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Enhancing Student Learning With PowerPoint Presentations

presented by

Ernest P. Luttig

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ENHANCING STUDENT LEARNING WITH POWERPOINT PRESENTATIONS

By

Ernest P. Luttig

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

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ABSTRACT

ENHANCING STUDENT LEARNING WITH POWERPOINT PRESENTATIONS AND EXCEL SPREADSHEETS

By

Ernest P. Luttig

As technology becomes more available and common in the workplace, it is apparent that students need to become familiar and comfortable with the computer as a tool for learning. I chose to use available software and acquire needed technology to develop and use PowerPoint presentations to introduce, reinforce or review various topics that were studied in College Prep Chemistry classes. Students were shown presentations using projection devices and were offered the opportunity to access and use the presentations as a means of review for the tests or final exam. In order to use them to review students were instructed on how to access the programs through an assignment folder that I set up in the school's computer center.

After analyzing student responses from surveys, I have concluded that using PowerPoint presentations is an excellent way to instruct many students at various times during the school year. These presentations, when used as a supplement to traditional teaching methods, are very effective in capturing the interest in students as well as helping them to develop understanding of various topics.

ACKNOWLEDGMENTS

I would like to thank the administration at Waverly High School for the financial support in supplying me with needed technologies to develop and implement the PowerPoint presentations that I used in this study. In particular I would like to thank Doug Keyes, who assisted me in gaining access to a Macintosh Powerbook which was used extensively in developing and presenting the various presentations that were used.

I would also like to thank Jack Vogel, who introduced me to PowerPoint and encouraged me to use it as a teaching tool.

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INTRODUCTION

Each year it seems that capturing or sustaining the interest and attention of students becomes increasingly difficult. With video games, computers and other advanced technologies that student have at their disposal, the attention span of many students in academic situations is decreasing. This requires the instructor to vary delivery styles including capturing their interest through some technological method. For this reason I chose to implement the use of the computer as a teaching tool in my College Prep Chemistry classes.

My choice to incorporate technology into the classroom also coincided with the goals of the school where I teach which are influenced by the Michigan Essential Goals and Objectives for Science Education. The fifth goal of MEGOSE is to develop support systems for teachers. This goal is further reinforced at my district where the mission statement describes the implementation of "quality instruction". Our district, in particular the high school, clearly encourages the development and implementation of various types of technology to be used in instruction. The board had approved PowerPoint as the district-wide presentation tool and offered the opportunity for some teachers to acquire Powerbook computers to be used for two years provided they demonstrate that they are actively using the computer as a teaching tool and not for personal use. Upon successfully applying for the hardware I immediately began exploring how to best use PowerPoint as a teaching tool.

PowerPoint is a graphics software package, available in Macintosh or Windows versions, that allows the user to create professional-looking presentations. The presentation may then be used as a slide-show controlled by either an instructor or person who wishes to view the slides. In my case, after developing the slide-shows, I chose to use some of the presentations to show on an overhead projector to introduce topics and for students to use in reviewing for the final exam.

When used as a presentation tool, the pace of the presentation is controlled by the instructor. By simply pressing a button the screens or individual lines will appear on a screen with the assistance of an overhead projecting device. The slides may be stopped or started at any time, and the blackboard may also be utilized to further develop a concept. The slide-shows work very effectively in a dimly lit room allowing students to write down information and see the blackboard as well. The slides may also be printed as handouts by the instructor and in some cases the students may benefit if some slides are copied and distributed prior to or after the presentation is complete. This would be especially effective if graphs or items that are difficult to copy were shown.

In using the review slide-shows students may also view the panels on an individual computer. Students simply push the enter button once the program is started and line by line the text or pictures appear. This step by step method allows students to work independently through problems and think about how to solve problems before the answer or hints appear. The actual panels as seen by the students are the full size of the available screen. They are also all in color and often include a Quicktime or AVI movie clip. These are all automatically included in the screen frame when the student pushes the enter button. Pauses and repetition of certain information are also included as the student continues through the presentation. The students access the presentation in read only mode, so they cannot modify the contents. The only interaction that they may be involved in at this time is the ability to click on a pen that appears on the screen. With this pen they may write anywhere on the screen and it will show up. This would allow them to practice canceling units, or check off various steps as they are completed. If the next screen is chosen the lines that were drawn in will disappear. The students may also elect to go back to a previous screen. This is accomplished by using the reverse arrow button on the keyboard.

For this study a total of eleven PowerPoint presentations were constructed. Several of these were used for review at the end of the year, including slide-shows titled Conversion Factors, Determining Molar Mass and Percent

Composition, Lab Apparatus and Uses, More Practice Writing Chemical Equations, Naming Ionic Compounds, Naming Molecular Compounds, and Significant Digits. In addition, several others were used to introduce or develop a concept. Acid Base Titrations, Gas Laws (Charles), Molarity Calculations, and Heat Calculations are the topics covered in this thesis. These titled presentations were developed with the assistance of "Microsoft PowerPoint User's Guide" several Web sites and the knowledge of other users, including Michigan State University staff and colleagues at my school. The first few presentations took several hours each to develop, but with experience the time decreased. Becoming familiar with the program actually enables changes to be made between classes if an adjustment is required. The most time is probably spent trying to locate visuals such as Quicktime movies that will spice up the presentations. Many are found on the internet and in the future I plan to develop them using Quicktime movies recorded from videotape.

In my study I chose to develop PowerPoint presentations for primarily second semester topics for two reasons. It would allow me to first instruct the students in my classes with traditional instruction techniques that I have used in the past. I could then implement PowerPoint based lessons and measure the effectiveness. Secondly, it would allow me to develop presentations that I could put in an assignment folder for students to use for review for the second semester exam. The final exam outline included reference to six PowerPoint presentations that students could access to review concepts covered earlier. The fresh approach to these topics by viewing something on the computer seemed to motivate students to rethink the concepts and better understand them as well.

In addition, the visual approach used in the PowerPoint presentations may allow greater understanding for students with certain learning styles. According to Howard Gardner (1991) there are seven forms of intelligence (verbal linguistic, verbal spatial, logical mathematical, musical, interpersonal, intrapersonal and bodily kinesthetic) which will dictate the way a student learns best. The use of PowerPoint introduces an alternate way to reach many of the students who learn with different perspectives because it uses illustrations, sound, music, questioning, self-assessing, discussing and many other ways to experience learning that Gardner has identified.

Since the PowerPoint presentations are appropriate for virtually any concept covered in chemistry, it is likely that in years to come I will expand on the number that are used and find timely ways to incorporate them into my instructional strategies. Furthermore, with upgraded versions of the program soon to be released, improvements may be made to existing presentations. The dynamics of this program, and the ease with which presentations can be modified, are appealing features of the program. Another important aspect of this and other presentations is that they allow students who are absent on a given day to go to the computer center and call up the presentation and discover first hand what was discovered by the rest of the class. This will work well in conjunction with time provided by the instructor to answer the students' questions.

There are many reasons why the use of the computer and appropriate software including the PowerPoint program should be used in today's schools. In 1997, President Clinton and the U.S. Department of Education released "The President's Educational Technology Initiative", with four principles to be addressed. Included in these principles are the need for teachers to be "ready to use and teach technology". The use of the computer to deliver PowerPoint presentations is directly related to this goal. Furthermore, the possibilities of future PowerPoint presentations are justified by the third goal of the initiative, which states, "Educational software will be an integral part of the curriculum--and as engaging as the best video game." The more interested the student is in the software the more motivated they are to learn.

There has been much debate for many years concerning the best methods of teaching and learning. There are no simple solutions, yet most people claim that diversifying the instruction is crucial to gaining students interest and ultimately helping them learn. According to Erik Stommen and Bruce Lincoln (1998),

"children have grown up with remote controls, and spend more time watching television and video tapes than reading.

Toys are now filled with buttons and blinking lights. They talk and listen, and interact with children, ...Our children have been raised in a world of instant access to knowledge, a world where vivid images embody and supplement information formerly presented solely through text." They go on to say, "the immediate task for American education is to embrace the future and empower our children to learn with the cultural tools they have already been given."

Clearly, we need to diversify the way we teach to reach more students along with their diverse backgrounds and experiences. The use of the computer and visual tools such as PowerPoint are needed to mesh the learning styles of students to the way material is taught.

According to Bielefeldt (1997), "Technology and structural change in education are inextricably linked." That is, schools generally need to change the way they do things to take full advantage of technology, and the use of technology tends to change what happens in schools. This is very apparent where I teach. The students that come through our system have been exposed to computer centers at every building in our district since they were in first grade. When they reach high school, most are very competent with computers and are well prepared to use them as a tool. Finding new ways to utilize these machines and take advantage of the knowledge and interest the students have has been an ongoing goal in our district. In fact, many teachers who were not comfortable with the use or application of computers have been pressured by their students and colleagues to take advantage of the technologies that are now being used. Furthermore, many instructors at our school have found the statements of Bennett (1997) to be true. He sees the use of computers not as a way to take the place of teachers but as a way to free up time for instructors and enable them to reach more students. This is very true in PowerPoint presentations. These dynamic presentations can be modified to meet student needs every year, but once the initial time has been spent developing the program, more time is allowed to refine the quality of the presentation during precious teacher planning time.

Another characteristic of the PowerPoint presentations is the motivation it provides for students to create their own slide shows. In an environmental unit (outside the scope of this thesis) I taught near the end of the school year, several groups of students chose to create their own presentations using PowerPoint. The exposure they had to the program in my class initiated an interest in them to create their own. Their presentations were most impressive. In the Educational Technology Journal, Doug Johnson (1998) states, "the use by students at all grade levels of real-world productivity software like..presentation programs, multimedia authoring tools,...is the proper instructional use of technology." Based on the experiences I have been exposed to during this project, I will insist that students use some authoring tool program to present materials in the future.

In short, technology, in this case PowerPoint presentations, offers powerful tools for thinking more deeply, pursuing curiosity, and exploring and expanding intelligence as students build "mental models" with which they can visualize connections between ideas in any topic. In the district where I teach, a small class A school in suburban Lansing, the technology is being made readily available to both students and faculty. Using the equipment and software to instruct and motivate the culturally and economically diverse students of our district is a challenge that must be accepted to prepare our students for the future workplace. The use of PowerPoint presentations is a beginning for me to address that goal.

