

Polyatomic Ions

Can a group of atoms have a charge?

Why?

Do you know you eat a lot of "-ates"? Next time you look at a food label, read the ingredients and you will likely find a number of ingredients that end with "-ate," such as sodium phosphate or calcium carbonate. Did you ever wonder what the chemical formulas of these ingredients look like? In this activity we will explore polyatomic ions, which are groups of atoms that carry a charge. These ions are found in our food ingredients, natural waterways, and many other chemical compounds you encounter every day.

Model 1 – Types of Ions

Monatomic Ions	Nitride 	Sulfide 	Chloride 
Polyatomic Ions	Nitrate 	Sulfate 	Ammonium 
	Nitrite 	Sulfite 	Hydroxide 

1. Use Model 1 to complete the table below.

Name of Ion	Nitride	Nitrate	Sulfate	Sulfite	Ammonium
Charge on Ion	-3	-1	-2	-2	+1
Type and Number of Atoms	1 nitrogen	1 nitrogen 3 oxygen	1 sulfur 4 oxygen	1 sulfur 3 oxygen	1 nitrogen 4 hydrogen
Chemical Formula	N^{3-}	NO_3^{1-}	SO_4^{2-}	SO_3^{2-}	NH_4^{1+}

Polyatomic Ions Pogil Key

Luke Hanley

A red circular graphic with a gradient, appearing as a stylized arrow or a partial circle, located to the right of the name bar.

Polyatomic Ions Pogil Key:

Polyatomic Ions for Surface Analysis and Modification Erick Ryan Fuoco, 2003 *High Resolution Studies of the Origins of Polyatomic Ions in Inductively Coupled Plasma-Mass Spectrometry* Jill Wisnewski Ferguson, 2006 The inductively coupled plasma ICP is an atmospheric pressure ionization source. Traditionally the plasma is sampled via a sampler cone. A supersonic jet develops behind the sampler and this region is pumped down to a pressure of approximately one Torr. A skimmer cone is located inside this zone of silence to transmit ions into the mass spectrometer. The position of the sampler and skimmer cones relative to the initial radiation and normal analytical zones of the plasma is key to optimizing the useful analytical signal.

1 The ICP both atomizes and ionizes the sample. Polyatomic ions form through ion molecule interactions either in the ICP or during ion extraction.

1 Common polyatomic ions that inhibit analysis include metal oxides. MO sup adducts with argon, the gas most commonly used to make up the plasma, and hydride species. While high resolution devices can separate many analytes from common interferences, this is done at great cost in ion transmission efficiency, a loss of 99% when using high versus low resolution on the same instrument.

2 Simple quadrupole devices, which make up the bulk of ICP MS instruments in existence, do not present this option. Therefore, if the source of polyatomic interferences can be determined and then manipulated, this could potentially improve the figures of merit on all ICP MS devices, not just the high resolution devices often utilized to study polyatomic interferences.

Investigations Into the Origins of Polyatomic Ions in Inductively Coupled Plasma-mass Spectrometry Sally M. McIntyre, 2010 **The Particulate Nature of Polyatomic Ions**, 2007 *Investigations Into the Origins of Polyatomic Ions in Inductively Coupled Plasma-mass Spectrometry*, 2010 An inductively coupled plasma mass spectrometer (ICP MS) is an elemental analytical instrument capable of determining nearly all elements in the periodic table at limits of detection in the parts per quadrillion and with a linear analytical range over 8-10 orders of magnitude.

Three concentric quartz tubes make up the plasma torch. Argon gas is spiraled through the outer tube and generates the plasma, powered by a looped load coil operating at 27.1 or 40.6 MHz. The argon flow of the middle channel is used to keep the plasma above the innermost tube, through which solid or aqueous sample is carried in a third argon stream. A sample is progressively desolvated, atomized, and ionized. The torch is operated at atmospheric pressure. To reach the reduced pressures of mass spectrometers, ions are extracted through a series of two approximately one millimeter wide circular apertures set in water-cooled metal cones. The space between the cones is evacuated to approximately one torr. The space behind the second cone is pumped down to or near to the pressure needed for the mass spectrometer.

