Chemistry 217

Chemical Principles I

Student Manual

Note: This *Student Manual* was prepared primarily for individualized-study students. Students who are taking this course with seminar support or through a co-operating institution should be aware that some of the information will not apply in their situation. In case of doubt, please ask your tutor or seminar leader about any problems that might arise. Further clarification can be obtained from the course professor.

Athabasca University

Course Team

Author: Lawton Shaw
Editor: Gilda Sanders
Cover Design: Jingfen Zhang
Visual Presentation: Digital Media Technology Unit

This course replaces *Chemistry 217: Chemical Principles I* which was prepared for Athabasca University by the following course team:

Author: Dietmar Kennepohl
Editor: Erna Dominey

This course includes learning objectives and other materials developed by Dr. Arthur Last for the original version of Athabasca University's introductory chemistry course.

The cover image shows a member of the fullerene family of carbon molecules. Technically known as "buckminsterfullerene" and colloquially called the "buckeyball," this sixty carbon (C_{60}) molecule is the most common of the fullerenes. Fullerenes have been studied for use in armor, carbon nanotubes and nanowires; in medicine as antimicrobial agents and protease enzyme inhibitors; and as possible superconductors.

C_{60} was discovered in 1985 by a team of chemists working at Rice University, Houston Texas. Before this time, only two allotropes of carbon were known in nature: graphite and diamond. Robert F. Curl, Jr., Harold W. Kroto and Richard E. Smalley received the Nobel Prize in Chemistry (1996) for the discovery of this third allotrope of carbon.

"Fullerene," "buckminsterfullerene" and "buckeyball" all derive from the name of Richard Buckminster Fuller, the American author, architect, and visionary who developed the geodesic dome.

Image: Fullerene ball-and-stick created from a protein data bank (PDB) format file using Piotr Rotkiewicz's *iMol* program.
http://commons.wikimedia.org/wiki/Image:Fullerene-C60.png#file

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The Course

Welcome to *Chemistry 217: Chemical Principles I*, the first of two three-credit courses in general chemistry. We assume that on completing *Chemistry 217* most students will wish to proceed to *Chemistry 218: Chemical Principles II* to obtain a total of six credits in chemistry. These two courses provide an essential foundation for further studies in chemistry, biology, physics, earth sciences, or environmental science. They can also be used towards fulfilling the entry requirements for medicine, pharmacy, food science, agricultural science, forestry, and other programs. Wherever possible, the course material discusses the relevance of chemistry to the contemporary world. Laboratory exercises illustrate many of the theoretical concepts covered in the course, and give students an opportunity to develop practical laboratory skills. Together, *Chemistry 217* and *Chemistry 218* are equivalent to an eight-month, two-semester course in a traditional university.

Topics in *Chemistry 217* include chemical reactions and equations; energy in chemical systems; and the structure and properties of atoms, molecules, gases, liquids, solids, and solutions. The course outline, given in the "Course Outline and Study Schedules" section of this manual, provides a more detailed description.

This *Student Manual* contains essential information about the design of the course and the course materials. It also contains sample examinations, tutor-marked assignments and information about the procedures you should follow to obtain the maximum benefit from your studies. Before you begin to work on *Chemistry 217*, please read this *Student Manual* through carefully. If you have any questions about the course itself, or how to proceed with your studies, please contact your tutor or the course professor.

The myAU Portal

MyAU is a personalized portal to the University through which you can quickly access information that is relevant to you, including online components of your courses. Through myAU, you can view personal information, such as library accounts and assignment marks and course grades, and take care of administrative matters, such as booking examinations, submitting assignments, applying for extensions, registering for courses, and so on. Athabasca University will also communicate directly with you through myAU. Check the Message Centre on your myAU home page both for general information and for mail addressed specifically to you.

To login at

http://my.athabascau.ca/

enter your student ID number and password where requested. If you are having browser difficulties or you need help, refer to myAU Help at

http://www.athabascau.ca/uportal/help/index.php

Your Student ID Number

In contacts with your tutor, on assignments, or in any correspondence or other contact with the University, you are asked to provide your student ID number. Record this number in the space below. Having your student ID number will help University personnel process requests, grades, and administrative matters more quickly.

Student ID number: _____

Note: It is important that we receive notification of any change of address or telephone number. Please inform the Office of the Registrar whenever such a change occurs. You can update your contact information through your myAU portal, or use the form included in the course materials package. In addition, you should send change-of-address cards to your tutor and to the course professor, so that your student files can be kept up-to-date.

Freedom of Information and Protection of Privacy

The personal information and records collected and maintained by Athabasca University as a result of a student's registration in this course, such as completed assignments and examinations, electronic communications, and correspondence, are subject to University policies and the privacy and access provisions of Alberta's *Freedom of Information and Protection of Privacy Act*.

The Athabasca University Calendar

Because Athabasca University's policies, practices, and procedures change over time, some of the information in this *Student Manual* may lose its currency between course revisions. We therefore recommend that students refer to the current *Athabasca University Calendar* on important issues concerning University policies, procedures, and practices. In the event of any discrepancy between the printed version of the *Calendar* and the official Web-based *Calendar*, the Web-based version will be binding.

Course Materials

The package you received should include each of the items listed below. If anything is missing from your package, please contact the Course Materials division of Athabasca University as soon as possible. If you live in Calgary or Edmonton, you can call the Learning Centre in your city and use the automated telephone attendant to connect with Course Materials (the extension is 6366). If you live within Canada or the United States, but outside of Edmonton or Calgary, you can call the automated attendant by dialing 1.800.788.9041. If you live outside of Canada or the United States, or if you do not wish to use the automated system, you can call 780.675.6366. You can write to Course Materials, Tim Byrne Centre, 4001 Hwy 2 South, Athabasca, AB T9S 1A4 or send electronic mail to

cmat@athabascau.ca

Commercial Materials

Brown, T. L., H. E. LeMay, B. E. Bursten, and C. J. Murphy (contributing author). *Chemistry: The Central Science*, *Volume I*, custom edition for Athabasca University. Saddle River, NJ: Pearson Prentice Hall, 2006.

Hill, J. C., and R. Wilson. *Student's Guide and Student Solutions Manual, Volume I*, custom edition for Athabasca University. Saddle River, NJ: Pearson Prentice Hall, 2006.

Student MediaPak: Chemistry the Central Science, 10th ed., Brown / LeMay / Bursten. Upper Saddle River, NJ: Pearson Prentice Hall, 2006.

Athabasca University Materials

Chemistry 217: Chemical Principles I—Student Manual. Athabasca, AB: Athabasca University, 2007.

Chemistry 217: Chemical Principles I—Study Guide. Athabasca, AB: Athabasca University, 2007.

Forms: The forms you will need to submit assignments or inform the University of a change in your status as a student are included in your course package. You can also access forms online through your "myAU" portal (see the section of this manual titled "The myAU Portal").

Other Materials

The items listed below are *not* supplied; you should purchase them before you begin to work on the course. You will need

- an electronic calculator capable of handling logarithms and exponentials.

  Remember: Take your calculator with you whenever you write an examination or attend a laboratory session.

- other stationery, including paper for assignments, pens, pencils, a ruler, etc.

Course Web Site

Please visit the *Chemistry 217* course Web site, through your myAU portal. This site contains:

- information about the course professor.
- a description of the home lab kits.
- additional learning resources.
- relevant links for the course.

Note: A student can pass the course without visiting the course Web site.

