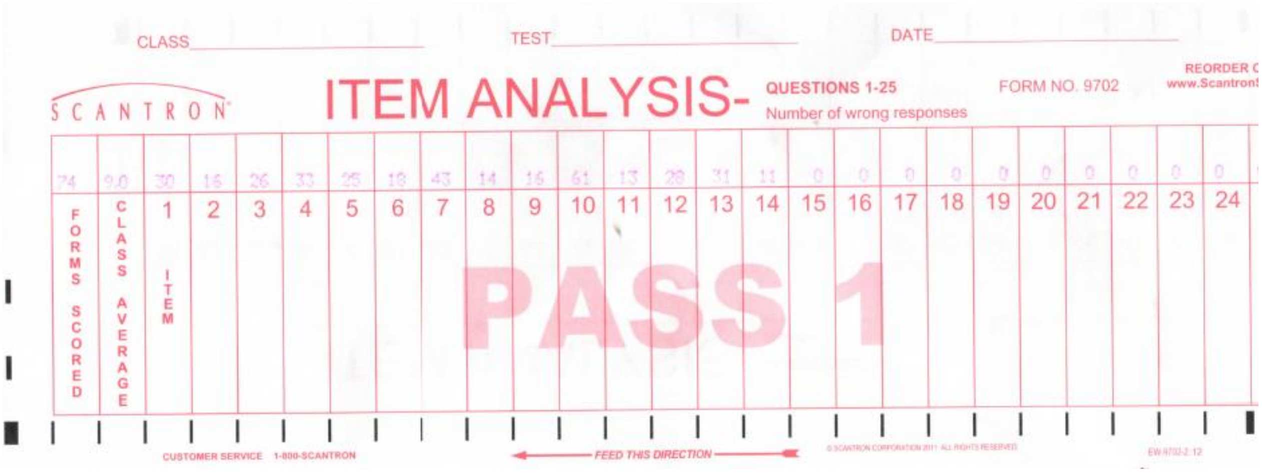
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DATE
SCANTRON
ITEM ANALYSIS-
QUESTIONS 1-25
Number of wrong responses
FORM NO. 9702
FORMS SCORED 74
CLASS AVERAGE 9.0
ITEM
1 30
2 16
3 26
4 33
5 25
6 18
7 43
8 14
9 16
10 61
11 13
12 28
13 31
14 11
15 0
16 0
17 0
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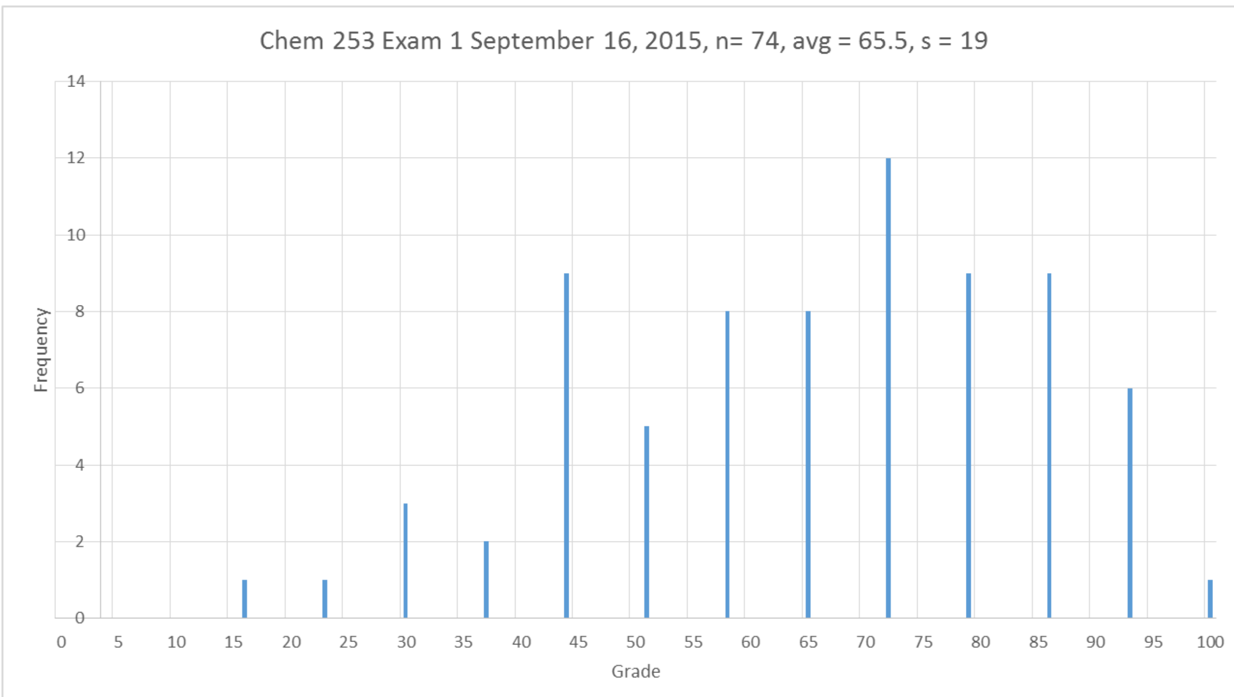
19 0
20 0
21 0
22 0
23 0
24 0
PASS 1
CUSTOMER SERVICE 1-800-SCANTRON
FEED THIS DIRECTION


