

EXAM  
CODE **107**

CATALOG  
NUMBER **CHEX101**

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**PRACTICE  
EXAMS**

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# General Chemistry I

CREDIT  
HOURS

**3**

LEVEL

**LOWER**

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# CONTENTS

<b>Preparing for the Exam</b> .....	<b>1</b>
<b>Before You Choose This UExcel Exam</b> .....	<b>1</b>
Uses for the Examination.....	1
Examination Length and Scoring.....	1
Score Reporting.....	2
Letter Grade Description.....	2
Excelsior College Bookstore.....	2
Excelsior College Library.....	2
<b>Take Charge of Your Own Learning</b> .....	<b>2</b>
How Long Will It Take Me to Study?.....	2
How Can I Create an Effective Long-Term Study Plan?.....	3
What Learning Strategy Should I Use?.....	4
Study Tips.....	4
Using UExcel Practice Exams.....	5
About Test Preparation Services.....	6
<b>Exam Preparation Strategies</b> .....	<b>6</b>
Content Guides.....	6
Using the Content Outline.....	6
Using the Sample Questions and Rationales.....	6
<b>Recommended Resources for the UExcel Exam in General Chemistry I</b> .....	<b>7</b>
Textbook Editions.....	7
Strongly Recommended.....	7
Optional Resources.....	7
Reducing Textbook Costs.....	7
Open Educational Resources.....	7
<b>Content Outline</b> .....	<b>9</b>
General Description of the Examination.....	9
Learning Outcomes.....	9
General Education Career Competencies Addressed in this Exam.....	9
Content Outline.....	10
<b>Sample Questions</b> .....	<b>13</b>
<b>Rationales</b> .....	<b>16</b>
Equations and Constants.....	22
<b>Taking the Exam</b> .....	<b>23</b>
<b>Registering for Your Exam</b> .....	<b>23</b>
Register Online.....	23
Examination Administration.....	23
Accessibility Services.....	23
Computer-Delivered Testing.....	23
Whiteboards.....	23
Calculator.....	23
Breaks.....	24
Online Proctoring.....	24
<b>On the Day of Your Exam</b> .....	<b>24</b>
Important Reminders.....	24
Academic Integrity Nondisclosure Statement.....	24
UExcel Grade Report.....	24
Grade Appeals.....	24
What If I Miss My Appointment?.....	24
Late Arrivals.....	24
Information About UExcel Exams for Colleges and Universities.....	25
<b>General Chemistry I Exam Development Committee</b> .....	<b>25</b>
<b>Sample Grade Report</b> .....	<b>26</b>



## SECTION ONE

# Preparing for the Exam

## Before You Choose This UExcel Exam

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### Uses for the Examination

- Excelsior College, the test developer, recommends granting three (3) semester hours of lower-level undergraduate credit to students who receive a letter grade of C or higher on this examination.
- Other colleges and universities also recognize this exam as a basis for granting credit or advanced standing.
- Individual institutions set their own policies for the amount of credit awarded and the minimum acceptable score.

Examinees who have applied to Excelsior College should ask their academic advisor where this exam fits within their degree program.

Examinees **not enrolled** in an Excelsior College degree program should check with the institution from which they wish to receive credit to determine whether credit will be granted and/or to find out the minimum grade required for credit. Those who intend to enroll at Excelsior College should ask an admissions counselor where this exam fits within their intended degree program.

For more information on exam availability and actual testing information, see the [Exam Registration and Information Guide](#).

### Examination Length and Scoring

This examination consists of 100 multiple choice and other type questions. You will have two (2) hours to complete the exam. Your score will be reported as a letter grade. Questions are scored either correct (1) or incorrect (0). There is no partial credit. Each credit-bearing exam contains pretest questions, which are embedded throughout the exam. They are indistinguishable from the scored questions. It is to your advantage to do your best on all the questions. Pretest questions are being tried out for use in future versions of the exam.

The UExcel exams do **not** have a fixed grading scale such as A = 90–100%, B = 80–90%, and so forth, as you might have seen on some exams in college courses. Each UExcel test has a scale that is set by a faculty committee and is different for each exam. The process, called standard setting, is described in more detail in the [Technical Handbook](#). Excelsior puts each exam through a standard setting because different test questions have different levels of difficulty. To explain further, getting 70% of the questions right on the exam when the questions are easy does not show the same level of proficiency as getting 70% of questions correct when the questions are hard. Every form of a test (a form contains the test questions) has its own specific grading scale tailored to the particular questions on each exam form.

Please also note that on each form, some of the questions (referred to as pretest questions) count toward the score and some do not; the grading scale applies only to those questions that count toward the score. The area with percentage ratings on the second page of your score report is intended to help identify relative strengths and weaknesses and which content areas to emphasize, should you decide to take the examination again. Your grade

is **based on only the scored questions**. Therefore, the percentage ratings do not necessarily reflect the total percentage that counted toward your grade.

For the best view of the types of questions on this exam, see the sample questions in the back of this guide. Practice, practice, practice!

## Score Reporting

For most of our examinations, based on performance, an examinee is awarded a letter grade of A, B, C, or F. A letter grade of D can be given, but credit is awarded for A, B, and C letter grades only. The letter grades reported to examinees indicate that their performance was equivalent to the performance of students who received the same letter grade in a comparable, on-campus course.

More specifically, the letter grade indicates the examinee's proficiency relative to the learning outcomes specified in the exam content guide. Following are general descriptions of examinee performance at each level:

## Letter Grade Description

- A Highly Competent: Examinee's performance demonstrates an advanced level of knowledge and skill relative to the learning outcomes.
- B Competent: Examinee's performance demonstrates a good level of knowledge and skill relative to the learning outcomes.
- C Marginally Competent: Examinee's performance demonstrates a satisfactory level of knowledge and skill relative to the learning outcomes.
- D Not Competent (no credit recommended): Examinee's performance demonstrates weak knowledge of the content and minimal skill relative to the learning outcomes.<sup>①</sup>
- F Fail (no credit recommended): Examinee's performance demonstrates no knowledge of the content and no skill in the subject relative to the learning outcomes.