Laboratories

You must complete 32 hours of laboratory work, using a home-study laboratory kit, to obtain credit in this course. You may order the laboratory kit online, through your myAU portal. If you cannot make your request online, please contact the Science Lab Coordinator, at 780.675.6276 or 780.481.3704.

Note that your laboratory work accounts for 20% of your overall course mark. You must satisfactorily complete and write up a specified minimum number of experiments in order to obtain credit for this course (see the section of this manual titled "Assessment").

Note: We strongly recommend that you complete Units 1 and 2 before attempting any laboratory work.

The Course Tutor

Athabasca University provides each student in each course with a tutor whose responsibility is to help the student complete the course successfully. A letter containing your tutor's name, address, telephone number, and tutoring hours was mailed to you shortly before your official start date. If you have not yet received your tutor letter, please contact Learning Services—Tutorial at Athabasca University as soon as possible. You can use the automated attendant (see the "Course Materials" section of this manual for instructions, the extension is 6196); you can call 780.675.6196; or you can send electronic mail to

tutserv@athabascau.ca

Note: If you have chosen to receive communications from Athabasca University in electronic form, please check your myAU portal for your tutor letter.

Your tutor has excellent academic qualifications, and is committed to helping students learning at a distance. He or she is available to answer your questions about course content or how to approach a problem or an assignment, and can direct you to the right person or department to help you with other problems that may be hindering your progress in your course or program. In addition, your tutor will be responsible for marking your assignments. In general, you should call your tutor first with any queries about Athabasca University.

The tutor letter will help you become acquainted with your tutor and will provide information about your tutor's schedule. If you have not yet received a call from your tutor, do not hesitate to make the first call yourself. If you live in Canada or the United States, you may call your tutor, toll free, during his or her tutoring hours, using the information provided in the tutor letter. If you live outside of Canada or the United States, please refer to the tutor letter and the current *Athabasca University Calendar* for information about calling your tutor. You may find it useful to schedule a regular study period when your tutor is available so that you can call him or her when questions arise. If you are unable to take advantage of the regular tutoring hours, contact your tutor or the course professor to determine whether alternative arrangements can be made.

We suggest that you call your tutor as soon as you receive the course materials, and then get into the habit of phoning regularly, when you complete a unit or when you run into any special problem. We have found that students who maintain regular contact with their tutors are most likely to be successful in completing their courses, so do keep in touch.

When you mail an assignment to your tutor, be sure to attach a tutor-marked exercise form, and to keep a copy, at least a rough draft, in case the original goes astray in the mail. Note that we can only give credit for work that is actually received; this is why we strongly advise that you keep a rough copy of all of the work that you submit to your tutor for marking.

If you wish to submit your assignments electronically, contact your tutor to discuss appropriate formats. An electronic version of the tutor-marked exercise form is available online through your "myAU" portal, or under "T" on the general index page

http://www.athabascau.ca/search/index.php?value=&type=index

Allow several working days, in addition to mailing time each way, before you expect to receive the graded assignment.

When you receive the graded assignment, review your tutor's comments carefully. Your tutor will be pleased to provide additional feedback on your assignments over the telephone. Be sure to mention any questions you have about the assignment or the grade.

Keep your tutor's letter of introduction with your course materials, and use the space provided below to record information about your tutor.

Tutor's name: _____

Address: _____

Telephone number: _____

Electronic mail address: _____

Tutoring hours: _____

The Course Professor

The course professor is the member of Athabasca University's academic staff who is in charge of a given course. The professor works directly with tutors on both academic and administrative matters. If you have difficulties you cannot resolve with your tutor's help, you may wish to speak with the professor directly. You should also address any questions about credit records or centrally marked examinations to the course professor. The professor can also provide general information about program planning and curriculum development. The course professor welcomes students' comments on the course.

Services to Students

Athabasca University offers a wide range of services to its students. The Athabasca University Information Centre (1.800.788.9041) can help you find the answer to most administrative questions. The Centre is staffed on regular business days from 7:00 a.m. to 5:30 p.m. Mountain Time.

Advisors are available to assist students in planning their programs and selecting appropriate courses. Counsellors assist students in improving their study skills and clarifying their educational goals. You may reach an advisor or counsellor in several ways: by dialling 1.800.788.9041 and asking to speak with an advisor or counsellor; by visiting Athabasca University's Central Office in Athabasca, or the Learning Centre in Edmonton or Calgary; or by directing your query to

http://www.askau.ca

Students who are looking for information about student awards and advice about obtaining financial assistance are asked to contact the Office of the Registrar. You may do so by dialling 1.800.788.9041 and asking for the Office of the Registrar, or by inquiring through

http://www.askau.ca

Note: Students may write examinations at the Athabasca University Central Office in Athabasca, at one of the Learning Centres, or at the other locations listed online at

http://www.athabascau.ca/registrar/invignet.php

At the Learning Centres, students can also order materials from the Library, and take care of various administrative matters, such as course registration and arrangements for extensions. Other services include advice on program planning and course selection, on developing a successful approach to studying at a distance, on improving study habits and skills, and on career and educational goal setting.

Indigenous Services at Athabasca University

If you are a student of Indigenous ancestry (Aboriginal, First Nations, Indian, Inuit, Native, Métis) or a non-Indigenous student who is interested in identifying culturally appropriate services designed for Aboriginal students or counselling that is sensitive to the challenges Aboriginal students face, please contact the Centre for World Indigenous Knowledge and Research, by telephone at 1.800.788.9041, extension 2064, or by electronic mail at

indigenous@athabascau.ca

Library Services

The Athabasca University Library collection contains more than 140,000 books, many periodical titles, and a range of audio-visual resources. The Library subscribes to over 100 online databases, providing full text access to selected articles from more than 20,000 journals.

Athabasca University Library's collection primarily supports Athabasca University courses and programs. Materials found in the print and electronic collections are available for use by our students, faculty, and staff for reference and research purposes. Requests for library materials or services can be made, by e-mail, phone, fax, or mail, 24 hours a day (contact information is provided below). Responses to most requests are handled within 24 hours, or by the next business day. Borrowed materials are normally mailed to the student's home address, along with a return-mail card.

Core Services to Students

Athabasca University students registered in a course may

- borrow library materials.
- search the Library's online catalogue (AUCAT).
- access resources through the Library's Web site.
- receive library instruction and research assistance.
- request interlibrary loan (ILL) services for journal articles and book chapters.

Digital Resources

Access to online journal databases, the Digital Reference Centre (DRC), and the Digital Reading Room (DRR) is available from Athabasca University Library's main Web page

http://library.athabascau.ca

Tips on searching the journal databases and help with researching, writing, and citing (referencing) can be found in the Help Centre

http://library.athabascau.ca/help.php

Supplementary Materials

University courses often require that students investigate material beyond the contents of the course materials package. Some Athabasca University course *Study Guides* list "Supplementary Materials," including books, journal

articles, or audio-visual materials, which students may find useful when completing assignments and course projects. The supplementary materials referenced in your course materials package are usually available from the Athabasca University Library or your local library. Contact the Athabasca University Library to request materials.

How the Library Gateway Works

The Library Web site contains the Library's online catalogue (AUCAT), and it is also the gateway to other online information. The Web site provides links to journal databases and other subscribed online resources, as well as to selected, publicly accessible Internet sites. Subscribed resources are available to Athabasca University students, faculty, and staff. You will be required to enter your first and last names as your username, and your student ID number as your password.

The Library Web site also provides access to selected library catalogues from Canadian public and academic libraries.

