

Tables to Accompany 2010 Assessment Report
 Science with Chemistry Curriculum
 Part 1 of 4

Table 1. CHEM 1115 Summary and Trend Data

	2010		2009	2008	2007	2006	2005	2004	2003	
	# Sections Assessed	# Students Assessed	% Meeting Criterion*	% Meeting Criterion*	% Meeting Criterion*	% Meeting Criterion*	% Meeting Criterion*	% Meeting Criterion*	% Meeting Criterion*	
Overall	24	628	75.5	79.3	63.3	70	74.4	75	67.2	49.2
Full-time	14	381	78.0	81	58.4	72.8	83.8	86.8	-	-
Adjunct	10	247	71.7	77.2	67.2	66	69.6	64.8	-	-

* Benchmark: $\geq 80\%$ of students will score 70% or higher on an exit assessment.

Table 2. CHEM 1215 Summary and Trend Data

% Meeting Criterion*	2010	2009	2008	2007	2006	2005	2004	2003
overall average	74	54	59	68	57	61	74	70
50-pt final	64							
100-pt final	78							

* Benchmark: $\geq 80\%$ of students will score 70% or higher on an exit assessment.

Table 3. CHEM 2115/CHEM 2114 Summary and Trend Data

	100 pt exam ^a		50 pt exam ^a		14 question multiple choice exam		
	2010	2009	2009	2008	2007	2006	2005
% Meeting Criterion							
Overall	41	66	32	24	28 ^b	23 ^b	41 ^c
Full-time	59						
Adjunct	26						
Average Exam Score	64.7%	73.8%	59.6%	57.8%			

^aBenchmark: > 80% of students will score at least 70%

^bBenchmark: \geq 80% of students will answer at least 10 out of 14 questions correctly.

^cBenchmark: \geq 50% of students will answer at least 8 out of 14 questions correctly.

Table 4. CHEM 2124 Summary and Trend Data

2010			2009	2008	2007	2006
# Sections Assessed	# Students Assessed	% Meeting Criterion	% Meeting Criterion	% Meeting Criterion	% Meeting Criterion	% Meeting Criterion
3	39	34.1	31.0	23.1	15.1	5.8

Table 5. CHEM 1123 Summary Data

	2010			2009
	# of Sections Assessed	# of Students Assessed	% Meeting Criterion*	% Meeting Criterion*
Overall	16	408	65.7	55.3
Full-time	10	281	66.2	62.5
Adjunct	6	127	64.6	48.9

* Benchmark: \geq 80% of students will score 70% or higher on an exit assessment.

Table 6. CHEM 1115 Error Analysis Overall Results

Problem Area	% Students with Error						
	2010	2009	2008	2007	2006	2005	2004
Inorganic nomenclature							
Incorrect formulas for common monatomic ions	27	11	20	36	20	30	
Incorrect formulas for common polyatomic ions	41	26	43	70	51	64	
Incorrect formula for sodium bicarbonate	52	39	70	81	71	85	84
Incorrect formula for metal hydroxide	31	22	43	77	71	67	76
Incorrect formula for $M_3(PO_4)_2$ or $M_2(SO_4)_3$	27	33	52	68	59		
Gas Laws							
Incorrect relationships between variables	14	13	22	28	27	55	32
Periodic Trends and Families of Elements							
Incorrectly considered H as an alkali metal	16	22	41	23	37	30	
Incorrectly considered H as a noble gas	22	24	20	46	32		
Incorrect family name	16	4	4	23	22	18	
Incorrect periodic trend (wrong size)	36	28	48	27	24	18	
Stoichiometry							
No attempt or wrong approach	6	0	26	19	22	30	
Incorrect grams to moles conversion (or vice versa)	18	22	48	16	9	39	48
Missing or incorrect stoichiometric ratio	4	4	37	13	17	27	
Molarity							
No attempt or wrong approach	4	9	33	21	24	46	
No gram to mole conversion	8	13	30	30	24	27	
No mL to L conversion	6	11	17	23	15	24	
Wrong g to mole conversion	16	2	13	9	22		
Incorrect equation (mass x d or other)	2	4	28	19	20		
Density							
No attempt or wrong approach	5	0	37	8	7	24	
Incorrect or missing mL to L conversion	4	11	22	21	24	30	
Incorrect relationship between mass and density	17	13	37	23	51	18	32
Diatomic Elements							
Incorrect elements	10	9	37	55	22	52	52
Lewis Structures							
Wrong structure	33	33	67	79	81		
No charge	27	48	30	15	15		

