Exam #1 Key

① weight %: Assume 1 g/mL, so 250. mL = 250. g

$$\Rightarrow \frac{45.1 \times 10^{-6}\,g}{250.\,g} \times 100 = 1.80 \times 10^{-5}\,\%$$

ppm: 1 ppm = 1 μg/mL

$$\Rightarrow \frac{45.1\,\mu g}{250.0\,mL} = 0.180\ ppm$$

ppb: 1 ppb = 1 μg/L

$$\Rightarrow \frac{45.1\,\mu g}{.250\,L} = 180.\ ppb = 1.80 \times 10^{2}\ ppb$$

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② $\mu = 77.5$ $\bar{x} = 76.73$ $s = 2.284$ $t = 2.262$

$$\bar{x} \pm \frac{ts}{\sqrt{n}} = 76.73 \pm \frac{2.262(2.284)}{\sqrt{10}} = 76.73 \pm 1.63$$

$\Rightarrow$ 95% C.I: $76.7 \pm 1.6 = 75.1$ to 78.3 (contains μ)

$\Rightarrow$ results do agree at the 95% C.L

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② (another way)

$$\mu = \bar{x} \pm \frac{ts}{\sqrt{n}}$$

$$t_{calc} = \frac{|\mu - \bar{x}|\sqrt{n}}{s} = \frac{|77.5 - 76.73|\sqrt{10}}{2.284}$$

$t_{calc} = 1.07$

$t_{tab} = 2.262$

$t_{calc} < t_{tab} \Rightarrow$ no significant difference

(3)

$$\frac{\left(\left[23.5811\,g\,(\pm.0003)\right]-\left[22.1559\,g\,(\pm.0003)\right]\right)\left(\frac{1\text{ mol}}{121.34\,g\,(\pm.01)\,g}\right)}{\left[100.0\text{ mL }(\pm.5)\right]\left(\frac{1\text{ L}}{1000\text{ mL}}\right)}$$

$= 0.117456\ M \pm ?$

$23.5811 - 22.1559 = 1.4252\ g$

$e = \sqrt{(.0003)^2+(.0003)^2} = .000424$

$$\frac{\left[1.4252\,g\,(\pm 0.000424)\right]\left[\frac{1}{121.34\,(\pm.01)}\right]}{\left[100.0 \pm .5\right]\left(\frac{1}{1000}\right)}$$

$$\frac{e}{.117456} = \sqrt{\left(\frac{.000424}{1.4252}\right)^2+\left(\frac{.01}{121.34}\right)^2+\left(\frac{.5}{100}\right)^2}$$

$e = .000588$

$\Longrightarrow$ **$0.1174_6\ (\pm 0.0005_9)\ M$**

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(4) % Fe in compound $= \frac{55.85}{392.14} \times 100 = 14.24_2$ % Fe

$.1424_2\,(.0729\,g) = 0.01038_3\ g$ Fe $= 10.38_3$ mg Fe

$\frac{10.38_3\text{ mg}}{1\text{ L}} = 10.38_3$ ppm

$M_1V_1 = M_2V_2$

$(10.38_3)(10) = M_2(50)$

$M_2 = 2.08$ ppm

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(5)

$$t_{calc} = \frac{|\bar{x}_1 - \bar{x}_2|}{s_p}\sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

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

$$s_p = \sqrt{\frac{.093^2(6-1) + .087^2(5-1)}{6+5-2}} = .09038$$

$$t_{calc} = \frac{|8.63 - 8.84|}{.09038}\sqrt{\frac{6 \cdot 5}{6+5}} = \boxed{3.84}$$

$t_{tab} = 2.262$ (9 d.f., 95%)

$t_{calc} > t_{tab} \implies$ difference IS significant.

