CHEM 132L – General Chemistry II Lab – Spring 2015 Lab Schedule

Section 1- Tuesday, 9am-12pm, Instructor: Dr. Robin Ertl

Section 2 – Wednesday, 6-9pm, Instructor: Mary Lynn Grayeski

Section 3- Thursday, 9am-12pm, Instructor: Dr. Robin Ertl

Section 4 - Thursday, 5-8pm, Instructor: Mary Lynn Grayeski

Section 6 – Friday, 1-4pm, Instructor: Jason Koval?

Tuesday	Wednesday	Thursday	Friday	Topic
	Jan. 14	Jan. 15	Jan. 16	***No labs***
Jan. 20	Jan. 21	Jan. 22	Jan. 23	Lab Check-In and Safety
Jan. 27	Jan. 28	Jan. 29	Jan. 30	Kinetics Experiment
Feb. 3	Feb. 4	Feb. 5	Feb. 6	Nut Energy
Feb. 10	Feb. 11	Feb. 12	Feb. 13	Le Chatelier's
Feb. 17	Feb. 18	Feb. 19	Feb. 20	Colormetric Equil Const I
Feb. 24	Feb. 25	Feb. 26	Feb. 27	Colormetric Equil Const Part II
March 3	March 4	March 5	March 6	Metal Activity
March 10	March 11	March 12	March 13	***No labs – Spring Break***
March 17	March 18	March 19	March 20	Spec Analysis Aspirin
March 24	March 25	March 26	March 27	Alum Part I & II
March 31	April 1	April 2	April 3	***No labs – Easter Break***
April 7	April 8	April 9	April 10	Alum Part III
April 14	April 15	April 16	April 17	Molec Geom Part I
April 21	April 22	April 23	April 24	Molec Geom Part II
April 28	April 29	April 30	May 1	MakeUp Expt: Copper Rxns & Check Out

Dropper tube apparatus for dispensing of chemicals from solution bottles will be provided on the chemical carts (Pasteur pipettes, rubber bulbs, masking tape and small test tubes). *It is the responsibility of the instructor to attach the apparatus to the chemical container prior to the start of lab and remove it at the end of lab. No dropper tube apparatus is allowed on bottles that are stored on the cart or in chemical cabinets.* Please make sure when attaching dropper apparatus not to cover up the chemical label.

Dropper bottles are only allowed for indicator solutions.

Please split all solutions into 100mL -250mL containers so that large bottles do not become contaminated.

*volumes based on **90** students*

Lab Check –in and Safety -

Material needs:

- Lab drawer check in sheets
- Lab Safety DVD/Safety Sheets

Introduction to Kinetics: Factors that Affect the Rate of Reaction – NO FOOD used in this lab experiment. See notes below and p. 83 of CHEM 131L/132L manual

Material needs:

- 5 – Hydrochloric acid solution 1.0 M (from Fisher already at 1.0M – cat. S25356)
- 5 – Hydrochloric acid solution 6.0 M (from Fisher already at 6.0M – cat. SA56-500)
- 1 – box white chalk
- Copper(II) Sulfate solution 0.2 M – 2.5 L
- Steel wool – 1 bag
- Food coloring
- Bottle of zinc metal (10 mesh – granular Carolina 899300- Flammble Solids)
- 6% hydrogen peroxide solution – 1 L (302 Fridge – Fisher S25361)
- potassium iodide – 100 g bottle

Special Handling or Additional PPE: 6.0 M HCl is caustic and causes severe skin burns; gloves, goggles, and lab coat are necessary. Hydrogen Peroxide causes skin burns; gloves, goggles, and lab coat are necessary.