Chem 253 Exam 1 September 16, 2015, n= 74, avg = 65.5, s = 19
Frequency
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2
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Grade
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

Exam 1 – Chem 253 – September 16, 2015

15 Questions, 7 points each for question 1-14

2 points for answering question 15 correctly

DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO

- Please print your name on the scantron
  - Last Name, First Name
  - That's all that's needed
- Sit in odd numbered seats
- Books & Bags in the front of the room.
- No text entry calculators.
- Use the exams as scratch paper.
- Keep the exams when you are done.
- Turn in the scantrons.

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

$$y = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}} \qquad z = \frac{x-\mu}{s} \qquad F = \frac{s_1^2}{s_2^2}$$

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

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

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

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

1] A 3.00 molal solution has a density of 1.50 g/mL. The MW of the solute is 100 g/mol. What is the molarity of this solution? [1]

2] What is the molarity of a solution that is 100 ppm F^- (AW = 19.00). Assume the density of this solution is 1.00 g/mL. [2]

3] What is the absolute error of the molarity of a solution that has a volume of 1.000 L ± 0.030 L and 58.44 g ± 0.02 g of NaCl (MW = 58.44 ± 0.01 g/mol)? [3]

4] What is the pH of $[H^+] = 3.22 \times 10^{-5}$ in the correct number of significant figures? [4]

5] Calculate of the concentration limit of detection of a method if the slope of the best fit line is 4.22 mV/M the intercept is 7.45 mV. 10 blanks were measure with an average of 7.88 mV and 10 samples were measure with an average of 14.77 mV with a standard deviation of 0.84 mV. [5]

6] 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?[6]

7] What is the pH of 0.100 F C_6H_5COOH (Benzoic Acid, $K_a = 6.5 \times 10^{-5}$) dissolved into water? [7]

8] Analysis of calcium in calcite gave 55.95%, 56.08% 56.04%, 56.00%, and 56.23 %. Can 56.23% be rejected at the 90% confidence level? [8]

9] Iron was measure in a soil sample in triplicate. The values are 0.0840%, 0.0890%, and 0.0790%. Calculate the 95% limit given the mean is 0.0840 and the standard deviation is 0.0050%.[9]

10] What is the pH of 1.00×10^{-2} M H_2A a diprotic acid given the following K_a's? [10]

K_{a1} $H_2A \rightleftarrows H^+ + HA^-$ $K_{a1} = 1.00 \times 10^{+3}$

K_{a2} $HA^- \rightleftarrows H^+ + A^{2-}$ $K_{a2} = 1.20 \times 10^{-8}$

11] What is the solubility of AgCl ($K_{sp} = 1.8 \times 10^{-10}$) in 0.10 M NaCl? [11]

12] Given the following K_a's what is K_b for $A^{2-} + H_2O \rightleftarrows HA^- + OH^-$ [12]

