)^2 = 1.7e-5$; $x = 1.7e-5/(0.122+2x)^2$;let 2x=0;
$x_1$=1.14e-3 (10pts) $x_2$=1.10e-3; $x_3$=1.10e-3 (2 extra credit pts)




**Chem 253 – Exam 1 – September 15, 2004** *Answers are at the end of this exam*

Name:_____ Circle Your Section Number 01 (morning lab)
02 (afternoon lab)
03 (night lab)

1) Detection limit of any instrumental method is defined as (5 points)

a) signal/background = 4/1 b) background/signal = 2/1
c) signal/background = 3/2 d) signal/background = 3/1

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

$(2.772 \pm 0.002 + 8.27 \pm 0.05) =$

Answer_____

3) The concentration of $H^+$ in a pH 6.772 solution is (5 points)

a) $1.6904 \times 10^{-7}$ b) $1.69 \times 10^{-7}$ c) $1.690 \times 10^{-7}$ d) $1.7 \times 10^{-7}$ e) $1.69044 \times 10^{-7}$

4) Standard deviation is expression of (5 points)

a) precision b) background c) sensitivity d) accuracy e) dynamic range

5) The analysis of Mn (m/m) was conducted on a Martian rock sample. The following values were obtained:

4.77% 4.82% 5.22% 4.92% 5.82% 4.99%

Using valid statistics, which if any of the values can be rejected? Show your work for credit (5 points)

6) Sketch a plot of a calibration curve. Label the axes and the following: (10 points)

a) background
b) dynamic range
c) sensitivity
d) limit of detection

7) A sample solution with an unknown concentration of herbicide ($\lambda_{max}$ = 636 nm) was analyzed by absorption spectroscopy. A 10.0 mL sample was diluted to 500.0 mL and the absorbance was measured as 0.366. Another 10.0 mL sample was mixed with 10.0 mL of $5.00\times10^{-3}$ M then diluted to 500.0 mL. The absorbance of this solution was measured as 0.559. The absorbance of the blank was zero. What is the concentration of this herbicide? (10 points)

Answer_____

8) 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? (5 points)

a) 0.245±0.065 ppm b) 0.245±0.011 ppm c) 0.245±0.013 ppm d) 0.245±0.007 ppm

9) The pH of a solution of a 0.100 M weak acid (HA) $K_a = 2.7\times10^{-6}$ is (5 points)

a) $4.7 \times 10^{-5}$ b) $4.7 \times 10^{-6}$ c) $2.7 \times 10^{-5}$ d) $5.2 \times 10^{-4}$

10) The solubility of the salt $MA_2$ ($K_{sp} = 8.9\times10^{-17}$) is (5 points)

$MA(s) = M^{2+}(aq) + 2A^{-}(aq)$

a) $3.9 \times 10^{-5}$ b) $2.8 \times 10^{-6}$ c) $4.5 \times 10^{-6}$ d) $8.4 \times 10^{-7}$

11) What is the solubility of a salt, AB ($K_{sp} = 7.2\times10^{-12}$) in the presence of 0.10 M $B^{-}$? (5 points)

a) $7.2 \times 10^{-12}$ b) $7.2 \times 10^{-11}$ c) $5.7 \times 10^{-13}$ d) $2.7 \times 10^{-6}$

12) 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 (5 points)

a) 83.9 g b) 128 g c) 72.9 g d) 197 g

13) 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 $1.00 \times 10^{-3}$ M. What is the concentration of this analyte in the original undiluted sample? (5 points)

a) $1.00 \times 10^{-3}$ M b) $2.00 \times 10^{-2}$ M c) $5.00 \times 10^{-5}$ M d) $2.00 \times 10^{-1}$ M

14) The $K_a$ of a weak acid (HA) is $7.2 \times 10^{-6}$. What is $K_b$ for the following reaction? (5 points)

$$A^- + H_2O = HA + OH^-$$

a) $1.4 \times 10^{-9}$ b) $7.2 \times 10^{8}$ M c) $7.2 \times 10^{-8}$ M d) $6.8 \times 10^{-1}$ M

15) 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? (10 points)

Answers to Exam 1 2004

1] d  2] 11.04+/-0.05  3] b  4] a

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

6] see book and lecture notes

7] $0.559 = kC_x(10.0/500.0) + k\ 5.00e\text{-}3*(10.00/500.0)$
$\underline{-0.366 = -\ kC_x(10.0/500.0)}$
$0.193 = k\ 5.00e\text{-}3*(10.00/500.0)$

$k = 1930$ use $0.559 = kC_x(10.0/500.0)$

$0.559 = 1930C_x(10.0/500.0)$
$C_x = 9.48e\text{-}3$ M

8] $0.245 +/- (2.571*0.011/6^{1/2}) = 0.245 +/- 0.0115$ ppm*  ***b** was the best answer.

