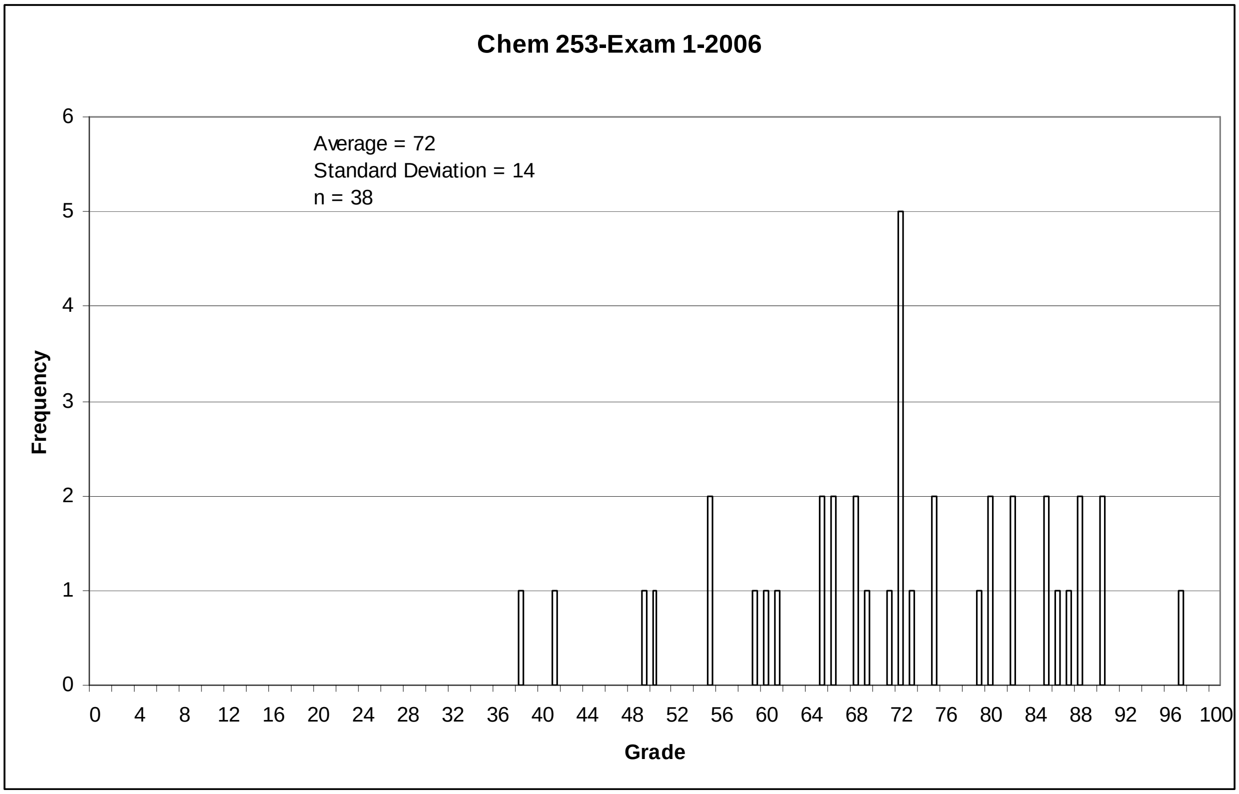

Chem 253-Exam 1-2006
Average = 72
Standard Deviation = 14
n = 38
Frequency
0
1
2
3
4
5
6
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 84 88 92 96 100
Grade

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.

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

$$t_{calculated} = \frac{|\bar{x}_1 - \bar{x}_2|}{s_{pooled}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

$$s_{pooled} = \sqrt{\frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}}$$

$$t_{calculated} = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$d.f. = \left(\frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} \right)^2}{\frac{(s_1^2/n_1)^2}{n_1 + 1} + \frac{(s_2^2/n_2)^2}{n_2 + 1}} \right) - 2$$

Chem 253 – Exam 1 – September 13, 2006

Read carefully

Use the scantron sheets to fill in your answers. Use the exam itself as scratch paper except for the last 2 problems which you must turn in. Questions 1-15 are worth 5 points each. Questions 16 and 17 are 10 and 15 points respectively for a total of 100 on the entire exam. Questions 16 and 17 are to be turned in with your scantron sheet at the end of the exam.

1] After rounding the correct representation of the following is

627.12 + 3.445 =

a) 630.6
b) 630.565
c) 630.57
d) 630.56
e) 631

2] 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?