While using PowerPoint to instruct the students in the four college prep chemistry classes involved in this study, I was also cognoscente of the conflicting evidence that exists pertaining to the use of technology to enhance instruction. According to Cradler (1998), there is no definitive evidence that computers, or technology in general, assist in the development of learning. It is very difficult to assess a learning situation accurately with the many variables that affect one's learning and it is therefore uncertain if the benefits of additional technology are justified by the expense. There is, however, much information that supports the approach of using technology as I mentioned earlier; and with this I approached my project. In my study I have used required quiz surveys and opinion and question surveys to discover the effectiveness of the programs that I have developed.

POWERPOINT PRESENTATIONS FOR REVIEW

The development of the PowerPoint presentations was based on first assessing the appropriateness of the material. Some topics lend themselves to a presentation whereas others are better understood by lecture, discussion, discovery learning, group work etc.. I chose to use some presentations as review tools to be used at the end of the year and some as ways to introduce or develop a concept or topic. One important aspect of using the presentations is that I did not want to use them too much. I strongly believe that diversifying the way the material is presented not only allows those with different learning styles to be exposed to material effectively but also prevents the boredom that seems to develop from daily repetition.

The first group of presentations that will be discussed are the review presentations. These could also be used as introductory lessons, and with modification I will use them in future years for that purpose. The primary reason for using them for review in this school year was to allow me to have a baseline of information from the students and how they learn from traditional teaching methods so that I could compare the effect of adding PowerPoint presentations. This necessitated postponing the use of presentations that applied to concepts learned early in the year. However, they were used by the students at the end of the year when studying for the comprehensive final exam.

The review presentation titles include Conversion Factors, Determining Molar Mass and Percent Composition, Lab Apparatus and Uses, More Practice Writing Chemical Equations, Naming Ionic Compounds, Naming Molecular Compounds, and Significant Digits. These presentations were placed on an assignment folder accessible through the school's server in the computer laboratory. Students were directed in class on how to access the program, but the use of these presentations was optional. Since these presentations were all used at the end of the year, the evaluation of them was performed simultaneously after students had used all the presentations. The evaluation will therefore be discussed at the end of this section. One exception to this is the Significant Digits presentation. The difficulty for students to understand significant digits prompted me to use this presentation during class the week before final exams. In addition I gave a prequiz and postquiz that covered the material presented in the presentation. The results are discussed at the end of this section under evaluation of PowerPoint Presentations for review.

CONVERSION FACTORS

This presentation (Appendix A) illustrates the use of conversion factors to change from number of atoms to moles or mass for any element. The reverse of this process is also discussed, and a map is illustrated showing the information needed to make any of the changes. The proper use of conversion factors is illustrated in several examples, and answers are provided to allow for student assessment. Some visuals are included to show common uses of some of the elements in the examples, and units and cancellation of units are also illustrated throughout the examples. Students are encouraged to write down the template in the first three slides as a way to remember how to solve the problems in the examples. The use of conversion factors is an early skill that is developed in chemistry and used throughout the year. A general approach to converting units for many different applications is a very important for students to understand.

DETERMINING MOLAR MASS AND PERCENT COMPOSITION

The second review presentation (Appendix B) addresses skills needed to perform many later problems, and practice is therefore essential for student mastery. This set of slides again includes some description as well as sample problems. The slides are set up for students to go step by step in calculating molar masses and later finding the percent composition of some compounds.

LAB APPARATUS AND USES

This presentation has pictures and explanations of uses of common lab equipment that will be used throughout the year in labs (Appendix C). The presentation again allows students to proceed through the slides line by line and prompts them for uses of lab apparatus and then describes one common use.

This allows students to test themselves and self assess their need to study further. The slides in the appendix represent only a few of the 53 total slides in this presentation. The other slides follow the same format with pictures and descriptions of the uses of the item. This PowerPoint presentation was especially helpful in assisting several students who were absent on the day when the actual materials and uses were discussed in class. I had these students come in at lunch and, using my computer, they were able to view the slides and gain the necessary information.

NAMING IONIC COMPOUNDS

Naming Ionic Compounds (Appendix D) is a series of slides on which students are quizzed about the makeup of ionic compounds and how to name them. Some sample problems are then presented where the student is given the formula and asked to name it or vice-versa. The answer is provided to give feedback on their response.

MORE PRACTICE WRITING CHEMICAL EQUATIONS

The fifth review presentation, More Practice Writing Chemical Equations (Appendix E), provides the opportunity to write balanced chemical equations from a Quicktime movie acquired from the internet. The students become very interested when some sort of visual prompt is part of the presentation. This one shows a Quicktime movie of cesium reacting with water. The students are asked to guess what is reacting and the answer is provided as they proceed through the slides. The steps for writing and balancing the equation are of course provided.

While only two slides are shown, the entire set of slides illustrates a step by step process of changing the word equation to chemical formulas and ultimately balancing the equation. I discovered after reading my students' surveys (Appendix P) that this Quicktime movie was very appealing to most students. The more visuals, especially movies, that I am able to use, the more interesting the presentation seems to be. I also used background pictures of molecules to spice up the slides and started creating other templates like this one that I could use for later presentations.

SIGNIFICANT DIGITS

The sixth review presentation (Appendix F) describes the rules for identifying significant digits, and includes examples and practice problems to illustrate the concept. The students are given several examples to predict the number of significant digits and then the answer is provided. The rules for adding, subtracting, multiplying and dividing are also covered and again sample problems with answers are provided.

The lack of understanding of the concept of significant digits also led me to develop a second presentation on this subject that I will use next year. On the second version the use of measurement is emphasized and a second perspective on significant digits is offered. This is another important aspect of the PowerPoint presentations. That is, they see a second way of looking at how to solve a problem. I always instruct students that there is no single way to get an answer and often times I offer a slightly different way of looking at a problem in the PowerPoint presentation compared to the way I may present it in class.

NAMING MOLECULAR COMPOUNDS

The final review presentation (Appendix G) again incorporates a Quicktime movie. The interest expressed by students regarding these movies when viewing PowerPoint Presentations motivated me to search the internet for appropriate movies for virtually all of the later presentations that I developed. In addition, I will certainly look back at other presentations and add them where I can.

This presentation follows the same format as the others. It reviews how to identify and name molecules, proceeds with examples and problems that students may attempt, and then provides the answer for the students to check their understanding.

EVALUATION OF POWERPOINT PRESENTATIONS FOR REVIEW

The use of the PowerPoint presentations for review was voluntary. The students (n=65) were given the opportunity over a two week period at the end of the second semester to utilize certain prescribed presentations for review. They were given instructions on how to access the presentations through the server in the computer center. They had to find time, outside of class, to use the materials to study for the exam. I was interested to see if students would choose to use them outside of class. If they elected to do so, it would indicate to me that the presentations were seen as worthwhile by the students. The following graph (Figure 1) shows the percentage of students who chose to use the presentations. This information was compiled from a survey

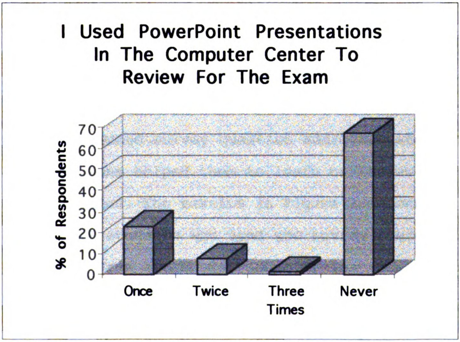


Figure 1 RESPONSE TO SURVEY QUESTION 1

(Appendix P) given to the students at the end of the final exam.

The percentage of students who used the presentations for review was about 32%. While this seems like a small fraction of the class, the timing was not ideal. The opportunity to use the presentations came at a time when the students had several final exams and projects to complete. Because they had to use time outside of class, and using the presentations was optional, many students must have decided to spend their time using other study methods. Another factor that likely influenced this number was the fact that students often are unable to access a computer in the center because all the computers are in use. This added frustration probably kept many students from using the presentations to review. In fact , one student stated on the survey that he tried twice to view the review presentations the last week of school and was unable to access a computer. This is a problem that is addressed every year at our school and will be solved in time with the addition of more computers

The second survey question addressed whether the review presentations helped them to learn or review the material being studied. The results in Figure 2 demonstrate that almost all students who used the review presentations (n=21) benefited from their use. Some student statements include "they were creative and caught my attention" and "it presents the material in easy to understand steps".

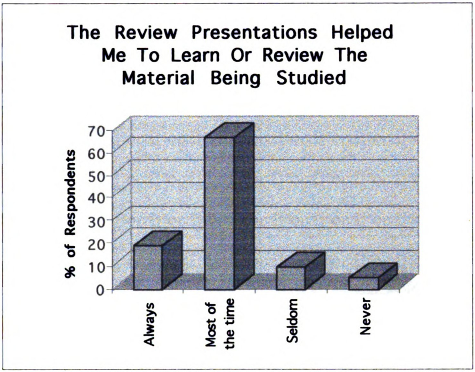


Figure 2 RESPONSE TO SURVEY QUESTION 2

Another question posed in the survey, intended to test the consistency of the feedback, asked students to comment on whether the review presentations were worth the student's time, if they were used. The results as shown in Figure 3 show a consistency with answers to the previous survey question. Most students agreed strongly or somewhat that the presentations were worth taking the time to use. Some student statements include "they were fun to watch" and "anything that's interesting or with color that's visual is cool" and "they kept my attention throughout the problem".

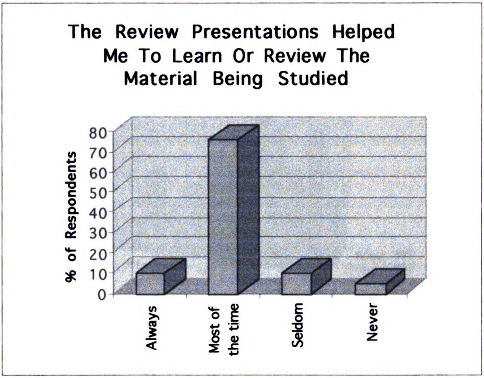


Figure 3 RESPONSE TO SURVEY QUESTION 3

A final analysis of the review presentations was carried out specifically for the Significant Digits presentation. The students present (n=52) on the day of the Significant Digit presentation were given a prequiz (Appendix N) and then shown a PowerPoint review presentation on significant digits. The students (n=52) were then given a second, similar quiz (Appendix O), worth 12 points. The results in Figure 4 demonstrate the improvement that the students achieved after viewing the presentation. In fact, the average increase was 2.19 which is an average increase of 18.24%. Furthermore, of the students taking both the prequiz and postquiz only 2.0% performed worse while 27.0% did the same and 71.0 % improved on their previous score. These results tend to indicate that the presentations were helpful.