Molecular Geometry	29	13	57	51	76		
Electron Configuration							
Wrong valence electrons	31	35	55	53	62		
Incorrect or not writing core structure	3	11					
Metathesis Reactions							
At least one wrong formula	27	17	15	46	38		
At least one wrong physical state	31	15	22	43	43		
Not balanced	20	13	43	42	20		
Significant figures	31	27	25	15	16		
Total math error in calculation	2	4					

**Table 7. CHEM 1215 Error Analysis Overall Results
(Highest percentages for each year are in bold.)**

Problem Area	% Students with Error			
	2010	2009	2008	2007
Hybrid Orbitals	32	38	46	37
Electron Domain Geometry	28	38	42	
Inorganic Nomenclature				
Incorrect formula for sodium bicarbonate	24	38	41	36
Incorrect formula for common oxyacids	28	28	40	35
Incorrect formula for metal hydroxide	17	22	20	16
Incorrect formula for $\text{Ca}_3(\text{PO}_4)_2$ or $\text{Al}_2(\text{SO}_4)_3$	37	57	46	43
Oxidation-Reduction Reactions				
Incorrect element oxidized or reduced	35	38	45	34
Incorrect oxidizing or reducing agent	41	44	44	31
pH Problems				
No attempt or wrong approach	9	6	28	8
Incorrect hydroxide ion concentration	26	43	40	36
Molarity				
No attempt or wrong approach	4	3	3	0
Incorrect grams to moles conversion	40	25	37	38
No gram to mole conversion	3	9	5	3
Energy Diagrams				
Could not distinguish endothermic vs. exothermic	22	28	25	14
Incorrect activation energy	38	50	35	40
Thermodynamic Quantities				
Incorrect units	45	82	58	45
Incorrectly predicted sign of entropy change	23	29	20	19
Wrong equation	8	13	7	0
Incorrect stoichiometry	6	12	12	
Stoichiometry				
Molarity: no attempt or wrong approach	10	9	5	6
Molarity: incorrect use of or missing NaOH molarity	5	12	14	14
Molarity: incorrect/missing molar ratio	4	10	11	5
Enthalpy: no attempt or wrong approach	10	19	14	
Enthalpy: incorrect / missing molar ratio	14	24	20	
Equilibrium				
No attempt or wrong approach	5	10	15	3
Incorrect formula for equilibrium constant	13	28	15	17
Intermolecular Forces				
Incorrect identification of IM force	15	22	30	37
Vapor pressure	21	24	18	
Significant Figures	25	17	11	4
Phase Diagram				
Cannot identify a phase-change point, e.g., a freezing point, among 4 choices	23	28	30	