Interlibrary Loans

An interlibrary loan (ILL) involves one library borrowing materials from another on behalf of a library user. Athabasca University Library will request photocopies of journal articles and book chapters through Interlibrary Loans, if you provide the Library staff with a complete bibliographic citation (author, title of article, name of journal, volume and issue number, year of publication, and page numbers) for the requested item. You are not required to return these items to us. Allow sufficient time for the material to be ordered and received. More information on the Interlibrary Loan process is available on the Library Web site at

http://aupac.lib.athabascau.ca/screens/ill.html

Contacts

Athabasca University Library
1 University Drive
Athabasca, AB Canada T9S 3A3

Library web site: http://library.athabascau.ca
E-mail: library@athabascau.ca

Phone: 1.800.788.9041 (ext. 6254) Canada/US
780.675.6254 Other
403.263.6465 (ext. 6254) in Calgary
780.421.8700 (ext. 6254) in Edmonton
Fax: 780.675.6477

Supplementary Materials

You will find all the information you need to master the objectives in the textbook and associated materials. However, if you want additional information or a different perspective on a topic, or if you want to read more about a subject that interests you, ask your tutor if he or she can suggest suitable books, articles, or audio visual aids pertaining to that particular topic. The Athabasca University library has, or will attempt to obtain, copies of all the materials that your tutor might recommend, and these materials can be sent to you on request.

Study Strategies

Chemistry 217 is a three-credit course and must be completed within six months of your official start date. This may seem like a long time, but procrastination can rapidly put you in a difficult position. We suggest you start right away and that you establish a study schedule. Your tutor can help you.

How fast you proceed through the first few units will depend on your background in general chemistry. If your background is weak, you may have to put in extra time, and this may affect your chances of completing the course within the normal six-month contract period. If you find that you really have trouble with Units 1 and 2, you should discuss the situation with your tutor and consider withdrawing from the course or taking some action to improve your understanding of chemistry and mathematics.

At a traditional university, this course would normally be spread over one semester and take about 12-13 weeks to complete. If you wish to attain this rate, follow the 13-week study schedule shown in the "Course Outline and Study Schedules" section of this *Student Manual*. If you wish to proceed at somewhat slower pace, refer to the 18- and 26-week schedules when you plan your own personal study schedule. Remember that regular study habits can be a major contributing factor to ultimate success in this course. Should unforeseen circumstances put you in a position where you find that you cannot complete the course within six months, check the *Athabasca University Calendar* for current regulations about extensions. [You may wish to check these regulations now, to ensure that you apply in a timely manner.]

We have found that many of the initial difficulties our students have with this course stem from weak skills in mathematics. Your skills may be somewhat rusty if you have not used them for a while. We have designed a math skills questionnaire that will help you assess your skill level and determine which areas require more review. The questionnaire appears in Appendix B of this manual.

We suggest that you start with the math skills questionnaire now. Once you have finished, go to Unit 1. As you work through Unit 1, make a note of any questions you have on content, study procedures, etc. Then, before you go on to the next unit, contact your tutor to clear up these questions.

Assessment

The assessment of students in this course is based on examinations, tutor-marked assignments, and laboratory work. Details are given in the table below. To obtain credit for *Chemistry 217*, you must complete *all* of the course work, and achieve

- an overall (composite) mark of at least 50%.
- at least 50% on each of the two examinations.

Component		**Percentage of total mark**
Midterm Examination (2 hours)	Covering Units 1-7	20%
Final Examination (3 hours)	Covering Units 1-13	40%
Tutor-marked Assignments	Following Units 4, 7, 9, and 13	20%
Laboratory Work		20%

Both examinations are supervised and "closed-book." However, you will be supplied with a periodic table and a list of appropriate data (physical constants, etc., but not formulas).

Remember: You must be sure to have your own electronic calculator with you when you write an examination. You should also take along a pencil, in case you are required to draw a graph in any of the questions.

The sample midterm and final examinations given in this *Student Manual* under "Sample Examinations" are an excellent study resource.

The midterm examination covers only the material in Units 1-7, while in the final examination, the emphasis (60-70%) is on Units 8-13.

If you are not satisfied with the mark you obtain on your first attempt at an examination, you may re-write that examination. The supplemental examination will be similar in format to the first one, and the higher of the two marks will be used when your overall course mark is determined. You *must* write a supplemental if you obtain less than 50% on an examination. Note that there is a fee for supplemental examination services.

The following hints may help you to write examinations successfully.

1. Write an examination only when you and your tutor feel that you are adequately prepared, and when you have successfully completed the relevant tutor marked assignments.

2. Remember that each examination is based on the list of objectives provided in each unit of the *Study Guide.*

3. Many of the questions will be similar in format to those given in the tutor-marked assignments and in the sample examinations in this manual.

4. For short-answer questions, do the ones that you find easiest first. This procedure has two benefits. First, you can more quickly accumulate enough marks to pass the examination. Second, you gain confidence to tackle the harder questions.

5. For numerical, long-answer problems, show your work! Part marks will be given for correct methods, even if your answer is incorrect.

6. The answers to numerical problems should be given to the correct number of significant figures, and where appropriate, with the correct units. Marks may be deducted if answers are given to an incorrect number of significant figures or in the wrong (or no) units.

Please see the section of this manual titled "Applying for and Writing Examinations" for further information.

Tutor-marked Assignments

Each of the tutor-marked assignments below is worth five per cent of your final course grade. The assignments consist of two parts: a series of questions taken from the textbook chapters, and sets of laboratory exercises taken from the *Virtual ChemLab* (VCL) included in the *MediaPak* that forms a part of your course materials. Note that for VCL exercises, you are asked to complete the tear-out worksheet for the designated exercise.

After you complete each assignment, submit it to your tutor for grading. Remember to attach a tutor-marked exercise form, from the course package, and to keep a copy (at least a rough draft) for your own files.

Tutor-marked Assignment 1 (Units 1-4)

	Problems	**VCL Worksheets**
Unit 1 / Chapter 1	1.28, 1.70	—
Unit 2 / Chapter 2	2.10, 2.30, 2.48, 2.108	VCL 2-3
Unit 3 / Chapter 3	3.52, 3.100, 3.120	VCL 3-8
Unit 4 / Chapter 4	4.52, 4.102, 4.111	—

Tutor-marked Assignment 2 (Units 5-7)

	Problems	**VCL Worksheets**
Unit 5 / Chapter 5	5.38, 5.56, 5.64, 5.72, 5.114, 5.129	VCL 5-5
Unit 6 / Chapter 6	6.54, 6.60, 6.110	VCL 6-2
Unit 7 / Chapter 7	7.26, 7.50, 7.104, 7.119	VCL 7-1

Tutor-marked Assignment 3 (Units 8 and 9)

	Problems	**VCL Worksheets**
Unit 8 / Chapter 8	8.20, 8.28, 8.50, 8.52, 8.62, 8.66, 8.98, 8.106	—
Unit 9 / Chapter 9	9.22, 9.36, 9.48, 9.54, 9.66, 9.68, 9.90, 9.97	—

Tutor-marked Assignment 4 (Units 10-13)

	Problems	**VCL Worksheets**
Unit 10 / Chapter 10	10.40, 10,97, 10.124	VCL 10-6
Unit 11 / Chapter 11	11.22, 11.40, 11.60, 11.78	—
Unit 12 / Chapter 12	12.28, 12.38, 12.84	—
Unit 13 / Chapter 13	13.44, 13.72, 13.90, 13.121	VCL 13-8

Applying for and Writing Examinations

Before you write the final examination for this course, you should have submitted all of your required course assignments and received feedback from your tutor.

