Chem 108: Lab

Week 6

Sign in: Roster @ front of lab

Pick up Papers & Handout:
HYDRATE Exp.
Replacement Page for Lab Manual's Pg. 29

Read Handout

Exp. 3 – Classification of Matter and Chemical Change

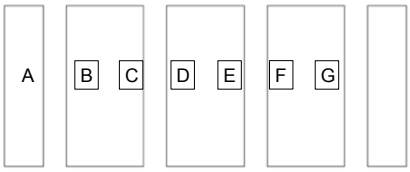
- Report Forms: *One form for each lab partner are both to be turned in; stapled together. Neatest one on top.*
  - Check sig figs are correct and units included
  - Show example of each type of calculation
  - Answer questions legibly in complete sentences.

Individually complete on-line post-lab questions and submit:
http://www.chemconnections.org/general/chem108/Physical%20Properties.html
Report Form & POST LAB DUE Today

Experiment 3:
Classification of Matter
and
Chemical Change

Locations from last week
Group can relocate if you want to choose a different space.

Front of Lab

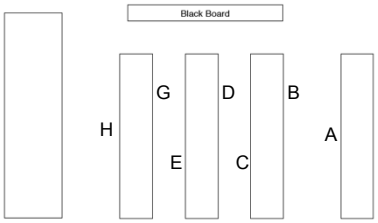


Work with the same group from last week's lab.

Chem 108: Lab

Week 6

Pick up one unknown for you & your partner
(2 unknowns per group)



Hydrates

Handout: Replace page #29 in Lab Manual

PERCENT WATER IN A HYDRATE

A hydrate is a solid substance, which contains water bound within the crystal lattice of a salt. Water molecules are present in definite proportions in hydrates. Epsom salts, also known as the mineral *epsomite*, is pure magnesium sulfate heptahydrate, $MgSO_4 \cdot 7\ H_2O$. There are seven water molecules present for every one molecule of the salt. Magnesium sulfate heptahydrate can react to produce other hydrates with one, two, three and six molecules of water respectively for each magnesium sulfate. The common name, Epsom salts, comes from the name of a small town in England where in the early 1600s the town's well water was regarded as being curative. Today, it is still regarded as being able to treat splinters, scrapes, insect bites, minor sprains and bruises, to produce lush, healthy lawns, vibrant plants and vegetables as well as a smoother softer skin, and to provide relief from everyday stress. In Shakespeare's 17th century, no one understood the therapeutic mystery of the town's water, and it wasn't until many, many decades later that modern chemistry identified the active mineral component as this particular hydrate.

magnesium sulfate heptahydrate

$MgSO_4 \cdot 7\ H_2O$

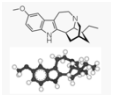
Chemical Formulas and Unambiguous Names

http://www.chemconnections.org/general/chem108/Nomenclature.htm

- Molecular Formula:
- **Elements' Symbols** = atoms
- **Subscripts** = relative numbers of atoms
- How are compounds named?

$CaCl_2$ CCl_4 NaOH $(NH_4)_2CO_3$

$C_{20}H_{26}N_2O$
(Ibogaine)
Tabernanthe iboga



Experiment 4

Lab Manual pp. 26-27

Hydrates

Background

It is common for salts (ionic compounds) to be hydrated; that is, to have specific amounts of water bonded to the ions in the salt. This water is called water of hydration or water of crystallization. Some examples of hydrated salts are: $CaCl_2 \cdot 2H_2O$, $Fe(NO_3) \cdot 9H_2O$, $MgCO_4 \cdot 3H_2O$, $Na_2SO_4 \cdot 10H_2O$. In the formula a dot precedes the number of moles of water per mole of anhydrous (without water) compound. The water molecules are usually not strongly held and often can be removed by heating.

$$BaCl_2 \cdot 2\ H_2O \xrightarrow{heat} BaCl_2 + 2H_2O$$

If a weighed hydrate sample is heated and then weighed again, the mass of water released can be determined and the percent water calculated. For example if a 10.00 g sample of a hydrate is found to have a mass of 8.53 g after heating, then the mass of water released can be calculated as follows:

$$10.00\ g - 8.53\ g = 1.47\ g$$

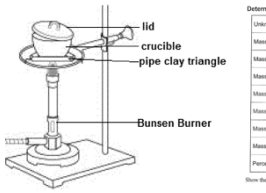
and the percent water is:

$$\frac{1.47\ g}{10.00\ g} = 14.7\ \%$$

This experiment is in two parts. In the first part you will verify that when a hydrate is heated, water is produced. The presence of water can be detected by using paper saturated with anhydrous cobalt (II) chloride. $CoCl_2$, which is blue, reacts with water to form red $CoCl_2 \cdot 6H_2O$.