9]

| | | | | | |
|---|---|---|---|---|---|
| HA | = | $H^+$ | + | $A^-$ | |
| 0.100-x | | +x | | +x | $x^2/0.100\text{-}x = 2.7e\text{-}6$ x = 5.2e-4 M, pH = 3.28 |

10]

| | | | | | |
|---|---|---|---|---|---|
| $MA_2$ | = | $M^{2+}$ | + | $2A^-$ | |
| -- | | +x | | +2x | $(2x)^2x = 8.9e\text{-}17$ x = 2.8e-6 M |

11]

| | | | | | |
|---|---|---|---|---|---|
| AB | = | $A^+$ | + | $B^-$ | |
| -- | | x | | 0.10+x | $x(0.10+x) \approx 0.10x = 7.2e\text{-}12$ x = 7.2e-11 M |

12] 2.00L*1.00 mol/L*36.46g/mol*1/0.371 = 197 g

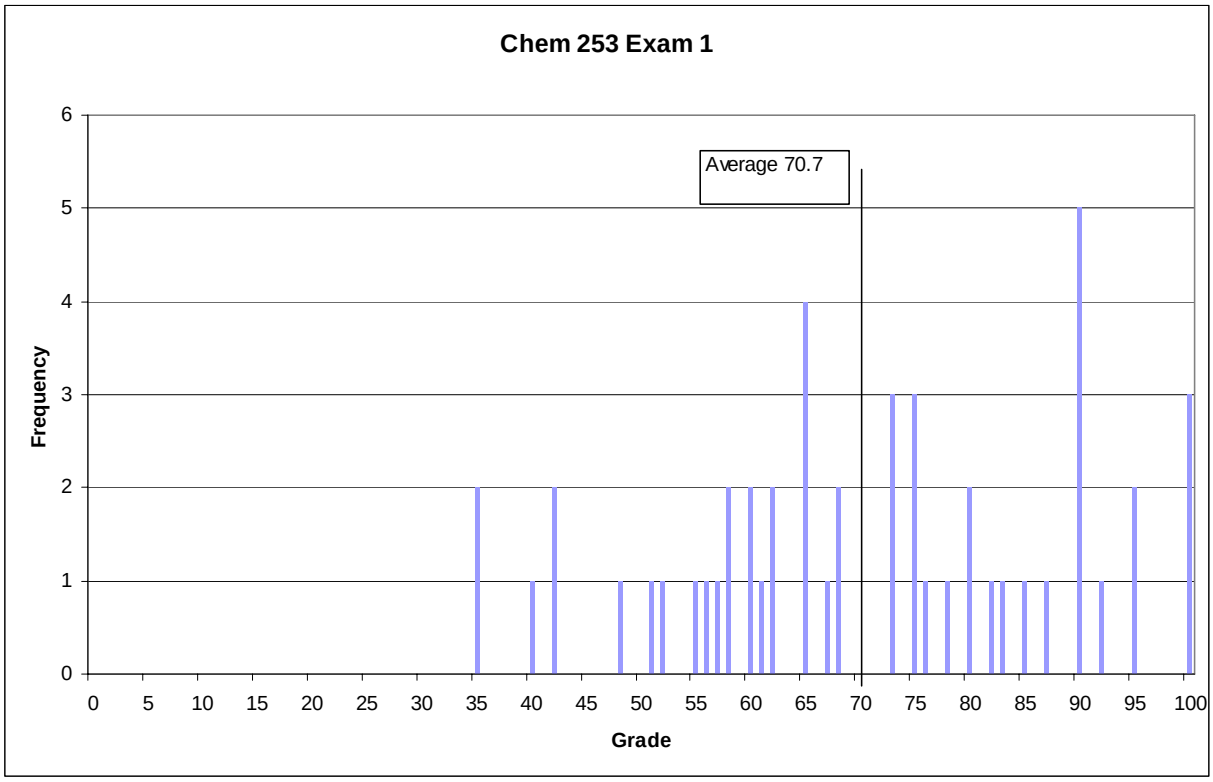
13] 1.00e-3 M * 2.00/0.1000 = 2.00e-2 M

14] $K_aK_b = K_w$  $K_b = 1.00e\text{-}14/7.2e\text{-}6 = 1.4e\text{-}9$

15] z = [x – x-bar]/s = [80 – 120]/60 = 0.667 z ≈ 0.7  area = 0.258

Area from 0 to 80 is  0.500 – 0.258 = 0.242  ≈24%

# Chem 253 – Exam 1 – September 14, 2005




1] The background of a method based on Beer's law is best described as

a) concentration b) absorbance c) molar absorptivity d) noise

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

(2.75cm ±0.03 cm × 4.28cm ±0.05 cm) = _____

All answers are in units of $cm^2$

a) 11.77 ± 1.6 b) 11.770 ± 1.60 c) 11.77 ± 0.20 d) 11.8 ± 0.2 e) 12 ± 0.2

3] The concentration of $H^+$ in a pH 8.55 solution is (5 points)

a) 2.82e-9 M b) 2.818e-9 M c) 3.5e8 M d) 3.55e8 M e) 2.8e-9 M

4] Linear Range is an expression of (5 points)

| | | | | |
|---|---|---|---|---|
| a) signal to noise ratio | b) analyte concentration range over which the c ∝ signal | c) analyte detection limits of method | d) accuracy and precision of method or technique | e) precision of repeated experiment results |

