

Chemistry Lab

Regina Zibuck, Ph.D.

rzibuck@wayne.edu

Description

- One or more tasks/experiments
- Answer questions involving the science processes of chemistry
- Gases
- Thermodynamics (new)

Routine Information

- Interpretation of experimental data (tabular and/or graphic)
- Observation of an experiment set up and running
- Computer or calculator sensors/probes
- Stoichiometry : mole conversions and percentage yield

Routine Information

Nomenclature and formula writing - symbols and charges for the polyatomic ions by memory: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate, and hydroxide (“ite” forms of “ates” listed)

Safety

- Students must wear:
 - Closed shoes
 - Slacks or skirts that come to the ankles
 - Lab coat or lab apron
 - Long-Sleeved Shirt (if wearing a lab apron)
 - Indirect vent or unvented chemical splash proof goggles. Eye protection C.
 - Long hair must be tied back
 - Gloves are optional

What Students Should Bring

- Safety gear
- Something to write with
- FIVE 8.5 X 11 sheets of paper (double sided, sheet protectors are allowed)
- TWO non-camera calculators

What the Supervisor Provides

- Everything the student will need
 - This may include:
 - Glassware
 - Reagents
 - Balances
 - Hot plates
 - Thermometers
 - Probes
 - Stirrers
 - A periodic table and any constants

Changes for 2017

- 1 new topic & 1 old topic:
 - Gases
 - Thermodynamics

How to prepare participants

- Make sure students read the directions and pay particular attention to the description of the event (The Competition)
- Have them do many experiments together
- Have them determine their individual strengths
- Divide (and conquer) tasks during competition
- Check each other's work

How to Prepare

- Use a college level General (Freshman) Chemistry textbook
 - *Chemistry* by Zumdahl and Zumdahl
- Start with a Prep-Gen Chem book if lower level background material needed
 - *Introductory Chemistry* by Zumdahl

How to Prepare

- Use lab textbooks and search the given topics
 - Gases
 - Thermodynamics

How to Prepare

- Gases
 - The ideal gas law and all variations
 - Boyle's Law
 - Charles Law
 - Avogadro's Law
 - Collection of gas over water

Gases

- Other gas laws:
 - Dalton's Law of Partial Pressures: The total pressure of a mixture of gases equals the sum of the individual partial pressures of each gas in the mixture. $P_{\text{total}} = P_1 + P_2 + P_3 + \dots$
 - Gay-Lussac's Law (the law of combining volumes): At a given pressure and temperature, the volumes of gases reacting with each other are in the ratios of small whole numbers.

Gases

- Grahams Law
- The Ideal Gas Law
- Physical properties of gases
- Greenhouse gases; ozone depletion
- Relative rates of diffusion of a gas

Gas Activities

- Determine the density of a gas
- Partial pressure of a gas
- Molar mass of a gas
- Relative rates of diffusion

Gases

- Determining the density of a gas:

$$D = m/V = n\mathcal{M}/V = P\mathcal{M}/RT$$

- Determining the molar mass of a gas:

$$\mathcal{M} = DRT/P = mRT/PV$$

- Determining the partial pressure of a gas:

$P_1 = X_1 P_{\text{total}}$ where X_1 is the mole fraction

of a gas. $X_1 = n_1/n_{\text{total}}$

How to prepare

- Search for experiments that fit the topics
 - Classic gas laws
 - Relationship between:
 - Pressure and volume
 - Pressure and temperature
 - Temperature and volume

Gas Activities

- <http://education.ti.com/en/us/activity/search/subject>
 - Science, chemistry, gases

Gas Activities

- Examine relationship between pressure and volume
- Examine relationship between pressure and temperature
- Examine relationship between temperature and volume

How to Prepare

- Thermodynamics
 - Direction of heat flow
 - Endothermic and exothermic processes
 - Units of heat measurement
 - Heat capacity
 - Calorimetry

Thermodynamics

- Enthalpy change
- Thermochemical equations
- Heat of fusion and solidification
- Heat of vaporization and condensation
- Phase diagrams
- Heat of solution
- Heat of combustion
- Heat of reaction
- Standard heat of formation

Thermodynamics Activities

- Determine the Specific heat of a metal (coffee cup calorimeter)
- ΔH of a reaction (acid/base)
- Determine specific heat of a liquid
- Heat exchange
- Heat of fusion of ice

Thermodynamics

- **State or National Competition**
 - Gibbs Free Energy
 - Entropy
 - Hess's Law
 - Calorimetry using a hydrate or non-hydrate

Thermodynamic Activities

- Students can look at the stoichiometry of a reaction using temperature to monitor the optimum reaction
- Students can look at dissolving solids or liquids in a solvent to determine if it is an endothermic or exothermic reaction
- Students can look at heating/cooling curves
- For State and National's Students can look at Hess's law

Thermodynamic Activities

- Students can reproduce phase diagrams.
- Students can determine the Caloric value of various foods

Thermodynamic Activities

- http://education.ti.com/educationportal/activityexchange/activity_list.do?cid=us
- <http://chemtutor.com/redox.htm>

Scoring

- 50% Gases
- 50% Thermodynamics