ELIMINATE THE FOLLOWING FROM THIS EXPERIMENT: coffee creamer, modeling clay, Styrofoam balls, hydrolysis of starch (saliva)

Wastes Produced:

- dispose of aqueous HCl solutions – 100 mL
- dispose of copper, iron, zinc solutions – 2.5 L
- **peroxide waste is NOT compatible with other chemical waste; dispose separately** – 1 L

Stored Energy in Various Nut Samples

Material needs:

- Bag of pecans, almonds, and walnuts (whole no shell)
- Box of large paper clips
- Aluminum Foil
- Box of matches
- Three empty soda cans – **PROVIDED BY STUDENT**

Special Handling or Additional PPE: NONE
Wastes Produced: NONE

Reaction Reversibility and Le Chatelier's Principle –

Material needs:

- 1.0 M potassium chromate – 200 mL
- 3.0 M sulfuric acid – 200 mL (from Fisher already at 3.0M – cat. S25899)
- 6.0 M sodium hydroxide – 300 mL (from Fisher already at 6.0M – cat. S25883)
- 1% methyl orange – 100 mL *in dropper bottles*
- 6.0 M hydrochloric acid – 300 mL (from Fisher already at 6.0M – cat. SA56-500)
- 0.05% phenolphthalein indicator (See indicators Table. Note: add phenolphthalein to ethanol and dissolve before adding water) – 100 mL in dropper bottles
- 0.1 M acetic acid – 200 mL
- 1.0 M sodium acetate – 200 mL
- 1.0 M ammonium hydroxide – 200 mL
- 6.0 M ammonium hydroxide – 200 mL
- 0.15 M cobalt(II) chloride hexahydrate in **Methanol** ($CoCl_2 \cdot (H_2O)_6$ – 400 mL
- 12.0 M hydrochloric acid (conc.) – 300 mL
- 0.1 M iron(III) nitrate (ferric nitrate) – 400 mL
- 0.1 M potassium thiocyanate – 400 mL
- 5.4 M sodium chloride (saturated) solution – 400 mL
- 0.1 M calcium chloride – 200 mL
- 0.25 M oxalic acid – 100 mL
- 0.25 M sodium oxalate – 100 mL

Special Handling or Additional PPE: 12.0 M and 6.0 M HCl is caustic and causes severe skin burns; gloves, goggles, and lab coat are necessary. Sodium hydroxide is caustic and causes severe skin burns; gloves, goggles, and lab coat are necessary.
Wastes Produced:

- aqueous chromate solutions – 200 mL
- 0.15 M cobalt(II) chloride hexahydrate ($CoCl_2 \cdot (H_2O)_6$ – 400 mL
- $Fe(SCN)^{2+}$ solution – 5.5 L
- Oxalic acid solution w/calcium hydroxide ppt – 200 mL
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Determination of an Equilibrium Constant Using a Spectrophotometer –

Material needs: (Based on groups of 3 students)

- **TURN ON SPEC20 INSTRUMENTS AT THE BEGINNING OF LAB PERIOD; set wavelength to 450 nm**
- Plastic cuvettes for Spec20 instruments (Extra can be located in Storage CNHS 95)
- 25-mL volumetric flasks w/plastic caps – 30
- 5-mL volumetric pipets – 5
- 10-mL graduated pipets – 5
- Box of Pasteur pipettes w/rubber tops
- Make the following solutions in 0.1M Nitric Acid
  - 0.200 M $Fe(NO_3)_3$ in .-- (ferric nitrate) – 100mL
  - 0.002 M $Fe(NO_3)_3$ -- (ferric nitrate) – 1.5 L
  - 0.002 M KSCN – (potassium thiocyanate) – 1 L
- 0.10 M HNO_3 (nitric acid) – 1 L

- Prepare Solutions for Calibration Curve (located on page 117 of Lab Manual only do half of the volume as indicated in the chart below)

Solution	0.200 M $Fe(NO_3)_3$	0.002 M KSCN	0.1M HNO_3
A-1	12.5mL	0.0 mL	37.5 mL
A-2	12.5mL	0.5 mL	37 mL
A-3	12.5mL	1.0 mL	36.5 mL
A-4	12.5mL	2.0 mL	35.5 mL
A-5	12.5mL	3.0 mL	34.5 mL
A-6	12.5mL	4.0 mL	33.5mL
A-7	12.5mL	5.0 mL	32.5 mL

Special Handling or Additional PPE:

- **Nitric acid can cause burns and skin discoloration. Gloves, goggles and lab coats are necessary.**

Wastes Produced:

- The solutions generated in this experiment are acidified nitrate and nitric acid. They are collected in waste containers. They are stored and disposed of as a hazardous waste.