Table 8. CHEM 2114 Error Analysis

Subject Area	2010	2010 FT	2010 KMB	2009	2008
Functional Groups Incorrect name or ID	12	7	6	9	22
Resonance structures Carbocation	27	7	8	16	37
Carbanion	48	37	29	41	
Acid/Base Reaction Products					
Incorrect conjugate base	34	17	17	25	47
Incorrect conjugate acid	35	23	21	19	56
Conformational Analysis					
Incorrect ID of more stable conformation (total)	43	37	29	50	73
Chose most stable material but was wrong isomer	26	24	25	38	54
Chose high energy conformation(s)	17	12	4	12	20
Stereochemistry Incorrect determination of configuration	28	20	14	30	33
Stereochemical relationships	58	48	29	38	48
# of asymmetric carbons	60	49	46	38	
Nomenclature Incorrect/missing EZ designation	15	5	4	19	63
Incorrect numbering	17	20	17	16	38
Kinetics and Transition States Could not identify the RDS	11	17	8	25	32
Concentration vs. Rate for S _N 2	27	32	29	34	36
Hammond Postulate	57	41	33	63	
Reaction Mechanism					
Acid Hydrolysis <i>major error protonation</i>	73	56	42		
<i>major error nucleophile attack</i>	58	34	29		
<i>major error acid/base rxn</i>	54	32	21		
<i>No clue</i>				19	29
One or more errors				66	
Williamson Ether Synthesis major error acid/base rxn	65	51	21		
major error S _N 2 rxn	56	22	21		
<i>No clue</i>				9	
One or more errors				75	
Free radical Incorrectly chose termination process	42	39	46	41	43
Substitution Chose wrong reaction type S _N 1/S _N 2	20	20	21	31	33
Incorrect intermediates	47	24	29	31	39
Incorrect stereochemistry	33	37	33	25	32

Table 8. CHEM 2114 Error Analysis (cont.)

Subject Area	2010	2010 FT	2010 KMB	2009	2008
Predicting Products of Reactions					
Elimination Incorrect stereochemistry	17	15	4	9	26
Incorrect/no rearrangement	11	1	0	13	54
Overall error rate	31	22	13	24	
Free radical halogenation Position error	26	17	8	6	27
Addition overall error rate	44	30	21	42	
Incorrect stereochemistry / did not show	18	15	8	25	51
Did not apply Markovnikov rule / wrong	51	41	13	25	55
Substitution Incorrect product w/ acetylide	32	15	8	28	51
Incorrect product w/3° amine	35	22	13	22	
Omitted charge on quat. N	52	59	63	59	
Incorrect choice of reagents for ether synthesis	18	10	0	22	42
Organometallic Overall error rate	42	44	29	31	46
Hydride reduction Overall error rate	26	24	13	31	57
Oxidation Chose wrong reagents	22	20	13	9	29
Two Step Synthesis Incorrect intermediate product	34	22	21	13	
Did not use bulky base	82	71	63	63	
Did not use anti-Mark conditions for alcohol	63	49	50	34	
IR Spectroscopy – Peak Label O-H peak	16	17	17	28	
incorrectly assigned ester C-O	23	15	21		
sp ² C-H	34	7	4		
sp ³ C-H	30	10	8		
Aromatic vs. C=C	30	24	21	19	
IR Spectroscopy – ID Structure All incorrect structures	52	41	50	31	
Chose ester vs. ketone	23	20	25	16	