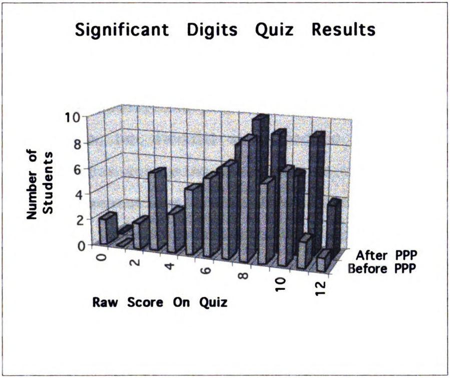


Figure 4 Significant Digits Quiz Results

From the information I learned from the surveys and difficulties accessing the program, I will make some changes for next year. First of all, I will make the presentations available at any time in the computer center instead of just the last week of school. Students will have the opportunity not only to review presentations but also to preview them or to use them for review at any time throughout the school year. Secondly, I will occasionally make some time available for students to access the computer center to use them during class time. This will be especially beneficial during the end of the year when finding time to review for several classes is difficult for most students.

POWERPOINT PRESENTATION AS A LEARNING TOOL

During the second semester of the school year not only were some PowerPoint presentations used to review for the final exam, but several were used to introduce or reinforce a concept that was being developed in class. The titles of these presentations are Acid Base Titrations, Gas Laws (Charles), Molarity Calculations, and Heat Calculations.

The first presentation used was Gas Laws (Charles). In this presentation students are not only taught how to solve problems using Charles Law but are also introduced to a five step problem solving technique. Again, this represents a slight change from the text and gives students an alternate way to solve a problem.

The presentation starts with a movie showing the lift-off of a hot air balloon that leads to a discussion of ballooning and the students attention is immediately engaged. The slide show functions exactly the same way as the review presentations except that the pace is controlled by the instructor. The panels appear on a screen, on which they are projected by an overhead projection panel. The blackboard is free and at times it is possible to add to the presentation by writing on the chalkboard.

GAS LAWS (CHARLES)

The Charles Law presentation (Appendix H) has an application of a gas law and several problems that are worked out step by step. The students can work through the problem and in the end check for mastery. The advantage of having the pace set by the instructor is that individual questions can be addressed by either the instructor or other students who may be drawn into the discussion. Student answers are often written on the board before the answer slide is shown. Students can gain the satisfaction of success, or try to correct their mistakes, by looking at the thoroughly worked out solution that follows. Another technique that is very effective is to use of a pen to write directly on the slide. Canceling units or drawing arrows to connect concepts is very effectively carried out in this way.

HEAT CALCULATIONS

In the second introductory presentation, Heat Calculations (Appendix I) the students are presented with a phase change problem that requires several steps. They are asked to calculate the energy required to take ice from a subzero temperature to steam at an elevated temperature. This slide show (only a few slides are shown in the Appendix) was shown on an overhead in conjunction with demonstrations to help students understand the need to do certain steps in the calculations. The pace of the presentation is matched to the understanding of the students and many questions are generated from the experiments. One of the demonstrations consists of boiling water in a paper cup to demonstrate that the maximum temperature of liquid water is 100 degrees Celsius. The students are led through the calculations and are prepared to solve similar questions after completing the presentation.

The rest of the slides (not included in Appendix I) continue the solution of this problem, and then demonstrate the addition of all energy terms to get the total energy to melt the ice and turn it into steam. The visual graphs in this presentation give students a better understanding of the various steps involved. The students must first warm the ice to the melting point of water, melt it, warm it to 100 Celsius, vaporize it, and finally raise the temperature of the steam to 140 Celsius. By referring to the diagrams the students are better able to get the big picture of the problem. Often students work in segmented steps and never understand the whole problem. The diagram and reference to the steps is a great asset in building understanding.

MOLARITY CALCULATIONS

In this introductory presentation (Appendix J) the quantitative aspects of making chemical solutions are discussed: how to calculate molarity, volume of solution, or grams of solute from relevant information. The use of the five step problem solving technique is recommended to solve these problems, and several are illustrated, solving for each of the variables previously mentioned.

As previously mentioned, I strongly recommend the use of visuals including pictures and movies as a means of getting students interested and engaged in a new topic. This presentation incorporates a Simpson's cartoon Quicktime movie in which Homer is involved in a beer explosion from improperly combining solutions. While this is not very important in solving problems of Molarity, many students were drawn into the problems by this video. It captured their attention. As mentioned by one student on the survey, "the Simpson's cut was great."

ACID BASE TITRATIONS

The final introductory presentation (Appendix K) illustrates the steps involved in finding the unknown concentration of an acid or base through the process of titration. This slide show was shown to the students before they solved a similar problem in the laboratory. The chemicals and explanation of steps to complete such a problem are included along with appropriate sample problems. In addition a Quicktime movie (found on the internet) pops up in the middle of the explanation, showing students the process of titrating including the use of and change of indicator color as the endpoint is reached.

EVALUATION OF POWERPOINT PRESENTATIONS AS A LEARNING TOOL

Evaluation of the PowerPoint presentations to introduce or reinforce concepts was carried out in two ways. For one of the presentations, Acid-Base Titrations, students (n=66) were given a quiz (Appendix L) followed by the presentation. They were immediately given a similar quiz (Appendix M) to check for any increase in understanding. The primary focus was not for students to master the material but to gauge the change in their understanding of the problems solved in this presentation. The results of the students scores are illustrated in Figure 5. The students clearly performed better after viewing the presentation, even though no direct instruction or clarification was given by the instructor between quizzes. The students were learning how to solve Acid-Base titration problems by viewing the PowerPoint presentations. More specifically, only 10.5 % of the students had a lower raw score on the retake, 16.4 % earned the same raw score, and 73.1 % improved their raw score.

This would tend to indicate that the PowerPoint presentations were effective in terms of influencing short term memory. The effects of long term memory are beyond the scope of this investigation, but I would expect comparable results, if it were measured.

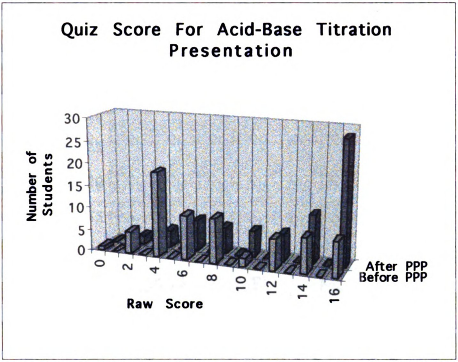


Figure 5 Titration Quiz Results

For additional information regarding the effectiveness of the presentations I asked students to respond to 3 statements (Appendix P). They also could provide free response input for future use of the slide-shows. The following graphs show how students (n=69) responded to these statements about PowerPoint Presentations. The statements along with student responses are included in each diagram.

The first graph (Figure 6) shows that 81.1 % of students surveyed would like to see one or two PowerPoint presentations per week, 13.1 % would like to see more

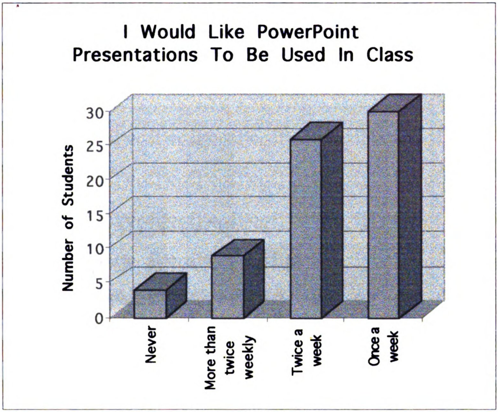


Figure 6 RESPONSE TO SURVEY QUESTION 5

than two a week, and only 5.8% would not like to see any. Certainly because of different learning styles there will be some students who do not like something about the presentations. However, for a large majority of students, the PowerPoint presentations are meaningful. In fact, upon further analysis, one of the students who did not want any presentations said it was because they go too fast. This problem is easily remedied by allowing the student access to the programs to use at his/her own pace.

Figure 7 shows responses (n=66) to a statement about using the PowerPoint presentations in other classes. This correlates well with the previous conclusion showing that 78.8% of students surveyed either strongly or somewhat agree

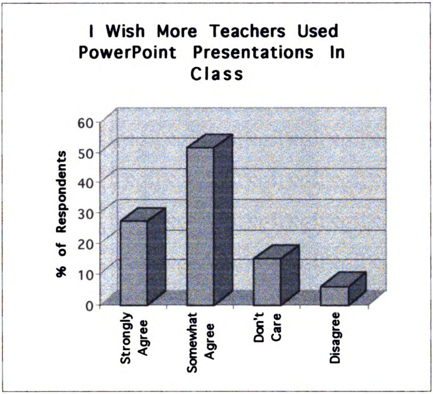


Figure 7 RESPONSE TO SURVEY QUESTION 9

that they would like to see more teachers use PowerPoint presentations in class. This indicates that students generally like the idea of the presentations being used in other contexts.

Responses to the seventh survey question statement reflect the students' (n=69) perceptions when asked to describe their ability to learn when using PowerPoint presentations in chemistry class (Figure 8). 45.6 % of the students felt they learned more

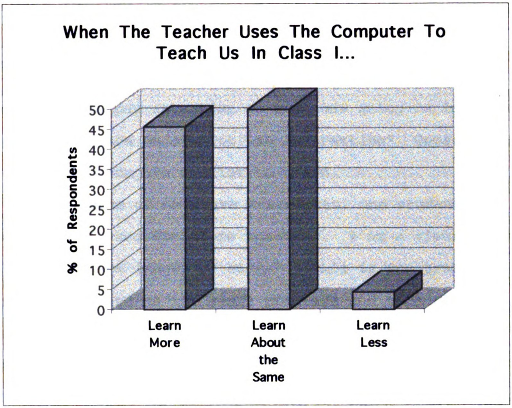


Figure 8 RESPONSE TO SURVEY QUESTION 7

when learning material from a PowerPoint presentation, 50.0 % thought they learned the same and only 4.4 % felt they learned less. With almost half of the students feeling they learn more with these presentations there is an indication that the time to develop and use is worthwhile. Furthermore, with alternate teaching strategies employed to give students a different perspective the 4.4% should still be able to learn the concepts.