Activity Series –

Material needs:

- 6.0 M HCl (240 mL) – (hydrochloric acid)
- 0.2 M $Ca(NO_3)_2 \cdot 4\ H_2O$ (1.5 L) – (calcium nitrate)
- 0.2 M $Mg(NO_3)_2 \cdot 6\ H_2O$ (1.5 L) – (Magnesium nitrate)
- 0.2 M $Zn(NO_3)_2 \cdot 6\ H_2O$ (1.5 L) – (Zinc nitrate)
- 0.2 M $Fe(NO_3)_3 \cdot 9\ H_2O$ (1.5 L) – (Iron(III) nitrate, or ferric nitrate)
- 0.2 M $FeSO_4 \cdot 7\ H_2O$ (1.5 L) – (Iron(II) sulfate, ferrous sulfate)
- 0.2 M $SnCl_4 \cdot 5\ H_2O$ (1.5 L) – (Tin(IV) chloride, stannic chloride)
- 0.5 M $CuSO_4 \cdot 5\ H_2O$ (1.5 L) – (Copper(II) sulfate pentahydrate or Cupric Sulfate)
- Bottle of calcium shavings
- Package of magnesium ribbon
- Bottle of granular zinc
- Bag of steel wool
- 250 g granular tin
- Copper wire and wire cutters
- Appropriate waste containers: Ca^{2+}, Cu^{2+}, Mg^{2+}, Fe^{2+}, Sn^{2+}, Zn^{2+}, & Co^{2+}, in aqueous HCl; Ca, Cu, Mg, Fe, Sn, Zn, Co (solid metals)

Special Handling or Additional PPE:

- HCl causes severe skin burns; gloves are necessary
- Hydrogen gas is produced in the reactions of each of the metals with HCl, which is conducted in the hood with the exhaust on and in the absence of any open flames

Wastes Produced:

- Ca, Cu, Mg, Fe, Sn, Zn, Co (solid metals) – <1 g – are collected and may be mixed with other transition metal solids. It is stored and disposed of as a hazardous waste.

Spectrophotometric Analysis of Aspirin

Material needs:

- Reagent-grade acetylsalicylic acid (6.4 g)
- 1.0 M sodium hydroxide – 500 mL
- 0.0 2M iron(III) chloride – 750 mL
- Bottle of commercial aspirin – not enteric coated
- 100-mL volumetric flasks w/plastic caps – 10
- 1-mL **GRADUATED** pipettes –10
- 10-mL volumetric flasks w/plastic caps – 40
- hotplates

Special Handling or Additional PPE:

- NaOH causes severe skin burns; gloves, lab coat, and goggles are necessary
- The aspirin-NaOH solution may splatter upon heating and therefore should be handled in the laboratory hood.

Wastes Produced:

- $FeCl_{3(aq)}$ solutions (750 mL) mixed with acetylsalicylic acid are collected as waste containers. They are stored and disposed of as a hazardous waste (organic mixed with $Fe^{3+}_{(aq)}$)

The Synthesis of Alum Part I.

Material needs:

- Aluminum foil or aluminum cans
- 4.0 M potassium hydroxide – 2.5 L
- 9.0 M sulfuric acid – 2 L
- 50% aqueous ethanol (v/v) – 1.1 L
- 95% aqueous ethanol (v/v) – 2.7 L
- whatman filter paper for Buchner funnels
- several pairs of scissors

Special Handling or Additional PPE:

- Hydrogen gas is generated in the first part of this lab experiment
- Eye protection must be worn at all times
- Sodium Hydroxide causes severe skin burns; gloves, goggles, and lab coat are necessary.
- Sulfuric and nitric acids cause sever skin burns; gloves, goggles, and lab coat are necessary.