One unknown for you & your partner

(2 unknowns per group)



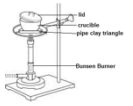
Determination of Percent Water in a Hydrate

Unknown number	
Mass, crucible + lid + hydrate sample	
Mass, crucible + lid	
Mass, hydrate sample*	
Mass, crucible + lid + anhydrous product (1st heating)	
Mass, crucible + lid + anhydrous product (2nd heating)	
Mass, crucible + lid + product (3rd heating if necessary)	
Mass, water lost*	
Percent water in hydrate*	

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

Hydrates
Handout
Replaces Page 29

Using your unknown, complete the procedure, and accurately record all data on your individual Report Form.



Determination of Percent Water in a Hydrate

Unknown number	
Mass, crucible + lid + hydrate sample	
Mass, crucible + lid	
Mass, hydrate sample*	
Mass, crucible + lid + anhydrous product (1st heating)	
Mass, crucible + lid + anhydrous product (2nd heating)	
Mass, crucible + lid + product (3rd heating if necessary)	
Mass, water lost*	
Percent water in hydrate*	

Show the calculations for each of the entries in the Data Table marked with * on the calculations page.

Hydrates
Handout

1) Name the following hydrates:

$CoSO_4 \cdot 6\ H_2O$

$MgO_4 \cdot 6\ H_2O$

$CuSO_4 \cdot 5\ H_2O$

2) Write formulas for the following hydrates:

Sodium dihydrogenphosphate nonahydrate

Potassium chromate tetrahydrate

Lead (II) acetate trihydrate

Report Form – Hydrates 29

Show completed pg. 29 data & questions (both sides except Post-Lab Question) on individual Reports to Dr. R. before leaving lab.

Hydrates

Page #29 Handout: Opposite side from Data Table

After completing the heating and data form for your unknown, calculate the % water in the following samples.
Show your calculations on your individual handout page to Dr. R. before leaving lab.

An "Epsom" salt sample (A) of 10.00 g was heated and re heated until it reached a "constant" mass of 5.70 g. What is the % water in the sample?

An "Epsom" salt sample (B) of 10.00 g was heated and re heated until it reached a "constant" mass of 4.88 g . What is the % water in the sample?

Nomenclature
Unambiguous Chemical Names

http://www.chemconnections.org/general/chem108/Nomenclature.htm

Group is to complete Lab manual pages 109-114.

1 Set of pages per group
DUE Next Lab

Handout

Post-Lab Question:

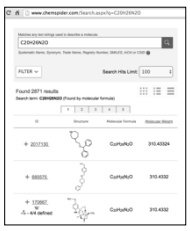
Spectroscopic satellite analysis of the composition of the moon was completed during the Clementine and subsequent NASA missions. The data indicates that water is present on the moon and there may be enough to allow human colonization. The water is tied up in rock (hydrates) and as ice. A notable hydrate for its high water content is Glauber's salt, sodium sulfate decahydrate. If a human were to require the equivalent of 2 liters of water per day, how many kilograms of Glauber's salt would need to be processed per month to meet one person's need. Assume a month is 30 days and that all of the water in the salt is recovered in the process. Glauber's Salt is 56% water by weight.