Along with responding to these questions students were asked to indicate things they liked, disliked or wished would change about the PowerPoint presentations. Some of the positive comments indicate some of the desirable traits I mentioned previously about the program. For example, one student wrote, “I liked the way we could go back whenever we needed to”. Another wrote, “you can go through the material at a pace that you like”. Still another respondent stated, “It made me pay attention to what was going on in class. I paid attention because it was interesting” Several others expressed thoughts similar to these.

In terms of negative statements, one student replied, “I still can’t see the atoms reacting. I am a visual learner. I want to see images of atoms”. This is one area I am working on and as the years progress and technology in computers increases I plan to include many more images. Many of the other negative comments related to the speed of the presentations. Many students felt they did not have time to adequately write down and think about the concepts being presented. This is another area I am modifying to meet student needs. Making the programs accessible to more students outside of class will also help with this problem. One possible solution is to eventually have these presentations available on the Waverly homepage accessible through the internet.

SUMMARY AND CONCLUSIONS

In conclusion, I am confident that the use of this new technology, PowerPoint presentations, will improve both the teaching style that I have developed and the learning of my students. The PowerPoint presentations generate interest among students. The survey and general statements about the presentations indicate that students both enjoy and learn effectively from the slide shows. It is also evident that it is important to use other teaching methods in conjunction with the presentations. By diversifying the instructional technique, student interest is piqued and motivation is kept high.

The presentations are also dynamic. As the students are given feedback about certain presentations, it is easy for the instructor to modify and add onto presentations to make them more effective or interesting to students. The pace of the slide shows are easily adjusted and the use of other modes of teaching such as demonstrations or discussion can be interjected to maximize the learning of students.

The use of the PowerPoint presentations is effective both in presenting new material and as a review tool. This is especially important for students who are absent on days when new material is introduced. For this reason I am trying to gain access to a second computer on which the presentations could be reviewed at lunch, when I make myself available for help. The students will be able to use the programs outside of class and efficiently obtain the missed information. The only difficulty will be gaining access to computers for this use. The Web is a possible solution to be used in the future enabling students to access the presentations from home.

Other interesting aspects of PowerPoint are its potential for uses in other classes as well as the use by students to present information themselves. The computer is a fixture in today's workplace and student exposure to its uses will benefit them in the future. Whether the instructors are motivating students to create their own presentations or modeling the effective use of technology, the students will gain insight into the advantages of computers as a tool.

In conclusion, the computer, and PowerPoint presentations in particular, have significant possibilities towards improving instruction and the ability of students to learn and prepare for their future. With continuing or increasing support for computer use in schools, programs such as PowerPoint will play a very important role in effective education. I hope that other schools will follow the lead of districts such as the one in which I teach and support the use of programs like PowerPoint to enhance student learning.

APPENDICES

CONVERSION FACTORS

Conversion Factors

Number of Atoms<->
Moles<->Mass

Moles can be converted to mass and vice-versa

Moles	$= \frac{1\ \text{mol}}{\text{molar mass of element}}$ x	Mass (g)
	x $\frac{\text{molar mass of element}}{1\ \text{mol}}$ =	

Moles can be converted to number of particles and vice-versa

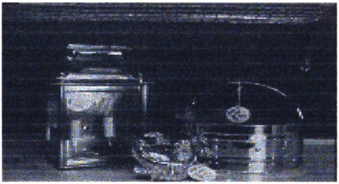
Moles	$= \frac{1\ mol}{6.022 \times 10\ atoms}$ x	Number of Atoms
	x $\frac{6.022 \times 10^{23}\ atoms}{1\ mol}$ =	

Example: How many grams of Copper are needed to make some copper products that require 20.00 moles of Copper to create?

- **Start with the given number of moles** and multiply by the correct conversion factor. (Hint: use the diagram on the previous slide)

Solution:

$$20.00 \text{ mol Cu} \times \frac{63.55 \text{ g Cu}}{1 \text{ mol Cu}} = \mathbf{1270g}$$

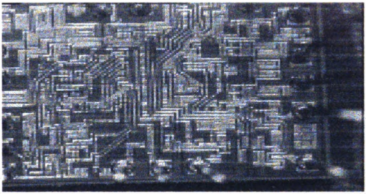


Example: How many moles of Gold are required to make a computer circuit board that needs 45.0 g of gold to complete?

Start with the given number of grams and find a conversion factor that will change to moles. (Hint: use the diagram that relates moles to mass)

Solution:

$$45.0 \text{ g Au} \times \frac{1 \text{ mol Au}}{196.97 \text{ g}} = 0.228 \text{ mol}$$



Find the mass of a single atom of silicon which is used in making computer chips, caulking, detergents and more.

Start with the amount given (in this case 1 atom Si) and find an appropriate conversion factor(s) to change to the desired units (mass of one atom Si).

Solution: Why must you assume that one atom of silicon has an infinite number of significant digits?

1.00 atom Si x $\frac{\text{What unit are you trying to acheive}}{\text{What unit do you want to cancel?}}$

1.00 atom Si x $\frac{\text{You want the mass of one atom Si here}}{\text{You want to cancel atom Si here}}$

There is no direct equality between these two but I do know that there are 6.022 x 10^{23} atoms in one mole of Si. Therefore;

$1.00 \text{ ~~atom Si~~} \times \frac{1 \text{ mol Si}}{6.022 \times 10^{23} \text{ ~~atoms Si~~}}$

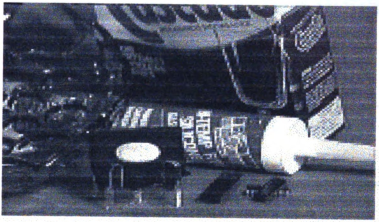
Now we have accomplished cancelling the atoms Si but we **still do not have the units we** want (grams of Si), so we try to find another equality to make a conversion factor relating mol Si and grams Si.

That relationship is 1 mol Si = 28.09 g. Therefore;

$1.00 \text{ ~~atom Si~~} \times \frac{1 \text{ ~~mol Si~~}}{6.022 \times 10^{23} \text{ ~~atoms Si~~}} \times$

$\frac{28.09 \text{ g Si}}{1 \text{ ~~mol Si~~}} =$

1.66×10^{-23} g Si



APPENDIX B

DETERMINING MOLAR MASS AND PERCENT COMPOSITION

Molar Mass of a Compound

To determine the molar mass of a substance you must add the individual molar masses of all of the elements in the formula.

Example: What is the molar mass of barium nitrate?

- Write and interpret the formula.

The formula for barium nitrate is $Ba(NO_3)_2$. The subscript 2 means there are 2 NO_3^- ions each containing 1 N and 3 O atoms.

Therefore; every mole of the compound contains 1 mol of Ba, 2 mol of N and 6 mol of O.

Example: What is the molar mass of $Ba(NO_3)_2$?

- Check the periodic table for the molar mass of each element. (Round to the nearest 1/100 g.)

Ba molar mass = 137.33 g/mol

N molar mass = 14.01 g/mol

O molar mass = 16.00 g/mol

$Ba(NO_3)_2$

- Next determine the total weights of the number of moles each atom in the formula.

$$1 \text{ mol Ba} \times \frac{137.33 \text{ g}}{1 \text{ mol Ba}} = 137.33 \text{ g}$$

$$2 \text{ mol N} \times \frac{14.01 \text{ g}}{1 \text{ mol N}} = 28.02 \text{ g}$$

$$6 \text{ mol O} \times \frac{16.00 \text{ g}}{1 \text{ mol O}} = 96.00 \text{ g}$$

$Ba(NO_3)_2$

- Add the masses calculated to get the total molar mass of the compound.

1 mol Ba	=	137.33 g
2 mol N	=	28.02 g
6 mol O	=	96.00 g
Molar mass of $Ba(NO_3)_2$		261.35 g/mol

Example: What is the molar mass of Iron III oxide? (ferric oxide)

Write and interpret the formula.

The formula for iron III oxide is Fe_2O_3.

Therefore; every mole of the compound contains 2 mol of Fe, and 3 mol of O.

What is the molar mass of Iron III oxide? (Fe_2O_3)?

- Check the periodic table for the molar mass of each element. (Round to the nearest 1/100 g.)

Fe molar mass = 55.85 g/mol

O molar mass = 16.00 g/mol

Fe_2O_3

- Next determine the total weights of the number of moles each atom in the formula.

$$2 \text{ mol Fe} \times \frac{55.85 \text{ g}}{1 \text{ mol Fe}} = 111.70\text{g}$$

$$3 \text{ mol O} \times \frac{16.00 \text{ g}}{1 \text{ mol O}} = 48.00 \text{ g}$$

Fe_2O_3

- Add the masses calculated to get the total molar mass of the compound.

2 mol Ba	=	111.70g
3 mol O	=	48.00 g
Molar mass of Fe_2O_3		159.70 g/mol

Percent Composition problems (more uses of molar mass to describe compounds)

- The percent of each element is simply the molar mass of the element divided by the molar mass of the whole compound and multiplied by 100.

Example: Find the percent composition of magnesium hydroxide.

- Find the correct formula

Example: Find the percent composition of magnesium hydroxide.

- Find the correct formula
- $Mg(OH)_2$

$Mg(OH)_2$

- Find the molar mass of $Mg(OH)_2$.

$Mg(OH)_2$

$$1 \text{ mol Mg} \times \frac{24.31 \text{ g}}{1 \text{ mol Mg}} = 24.31 \text{ g}$$

$$2 \text{ mol O} \times \frac{16.00 \text{ g}}{1 \text{ mol O}} = 32.00 \text{ g}$$

$$2 \text{ mol H} \times \frac{1.01 \text{ g}}{1 \text{ mol H}} = 2.02 \text{ g}$$

Molar Mass of $Mg(OH)_2$ =58.33 g/mol

Use the molar masses of Mg, O and H to set up calculations of percentage composition for each element in the compound

$$\text{Percent Mg} = \frac{\text{Mass of 1 Mol Mg}}{\text{Molar mass of } Mg(OH)_2} \times 100$$

$$\text{Percent O} = \frac{\text{Mass of 2 Mol O}}{\text{Molar mass of } Mg(OH)_2} \times 100$$

$$\text{Percent H} = \frac{\text{Mass of 2 Mol H}}{\text{Molar mass of } Mg(OH)_2} \times 100$$

Solution for Percent Composition of $Mg(OH)_2$

- Percent Mg = $\frac{24.31 \text{ g}}{58.33 \text{ g}} \times 100 = 41.68\%$
- Percent O = $\frac{32.00 \text{ g}}{58.33 \text{ g}} \times 100 = 54.86\%$
- Percent H = $\frac{2.02 \text{ g}}{58.33 \text{ g}} \times 100 = 3.46\ \%$

What do you notice about the percentages?