$(1.2 \pm 0.2\%) \times (71.2 \pm 0.3\%)$

a) 0.2%
b) 0.3%
c) 0.4%
d) 0.5%
e) 0.6%

3] The standard deviation for the mean value of the following is

36.78, 36.82, 36.75

a) 0.1
b) 0.04
c) 0.8
d) 0.01
e) 0.06

4] The proper method for the delivery of solution from a filled 10-mL a pipette marked “TD” to a flask is

a) allow all the liquid to flow out then blow out the remaining liquid in the tip.
b) allow all the liquid to flow out and allow any remaining liquid to stay in the tip
c) allow the liquid to flow out until the 10-mL mark is reached then shut off the stopcock.
d) force the liquid out until the top of the meniscus reaches the10-mL mark
e) allow the liquid to flow out until the meniscus reaches the10-mL mark

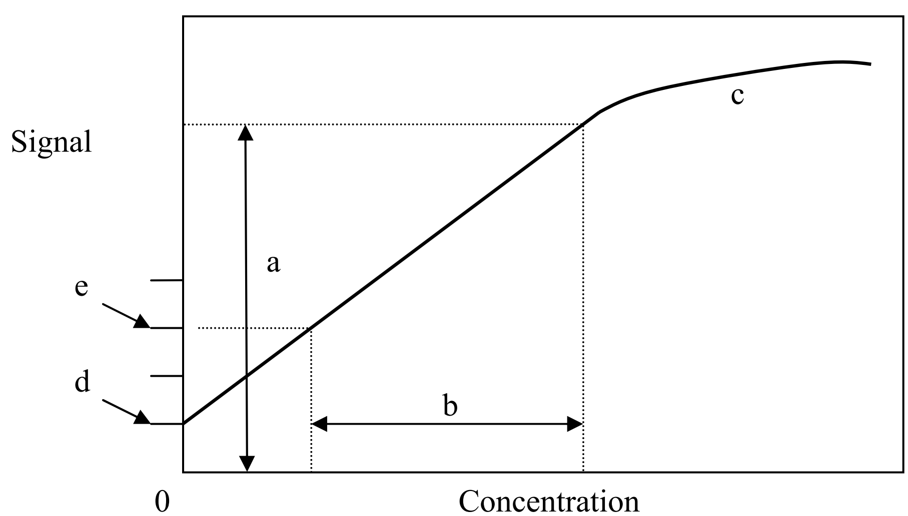
5] A method for the determination of iron in drinking water was conducted 5 times and mean value was found to be 11.7 ppm with a standard deviation of 0.7 ppm. What is the 95% confidence interval that expresses likelihood that true mean lies within the calculated one?

a) 0.6 ppm
b) 0.7 ppm
c) 0.8 ppm
d) 0.9 ppm
e) 1 ppm

6] What is the molarity of an aqueous solution that is 1.00 ppm in a solute has a molecular weight of 103 g/mol?

a) 3.01×10^{3} M
b) 3.01×10^{-3} M
c) 1.00×10^{-1} M
d) 9.71×10^{6} M
e) 9.71×10^{-6} M

The following diagram applies to questions 7-10



7] The detection limit of any instrumental method is best expressed as which of the labeled points in the graph above?

a)
b)
c)
d)
e)

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

a)
b)
c)
d)
e)

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

a)
b)
c)
d)
e)

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

a)
b)
c)
d)
e)

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

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

12] The absorbance of a solution that is 153 ppm in a metal ion is 0.55 at a wavelength of 330 nm. A sample solution of that same metal ion is measured at the same wavelength and is 0.37. What is the concentration of that metal ion in the sample?

a) 103 ppm
b) 97.0 ppm
c) 252 ppm
d) 313 ppm
e) 162 ppm

13] What is the pH of a solution that is 1.00×10^{-3} M in H_2SO_4?

a) 2.699
b) 2.70
c) 3.00
d) 3.000
e) 3.0

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

8.55   9.32   7.19   9.06   8.37

a) none of the above
b) 9.32
c) 7.19
d) 8.37
e) 9.32 and 7.19

15] What is the H^+ concentration of a solution that has a pH of 5.32?

a) 4.79×10^{-6} M
b) 4.79×10^{6} M
c) 4.786×10^{-6} M
d) 4.786×10^{6} M
e) 4.8×10^{-6} M

16] 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?

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

	$\bar{x}$	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?

Answers

1] d-630.56   2] $e = \sqrt{0.2\%^2 + 0.3\%^2} = 0.4\%$

3] b- Mean value = 36.78

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

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

4] b   5] $\mu = \bar{x} \pm \frac{ts}{\sqrt{n}} = 11.7 \pm \frac{2.776(0.7)}{\sqrt{5}} = 11.7 \pm 0.9\,ppm$

6] $\frac{1.00g \;\; solute}{1\times10^6 g \;\; H_2O} \times \frac{1g \;\; H_2O}{1ml} \times \frac{1000mL}{1L} \times \frac{mol \;\; solute}{103g} = 9.71\times10^{-6}\,M$

7] e 8] c 9] b 10] d 11]e

12] A = ebc; must find eb for the system.

0.55 = eb*153 ppm   eb = 3.5<u>9</u>e-3

0.37 = 3.5<u>9</u>e-3*c   c = 103 ppm

13] a 14] $Q_{calc} = \frac{7.19 - 8.37}{7.19 - 9.32} = 0.554$ $Q_{table} > Q_{calc}$ so we cannot discard any of the data.

15] e

16] 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

$0.5000 + 0.1554 \approx 0.65$ or about 65%

17] First calculate F value

$F_{calc} = 0.197^2/0.110^2 = 3.21$ 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.