Include answer plus calculation on individual Lab Reports
DUE Next Lab

Chemical Formulas and Unambiguous Names

- Molecular Formula:

$C_{20}H_{26}N_2O$



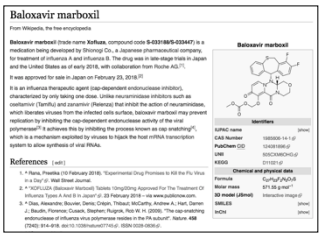
Search term: $C_{20}H_{26}N_2O$ produced 2871 results, ***where names were all different.***

Chemical Formulas and Naming Organic Molecules

https://pubchem.ncbi.nlm.nih.gov/compound/124081896

(((12aR)-12-{(11S)-7,8-Difluoro-6,11-dihydrodibenzo(b,E)thiepin-11-yl)-6,8-dioxo-3,4,6,8,12,12ahexahydro-1H-(1,4)oxazino(3,4-C)pyrido(2,1-F)(1,2,4)triazin-7-yl)oxy)methyl methyl carbonate

Carbonic acid, (((12aR)-12-{(11S)-7,8-difluoro-6,11-dihydrodibenzo(b,E)thiepin-11-yl)-3,4,6,8,12,12a-hexahydro-6,8-dioxo-1H-(1,4)oxazino(3,4-C)pyrido(2,1-F)(1,2,4)triazin-7-yl)oxy)methyl methyl ester



Nomenclature

- Nomenclature: the unambiguous naming of compounds/ molecules
- Governed by the IUPAC: *International Union of Pure and Applied Chemistry*
- International rules are updated periodically

https://www.iupac.org/fileadmin/user_upload/databases/Red_Book_2005.pdf

Organic and Inorganic compounds/ molecules have separate naming rules.

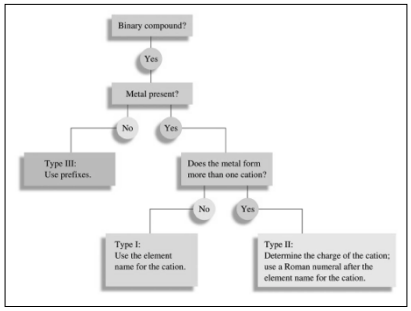
Chemical Formulas and Unambiguous Names

http://www.chemconnections.org/general/chem108/Nomenclature.htm

- Molecular Formula:
- **Elements' Symbols** = atoms
- **Subscripts** = relative numbers of atoms
- How are compounds named?

$CaCl_2$ CCl_4 NaOH $(NH_4)_2CO_3$

Naming Inorganic Compounds



https://chem.libretexts.org/Core/Inorganic_Chemistry/Chemical_Compounds/Nomenclature_of_Inorganic_Compounds

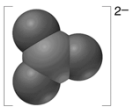
Ions

- Cation: A positive ion
  - Mg^{2+}
- Anion: A negative ion
  - Cl^-
- Ionic Bonding: Force of attraction between oppositely charged ions.
- Compounds & Formulas

Compounds with more than two different elements

- Polyatomic ions: [oxygen as the third atom]

http://chemconnections.org/general/chem120/polyatomics.html



Carbonate ion CO_3^{2-}

Common Polyatomic Ions

Ion	Name	Ion	Name
Hg_2^{2+}	Mercury(I)	NCS^-	Thiocyanate
NH_4^+	Ammonium	CO_3^{2-}	Carbonate
NO_2^-	Nitrite	HCO_3^-	Hydrogen carbonate (bicarbonate is a widely used common name)
NO_3^-	Nitrate		
SO_3^{2-}	Sulfite	ClO^-	Hypochlorite
SO_4^{2-}	Sulfate	ClO_2^-	Chlorite
HSO_4^-	Hydrogen sulfate (bisulfate is a widely used common name)	ClO_3^-	Chlorate
		ClO_4^-	Perchlorate
OH^-	Hydroxide	$C_2H_3O_2^-$	Acetate
CN^-	Cyanide	MnO_4^-	Permanganate
PO_4^{3-}	Phosphate	$Cr_2O_7^{2-}$	Dichromate
HPO_4^{2-}	Hydrogen phosphate	CrO_4^{2-}	Chromate
$H_2PO_4^-$	Dihydrogen phosphate	O_2^{2-}	Peroxide
		$C_2O_4^{2-}$	Oxalate

Chem 108: Lab

Week 6

Using your group number from the roster, consult the Lab Map for your location, move to that area on the map and introduce yourself to your team members. Read today's handouts. Each of you, pick one partner who is in your group.