$K_{a1} = 3.0 \times 10^{-4}$ $K_{a2} = 4.0 \times 10^{-9}$

13] In the comparison of two sets of replicate measurements it is apparent that the standard deviations are significantly different. Which sets of equations allow for the means to be compared for significant differences? [13]

a) $\mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}}$ **b)** $Q = \frac{d}{w}$ **c)** $y = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$

d) $z = \frac{x-\mu}{s}$ **e)** $F = \frac{s_1^2}{s_2^2}$ **f)** $t_{calculated} = \frac{|\bar{x}_1 - \bar{x}_2|}{s_{pooled}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$

g) $s_{pooled} = \sqrt{\frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}}$ **h)** $d.f = n_1 + n_2 - 2$

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

14] Concentrated acetic acid (MW = 60.05 g/mol) has a weight percentage of 99.5% and a density of 1.05 g/mL. What is its molarity? [14]

Answers

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[1] Assume 1 kg of solvent and 3.00 mol of solute.

What is the volume of the solution that contains 1 kg of pure solvent? – Calculate total mass and then volume through density.

Mass of solution = 1 kg contains 3.00 mol solute
Mass of solute = 3.00 mol * 100 g/mol = 300 g
Mass of solution = 1000 g + 300 g = 1300 g
Vol. Soln = 1300 * (0.001 L/1.50 g) = 0.8666 L

Molarity = 3.00 mol / 0.866666 L = 3.46 M

[2] 100 ppm = 100 g F / 1.00e6 g solution

Mols of F^- = 100 g F * (mol / 19.00 g) = 5.263 mols vol = 1.00e6 g * (0.001 L / 1g) = 1000 L

Molarity = 5.263 / 1000 L = 5.26e-3 M

[3] %€1 = 0.030/1.000 *100 = 3%
%€2 = 0.02/58.44 * 100 = 0.034%

%€3 = 0.01/58.44 *100 = 0.017%

%€total = (3%^{2} + 0.034%^{2} + 0.017%^{2})^{½} = 3%

[4] pH = -log[H^+] = -log(3.22 x 10^{-5}) = 4.492 note only numbers to the right of the decimal count as SF

[5] LOD = 3s/m 3 (0.84 mV) / 4.22 mV/M = 0.59 M

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

[7]

HA	=	H+	+	A-
0.100 F		0		0
-x		+x		+x
0.100-x		x		x

Ka = 6.5e-5 = x^2 / 0.100-x ≅ x^2 / 0.100
X = 2.5495 = [H^+]
pH = 2.59

[8] Q-calc = 56.23-56.08 / 56.23-55.95 = 0.54
Q-table = 0.64 Q-calc < Q-table the date pt must be retained

[9] $\mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}}$ = 0.084 ± 4.303(0.005)/√3 = 0.084 ± 0.012

[10] K_{a1} >> K_{a2} so only K_{a1} will release H^+ $H_2A \rightleftarrows H^+ + HA^-$

[H^+] = 0.0100 M pH = 2.000

You check your answer by calculating the [H^+] released by K_{a2}.

HA^-	⇄	H^+	+	A^{2-}	K_{a2} = 1.20 x 10^{-8}
0.0100		0.0100		0	
-x		+x		+x	

K_{a2} = 1.20 x 10^{-8} = (0.0100-x)x / (0.0100 – x) ≅ x^2 / 0.0100

X = 1.10e-5 M

0.0100 >> 1.1e-5

[H^+]total = 0.0100 + 1.1e-5 = 1.00<u>11</u>e-2

[11] AgCl (Ksp = 1.8 x 10^{-10})

AgCl	=	Ag+	+	Cl-
--		0		0.10

-- +x +x

$x(0.10+x) = 1.8 \times 10^{-10}$ $0.10x \cong 1.8 \times 10^{-10}$ $x = 1.8 \times 10^{-9}$

[12] must use K_{a2} $K_a K_b = K_w$ K_b = 1.00e-14 / 4.0e-9 = 2.5e-6

[13] Use equations i, and j

[14] 99.5% is 99.5 g HAc/ 100 g solution

mol HAc = 99.5g HAc * (mol/60.05 g) = $1.65\underline{7}$ mol

volume of solution = 100 g * (mL / 1.05 g) * (L / 1000 mL) = 9.523e-2 L

molarity = 1.657 mol / 9.523e-2 L = 17.4 M