- When you add them up;

$$41.68\% + 54.86\% + 3.46\% = 100\%$$

This will be true any time you find the percent composition of all of the elements in a compound.

Example : Finding a formula from percent composition data.

- Find the formula for the ingredient of a rechargeable battery that has the following percentage composition:

  21.9 % O, 1.4 % H, and 76.7 % Cd

(You may first notice something about the sum of these percentages.)

Since these are percentages the first thing we can do to solve the problem is assume we have a certain amount of grams of the substance

- Should we assume any particular amount?
- What amount should we choose?
- Why is this a good assumption?

We should assume we have 100 grams. Even though it makes no difference what amount we pick, 100 is easy to work with when dealing with percentages.

- Therefore we have

21.9 g O

1.4 g H

76.7 g Cd

Next we need to change these to moles

- Therefore we have

$$21.9 \text{ g O} \times \frac{1 \text{ mol}}{16.00 \text{ g O}} = 1.37 \text{ mol}$$

$$1.4 \text{ g H} \times \frac{1 \text{ mol}}{1.01 \text{ g H}} = 1.39 \text{ mol}$$

$$76.7 \text{ g Cd} \times \frac{1 \text{ mol}}{112.41 \text{ g Cd}} = .682 \text{ mol}$$

Next we need to find the simplest whole number Ratio of moles of each element

- To do this divide each number of moles by the smallest number of moles present.

Solution

The smallest number in our data is 0.682 mol, therefore;

O $\frac{1.37 \text{ mol}}{0.682 \text{ mol}} = 2.01$

H $\frac{1.39 \text{ mol}}{0.682 \text{ mol}} = 2.02$

O $\frac{0.682 \text{ mol}}{0.682 \text{ mol}} = 1.00$

Now you can see the simplest whole number ratio of elements and use these to write the formula

O : H : Cd

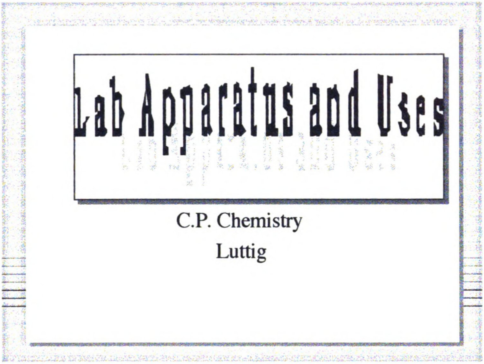
2 : 2 : 1

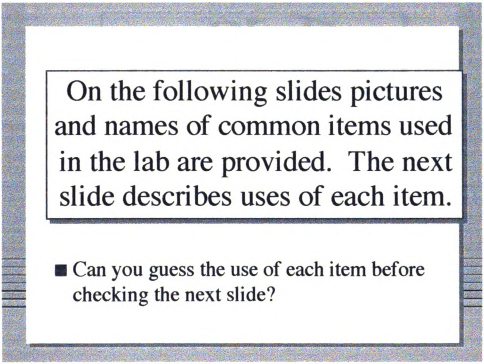
$O_2H_2Cd_1$ After rearranging and dropping the one the correct formula becomes:

$Cd(OH)_2$

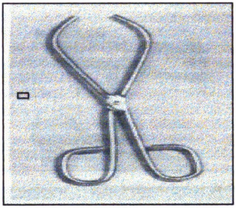
APPENDIX C

LAB APPARATUS AND USES





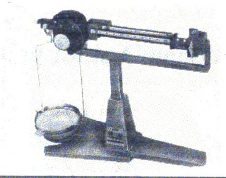
Beaker Tongs



Beaker Tongs

Not surprisingly, beaker tongs are used to pick up hot **beakers.**

Dial-O-Gram Balance



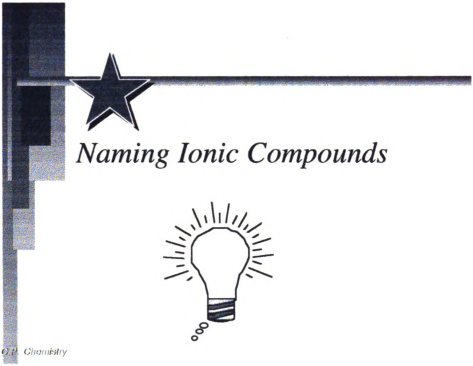
Dial-O-Gram Balance

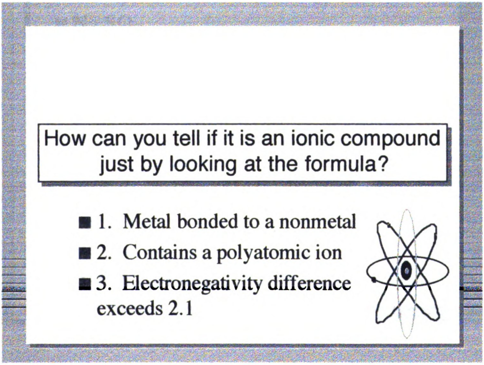
Used to find the mass of objects to the nearest 1/100th of a gram.

Always use a weighing boat.

APPENDIX D

NAMING IONIC COMPOUNDS





Once you know that it is an ionic substance you use the following rules to name the compound:

- **a. Name the cation (If multivalent use roman numerals or -ic or -ous to identify which charge the ion has)**
- **b. Name the anion.**

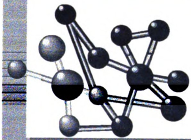
- Example: Name the following;
- Na_2SO_4
- Is this an ionic substance?
- -Yes, it contains a cation bonded to a polyatoimc ion.
- What is the cation? Is the cation multivalent?
- -It is the sodium ion. No, It is not multivalent.
- What is the anion?
- -It is the polyatomic ion, sulfate

What is the name of this compound?

–Sodium sulfate

- Example: Name the following;
- Fe_2O_3
- Is this an ionic substance?
- -Yes, it contains a metal bonded to a nonmetal
- Is the cation multivalent? What is the cation?
- -Yes, it is the Iron III ion (ferric)
- What is the anion?
- -It is the oxide ion.

What is the name of this compound?



Iron III Oxide

APPENDIX E

MORE PRACTICE WRITING CHEMICAL EQUATIONS

More Practice Writing Chemical Equations

Write the balanced chemical equation for the reaction shown below.

Can you guess what is reacting here?

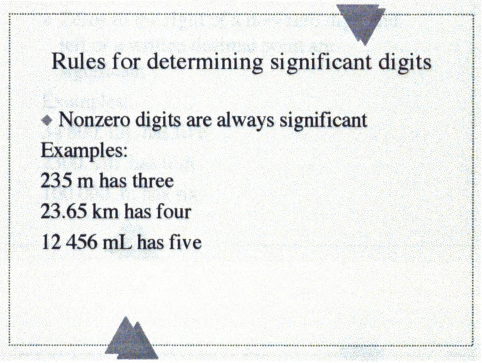
The reaction shows Cesium metal reacting with Water.

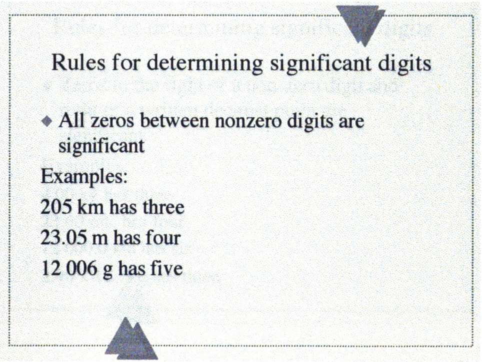
- How do you start?
- Write the word equation for the reaction.

- Cesium + water → Cesium hydroxide + Hydrogen

APPENDIX F

SIGNIFICANT DIGITS





Rules for determining significant digits

- Zeros to the right of a non-zero digit and left of a written decimal point are significant

Examples:

34 800. mL has five

2300. cm has four

100 000. m has six

Rules for determining significant digits

- Zeros to the right of a non-zero digit and right of a written decimal point are significant.

Examples:

4.00 kg has three

23.60 mL has four

12 000.0 km has six

2.90×10^5 kg has three

Rules for determining significant digits

- Zeros to the left of the decimal point in numbers less than one are **not** significant.

Examples:

0.985mL has three

0.65 kg has two

0.6 g has one

Rules for determining significant digits

- Zeros to the right of a decimal point, but to the left of the first non-zero digit are **not** significant.

Examples:

0.067 km has two

0.005 has one

0.0050has two

Practice

- How many significant digits are in each of the following?

0.00980 m

3

100. m

3

10 000 m

1

2.0×10^4 m

2

Exceptions to the rules

- Exact conversion factors are understood to have an unlimited number of significant digits and do not count when used in problems.
- Counting numbers are understood to have an unlimited number of significant digits.

(i.e. there are exactly 30 days in September but it appears to only have one significant digit)

Calculating with significant digits

▼Rule One for addition and subtraction

- The answer must be rounded so that it contains the same number of digits to the right of the decimal point as there are in the measurement with the smallest number of digits to the right of the decimal point.

(i.e. the answer may only be as precise as the least precise number)

- Examples

2.89 m + 0.0432 m

=2.9332 m

=2.93 m

- 60 054 mL + 101 000 mL

=161 054 mL

=161 000 mL

Calculating with significant digits

Rule Two for multiplication and division

- The product or quotient should be rounded off to the same number of significant digits as in the measurement with the fewest significant digits.

- Examples
- 2.89 m x 0.043 m

$=0.12427 m^2$

$=0.12\ m^2$

- $60\ 054\ m^2 \times 101\ m^2$

$=6\ 065\ 454 m^2$

$=6\ 070\ 000 m^2$

- $2.900 \times 10^4 cm \times 1.8 \times 10^5 cm$

$=5.22 \times 10^9 cm^2$

$=5.2 \times 10^9 cm^2$

Final Considerations on significant digits

- The coefficient in a number written in scientific notation always reflects all significant digits.

2.90×10^{4} cm has three

Final Considerations on significant digits

- *Rules for rounding*
- *If the digit immediately to the right of the last significant digit you want to retain is*

Greater than 5, increase the last digit by 1.