Wastes Produced:

- Dispose of sulfuric acid solution – 2 L
- Dispose of aqueous ethanol solution – 3.8 L

The Synthesis of Alum Part II. and III.

Material needs:

- 0.1 M barium chloride – 50 mL
- 0.1 M potassium hydroxide – 50 mL
- 6.0 M nitric acid – 500 mL
- nichrome wire loops – 10
- 1.0 M potassium chloride solution – 100 mL

Special Handling or Additional PPE:

- Eye protection must be worn at all times
- Sodium Hydroxide causes severe skin burns; gloves, goggles, and lab coat are necessary.

Wastes Produced:

- Collect alum crystals in waste container for disposal

Molecular Geometries; VSPER Theory (2 week lab)

Material needs:

- NEW molecular model kits purchased from Fisher Scientific

Special Handling or Additional PPE:

- None

Wastes Produced:

- None

Make-Up Experiment – Chemical Reactions of Copper –

Material needs:

- copper wire (16- or 18-gauge)
- pair of wire cutters
- 100 g granular zinc – 0.5 g/student – 30-mesh size
- methanol (100 mL)
- acetone (100 mL)
- conc. nitric acid (100 mL)
- 3.0 M NaOH (1.5 L) (from Fisher already at 3.0M – cat. S25884)
- 6.0 M H_2SO_4 (500 mL) (from Fisher already at 6.0M – cat. S25900)
- Conc. hydrochloric acid (100 mL)
- Aluminum foil
- boiling chips – DO NOT USE calcium carbonate chips
- Appropriate waste containers for: NaOH, Cu metal (recovered), MeOH, EtOH
- Evaporating dishes

Special Handling or Additional PPE:

- NaOH is caustic and should be handled with care in the hood
- HCl causes severe skin burns; gloves are necessary
- H_2SO_4 causes severe skin burns; gloves are necessary
- HNO_3 causes severe skin burns; gloves are necessary
- Nitrous oxide gas is formed during during the first reaction and should be performed in the lab hood

Wastes Produced:

- H_2SO_4 – 1 L – is collected and may be mixed with other acid waste. It is stored and disposed of as a hazardous waste.
- MeOH – 0.5 L and Acetone – 0.5 L – is collected and may be mixed with other organics. It is stored and disposed of as a hazardous waste.
- HCl – 50 mL – is collected and may be mixed with other acid waste. It is stored and disposed of as a hazardous waste.
- NaOH wash - 8L is collected and disposed of as a hazardous waste.
- Cu metal ~ 30 g – is collected and may be mixed with other transition metals. It is stored and disposed of as a hazardous waste.

- Conc. Nitric acid - is collected and may be mixed with other acid waste. It is stored and disposed of as a hazardous waste.
- Acidified Zinc is collected and may be mixed with other acid waste. It is stored and disposed of as a hazardous waste.

Lab Check-Out –

Material needs:

- Lab drawer check in sheets

Preparation of Acid-Base Indicators Table

Indicator	pH Change	Color Change	Preparation
Methyl Violet	0.0 - 1.6	yel to bl	0.01- 0.05 % in water
Crystal Violet	0.0 - 1.8	yel to bl	0.02% in water
Ethyl Violet	0.0 - 2.4	yel to bl	0.1 g in 50 ml of MeOH + 50 ml of water
Malachite Green	0.2 - 1.8	yel to bl grn	water
Methyl Green	0.2 - 1.8	yel to bl	0.1% in water
2 - (p - dimethylaminophenylazo)pyridine	0.2 - 1.8, 4.4 - 5.6	yel to bl, red to yel	0.1 % in ETOH
o - Cresolsulfonephthalein (Cresol Red)	0.4 - 1.8, 7.0 - 8.8	yel to red, yel to red	0.1 g in 26.2 ml 0.01M NaOH + 223.8 ml water
Quinaldine Red	1.0 - 2.2	col to red	1 % in ETOH
p - (p - dimethylaminophenylazo) - benzoic acid, Na - salt (Paramethyl Red)	1.0 - 3.0	red to yel	ETOH
m - (p - anilnophenylazo)benzene sulfonic acid, Na - salt (Metanil Yellow)	1.2 - 2.4	red to yel	0.01% in water
4 - Phenylazodiphenylamine	1.2 - 2.6	red to yel	0.01 g in 1 ml 1M HCI + 50 ml ETOH + 49 ml water
Thymolsulfonephthalein (Thymol Blue)	1.2 - 2.8, 8.0 - 9.6	red to yel, yel to bl	0.1 g in 21.5 ml 0.01 M NaOH + 229.5 mL water
m - Cresolsulfonephthalein (Metacresol Purple)	1.2 - 2.8, 7.4 - 9.0	red to yel, yel to purp	0.1 g in 26.2 ml 0.01M NaOH + 223.8 ml water
p - (p - anilinophenylazo)benzenesulfonic acid, Na - salt (Orange IV)	1.4 - 2.8	red to yel	0.01 % in water
4 - o - Tolylazo - o - toluidine	1.4 - 2.8	or to yel	water
Erythrosine, disodium salt	2.2 - 3.6	or,to red	0.1% in water
Benzopurpurine 48	2.2 - 4.2	vt to red	0. 1 170 in water
N,N - dimethyl - p - (m - tolylazo)aniline	2.6 - 4.8	red to yel	0.1% in water
4,4' - Bix(2 - amino - l - naphthylazo)2,2' - stil - benedisulfonic acid	3.0 - 4.0	purp to red	0.1 g in 5.9 ml 0.05 M NaOH + 94.1 ml water
Tetrabromophenolphthaleinethyl ester, K - salt	3.0 - 4.2	yel to bl	0.1 % in ETOH
3',3",5',5" - tetrabromophenol - sulfonephthalein (Bromophenol Blue)	3.0 - 4.6	yel to bl	0.1 g in 14.9 ml 0.01M NaOH + 235.1 ml water
2,4 - Dinitrophenol	2.8 - 4.0	colorless to yel	saturated water solution
N,N - Dimethyl - p - phenylazoaniline (p - Dimethylaminoazobenzene)	2.8 - 4.4	red to yel	0.1 g in 90 ml in ETOH + 10 ml water
Congo Red	3.0 - 5.0	blue to red	0.1% in water
Methyl Orange - Xylene Cyanole solution	3.2 - 4.2	purp to grn	ready solution
Methyl Orange	3.2 - 4.4	red to yel	0.01 % in water
Ethyl Orange	3. 4 - 4. 8'	red to yel	0.05 - 0.2% in water or aqueous ETOH
4 - (4 - Dimethylamino - 1 - naphthylazo) - 3 - methoxybenzenesulfonic acid	3.5 - 4.8	vt to yel	0.1% in 60% ETOH
3',3",5',5" - Tetrabromo - m - cresol - sulfonephthalein (Bromocresol Green)	3.8 - 5.4	yel to blue	0.1 g in 14.3 ml 0.01 M NaOH + 235.7 ml water
Resazurin	3.8 - 6.4	or to vt	water
4 - Phenylazo - l - naphthylamine	4.0 - 5.6	red to yel	0.1 % in ETOH
Ethyl Red	4.0 - 5.8	col to red	0.1 g in 50 ml MEOH + 50 ml water