(6) a) Volumetric unknown:

$\bar{x} = 61.04$ $\quad n = 46$ $\quad \mu = 59.85$

$s = 1.89$ $\quad t_{95\%} = 2.014$

$t_{99\%} = 2.690$

$$t_{calc} = \frac{|\mu - \bar{x}|}{s}\sqrt{n}$$

$$= \frac{|59.85 - 61.04|}{1.89}\sqrt{46} = 4.27$$

$t_{calc} > t_{tab}$ for both 95% + 99% CI

$\Rightarrow$ method does not give correct result

Gravimetric:

$\bar{x} = 60.33$ $\quad n = 46$ $\quad \mu = 59.85$

$s = 0.56$ $\quad t_{95\%} = 2.014$

$t_{99\%} = 2.690$

$$t_{calc} = \frac{|\mu - \bar{x}|}{s}\sqrt{n} = \frac{|59.85 - 60.33|}{0.56}\sqrt{46} = 5.81$$

$t_{calc} > t_{tab}$ for both 95% + 99% CI

$\Rightarrow$ method does not give the correct result

Alternatively: $CI = \bar{x} \pm \frac{ts}{\sqrt{n}}$

Volumetric:

$\frac{ts}{\sqrt{n}} = 0.561$ for 95%

$\Rightarrow$ ~~59.62 to~~ 60.48 to 61.60

$\frac{ts}{\sqrt{n}} = 0.749$ for 99%

$\Rightarrow$ 60.29 to 61.79

} neither CI contains μ

Gravimetric:

$\frac{ts}{\sqrt{n}} = 0.166$ for 95%

$\Rightarrow$ 60.16 to 60.50

$\frac{ts}{\sqrt{n}} = 0.222$ for 99%

$\Rightarrow$ 60.11 to 60.55

} neither CI contains μ

b) F: test

$$F_{calc} = \frac{1.89^2}{0.56^2} = 11.4 \qquad F_{tab} = 1.64$$

$\Rightarrow$ variances are <u>different</u> at the 95% C.L.

c) T-test assuming unequal variances:

$t_{calc} = 2.43$
$t_{tab} = 2.01$
} $t_{calc} > t_{tab}$ $\Rightarrow$ results are different at the 95% C.L.

d) Volumetric: Standard: 0.10034 (± .0015) mol/L
unknown: 0.03360 (± .000964) g/mL

Calculation:

$$\left(\frac{.10034 \text{ mol NaOH}}{\text{L NaOH}}\right)\left(\frac{1 \text{ L NaOH}}{1000 \text{ mL NaOH}}\right)\left(\frac{1 \text{ mL NaOH}}{0.03360 \text{ g solid}}\right)\left(\frac{1 \text{ mol KHP}}{1 \text{ mol NaOH}}\right)\left(\frac{204.221 \text{ g KHP}}{1 \text{ mol KHP}}\right)$$

$$= .60987 \text{ g KHP/g solid}$$

Error:

$$\frac{e}{.60987} = \sqrt{\left(\frac{.0015}{.10034}\right)^2 + \left(\frac{.000964}{.03360}\right)^2} \Rightarrow e = .0197$$

$\Rightarrow$ .6099 (± .0197) = **61.0 (± 2.0)%**

Gravimetric: Standard: .10002 (± .00120) mol/kg soln
unknown: .033862 (± .000310) g unk/g NaOH soln

Calculation:

$$\left(\frac{0.10002 \text{ mol NaOH}}{\text{kg NaOH soln}}\right)\left(\frac{1 \text{ kg NaOH soln}}{1000 \text{ g NaOH soln}}\right)\left(\frac{1 \text{ g NaOH soln}}{.033862 \text{ g unk}}\right)\left(\frac{1 \text{ mol KHP}}{1 \text{ mol NaOH}}\right)\left(\frac{204.221 \text{ g KHP}}{1 \text{ mol KHP}}\right)$$

$$= 0.60322 \text{ g KHP/g unknown}$$

Error:

$$\frac{e}{.60322} = \sqrt{\left(\frac{.00120}{.10002}\right)^2 + \left(\frac{.000310}{.033862}\right)^2} \Rightarrow e = .00910$$

$\Rightarrow$ .6032 (± .00910) =

= **60.3_2 (± 0.9_1)%**

7)