Less than 5, do not change the last digit.

5, followed by nonzero digit(s), increase the last digit by 1.

5, not followed by a nonzero digit and preceded by odd digit(s), increase the last digit by 1.

5, not followed by nonzero digit(s), and the preceding significant digit is even, do not change the last digit, Practice

- Round the following to 4 significant dig

0.0098050 m

0.009805 m

10 235 m

10240 m

0.0543529 m

0.05435 m

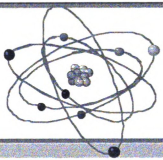
2.07655×10^{4} m

2.077×10^{4} m

APPENDIX G

NAMING MOLECULAR COMPOUNDS

Naming Binary Molecular Compounds (Covalent Bonds)



How do you know if it is a binary molecular substance (covalent bond) by looking at the formula?

- Nonmetal bonded to nonmetal
- Hydrogen bonded to metal or nonmetal.
- Electronegativity difference less than 2.1
- It contains only two kinds of elements.(binary)

Rules for naming Binary Molecular compounds

- Identify the names of the two elements that are contained in the formula.
- *Use Latin prefixes to describe how many of each atom are contained in the formula along with the name of each element.
- Make sure the second element in the name ends in in -ide.

*Some exceptions will be illustrated in the examples .

The Latin prefixes used in naming molecular substances are:

mono-	**one**
di-	**two**
tri-	**three**
tetra-	**four**
penta-	**five**
hexa-	**six**
hepta-	**seven**
octa-	**eight**
nona-	**nine**
deca-	**ten**

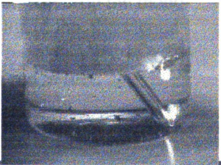
Example: Name the following
P_2O_5

- Is the substance in question a molecule?
- Yes, it is a nonmetal bonded to a nonmetal.
- What are the names of the elements?
- Phosphorous and oxygen.
- How many of each in the formula?
- Two phosphorous (di-) and five oxygen (penta-)
- What is the name of this molecule?

Diphosphorous pentoxide

Notice that the second element oxygen has been changed to oxide to satisfy the need to end in ide-.

Production of diphosphorous pentoxide under water



Example: Name the following NO_2

- **Is the substance in question a molecule?**
- **Yes, it is a nonmetal bonded to a nonmetal.**
- **What are the names of the elements?**
- **Nitrogen and oxygen.**
- **How many of each in the formula?**
- **One nitrogen (mono-) and two oxygen (di-)**
- **What is the name of this molecule?**

Nitrogen dioxide

- This is an exception that was mentioned earlier. When there is only one of the first element in the formula you drop the mono- in the prefix. Notice again that the second element oxygen has been changed to oxide to satisfy the need to end in ide-.

Example: Name the following N_2O

- **Is the substance in question a molecule?**
- **Yes, it is a nonmetal bonded to a nonmetal.**
- **What are the names of the elements?**
- **Nitrogen and oxygen.**
- **How many of each in the formula?**
- **Two nitrogen (di-) and one oxygen (mono-)**
- **What is the name of this molecule?**

Dinitrogen Monoxide

- While this seems similar to the previous example, the mono- prefix must be included in the second element named.

Example: Name the following: SiO_2

- Is the substance in question a molecule?
- Yes, it is a metalloid bonded to a nonmetal but the electonegativity difference is 1.7 indicating it is a covalent bond.
- What are the names of the elements?
- Silicon and oxygen.
- How many of each in the formula?
- One silicon (mono-) and two oxygen (di-)
- What is the name of this molecule?

Silicon Dioxide

Example: Name the following: CCl_4

- **Is the substance in question a molecule?**
- **Yes, it is a nonmetal bonded to a nonmetal.**
- **What are the names of the elements?**
- **Carbon and Chlorine.**
- **How many of each in the formula?**
- **One carbon (mono-) and four chlorine (tetra-)**
- **What is the name of this molecule?**

Carbon Tetrachloride

Once again the mono- is dropped because it appears in the first element named and the root of chlorine is changed to end in ide-.

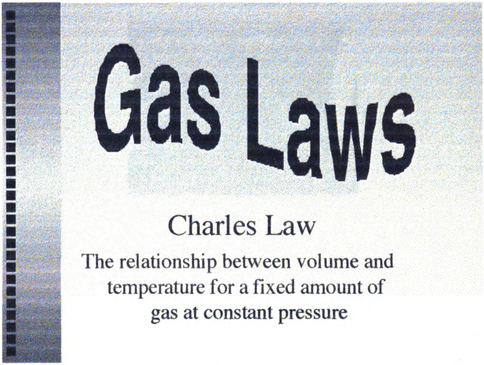
Example: Other uses of the Latin Prefixes in naming certain compounds. Name the following: $CuSO_4 \cdot 5H_2O$

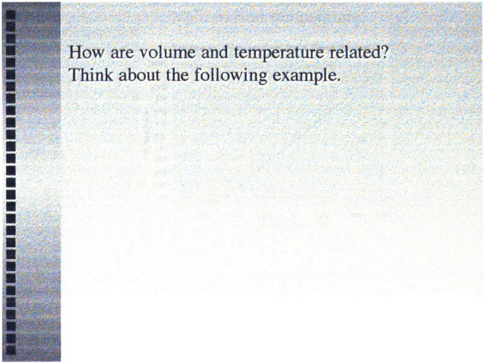
- This is clearly not a molecular substance, yet it does contain a molecule *(H_2O)*.
- In this special case (a water of crystallization) you name the ionic substance (copper II sulfate) and then use Latin prefixes to describe the number of water molecules associated with each formula unit.
- What is the name of this compound?

Copper II Sulfate Pentahydrate

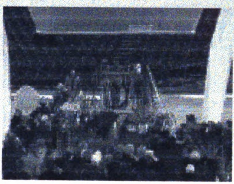
APPENDIX H

GAS LAWS (CHARLES)

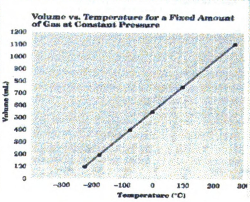




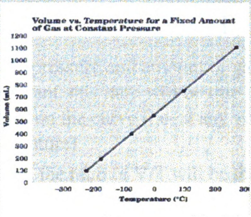
How are volume and temperature of a gas related?
Think about the following example.



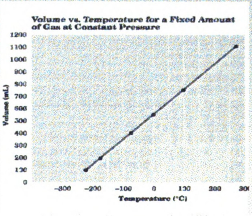
Clearly the balloon shows that volume and temperature must be directly related.
The graph shows a direct relationship between volume and temperature.



What is the formula to describe this curve?



The graph shows a direct relationship between volume and temperature.
What is the formula to describe this curve?



$V = kT$

Since V=kT ;

$$\frac{V}{T} = \frac{kT}{T} \qquad \frac{V}{T} = k$$

- Since the pressure and amount of gas are kept constant, this ratio will be true anywhere on the curve (i.e. at any volume or temperature)
- Therefore, the ratio of V/T will be the same for this gas throughout
- Therefore, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Sample Problem: A balloon contains gas that occupies 24. 0 m^3 at 105 K. What volume would the gas occupy at 450 K? (Assume constant pressure and moles of gas.)

Sample Problem: A sample of gas occupies 24.0 m^3 at 105 K. What volume would the gas occupy at 450 K? (Assume constant pressure and moles of gas.)
Use the following 5-step problem solving technique to discover the answer.

- **Step 1**: Write down all of the known and unknown information.

  $V_1 = 24.0\ m^3$

  $V_2 = ???$

  $T_1 = 105\ K$

  $T_2 = 450\ K$

- **Step 2**: Find a formula that will fit the variables from step 1.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

- **Step 3**: Solve the equation for the desired variable. (unknown variable

$$T_2 \times \frac{V_1}{T_1} = \frac{V_2}{T_2} \times T_2$$

$$V_2 = T_2 \times \frac{V_1}{T_1}$$

- **Step 4**: Substitute the unknowns into the equation and calculate.

$$V_2 = 450\ K \times \frac{24.0\ m^3}{105\ K} = 103\ m^3$$

- **Step 5**: Check to make sure your answer has correct units and check to see if the magnitude of the answer makes sense.

The units in the answer are m^3 and these are appropriate for volume. Furthermore, since the temperature increases you would expect the volume to increase due to the direct relationship. This is also consistent with our answer.

Sample Problem 2: A sample of gas occupies 37.4 cm^3 at 25.0^{0}C. What temperature would the gas be at if the volume expands to 67.8 cm^3? (Assume constant pressure and moles of gas.)

Sample Problem 2: A sample of gas occupies 37.4 cm^3 at - 25.0°C. What temperature would the gas be at if the volume expands to 67.8 cm^3? (Assume constant pressure and moles of gas.)
Again use the 5-step problem solving technique to discover the answer.

- **Step 1**: Write down all of the known and unknown information.

  $V_1 = 37.4\ cm^3$

  $V_2 = 67.8\ cm^3$

  $T_1 = -25.0\ ^oC$

  $T_2 = ???$

Remember to change Celsius to Kelvin before using equations.

Sample Problem 2: A sample of gas occupies 37.4 cm^3 at - 25.0°C. What temperature would the gas be at if the volume expands to 67.8 cm^3? (Assume constant pressure and moles of gas.)
Again use the 5-step problem solving technique to discover the answer.

- Step 1: Write down all of the known and unknown information.

  $V_1 = 37.4\ cm^3$

  $V_2 = 67.8\ cm^3$

  $T_1 = -25.0\ ^oC + 273 = 248\ K$

  $T_2 = ???$

Remember to change Celsius to Kelvin before using equations.

- Step 2: Find a formula that will fit the variables from step 1.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

- **Step 3:** Solve the equation for the desired variable. (unknown variable T_2)

$$T_2 \times \frac{V_1}{T_1} = \frac{V_2}{T_2} \times T_2$$

$$\frac{T_1}{V_1} \times T_2 \times \frac{V_1}{T_1} = V_2 \times \frac{T_1}{V_1}$$

$$T_2 = \frac{V_2 \times T_1}{V_1}$$

- **Step 4:** Substitute the unknowns into the equation and calculate.

$$T_2 = \frac{67.8\ cm^3 \times 248\ K}{37.4\ cm^3}$$

$$T_2 = 450.\ K$$

- **Step 5**: Check to make sure your answer has correct units and check to see if the magnitude of the answer makes sense.