5] What is the pH of a 2.11 M solution of $HNO_3$(aq)?

| | | | | |
|---|---|---|---|---|
| a) -0.324 | b) 0.324 | c) -0.32 | d) 7.76e-4 | e) 0.32 |

6] Which of the following best describes the reason for using the method standard addition over the calibration curve?

| | | | | |
|---|---|---|---|---|
| a) Limited dynamic range of technique | b) To compensate for nonlinear effects | c) To accommodate the effects of a complex matrix | d) To increase the detection limit of the method | e) To decrease the detection limit of the method |

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

| | | | | |
|---|---|---|---|---|
| a) ± 0.04 | b) ± 0.4 | c) ± 0.05 | d) ± 0.1 | e) ± 0.06 |

8) 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?

| | | | | |
|---|---|---|---|---|
| a) 0.50% | b) 3.6% | c) 1.8% | d) 46% | e) 0. 18% |

9) Which of the following values may be discarded with 90% confidence?

9.11 8.89 9.01 9.77 9.05

| | | | |
|---|---|---|---|
| a) 9.77 | b) 9.11 | c) 8.89 | d) none of the above |

10) 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)?

| | | | | |
|---|---|---|---|---|
| a) 90.0-mL | b) 622-mL | c) 33.4-mL | d) 180-mL | e) 233-mL |

11) 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?

a) 6.22 M b) 8.44 M c) 12.1 M d) 3.77 M e) 6.71 M

12) 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?

a) 0.924 M b) 1.24 M c) 2.81 M d) 1.82 M e) 0.155 M

13) A sample solution of an analyte has an absorbance of 0.229. A solution of standard has an absorbance of 0.327 when that analyte has a concentration of 3.44e-3M. Assuming that Beer's law applies to both solutions what is the concentration of analyte in the sample? Also assume that the absorbance of the blank solution is zero.

a) 3.77e-3 M b) 1.81e-3 M c) 8.19e-4 M d) 4.66e-3M e) 2.41e-3 M

14) 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?

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

15) Standard deviation can be best described as a measure of

a) detection limit b) accuracy c) sensitivity d) linearity e) precision

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

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

17) When does Beer's law typically fail?

a) when c < 1 M b) when A > 1 c) when e > 1e4 d) when b = 1 cm e) when eb < 0

18) Sensitivity in a Beer's law analysis can be best described as

a) The value of A when c = 0 b) The product of e×b c) The minimum c detectable by d) The concentration e) The precision achieved when

| | | | |
|---|---|---|---|
| | the method | range in which $A \propto c$ | the method is repeated several times |

19) (10 points) A sample solution was analyzed by the standard addition method using its absorbance characteristic at 455 nm.

a) In the first experiment a 10.00-mL of aqueous sample was diluted to 500.0-mL with water. Its measured absorbance is 0.378.

b)In the second experiment 10.00-mL was mixed with 1.00-μL of 3.22e-5M and diluted to 500.0-mL with water. The measured absorbance of this solution is 0.402. What is the concentration of the analyte in the sample?

Answers

1) d 2) d $(2.75\ \text{cm} \pm 0.03\ \text{cm} \times 4.28\text{cm} \pm 0.05\ \text{cm})$
$= (2.75\ \text{cm} \pm 1.1\% \times 4.28\ \text{cm} \pm 1.2\%)$
$= 11.77 \pm (1.1\%^2 + 1,2\%^2)^{1/2} = 11.8\ \text{cm}^2 \pm 1.6\% = 11.8\ \text{cm}^2 \pm 0.2\ \text{cm}^2$

3) e 4) b 5) a 6) c 7) c $\pm\ 2.776\ (0.04)/(5)^{1/2}$

8) b $z = (33.8\text{-}55.1)/11.8 \cong 1.80$ use table 4-1 area = 0.4641
above = 0.5000 – 0.04641 ≅ 3.6%

9) a $Q = 9.77\text{-}9.11/9.77\text{-}8.89 = 0.75$ $Q_{table} = 0.64$ for n = 5 so 9.77 can be discarded

10) d 11) c 12) d 1.56 mol * 88.2 g HX = 137.5 g
1.56 mol HX/1137.5g soln * 1.33 g/mL * 1000 mL/L = 1.824 mol/L

13) e $0.229/0.327 = c/3.44\text{e-}3$

14) a 15) e 16) c 17) b 18) b

19) Part a $0.378 = k\ (10.00/500.0)\ c$

Part b $0.402 = k\ (10.00/500.0)\ c + k\ (1.00\text{e-}6/0.5000)\ 3.22\text{e-}5$
$0.402 = 0.378 + k\ (1.00\text{e-}6/0.5000)\ 3.22\text{e-}5$
$k = 3.73\text{e}8$
$0.378 = 3.73\text{e}8\ (10.00/500.0)\ c$
$c = 5.1\text{e-}8\ \text{M}$