MS The first cone, called the sampler, is placed directly in the plasma plume and its position is adjusted to the point where atomic ions are most abundant. The hot plasma gas expands through the sampler orifice and in this expansion is placed the second cone, called the skimmer. After the skimmer, traditional MS designs are employed, i.e., quadrupoles, magnetic sectors, time of flight. ICP MS is the leading trace element analysis technique. One of its weaknesses are polyatomic ions. This dissertation has added to the fundamental

understanding of some of these polyatomic ions their origins and behavior Although mainly continuing the work of others certain novel approaches have been introduced here Chapter 2 includes the first reported efforts to include high temperature corrections to the partition functions of the polyatomic ions in ICP MS This and other objections to preceeding papers in this area were addressed Errors in the measured Tgas values were found for given errors in the experimental and spectroscopic values The ionization energy of the neutral polyatomic ion was included in calculations to prove the validity of ignoring more complicated equilibria Work was begun on the question of agreement between kinetics of the plasma and interface and the increase and depletion seen in certain polyatomic ions This dissertation was also the first to report day to day ranges for Tgas values and to use a statistical test to compare different operating conditions This will help guide comparisons of previous and future work Chapter 4 was the first attempt to include the excited electronic state 2 in the partition function of ArO as well as the first to address the different dissociation products of the ground and first electronic levels of ArO Chapter 5 reports an interesting source of memory in ICP MS that could affect mathematical corrections for polyatomic ions For future work on these topics I suggest the following experiments and investigations Clearly not an extensive list they are instead the first topics curiosity brings to mind 1 Measurement of Tgas values when using the flow injection technique of Appendix B It was believed that there was a fundamental difference in the plasma when the auto sampler was used versus a continuous injection Is this reflected in Tgas values 2 The work of Chapter 3 can be expanded and supplemented with more trials new cone materials i e copper stainless steel and more cone geometries Some of this equipment is already present in the laboratory others could be purchased or made 3 Tgas values from Chapter 3 could be correlated with instrument pressures during the experiment Pressures after the skimmer cone were recorded for many days but have yet to be collated with the measured Tgas values 4

Unimolecular and Collision-induced Dissociation Study of Polyatomic Ions at High Collision Energy Xuedong Zhou,2001 **Standard Thermodynamic Functions of Gaseous Polyatomic Ions at 100-1000 K** Aharon Loewenschuss,Y. Marcus,1987 **Structure of Free Polyatomic Molecules** Kozo Kuchitsu,2013-03-09 This volume Structure of Free Polyatomic Molecules Basic Data contains frequently used data from the corresponding larger Landolt B rnstein handbooks in a low price book for the individual scientists working in the laboratory Directories link to the more complete volumes in the library The book contains important information about a large number of semiconductors **Energy Partitioning and Timescales for the Surface-induced Dissociation of Polyatomic Ions** David Garrett Schultz,1999 **Structure Data of Free Polyatomic Molecules** K. Kuchitsu,1995-11-27 Since the publication of Volumes II 7 in 1976 and its supplements II 15 in 1987 and II 21 in 1992 the information on the structure of free molecules in the ground state and in excited electronic states has increased considerably Therefore this volume II 23 contains data from 148 inorganic and 498 organic polyatomic free molecules including free radicals and molecular ions published between 1990 and 1993 inclusively and a small number of structures published 1994 All experimental methods for

the determination of structural data of free molecules have been considered all data obtained by these methods have been critically evaluated and compiled The structural data for more than 3400 polyatomic free molecules can be completely surveyed and easily retrieved by means of this volume **Polyatomic Ion-surface Interactions** Luke Hanley,1998

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interactions Luke Hanley,1998 **Experimental Studies of Polyatomic Ion Interactions with Clean and Adsorbate Covered Metal Surfaces** Samuel B. Wainhaus,1997 *High Resolution Studies of the Origins of Polyatomic Ions in Inductively Coupled Plasma-Mass Spectrometry* ,2006 The inductively coupled plasma ICP is an atmospheric pressure ionization source Traditionally the plasma is sampled via a sampler cone A supersonic jet develops behind the sampler and this region is pumped down to a pressure of approximately one Torr A skimmer cone is located inside this zone of silence to transmit ions into the mass spectrometer The position of the sampler and skimmer cones relative to the initial radiation and normal analytical zones of the plasma is key to optimizing the useful analytical signal 1 The ICP both atomizes and ionizes the sample Polyatomic ions form through ion molecule interactions either in the ICP or during ion extraction l Common polyatomic ions that inhibit analysis include metal oxides MO adducts with argon the gas most commonly used to make up the plasma and hydride species While high resolution devices can separate many analytes from common interferences this is done at great cost in ion transmission efficiency a loss of 99% when using high versus low resolution on the same instrument 2 Simple quadrupole devices which make up the bulk of ICP MS instruments in existence do not present this option Therefore if the source of polyatomic interferences can be determined and then manipulated this could potentially improve the figures of merit on all ICP MS devices not just the high resolution devices often utilized to study polyatomic interferences