The units in the answer are K and these are appropriate for temperature. If the temperature needed to be expressed in Celsius, what would you do?

$$^{0}C = K - 273 = 450\ K - 273 = 177\ ^{0}C$$

What answer would you get if you did not change to Kelvin before using the formula?

Is this answer possible?

To check to see if our answer makes sense qualitatively, the volume increases so the temperature should also increase and our result shows that it does.

Now you try!

- How many Liters of gas were initially present if a gas originally at 30.0 ^{0}C occupies 24 000 cm^3 at 89.0 ^{0}C ?
- Answer: 20 100 cm^3

APPENDIX I

HEAT CALCULATIONS

Heats Changes and Calculations

Kinetic and Potential Energy Changes in Action

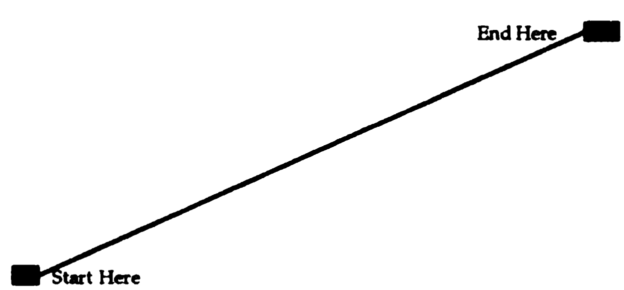
Calculating the heat required to turn ice into steam

- Study the following cooling/heating curve to determine the energy changes involved.
- Use the formulas with each accompanying change to calculate the energy change.

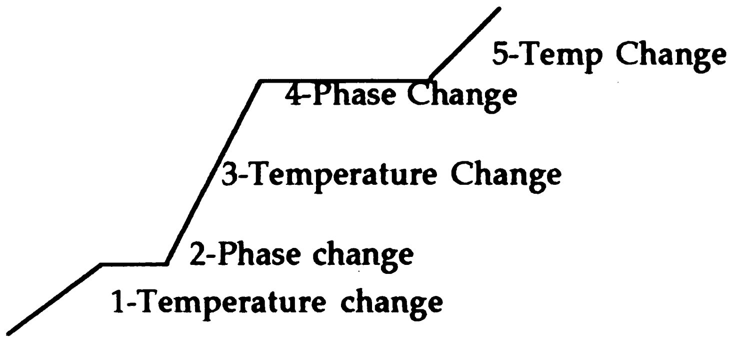
Calculating the heat required to turn ice into steam

How many Joules of energy would be required to turn 25.0 grams of ice at -40.0°C to steam at 140.0°C?

- **First determine if any phase changes occur and points where the temperature changes by studying the diagram**

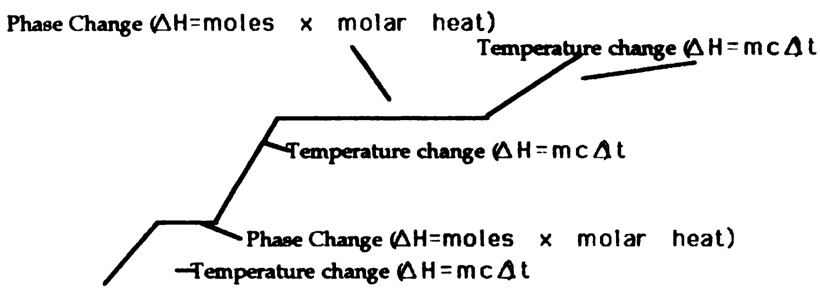


The water must go through two phase changes and three different temperature changes



How many Joules of energy would be required to turn 25.0 grams of ice at -40.0°C to steam at 140.0°C?

- Next you calculate each of the five steps by using the formula to accompany each change.



Calculations

Step One

Raise the temperature of the ice from -40.0° C to 0 °C. This is a kinetic energy change because the temperature changes but the phase stays the same.

1. $\Delta H = mc\Delta t$

$\Delta H = 25.0\ g \times 4.18\ J/g^{\circ}C \times (0.0^{\circ}C - (-40.0^{\circ}C))$

Calculations

Step Two

Melt the ice at 0°C. This is a potential energy change because the phase changes but the temperature stays the same.

1. $\Delta H = mol \cdot molar\ heat$

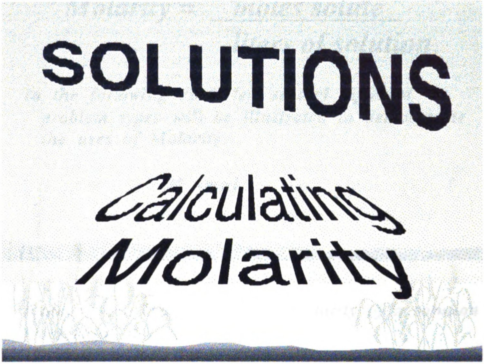
The molar heat to be used is the molar heat of fusion since the phase change is from solid to liquid.

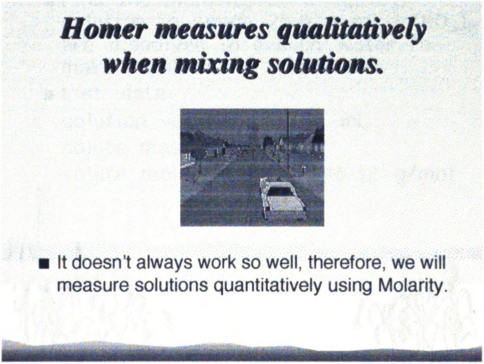
The mass of ice (H_2O) must be converted into moles.

$\Delta H = 25.0\ g \times \frac{1\ mol}{18.02\ g}$

APPENDIX J

MOLARITY CALCULATIONS





Molarity is a quantitative way to measure concentration

$$\text{Molarity} = \frac{\text{moles solute}}{\text{liters of solution}}$$

In the following examples, several different problem types will be illustrated to demonstrate the uses of Molarity

$$M = \frac{mol}{L}$$

Example 1: Determining the molarity of a solution from mass and volume data.

- Find the molarity of a $Mg(NO_3)_2$ solution in which 25.0 g of $Mg(NO_3)_2$ are dissolved in enough water to make 1350 mL of solution
- List data

  solution volume = 1350 mL

  solute mass = 25.0 g

  solute molar mass = 148.32 g/mol

To find the solution concentration use

$$M = \frac{mol}{L}$$

- Molarity is moles of solute per Liter solution. Place the solute amount over the solution amount, even though they are not in the correct units

$$M = \frac{25.0\ g\ Mg(NO_3)_2}{1350\ mL\ solution}$$

- Multiply by a conversion factor that will cancel the mL and covert to L

$$M = \frac{25.0\ g\ Mg(NO_3)_2}{1350\ mL\ solution} \times \frac{1000\ mL}{1\ L}$$

Next, use the conversion factor from the molar mass that will cancel the mass of $Mg(NO_3)$ to give the amount in moles.

$$M = \frac{25.0\ g\ Mg(NO_3)_2}{1350\ mL\ solution} \times \frac{1000\ mL}{1\ L} \times \frac{1\ mole\ Mg(NO_3)_2}{148.32\ g\ Mg(NO_3)_2}$$

The final answer will be:

0.125 M

(Reflecting 3 significant digits)

Example 2: Finding mass needed to make a solution of a specified molarity.

- Find the amount of $AgNO_3$ needed to make 375 mL of a 0.750 M solution.
- List data

  solution volume = 375 mL

  solution concentration = 0.750 M

  solute molar mass = 169.88 g/mol

  solute mass = ???

Again we use the formula

$$M = \frac{mol}{L}$$

Solving this time for moles. We can then change moles into grams.

$$mol = M \cdot L$$

$$mol = 0.750M \cdot 375mL \cdot \frac{1\ L}{1000mL} = 0.281\ mol$$

$$0.281\ mol \times \frac{169.88\ g}{1\ mol} = 47.7\ g$$

Example 3: Determining the volume of a solution from Molarity and mass data.

- Determine the volume of 0.250 M $NaHCO_3$ needed to react with 5.00 g of H_2SO_4 and produce Na_2SO_4, CO_2 and H_2O.
- List

Volume =?

Molarity = 0.250 M

mass of reactant = 5.00 g

balanced equation=

$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2CO_2 + 2H_2O$.

- $5.00\ g\ H_2SO_4 \times \frac{1\ mol\ H_2SO_4}{98.09\ g} \times \frac{2\ mol\ NaHCO_3}{1\ mol\ H_2SO_4} \times \frac{1\ L}{0.250\ mol\ NaHCO_3} \times \frac{1000\ mL}{1\ L} =$

444mL $NaHCO_3$

APPENDIX K

Quiz 1 Titration

name____________________________

1. The titration procedure for determining the concentration of an unknown acid does not include

.

a. removing air bubbles from burets
b. adding indicator to a buret
c. constant swirling of an Erlenmeyer flask
d. recording the exact volume of a titration standard

2. In the titration of 30 mL of KOH solution, 25 mL of 0.30 M HCl were needed to reach the equivalence point. What is the molarity of the KOH solution?

3. Calculate how many milliliters of 0.50 M $Ba(OH)_2$ must be added to titrate 35 mL of 0.25 M H_2SO_4

APPENDIX L

Titration Quiz 2

name______________________

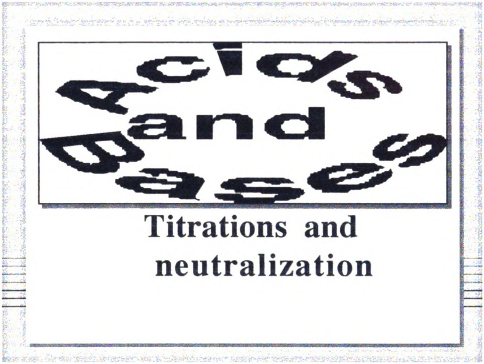
1. What do you do if you are titrating an acid and you add too much base causing the color of the indicator to turn dark pink?

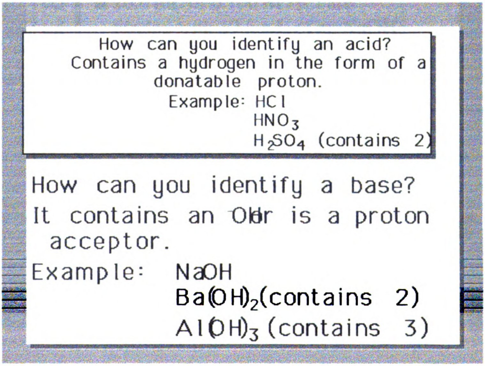
2. If 20 mL of 0.020 M aqueous HNO_3 are required to titrate 25 mL of an aqueous solution of NaOH, what is the molarity of the NaOH solution?