Although you do not need permission to apply for an examination, you are advised to consult your tutor about your readiness to write, and about examination writing strategies. Your tutor can also provide information about the examination format, and about study strategies.

To request an examination follow the steps below. Remember that requests for examinations from students in North America must be received by the Office of the Registrar a minimum of 15 business days before the intended writing date. Students elsewhere must allow additional time for shipment of examination materials.

1. Review the "Examinations and Grades" section of the current *Athabasca University Calendar*.

2. Arrange for a time to write your examination with one of Athabasca University's Examination Centres or with an invigilator. For a list, see the Web site

   http://www.athabascau.ca/registrar/invignet.php

   If you would like to use an invigilator who has not been approved by the Office of the Registrar, you may propose their approval by filling in the appropriate details on the online Examination Request Form. Keep in mind that invigilators may charge a fee, for which you will be responsible.

3. Complete and submit the online Examination Request Form. If you do not have access to the Internet, fill out the Examination Request Form from your course materials package and submit it by fax (780.675.6174); or in person or by postal mail to Examination Services, Office of the Registrar, at Athabasca University's central office.

   Note: To minimize the time required to process your application, be sure that you provide all of the information requested on the form, and that you write legibly.

4. Confirm that your invigilator has received the examination package before you arrive to write your examination. Take picture identification and your student number with you when you go to the examination site.

The examination results and your final grade will be sent to you approximately four to six weeks after you write the examination. The examination paper and your booklets or answer sheets will not be returned to you.

Appeals to examination or assignment grades should be discussed first with your tutor or instructor. For the correct procedure, see "Student Code of Conduct and Right to Appeal Regulations" in the current *Athabasca University Calendar.*

Plagiarism and Academic Honesty

Students enrolled in an Athabasca University course such as *Chemistry 217* are considered to be responsible scholars, and are therefore expected to adhere rigorously to the principles of intellectual honesty. Plagiarism is a form of intellectual dishonesty in which another's work is presented as one's own. As is the case with any form of academic misconduct, plagiarism will be severely penalized. Depending on the circumstances, penalties may involve rejection of the submitted work; expulsion from the examination, the course or the program; or legal action

Students sometimes commit plagiarism inadvertently. To avoid doing so, make certain that you acknowledge all your sources both primary and secondary in a full and consistent manner. All direct quotes (quotations from the original work) and indirect quotes (paraphrases of ideas presented in the original work) must be acknowledged. There are three conventional ways of acknowledging your sources: in-text citations, footnotes or endnotes. We prefer that you use endnotes. Whenever you use someone else's work, place a subscript number at the end of that sentence or paragraph. The numbers refer to a list of notes (or references) at the end of your writing assignment. This list must provide the author's name, the title of the work, the name of the publisher and the place of publication, the page on which the cited material appears, and the date of publication.

Note that all of the assignments you submit for *Chemistry 217* must be original work completed especially for this course. The use of assignments you have completed for other courses, or assignments completed by other students, are both considered cheating, and will be penalized as such.

Transferring Credit

If you wish to transfer credit to another institution, contact the Office of the Registrar at Athabasca University. Remember, though, that transfer of credit is determined by the *receiving* institution. If you plan to transfer *Chemistry 217* to another institution, we suggest you get an agreement, in writing, from that institution.

Transcripts

A student may request an official transcript by completing a paper "Transcript Request" form, by writing to the Office of the Registrar, by appearing at the Office of the Registrar in person, or by using the secure online request form. For instructions on making an online request, please see

http://www.athabascau.ca/registrar/transcripts_FAQ.php

Only the student whose transcript is being issued may make the request, and a paper request must bear the student's signature.

No partial transcripts are issued. The student's entire record is shown on each transcript.

Most institutions and agencies require that official transcripts be sent directly from Athabasca University. Please allow a minimum of ten working days for the receipt of a transcript. Consult the current edition of the *Athabasca University Calendar* for further information about transcripts.

Applying for Extensions

If you are unable to complete this course within the six-month course contract period, you may apply for and purchase up to three, two-month extensions. Note that extension request forms must be received by the Office of the Registrar a minimum of one month before the end of your course contract. Requests for second and third extensions must be received by the Office of the Registrar a minimum of one month before the expiry of the previous extension. Consult the online *Athabasca University Calendar* for more information about obtaining extensions.

Course Outline and Study Schedules

The table below gives a brief course outline and suggests the amount of time students should spend on each unit for 13-, 18- and 26-week schedules.

Note: Students who are receiving financial assistance may face special time constraints. Please check your course registration for any restrictions on the length of registration, and be prepared to adjust your schedule.

Unit number and title		13-week schedule	18-week schedule	26-week schedule
1	Introduction: Matter and Measurement	Week 1	Week 1	Week 1
2	Atoms, Molecules, and Ions	Week 1	Week 2	Weeks 2
3	Stoichiometry: Calculations with Chemical Formulas and Equations	Week 2	Week 3	Week 3
4	Aqueous Reactions and Solution Stoichiometry (TMA 1)	Week 2	Week 4	Week 4
5	Thermochemistry	Week 3*	Week 5	Weeks 5-6
6	Electronic Structure of Atoms	Week 4	Weeks 6-7*	Weeks 7-9
7	Periodic Properties of the Elements (TMA 2)	Week 5	Weeks 8-9	Weeks 10-12*
	Review for and write Midterm Examination	Week 6	Week 10	Week 13
8	Basic Concepts of Chemical Bonding	Week 7	Weeks 11-12	Weeks 14-15
9	Molecular Geometry and Bonding Theories (TMA 3)	Week 8	Week 13-14	Weeks 16-18
10	Gases	Week 9	Week 15	Weeks 19-20
11	Intermolecular Forces, Liquids, and Solids	Week 10**	Week 16**	Weeks 21-22
12	Modern Materials	Week 11	Week 16	Weeks 22-23**
13	Properties of Solutions (TMA 4)	Week 12	Week 17	Weeks 24-25
	Review for and write Final Examination	Week 13	Week 18	Week 26

* Request Midterm Examination
** Request Final Examination

Sample Examinations

On the following pages you will find sample examinations that will help you to prepare for your midterm and final examinations. We have included such questions in this manual so that students may obtain a better idea of the length of a normal Athabasca University chemistry examination. Short answers for the questions are given at the end of the sample examinations.

During an actual examination you would be provided with a periodic table and a data sheet of physical constants. Note that the data sheet contains no formulas.

Examination answer keys appear in Appendix A of this manual.

Sample Midterm Examination

The midterm examination is two (2) hours long. In the actual examination you would not be allowed consult your books or notes; however, you would be able to use a calculator. We strongly recommend that you sit this examination as if you were writing it in an invigilated setting. You will get a much better idea of your degree of preparedness for the actual examination.

Part A: Short-answer Questions (1 mark each)

1. Calculate the density of bromine, given that 120.0 mL has a weight of 374.3 g. Report your answer to the correct number of significant figures and in units of g/mL.