Patient	Method A	Method B
1	1044	1028
2	720	711
3	845	820
4	800	795
5	957	935
6	650	639

t-Test: Paired Two Sample for Means

		Method A	Method B
	Mean	836	821.33333
	Variance	21466.8	20349.067
	Observations	6	6
	Pearson Correlation	0.9989157	
	Hypothesized Mean Difference	0	
	df	5	
t(calc) =	**t Stat**	**4.6277348**	
	P(T<=t) one-tail	0.0028477	
	t Critical one-tail	1.475884	
	P(T<=t) two-tail	0.0056954	
t(tab) =	**t Critical two-tail**	**2.0150484**	

t(calc) > t(tab), so there is a signficant difference

OR (alternatively):

Patient	Method A	Method B	di	$(d_i-d_{i,ave})^2$
1	1044	1028	16	1.78
2	720	711	9	32.11
3	845	820	25	106.78
4	800	795	5	93.44
5	957	935	22	53.78
6	650	639	11	13.44

$d_{i,ave}$ = 14.7

$\Sigma[(d_i-d_{i,ave})^2]$ = 301.33

n = 6

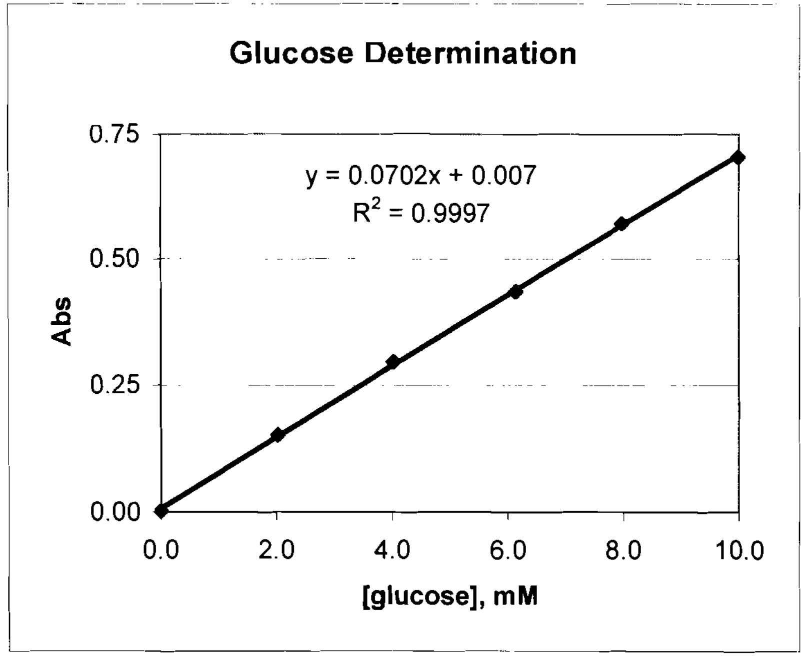
s_d = 7.76

t_{calc} = 4.63

t_{tab} = 2.015

8)

Protein (μg)	Abs (595 nm)	$(x_i - x_{ave})^2$
0.000	0.0021	25.23
2.024	0.1517	8.99
4.018	0.2947	1.01
6.135	0.4342	1.24
7.975	0.5701	8.72
9.984	0.7045	24.61
	Sum =	69.80



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999859474
R Square	0.999718968
Adjusted R Square	0.99964871
Standard Error	0.004916688
Observations	6

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.34397538	0.34397538	14229.25006	2.96199E-08
Residual	4	9.66953E-05	2.41738E-05		
Total	5	0.344072075			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.006951958	0.003572993	1.94569571	0.123566294	-0.002968262	0.016872178	-0.00296826	0.016872178
Protein (mg)	0.070201362	0.000588511	119.2864203	2.96199E-08	0.068567394	0.071835331	0.068567394	0.071835331

sy = 0.004916688
|m| = 0.070201362
b = 0.006951958
k = 3
n = 6
y(ave)= 0.3596
y = 0.350
x(ave)= 5.02

x = 4.887 E30=(C38-C34)/C38

s_x = 0.0495

(C32/C33) * SQRT((1/C35) + (1/C36) + ((C38-C37)^2) / ((C33^2)*SUM(D4:D9)))

4.88_7 ($\pm$ 0.05_0) mM