3. If 25 mL of 0.25 M aqueous H_2SO_4 solution are required to titrate 30 mL of an aqueous solution of NaOH, what is the molarity of the NaOH solution?

APPENDIX M

ACID BASE TITRATIONS





An Acid-Base titration is performed as follows.

- Place the acid in one of the burets
- Place the base in the other buret.
- Add a random amount of acid or base to an Erlenmeyer flask along with an appropriate indicator.
- Perform titration

EXAMPLE1

- 20.0 mL of 0.100 M HCl are titrated with 19.5 mL of an NaOH solution. What is the molarity of the NaOH solution?

-Write the balanced equation

$HCl + NaOH \rightarrow NaCl + H_2O$

-List

Vol. Acid = 20.0 mL

Concentration Acid = 0.100M

Vol. Base = 19.5 mL

Concentration Base = ???

1. Start with the known concentration and volume to determine moles of known. Substitute to find concentration of unknown.

- Molarity = $\frac{\text{mol}}{\text{Liter}}$ therefore;

mol = Molarity x Liter

mol = 0.100 M x 20.0 mL x $\frac{1\ \text{L}}{1000\ \text{mL}}$ =

0.00200 mol HCl

2. Use stoichiometry to determine moles of unknown.

0.00200 mol HCl x $\frac{1\ \text{mol NaOH}}{1\ \text{mol HCl}}$ =

0.00200 mol NaOH

3. Calculate the molarity of the unknown.

Molarity = $\frac{\text{mol}}{\text{Liter}}$ =

$\frac{0.00200\ \text{mol NaOH}}{19.5\ \text{mL NaOH}}$ x $\frac{1000\ \text{mL}}{1\ \text{L}}$ =

0.103M NaOH

- Check to make sure your answer makes sense.
- The concentration of NaOH should be a little higher since it required a larger amount of acid to neutralize it. Furthermore, the mole ratio is 1:1.

EXAMPLE 2

- 35.5 mL of 0.345 M H_2SO_4 are used to titrate 42.7 mL of KOH solution. What is the molarity of the KOH solution?

-Write the balanced equation

H_2SO_4+2 KOH -->K_2SO_4 +2 H_2O

-List

Vol. Acid = 35.5 mL

Concentration Acid = 0.345M

Vol. Base = 42.7 mL

Concentration Base = ???

1. Start with the known concentration and volume to determine moles of known.

- Molarity = $\frac{mol}{Liter}$ therefore;

mol = Molarity x Liter

mol = 0.345 x 35.5 mL x $\frac{1 L}{1000 mL}$ =

0.0122 mol H_2SO_4

2. Use stoichiometry to determine moles of unknown.

0.0122 mol H_2SO_4 x $\frac{2 \text{ mol KOH}}{1 \text{ mol } H_2SO_4}$ =

0.0244 mol KOH

3. Calculate the molarity of the unknown.

Molarity = $\frac{mol}{Liter}$ =

$\frac{0.0244 \text{ mol KOH}}{42.7 \text{ mL KOH}}$ x $\frac{1000 \text{ mL}}{1 \text{ L}}$ =

0.571M KOH

- Check to make sure your answer makes sense.
- The concentration of KOH should be a little higher since it requires twice as much base as acid according to the balanced equation. Even though a little more base is needed it does not outweigh the need for twice as much base from the stoichiometry.

EXAMPLE 3

- How many mL of 1.000 M H_2SO_4 would be needed to neutralize 35.4 mL of 0.526 M LiOH?

-Write the balanced equation

H_2SO_4+2 LiOH -->Li_2SO_4 +2 H_2O

-List

Vol. Acid = ??? mL

Concentration Acid = 1.000 M

Vol. Base = 35.4 mL

Concentration Base = 0.526 M

1. Start with the known concentration and volume to determine moles of known.

- Molarity = $\frac{\text{mol}}{\text{Liter}}$ therefore;

mol = Molarity x Liter

mol = 0.526 x 35.4 mL x $\frac{1\ \text{L}}{1000\ \text{mL}}$ =

0.0186 mol LiOH

2. Use stoichiometry to determine moles of unknown.

0.0186 mol LiOH x $\frac{1\ \text{mol}\ H_2SO_4}{2\ \text{mol LiOH}}$

0.00930mol H_2SO_4

3. Calculate the volume of the unknown.

Molarity = $\frac{\text{mol}}{\text{Liter}}$; Liter = $\frac{\text{mol}}{\text{Molarity}}$

$\frac{0.00930\text{mol}\ H_2SO_4}{1.000\ \text{M}\ H_2SO_4}$ = 0.00930Lx$\frac{1000\text{mL}}{1\text{L}}$ =

9.30 mL H_2SO_4

- Check to make sure your answer makes sense.

APPENDIX N

Quiz 1 Significant Digits

name________________________

Record the correct number of significant digits for each of the following

1. 0.000 760 m
2. 100. cm
3. 10 00.0 m
4. 35.10 km
5. 101 cm
6. 100.00 m

Perform the following with significant digits

7. 12 000 cm x 100. cm

8. 30.0 g + 12.70 g

9. 12.50 cm - 3.7 cm

10. 1.000 g x 35 g

11. 25 g ÷ 10.00 mL

12. 54 + 75.00 + 13.698

APPENDIX O

Quiz 2 Significant Digits

name________________________

Record the correct number of significant digits for each of the following

1. 10.050 m
2. 100 cm
3. 100.050 m
4. 3500 km
5. 101 000 cm
6. 1.00 m

Perform the following with significant digits

7. 12 cm x 100 cm

8. 0.050 g + 12.7 g

9. 120 cm - 3.7 cm

10. 1.0 g x 35 000 g

11. 25 g + 1mL

12. 54 + 700 + 13.6

APPENDIX P

PowerPoint Presentation Survey

Please circle the response that most correctly describes how you feel.

(1-3 refer to the review presentations in the SSSC)

1. I used the PowerPoint Presentations in the SSSC to review for the exam

once twice three times never

2. If I used the exam review presentations they helped me to learn or review the material that was presented?

always most of the time seldom never

3. If I used the review presentations, I think they were worth taking the time to use.

agree not sure disagree

(4-9 refer to presentations shown during class)

4. I would you like to see more PowerPoint Presentations in the future to help me learn science concepts? I agree with this statement

strongly somewhat don't care disagree

5. Ideally I would like PowerPoint presentations to be used in class

once a week twice a week more than twice a week never

6. I think the computer should be used to present other material in class

once a week twice a week more than twice a week never

7. When the teacher uses the computer to teach us in class I

learn more learn about the same learn less

8. The PowerPoint presentations helped me to concentrate more on material being taught. I agree with this statement

strongly somewhat don't care disagree

9. I wish more of my teachers used PowerPoint presentations in class.

I agree with this statement

strongly somewhat don't care disagree

Please describe at least one thing you liked about the PowerPoint presentations.

Which presentation was most helpful? Why?

Please describe at least one thing you did not like about PowerPoint presentations.

BIBLIOGRAPHY

BIBLIOGRAPHY

Beerexplosionsimpson. [Online Video] Available http://www.geocities.com/Hollywood/6174/cloudy.html, Feb. 2, 1998

Titration Movie. [Online Video] Available http://suzy.unl.edu/bruno/java/Titrate.html, Feb. 11, 1998

U.S. Department of Education, Office of Educational Technology. [Online] Available http://inet.ed.gov/Technology/pillar4.html, June 13, 1998

Technology's Impact on Learning, Department of Education. [Online] Available http://www.nsba.org/sbot/toolkit/tiol.html, June 11, 1998

Rodrigues, Susan. Review of Computer Based Technologies on Students' Learning School Science. [Online] Available http://www.sofweb.vic.edu.au/lt/research/sum_sci.htm, June 9, 1998

Cradler, John. Summary of Current Research and Evaluation Findings on Technology in Education. [Online] Available http://www.fwl.org/techpolicy/refind.html, June 15, 1998

Strommen, Erik and Lincoln, Bruce. Constructivism, Technology and the Future of Classroom Learning. [Online] Available http://www.ilt.columbia.edu/k12/livetext-nf/docs/construct.html, June 13, 1998

Johnson, Doug. Evaluating the Impact of Technology: The Less Simple Answer. [Online] Available http://ww.fromnowon.org/jan96/reply.html, June 13, 1998

Bennett, Frederick. Summary. [Online] Available http://www.concentric.net/~Fabenl/

Bielfeldt, Talbot. Systematic Planning for Technology, OSSC Bulletin; v40, Nov. 2, 1997

Report to the President on the Use of Technology To Strengthen K-12 Education in the United States, [Online] Available http://ericir.syr.edu/plweb-cgi/fastweb?searchform+ericdb, ED410950, June 15, 1998

Branch, Robert Maribe, Ed; Fitzgerald, Mary Ann, Ed., Educational Media and Technology Yearbook, 1998. Volume 23

Mckenzie, Jamie. Education, Technology , Planning. [Online] Available http://www.pacificrim.net/~mckenzie, June 12, 1998

PowerPoint Help Page, [Online] Available http://garfield.ir.ucf.edu/manual/lan/ppoint.html, August 2, 1997

Schenone-Stevens, M. Carla, Powerful Presentations with PowerPoint, [Online] Available http://ericir.syr.edu/plweb-cgi/fastweb?searchform+ericdb, ED404699, June 15, 1998

Reiber, Lloyd P. The Effects of Visual Grouping on Learning from Computer Animated Presentations. Abstract [Online] Available http://ericir.syr.edu/plweb-cgi/fastweb?searchform+ericdb,ED335006, June 12, 1998

Gibbs, W.J. An Analysis of a Computer Assisted Learning System: Student Perception and Reactions. Abstract [Online] Available http://ericir.syr.edu/plweb-cgi/fastweb?searchform+ericdb,ED335006, June 12, 1998.

Constructivist Model for Learning, [Online] Available htp://www.ncrel.org.sdrs/areas/issues/content/cntrareas/science/sc5model.htm, June 12, 1998

Slavin, Robert. Educational Psychology, Pub. Allyn and Bacon, 1991

Lang, Mozell, Michigan Essential Goals and Objectives for Science Education, . Michigan Dept. of Education , 7/94