2. What is the name of the compound $FeCl_3$?

3. What is the chemical formula of ammonium chlorate?

4. How many neutrons are in the nucleus of the isotope $^{238}_{92}U$?

5. What is the weight percentage of P in H_3PO_4? Report your answer to three significant figures.

6. What is the molar mass of $SnCl_2$? Report your answer to two decimal places.

7. 20.0 g each of BeO, carbon, and chlorine are mixed together and react according to the following equation. What is the theoretical yield of $BeCl_2$? Report your answer in grams, to three significant figures.

$$BeO(s) + C(s) + Cl_2(g) \; ? \; BeCl_2(g) + CO(g)$$

8. Write a balanced net ionic equation for the reaction between lead nitrate and sodium chloride, in solution.

9. What is the molarity of a 1.10 L solution containing 8.30 g of $CaCl_2$? Report your answer to the correct number of significant figures.

10. How many millilitres of 0.305 M NaOH would be required to titrate a 5.00 mL solution of 0.616 M HBr? Report your answer to the correct number of significant figures.

11. Write a balanced chemical equation for the combustion of benzene, C_6H_6.

12. If the standard heat of combustion of benzene is –3271 kJ / mol, $\Delta H_f^\circ[(CO_2(g)] = -394$ kJ / mol, and $\Delta H_f^\circ[H_2O(l)] = -286$ kJ / mol, calculate the standard heat of formation of benzene. Report your answer to the correct number of significant figures.

13. If a gas sample absorbs 59 kJ of heat and does 21 kJ of work, what is the change in its internal energy? Report your answer to the correct number of significant figures.

14. What is the energy of a photon of electromagnetic radiation having a wavelength of 436 nm? Report your answer in joules, to the correct number of significant figures.

15. Write the label of an orbital having the quantum numbers $n = 4$, $l = 0$, $m_l = 0$.

16. Write the electron configuration for a sulphur atom.

17. Write the electron configuration for a xenon atom.

18. Write a chemical equation corresponding to the second ionization energy of calcium.

19. Write down the second period elements (i.e., lithium through neon), in order of increasing atomic radius.

20. Write the chemical equation for calcium reacting with water.

Part B: Long-answer Questions (5 marks each)

21. In a combustion analysis, 0.7308 g of an organic compound yielded 2.0840 g CO_2 and 0.4874 g H_2O. From mass spectrometry, it was found that the molecular weight for the compound is 108 amu. Determine the mass composition of this compound, its empirical formula, and its molecular formula.

22. Define enthalpy in terms of internal energy, heat, and P-V work. What measurable quantity is equal to enthalpy change?

23. Explain how the periodic table is organized on the basis of electron configurations. Specifically, explain how periods, groups, and blocks are defined by similarities in electron configurations.

24. The following table gives the first ionization energies for the second period elements. Using electron configurations, explain why boron and oxygen have lower ionization energies than would be expected based on the general trend.

Element	Li	Be	B	C	N	O	F	Ne
IE (kJ/mol)	520	899	801	1086	1402	1314	1681	2081

Sample Final Examination

The final examination is three (3) hours long. In the actual examination you would not be allowed consult your books or notes; however, you would be able to use a calculator. We strongly recommend that you sit this examination as if you were writing it in an invigilated setting. You will get a much better idea of your degree of preparedness for the actual examination.

Part A: Short-answer Questions (1 mark each)

1. What is the chemical formula of ferric nitrate?

2. How many grams of KBr are contained in 200 mL of a 0.310 M KBr solution? Report your answer to three significant figures.

3. In an experiment, 5.00 g of Mg(s) was reacted completely with $Cl_2(g)$ to form $MgCl_2(s)$ and 63.0 kJ of heat was evolved. What is the molar enthalpy of formation of $MgCl_2(s)$? Report your answer in kJ/mol, to three significant figures.

4. What is the de Broglie wavelength of an electron travelling at 2.0×10^8 m/s? Report your answer in metres, in scientific notation, to two significant figures.

5. What is the energy of a photon released when an electron goes from $n = 3$ to $n = 1$ energy levels in a hydrogen atom? Report your answer in joules, in scientific notation, to two significant figures

6. Write the electron configuration of germanium.

7. Write the chemical equation for the reaction of SO_2 with water.

8. What is the electron configuration of a Cr^{3+} ion?

9. List the following ions in order of increasing ionic radius: S^{2-}, Cl^{-}, K^{+}, Ca^{2+}.

10. List the following compounds in order of increasing lattice energy: LiF, LiCl, MgO, $MgSO_4$.

11. In the space below, draw a Lewis structure for SO_4^{2-} that minimizes formal charges.

12. What is the molecular geometry of the perchlorate ion?

13. What is the molecular geometry of the SO_3 molecule?

14. What is the approximate F—C—F bond angle in CH_2F_2?

15. What is the hybridization of the central atom in AsH_3?

16. What is the hybridization of the central atom in BrF_5?

17. How many electrons are in π^* orbitals in the molecule N_2?

18. What is the bond order in O^{2+}?

19. What is the density of pure nitrogen gas at STP (1.00 atm and 273.15 K)? Report your answer to three significant figures and in units of g/L.

20. What is the change in pressure of a sample of gas when its volume is increased by a factor of two, and its temperature is increased by a factor of two?

21. Calculate the ratio of rates of effusion of CO_2 versus NO_2. Report your answer to three significant figures.

22. What is the partial pressure of oxygen in the atmosphere, at STP, if oxygen makes up 21% of the atmosphere, by volume. Report your answer in atmospheres, to two significant figures.

23. Under what conditions of pressure and temperature is a real gas most expected to exhibit ideal gas behaviour?

24. What intermolecular interactions would be the strongest between molecules of hydrogen sulphide?

25. List the following substances in order of increasing boiling point: N_2, O_2, F_2, Ne.

26. In which type of liquid crystal are the molecules ordered in one dimension?

27. Suggest an element to add to pure silicon to make a *p*-type semiconductor.

28. The vapour pressure of water at 20°C is 17.5 torr. What is the vapour pressure of water above an aqueous solution that is 40.0% glucose ($C_6H_{12}O_6$) by mass? Report your answer to three significant figures.

29. Calculate the boiling point of a 1.1 m sucrose aqueous solution, at STP (K_b = 0.51°C/m). Report your answer to two decimal places.

30. What is the molality of the final solution when 12.0 g of NaCl is dissolved in water to form 1530 g of solution? Report your answer to three significant figures.

Part B: Long-answer Questions (5 marks each)

31. In a calorimetry experiment, the following reaction was studied:

$$2NaOH(aq) + H_2SO_4(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$$

100.0 mL portions of 1.00 M NaOH and H_2SO_4, at 24°C, were mixed. The maximum temperature achieved was 30.6°C. Neglecting the heat capacity of the coffee-cup calorimeter, and assuming that the products has a density of 1.0 g/mL and a heat capacity of 4.184 $Jg^{-1}K^{-1}$, calculate

a. the heat released in the reaction, in J.

b. ΔH_{rxn}, in kJ/mol of Na_2SO_4 produced.

32. Given the data table of average bond enthalpies below, estimate the ΔH_{rxn} for the reaction

$$CH_3CHCH_2 + HBr \longrightarrow CH_3CHBrCH_3$$

Bond	**Average Bond Enthalpy (kJ/mol)**
C—H	413
C—C	348
C—Br	276
H—Br	366
C═C	614

33. a. Draw five valid Lewis resonance structures for the phosphate ion.

    b. Identify the most valid structure or structures.

    c. Is the octet rule obeyed in all of the structures? If not, how is this possible?

    d. What is the hybridization of phosphorus in each of your Lewis resonance structures?

34. Draw molecular orbital energy diagrams for H_2, H_2^+, H_2^-, He_2, and He_2^+. What is the bond order in each of these species?