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Plasma-treated Metal Surfaces Michael Volný,2006

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web anatomy of the frog s mouth pry the frog s mouth open and use scissors to cut the angles of the frog s jaws open cut deeply so that the frog s mouth opens wide enough to view the structures inside 1 locate the tongue play with the tongue does it attach to the front or the back of the mouth you may remove the tongue

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web 1 place the frog in the dissecting pan ventral side up 2 use scissors to lift the abdominal muscles away from the body cavity cut along the midline of the body to the forelimbs 3 make transverse horizontal cuts near the arms and legs 4

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web use a scalpel forceps and pins to dissect realistic male and female frogs organs can be removed and placed into organ system diagrams once the dissections are complete the frog organ systems can be compared zooming rotating and panning tools are available to examine the frog from any angle full lesson info

the ultimate frog anatomy review the biology corner - Jun 04 2023

web the links on this page are to help you study the locations and appearance of the structures most of the links are to images and virtual dissections of the frog locate all of your frog anatomy worksheets complete frog dissection guide external anatomy of frog frog dissection digestive urinary reproductive respiratory circulatory

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web lesson plan frog dissection background frogs are vertebrates in a class called amphibians frogs have similar body systems like the digestive and circulatory systems to other vertebrates like humans making them a nice specimen for comparative anatomy along with toads they make up the largest group of amphibians

lab no 6 frog dissection anatomy name date score studocu - Apr 21 2022

web laboratory no 6 frog virtual dissection introduction frogs belong to the class amphibia amphibians have adaptations for living in terrestrial as well as aquatic environments frogs are among the most commonly studied organisms in biology although many differences exist between humans and frogs the basic body plans are similar

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web frog dissection quiz complete the following questions 1 name the structure indicated liver 2 what is a function of this structure detoxifying blood storing of fats for name another frog structure that has a similar function mouth or skin 15 name the structure indicated stomach dissection 101 frog

lab frog dissection introduction astephensscience - Sep 26 2022

web in this investigation you will observe the external features of a preserved frog and identify parts of its external anatomy you will also dissect the preserved frog to observe its internal anatomy and make comparisons to human anatomy pre lab questions read the entire investigation then answer the following questions 1

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web 1 place the frog in the dissecting pan ventral side up examine the hind and forelegs the hind legs are strong and muscular for jumping and swimming the forelegs provide balance and cushion the frog when it lands after jumping notice the toes on each 2 locate the large bulging eyes the frog has 3 eyelids

frog dissection external and internal the biology corner - Mar 01 2023

web complete student instructions for the dissection of the frog starting with the external anatomy and the anatomy of the mouth student guide requires them to label images and answer questions students continue with the internal anatomy where

they open the abdominal cavity to reveal the major organs

frog dissection gizmo abbreviated 2021 studocu - Nov 28 2022

web in the frog dissection gizmo you will complete a virtual dissection of a female and male frog first select the female frog then click on the rotate button with the rotate button selected click and drag on the frog to rotate it observe what the female frog looks like now select show male at the bottom left to switch to the male frog

frog dissection virtual activity key by biologycorner tpt - Jun 23 2022

web description standards 1 reviews 3 q a 1 more from biologycorner description this activity was created as a virtual version of the frog dissection students use slides with descriptions and images to learn about the organ systems of the frog

frog dissection lab and answer sheet syndaver - May 03 2023

web and answer questions in italics during the lab and answer all others later part a introduction 1 what class does the frog belong to 2 why does a frog belong to that class 3 why are amphibians considered to be a unique evolutionary group part b external anatomy orientation 4 locate the following orientations on your frog a