Table 9. CHEM 2124 Error Analysis

Unit	Problem area	% of Students with Error Described		
		2010	2009	2008
-	General problems with nomenclature			
	Incorrect/missing configuration assignment for an alkene	34.1	12.1	61.5
	Incorrect/missing configuration assignment for an enantiomer	24.3	25.9	71.8
1	Recognizing aromatic rings			
	Failed to recognize tropylium ion as aromatic	39.0	43.1	53.8
	Failed to recognize a ring with an sp ³ atom as nonaromatic	51.2	37.9	28.2
1	Nomenclature of aromatic ring structures			
	Incorrect structure for pyridine ring	39.0	37.9	56.4
	Failed to use "phenyl" as a substituent name correctly	12.2	12.1	17.9
	Did not recognize phenol as main part of structure	9.7	6.9	20.5
1	Mechanism of electrophilic aromatic substitution			
	All errors	78.0	50.0	46.1
	Incorrect/missing arrow from ring to electrophile	51.2	37.9	28.2
	Incorrect/missing arrow to show bond breaking within electrophile	31.7	12.1	17.9
2	Hydrobromination of conjugated diene			
	Only one of two products correct	100	62.1	28.2
	All other errors	31.7	12.1	43.6
3	Predicting number of signals in NMR			
	Chose too many or too few	22.0	19.0	15.4
3	Predicting downfield shifts in NMR			
	All errors	55.5	65.5	61.6
	Failed to correctly identify most deshielded protons	24.4	24.1	23.1
	Reversed second and third most deshielded protons	39.0	32.8	35.9
	Failed to correctly identify most shielded protons	9.8	8.6	2.6
4	Nomenclature of ketones and aldehydes			
	One or more errors in naming a bi-functional compound	53.7	15.5	53.8
	Failed to give priority to aldehyde over ketone	9.8	1.7	23.1
	Failed to recognize aldehyde functional group in chain	0	0	12.8
4	Oxidation reactions			
	Failed to oxidize an aldehyde to an acid	43.9	53.4	64.1
	Failed to oxidize an 2° alcohol to a ketone	24.4	39.7	51.3
5	Basicity of primary amines			
	Total errors	73.2	72.4	66.6
	Failed to recognize basicity of primary amines versus other nitrogen-containing compounds	51.3	50.0	61.5
	Failed to recognize basicity of primary amines versus ethers (i.e. clueless or guessing)	22.0	22.4	5.1
6	Nomenclature of amides			
	Incorrect structure for an amide functional group	17.1	43.1	59.0
7	Acidity of carbonyl-containing compounds			
	Failed to recognize greater acidity of dicarbonyl	12.2	10.3	41.0

Table 10. Chemistry Program Error Analysis from CHEM 2124 Final

		% of Students with Error Described
CHEM 1115	Problem area	2010
	Stoichiometry Calculation	
	Used incorrect MW	14.6
	Used incorrect mole ratio	14.6
	Molarity Calculation	
	No mL to L conversion	26.8
	No g to mol conversion	26.8
	Writing chemical formulas	
	Incorrect formula for sodium bicarbonate	29.3
	Incorrect formula for nitric acid	26.8
CHEM 1215	Chemistry II calculations	
	Incorrect value for ΔG	48.8
	Incorrect units for ΔG	82.9
	Incorrect pH value	39.0
CHEM 2114	Identification of reaction mechanism	
	Incorrectly identified Sn2 rxn	26.8
	Incorrect reactive intermediate	51.2
	Mechanism for hydrobromination	
	Incorrect arrows from alkene to HBr	34.1
	Incorrect intermediate	24.4
	IR analysis	
	Did not identify cpd as ester	12.2
Did not identify cpd as aromatic	4.9	
Did not propose a structure consistent with data	14.6	

Table 11. CHEM 1123 Error Analysis

Problem Area	% Error	
	2010	2009
Dimensional Analysis		
Incorrect significant figures	13	27
Incorrect gram to kilogram conversion	23	
Families of Elements		
Incorrectly identified H as alkali metal	23	39
Incorrectly identified H as noble gas	27	27
Other misidentifications of H	10	9
Ions		
Incorrect charge or symbol for oxide	23	30
Incorrect charge or symbol for chloride or nitride	23	18
Covalent Compounds		
Incorrect name for CCl_4 or SCl_5	23	42
Incorrect name for CO or CO_2	33	36
Chemical and Physical Changes		
Identified dissolving as chemical change	35	39
Identified boiling as chemical change	4	18
Balancing Equations Given All Formulas		
One or more incorrect coefficient	15	18
Molarity		
One or more errors	46	82
No gram to mole conversion	27	52
No mL to L conversion	25	33
Did not divide by volume	10	27
No attempt / All other errors	6	18
Dilution		
Wrong equation / Incorrect approach	17	42
All other errors	10	15
Acid-Base Neutralization		
One or more errors	54	76
Incorrect formula for salt	42	61
Incorrect formula for water	17	21
pH		
Incorrectly identified acidic pH	17	15
Functional Groups		
Wrong ID for aldehyde or ketone	42	42
Wrong ID for alcohol	23	39