35. When calcium carbide (CaC_2) reacts with water, the gas acetylene (C_2H_2) is evolved.

    a. Write a balanced chemical equation for this reaction.

    b. If 2.00 g of CaC_2 reacts with water at 25°C, what volume of C_2H_2 is collected at 760 torr?

       Note: The vapour pressure of water at this temperature is 23.8 torr.

36. Describe the structure and bonding in diamond and graphite, which are two forms of pure carbon. In your description, include orbital hybridizations and bond angles. How do the network covalent structures of diamond and graphite translate into different physical properties?

Appendix A: Answer Keys

Sample Midterm Examination

Part A: Short Answer Questions

1. 3.119 g/mL
2. ferric chloride
3. NH_4ClO_3
4. 146 neutrons
5. 31.6%
6. 189.62 g/mol
7. 22.5 g
8. $Pb^{2+}(aq) + 2Cl^{-}(aq) \longrightarrow PbCl_2(s)$
9. 6.80×10^{-2} M
10. 10.1 mL
11. $C_6H_6 + 15/2\ O_2 \longrightarrow 6CO_2 + 3H_2O$
12. –49 kJ/mol
13. + 38 kJ
14. 4.56×10^{-19} J
15. $4s$
16. $[Ne]3s^2 3p^4$
17. $[Kr]4d^{10}5s^2 5p^6$
18. $Ca^{+}(g) \longrightarrow Ca^{2+}(g) + e^{-}$
19. Ne < F < O < N < C < B < Be < Li
20. $Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$

Part B: Long-answer Questions

21. Moles of carbon in sample =

$$(2.0840 \text{ g } CO_2) \times \frac{1}{44.01 \text{ g/mol } CO_2} = 0.04735 \text{ mol C}$$

Mass of carbon in sample =

$$(0.04735 \text{ mol C}) \times (12.10 \text{ g/mol C}) = 0.5687 \text{ g C}$$

Moles of hydrogen in sample =

$$(0.4874 \text{ g } H_2O) \times \frac{2 \text{ mole H}}{1 \text{ mole } H_2O} \times \frac{1}{18.02 \text{ g/mol } H_2O} = 0.5410 \text{ mol H}$$

Mass of hydrogen in sample =

$$(0.05410 \text{ mol H}) \times (1.008 \text{ g/mol H}) = 0.05453 \text{ g H}$$

Assume that the remainder of the sample is oxygen.

Mass of oxygen in sample =

$$(0.7308 \text{ g sample}) - (0.5687 \text{ g C}) - (0.05453 \text{ g H}) = 0.1076 \text{ g O}$$

Moles of oxygen in sample =

$$(0.1076 \text{ g O}) \times \frac{1}{16.00 \text{ g/mol O}} = 0.006723 \text{ mol O}$$

Converting the mole ratio into a whole number ratio:

$$C : H : O = 0.04735 : 0.05410 : 0.006723 \cong 7 : 8 : 1$$

Therefore, the empirical formula is C_7H_8O.

The formula weight of C_7H_8O = 108.15 g/mol.

As the formula weight corresponds to the molecular weight of 108 amu, the molecular formula is C_7H_8O.

22. Enthalpy (H) is defined as the sum of the internal energy (E) of a system and the product of pressure and volume (PV): $H = E + PV$.

The change in enthalpy (ΔH) is: $\Delta H = \Delta(E + PV) = \Delta E + P\Delta V$.

The change in internal energy, ΔE, is equal to heat (q) plus work (w). If the work is P-V work and it occurs under constant pressure, then $\Delta E = q_p + w$.

Substituting, $\Delta H = \Delta E + P\Delta V = (q_p + w) - w = q_p$.

Thus, enthalpy change is the same as the heat transferred at constant pressure. This is useful in chemistry because it is relatively straightforward to measure q_p in the laboratory; for example, using a coffee-cup calorimeter.

23. The periodic table is constructed using the *aufbau* (building up) principle, where electrons are sequentially added in order of orbital energies.

    Across a period, in a given block, the valence electrons are all in orbitals having the same principal quantum number. For example, in the second period, all of the elements have valence electrons in orbitals with $n = 2$.

    In each block, the valence electrons are in the same type of orbital (*s*, *p*, *d*, or *f*), having the same angular momentum quantum number. For example, in the *d* block, elements Cr and Mn have valence electron configurations of $3d^6$ and $3d^7$.

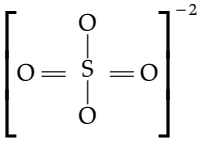
    Within a vertical group, valence electrons are in the same basic configuration, but the principal quantum number is different. For example, the valence electron configurations of Li and Na are $2s^1$ and $3s^1$, respectively.

24. Boron's valence electron configuration is $2s^2 2p^1$. On going from Be to B, the nuclear charge goes from 4 to 5, but the additional electron is in the $2p$ subshell, which is slightly further from the nucleus and experiences the shielding effects of the $2s^2$ electrons. Thus, its first IE is lower than expected.

    Oxygen's valence electron configuration is $2s^2 2p^4$. On going from N to O, the additional electron must go into a $2p$ orbital that already has an electron. That is, it must be paired. This causes more electron repulsions (i.e., shielding), and lowers the IE.

Sample Final Examination

Part A: Short-answer Questions

1. $Fe(NO_3)_3$
2. 7.38 g
3. 306 kJ/mol
4. 3.6×10^{-12} m
5. 1.9×10^{-18} J
6. $[Ar]3d^{10}4s^24p^2$
7. $SO_2 + H_2O \longrightarrow H_2SO_3$
8. $[Ar]3d^3$
9. $Ca^{2+} < K^+ < Cl^- < S^{2-}$
10. $LiCl < LiF < MgSO_4 < MgO$
11. 
12. tetrahedral
13. trigonal planar
14. 109.5°
15. sp^3
16. sp^3d^2
17. none
18. 2.5
19. 1.25 g/L
20. no change in pressure
21. $\frac{\text{rate } (CO_2)}{\text{rate } (NO_2)} = 1.01$
22. 0.21 atm
23. low pressure, high temperature
24. dipole-dipole

25. $Ne < N_2 < O_2 < F_2$

26. nematic liquid crystal

27. gallium

28. 16.4 torr

29. 100.56°C

30. 0.135 m

Part B: Long-answer Questions

31. a. $\text{Heat} = (30.6^\circ\text{C} - 24^\circ\text{C}) \times (4.184\ \text{J g}^{-1}\text{K}^{-1}) \times (1.0\ \text{g/mL}) \times (100.0\ \text{mL}) = 5.5 \times 10^3\ \text{J}$

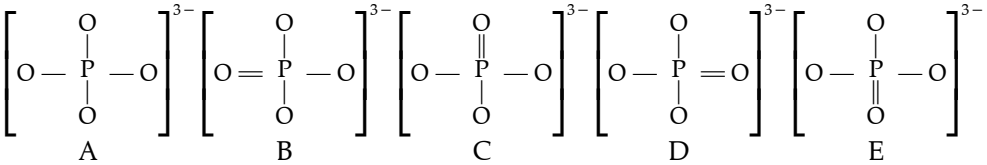
b. $n\text{Na}_2\text{SO}_4 = (100.0\ \text{mL}) \times \left(\frac{1\ \text{L}}{1000\ \text{mL}}\right) \times (1.00\ \text{M NaOH}) \times \left(\frac{1\ \text{mol Na}_2\text{SO}_4}{2\ \text{mol NaOH}}\right) = 0.0500\ \text{mol Na}_2\text{SO}_4$

$$\Delta H_{\text{rxn}} = \frac{5.5 \times 10^3\ \text{J}}{0.0500\ \text{mol Na}_2\text{SO}_4} \times \frac{1\ \text{kJ}}{1000\ \text{J}} = 110\ \text{kJ/mol}$$

32. Bonds broken: H—Br, C═C
Bonds made: C—C, C—H, C—Br

$$\begin{aligned}\Delta H_{\text{rxn}} &= \sum(\text{bond enthalpies, bonds broken}) - \sum(\text{bond enthalpies, bonds made}) \\ &= [D(\text{H—Br}) + D(\text{C═C})] - [D(\text{C—C}) + D(\text{C—H}) + D(\text{C—Br})] \\ &= [366 + 614] - [348 + 413 + 276]\ \text{kJ/mol} \\ &= -57\ \text{kJ/mol}\end{aligned}$$

33. a.