2 - (p - Dimethylaminophenylazo) - pyridine	0.2 - 1.8, 4.4 - 5.6	yel to red, red to yel	0.1 % in ETOH
4 - (p - ethoxyphenylazo) - m - phenylene - diamine monohydrochloride	4.4 - 5.8	or to yel	0.1% in water
Lacmoid	4.4 - 6.2	red to bl	0.2% in ETOH
Alizarin Red S	4.6 - 6.0	yel to red	0.2 g in 100 mL of 1.5% HCl
Methyl Red	4.8 - 6.0	red to yel	0.02 g in 60 ml ETOH + 40 ml water
Propyl Red	4.8 - 6.6	red to yel	ETOH
5',5" - Dibromo - o - cresolsulfone - phthalein (Bromocresol Purple)	5.2 - 6.8	yel to purp	0.1 g in 18.5 ml 0.01M NaOH + 231.5 ml water
3',3" - Dichlorophenolsulfonephthalein (Chlorophenol Red)	5.2 - 6.8	yel to red	0.1 g in 23.6 ml 0.01 M NaOH + 226.4 ml water
p - Nitrophenol	5.4 - 6.6	col to yel	0.1% in water
Alizarin	5.6 - 7.2, 11.0 - 12.4	yel to red, red to purp	0.1 % in MEOH
2 - (2,4 - Dinitrophenylazo) - l - naphthol - 3, 6 - disulfonic acid, di - Na salt	6.0 - 7.0	yel to bl	0.1% in water
3',3" - Dibromothymolsulfonephthalein (Bromothymol Blue)	6.0 - 7.6	yel to bl	0.1 gin 16 ml 0.01 M NaOH + 234 ml water
6,8 - Dinitro - 2,4 - (lH)quinazolinedione (m - Dinitrobenzoylene urea)	6.4 - 8.0	col to yel	25 g in 115 ml M NaOH + 50 ml boiling water 0.292g of NaCl in 100 ml water
Brilliant Yellow	6.6 - 7.8	yel to or	1 % in water
Phenolsulfonephthalein (Phenol Red)	6.6 - 8.0	yel to red	0.1 gin 28.2 ml 0.01M NaOH + 221.8 ml water
Neutral Red	6.8 - 8.0	red to amb	0.01 g in 50 ml ETOH + 50 ml water
m - Nitrophenol	6.8 - 8.6	col to yel	0.3170 in water
o - Cresolsulfonephthalein (Cresol Red)	0.0 - 1.0, 7.0 - 8.8	red to yel, yel to red	0.1 g in 26.2 ml 0.01 M NaOH + 223.8 ml water
Curcumin	7.4 - 8.6, 10.2 - 11.8	yel to red	ETOH
m - Cresolsulfonephthalein (Metacresol Purple)	1.2 - 2.8, 7.4 - 9.0	red to yel, yel to purp	0.1 gin 26.2 ml 0.01M NaOH + 223.8 ml water
4,4' - Bis(4 - amino - i - Daphthylazo) 2,2'stilbene disulfonic acid	8.0 - 9.0	bl to red	0.1 gin 5.9 ml 0.05 M NaOH + 94.1 ml water
Thymolsulfonephthalein (Thymol Blue)	1.2 - 2.8, 8.0 - 9.6	red to yel	0.1 g in 21.5 ml 0.01 M NaOH + 228.5 ml water
o - Cresolphthalein	8.2 - 9.8	col to red	0.04% in ETOH
p - Naphtholbenzene	8.2 - 10.0	or to bl	I % in dil. alkali
Phenolphthalein	8.2 - 10.0	col to pink	0.05 gin 50 mL ETOH + 50 mL water
Ethyl - bis (2.4 - dimethylphenyl)acetate	8.4 - 9.6	col to bl	saturated solution in 50% acetone alcohol
Thymolphthalein	9.4 - 10.6	col to bl	0.04 g in 50 ml ETOH + 50 ml water
5 - (p - Nitrophenylazo)salicylic acid, Na - salt (Alizarin Yellow R)	10.1 - 12.0	yel to red	0.01 % in water
p - (2,4 - Dihydroxyphenylazo)benzene - sulfonic acid, Na - salt	11.4 - 12.6	yel to or	0.1 % in water
5,5' - Indigodisulfonic acid, di - Na - salt	11.4 - 13.0	bl to yel	water
2,4,6 - Trinitrotoluene	11.5 - 13.0	co] to or	0.1 - 0.5% in ETOH
1,3,5 - Trinitrobenzene	12.0 - 14.0	col to or	0.1 - 0.5% in ETOH
Clayton Yellow	12.2 - 13.2	yel to amb	0.1% in water