Recommendations for Good Lab Results

1. Follow directions exactly.
2. Know why directions are being followed -that is, the reason for each step of the laboratory procedure.
3. Keep a laboratory notebook in which all the directions, results, and calculations are carefully recorded.
4. Be well organized in your thinking, in your notebook, and in the laboratory operations.
5. Know how to use each item of lab equipment and treat it with great care.
6. Know and observe the proper steps for cleaning lab glassware.
7. Follow the safety rules.
8. Know which laboratory chemicals are hazardous; use the in accordance with safety regulations, and discard them in accordance with hazardous waste regulations.
9. Be calm and deliberate in your work.
10. Be considerate of others in the laboratory in all that you do (i.e. clean up all messes immediately, leave all equipment the way you would expect to find it, etc ..).

Estimated Precision of Common Laboratory Apparatus··

Buret: ±0.02 mL for each reading

Analytical Balance: ±0.0001 g

Volumetric Pipets (Class A)	
Volume	**Tolerance**
5 ml	± 0.1 mL
10 mL	±0.02 mL
15 mL	±0.03 mL
20 mL	±0.03 mL
25 mL	±0.03 mL
50 mL	±0.05 mL
100 mL	±0.08 mL

Volumetric Flasks (TC, Class A)	
Volume	**Tolerance**
25 mL	±0.03 mL
50 mL	±0.05 mL
100 mL	±0.08 mL
250 mL	±0.12 mL
500 mL	±0.15 mL
1000 mL	±0.30 mL
2000 mL	±0.50 mL

Grades of Chemicals

Technical or Commercial: indeterminate quality of purity; may be used in preparation of cleaning solution only.
C.P. (Chemically Pure): more refined than technical, but still unknown quality.
USP: Meets minimum purity standards of tolerance set by the United States Pharmacopoeia for contaminants dangerous to human health.
A.C,S. Reagent: High purity; conforms to minimum specifications set by the Reagent Chemicals Committee of the American Chemical Society.
Primary Standard: Highest Purity; required for accurate volumetric analysis (for standard solutions).
Reference Standards: Materials of known composition used most frequently for validation of methods of analysis.

Concentration of Commercial Reagent-Grade Acids and Bases

Reagent	F.W.	Molarity	*% (w/w)*	Density (g/mL) @20°C
H_2SO_4	98.08	17.6	94.0	1.831
$HClO_4$	100.5	11.6	70.0	1.668
HCl	36.46	12.4	38.0	1.188
HNO_3	63.01	15.4	69.0	1.409
H_3PO_4	98.00	14.7	85.0	1.689
$HC_2H_3O_2$	60.05	17.4	99.5	1.051
NH_3	17.03	14.8	28.0	0.898

Rules for Handling Reagents·

1. Use the best available grade for analytical work.
2. Replace the top of the container immediately after removal or reagent
3. Hold stoppers for reagent bottles between your fingers and avoid setting them on the benchtop.
4. Never, ever return excess reagent to the bottle.
5. Never insert spatulas into a bottle (pour the reagent with a rolling motion from the bottle). There will be occasional exceptions to this rule when reagents "clump".
6. Keep your working area neat and dean. Spills are to be wiped up immediately!
7. Label EVERYTHING!

Dixon's Q-Test for Outliers

$$Q_{calculated} = \frac{|\text{suspect value} - \text{closest value}|}{|\text{highest value} - \text{lowest value}|} = \frac{\text{gap}}{\text{range}}$$

If $Q_{calculated} > Q_{critical}$, the suspect value should be discarded.

Number of Observations	$Q_{critical}$ At 90% confidence
3	0.94
4	0.76
5	0.64
6	0.56
7	0.51
8	0.47
9	0.44
10	0.41

Grubbs Test for Outliers

$$G_{calculated} = \frac{|\text{suspect value} - \bar{x}|}{s}$$

$\bar{x}$ = mean
s = sample standard deviation

If $G_{calculated} > G_{critical}$, the suspect value should be discarded.

Number of Observations	$G_{critical}$ At 95% confidence
4	1.463
5	1.672
6	1.822
7	1.938
8	2.032
9	2.110
10	2.176

Confidence Intervals

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

$\bar{x}$ = mean
s = sample standard deviation
n = number of data points
t = "Student's t"

Degrees of Freedom	*t* at 95% confidence level	Degrees of Freedom	*t* at 95% confidence level
1	12.7	7	2.36
2	4.30	8	2.31
3	3.18	9	2.26
4	2.78	10	2.23
5	2.57	15	2.13
6	2.45	∞	1.96