A B C D E

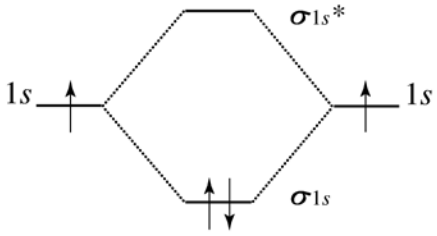
b. Structures B, C, D, and E are most valid, because they minimize formal charges.

c. No, the octet rule is violated in structures B, C, D, and E. This is possible because phosphorus has low-lying 3*d* orbitals available.

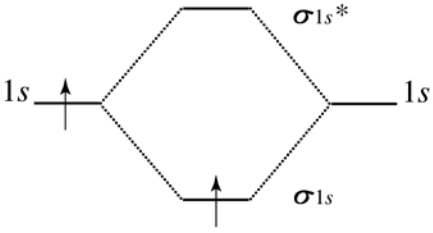
d. structure A: sp^3
structures B, C, D, E: sp^3

34.

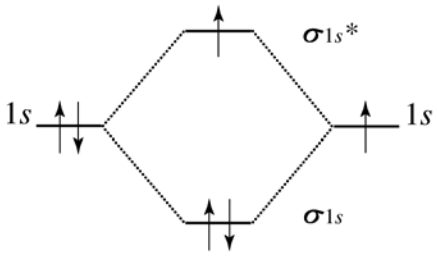
H_2, bond order = 1



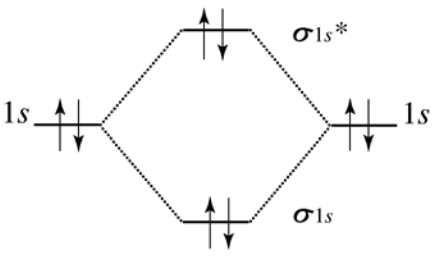
H_2^+, bond order = 0.5



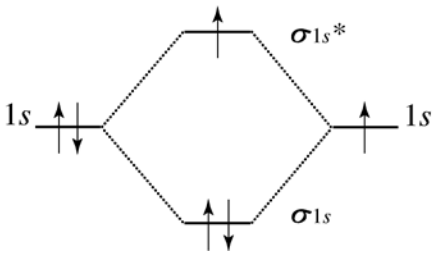
H_2^-, bond order = 1



He_2, bond order = 0



He_2^+, bond order = 0.5



35. a. $CaC_2 + 2H_2O \longrightarrow C_2H_2 + Ca(OH)_2$

b. moles C_2H_2 = moles CaC_2

$$= 2.00 \text{ g} \times \frac{1 \text{ mole } CaC_2}{64.10 \text{ g}} = 0.0312 \text{ mol } C_2H_2$$

Pressure $C_2H_2 = P_{TOTAL} - P_{WATER} = 760 \text{ torr} - 23.8 \text{ torr} = 736.2 \text{ torr}$

Using the ideal gas law,

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(0.0312 \text{ mole})(0.08206 \text{ L atm K}^{-1} \text{ mol}^{-1})(298 \text{ K})}{(736.2 \text{ torr})\left(\frac{1 \text{ atm}}{760 \text{ torr}}\right)}$$

$$= 0.788 \text{ L}$$

36. In diamond, carbon atoms are sp^3 hybridized, and are tetrahedrally bonded to other carbon atoms in a three-dimensional lattice of sigma bonds. Bond angles are 109.5°, because of the sp^3 hybridization.

In graphite, carbon atoms are sp^2 hybridized, and are bonded to other carbon atoms in two-dimensional sheets of hexagons, similar to a honeycomb, stacked together. Bond angles are 120°, because of the sp^2 hybridization. Bonding involves sigma bonds, and delocalized pi bonding throughout individual sheets.

As diamond involves a three-dimensional covalent bonding network, its physical properties include being very hard and having a very high melting point. Graphite is not as hard, and it is brittle because individual sheets are not covalently bonded to neighbouring sheets, and mechanical stress can cause them to separate.

Appendix B: Math Skills for Chemistry 217

Adapted from Athabasca University's *Math Skills Questionnaire*,
by Virginia Nilsson.

The purpose of the following questionnaire is to allow you to evaluate your math skills before proceeding with this course. Your success in *Chemistry 217* will depend, in part, on your performance of mathematical calculations. You probably used all of these skills in high school, but may have forgotten some of them over the years. Please complete the questionnaire and score yourself by checking the solutions at the end.

Note: You may use a calculator as you work through this questionnaire.

Exponents (Scientific Notation)

1. Write 1,200,000 in exponential form (i.e., in "scientific notation").

2. Write 0.000054 in exponential form.

3. Calculate the expressions below.

   a. $(6.40 \times 10^{-1}) + (1.1 \times 10^{-2})$

   b. $(3.20 \times 10^{-2}) - (3.2 \times 10^{-3})$

   c. $(2.50 \times 10^{-3}) - (3.0 \times 10^{-1})$

d. $\frac{(2.016)}{6.02 \times 10^{23}}$

e. $(2.0 \times 10^{-4})(5.0 \times 10^{-4})^2$

Fractions, Decimals, and Percentages

4. Express 75% as a fraction.

5. Express 75% as a decimal.

6. A student obtains 68 of a possible 80 marks on a chemistry examination. Express this grade as a percentage.

Algebra

7. If $x = \frac{(y - 32)5}{9}$, find the value of x when $y = 59$.

8. If $a = b - 298c$, find the value of c when $a = 370$ and $b = 105$.

9. Find the value of x if $27x^3 = 4.8 \times 10^{-56}$.

10. The formula for solving a quadratic equation of the type $ax^2 + bx + c = 0$ is

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Find the two possible values for x if

$$x^2 + (1.8 \times 10^{-5}x) - (1.80 \times 10^{-6}) = 0$$

Averages

11. A certain small industrial firm pays 65.0% of its workers \$7.50 per hour and 25.0% of its workers \$8.50 per hour. The remaining workers are much more fortunate and earn \$10.50 per hour. Calculate the average hourly wage paid by the company.

Logarithms and Natural Logarithms

12. Determine the logarithm (to the base 10) of 0.1542.

13. Find the value of x if

    a. $x = -\log_{10}(2.5 \times 10^{-3})$

    b. $x = \log_{10}\left(\frac{2.5 \times 10^{-3}}{2.5 \times 10^{-2}}\right)$

14. Find the value of x if

    a. $-\log_{10} x = 11.45$

    b. $\log_{10} x = 107$

15. If $y = e^{-x}$, then $\log_e y =$ _____.

16. What is the relationship between $\log_e y$ (or $\ln y$) and $\log_{10} y$?

Approximations and Assumptions

17. Given the equation $(0.01 - x)x = 2.0 \times 10^{-8}$, and the assumption that x is much smaller than 0.01, determine the (approximate) value of x without setting up a quadratic equation.

Graphs

18. Al Berta makes widgets for The Exploitation Co. of Edmonton and is paid a basic hourly wage of $\$B$ per hour, plus a bonus which depends on the number of widgets he produces each hour. Some examples of Al's total hourly pay ($\$T$) and the number of widgets produced per hour (n) are given below.

Widgets/hour (n)	100	120	150	170	210	250
Total hourly pay ($\$T$)	4.70	4.94	5.30	5.54	6.02	6.50

On the graph paper provided, plot a graph of Al's total hourly pay (y axis) against the number of widgets produced per hour (x axis). From the graph determine:

a. Al's basic hourly wage (i.e., how much is he paid per hour even if he does not produce any widgets).

b. the bonus paid by The Exploitation Co. for each widget that Al produces.

c. the number of widgets that Al must produce in order to earn $3.80 per hour.

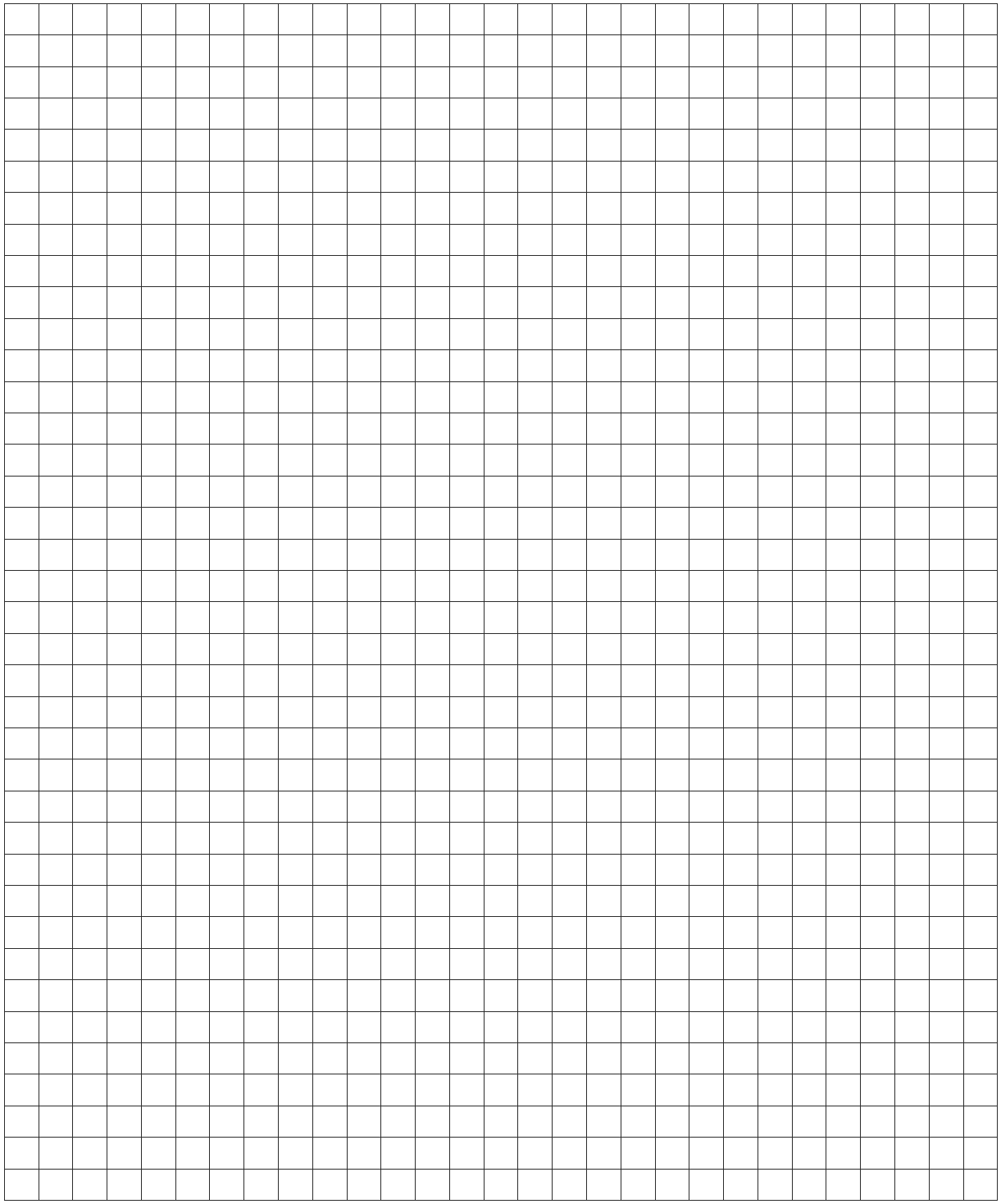
d. Al's total hourly pay if he produces 220 widgets per hour.

19. Write an equation that shows the relationship between Al's total hourly wage and the number of widgets produced per hour

The Metric System

20. Convert 12.5 mL to litres and 0.025 kg to grams.

***END OF QUESTIONNAIRE**



Answers

1. 1.2×10^{6}
2. 5.4×10^{-5}
3. a. 6.51×10^{-1}
   b. 2.88×10^{-2}
   c. 7.5×10^{-4}
   d. 3.35×10^{-24}
   e. 5.0×10^{-11}
4. 75/100 or 3/4
5. 0.75
6. 85%
7. $x = 15$
8. $c = -0.889$
9. $x = 1.2 \times 10^{-19}$
10. $x = 2.7 \times 10^{-3}$ and $x = -1.4 \times 10^{-3}$
11. $8.05 per hour
12. –0.812
13. a. $x = 2.6$
    b. $x = -1$
14. a. $x = 3.55 \times 10^{-12}$
    b. $x = 1.0 \times 10^{107}$
15. $\log_e y = -x$
16. $\log_e y = 2.303 \log_{10} y$
17. $x = 2.0 \times 10^{-6}$
18. You should obtain a graph of a straight line with a positive slope.
19. 3.50 per hour
20. 1.2 cents per widget

Evaluation

25-30 Questions Correct

Congratulations, you should have the skill level necessary for *Chemistry 217*. Proceed to Unit 1.

15-25 Questions Correct

The fundamentals are there, but you have probably forgotten some skills. Go to Appendix A, "Mathematical Operations," pages 1116-1121 of the textbook, and review this section in detail. Concentrate particularly on the topics that gave you difficulty in the questionnaire. When you have completed the review, proceed to the first unit of this course.

Less than 14 Questions Correct

This score indicates that you may be on shaky ground and should proceed cautiously with *Chemistry 217*. Before continuing with this course, we suggest that you

1. order *Math Survival Guide: Tips for Science Students*, by Jeffrey R. Appling, from the Athabasca University Library. This is a great book with straightforward explanations, useful hints, and good practice problems in all the areas of mathematics required for *Chemistry 217*.

2. review Appendix A (pp. 1116-1121) in the textbook while waiting for your library book to arrive. Concentrate particularly on the topics that gave you difficulty in the questionnaire. If the *Math Survival Guide* has not arrived by the time you have finished reviewing Appendix 1, please continue to the first unit of the course. Remember, having a good grasp of these math skills is crucial to your overall success in *Chemistry 217* and eventually *Chemistry 218*.