Credit is transcribed by Excelsior College for examinees who achieve letter grades of C or higher.

We encourage colleges and universities to use the Excelsior College letter grades of A, B, and C as acceptable standards for awarding credit.

<sup>①</sup> In general, two-hour exams do not award a D letter grade.

See page 26, at the back of this content guide, for a sample UExcel Grade Report for Examinations.

## Excelsior College Bookstore

The Excelsior College Bookstore offers recommended textbooks and other resources to help you prepare for UExcel exams.

The bookstore is available online at (login required): [www.excelsior.edu/bookstore](http://www.excelsior.edu/bookstore)

## Excelsior College Library

Library services are available to students enrolled in a degree program at Excelsior College. Created through our partnership with the Sheridan Libraries of The Johns Hopkins University, the library provides access to journal articles, books, websites, databases, reference services, and many other resources. To access the Excelsior College Library, visit [www.excelsior.edu/library](http://www.excelsior.edu/library) (login is required). Access to the library is available 24/7.

## Take Charge of Your Own Learning

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At Excelsior College, independent, self-directed study supported by resources we help you find is not a new concept. We have always stressed to students who take exams that they are acting as their own teacher, and that they should spend as much time studying for an exam as they would spend in a classroom and on homework for a corresponding college course in the same subject area.

Begin by studying the content outline contained in this content guide, at its most detailed level. You will see exactly which topics are covered, and where chapters on those topics can be found in the Recommended Resources. You will see exactly where you might need to augment your knowledge or change your approach.

The content outline, along with the learning outcomes for this exam and recommended textbooks, will serve as your primary resources.

## How Long Will It Take Me to Study?

Study for a UExcel exam is comparable to an equivalent college-level course. As an independent

learner, you should study and review as much as you would for the same subject in a campus-based college course. If you already have a background in the subject, you may be able to pass the exam successfully with fewer hours of study. It depends upon the learner as well as the subject, the number of credits (for example, a 6- or 8-credit exam will require more hours of study than a 3-credit exam), and the length of the exam. We strongly encourage you to create a long-term action or study plan, so that you have a systematic approach to prepare for the exam. We've included guidelines for creating such a plan.

## How Can I Create an Effective Long-Term Study Plan?

**1. Determine the time you will require to complete your preparation for this exam.** If you have not studied the subject before, you should plan to budget approximately 45 hours of study time for every credit: 135 hours for 3 credits, 180 hours for 4 credits, 270 hours for 6 credits, and 360 hours for 8 credits. These hours are rules of thumb based on expectations for a student taking a course in the subject; it may take you more or less time, depending on how familiar you are with the material and how easily you absorb the information studying on your own. Aside from the content review, you should then factor in time to search for and use other resources, and to complete any projects and assignments in the study materials that will clarify your understanding of the topics in the content outline (that part in the content guide where the specific areas of study are spelled out). Spend more time on concepts and areas in which you feel you are weak. Totaled, this is approximately the amount of time you should expect to devote to a three-credit, campus-based course. The actual amount of time you require depends on many factors, and will be approximate. If your background is weak, you may need to set aside substantially more than 135–150 hours. If your background is strong, you may budget less time.

Take a few minutes to review the content outline to assess your familiarity with the content. Then, in the space below, write the number of hours you will allocate to complete preparing for the exam.

Hours Required =

## 2. Determine the time you will have available for study.

In self-study, you need structure, as well as motivation and persistence, and a methodical approach to preparation. There is no set class to keep you on task. You have to do that yourself. Construct a time-use chart to record your daily activities over a one-week period. The most accurate way to do this is to complete the chart on a daily basis to record the actual amount of time you spend eating, sleeping, commuting, working, watching television, caring for others and yourself, reading, and everything else in an adult's life. However, if your schedule is regular, you might prefer to complete the chart in one sitting and, perhaps, by consulting your appointment book or planner.

After you have recorded your activities, you will be ready to schedule study periods around these activities or, perhaps, instead of some of them. In the space below, write the number of hours you will be able to set aside for study each week.

Hours Required =

## 3. Divide the first number by the second number.

This will give you the number of weeks you will need to set aside for independent study. For example, if you think you will require 170 hours of study and you have 10 hours available to study each week, divide 170 hours by 10 hours and you will get 17. This means that you will need about 17 weeks to complete this course of study. However, you will also need to allow about a week for review and self-testing. Moreover, to be on the safe side, you should also add two weeks to allow for unforeseen obstacles and times when you know you will not be able to study (e.g., during family illnesses or holidays). So, in this case, you should allot a total of 18 to 19 weeks to complete your study.

## 4. Schedule your examination to coincide with the end of your study period.

For example, if you plan to allow 18 weeks for study, identify a suitable examination date and begin study at least 18 weeks before that date. (The date you begin study assumes that you will have received all of your study materials, particularly textbooks, by that time.)

### **5. Format a long-term study plan.**

You will need to use a calendar, planner, or some other tool to format and track your long-term study plan. Choose a method that is convenient and one that keeps you aware of your study habits on a daily basis. Identify the days and exact hours of each day that you will reserve for study throughout your whole independent study period. Check to see that the total number of hours you designate for study on your long-term study plan adds up to the number of hours you have determined you will need to complete this course of study (Step 1).

### **6. Record in your long-term study plan the content you plan to cover during each study period.**

Enter the session numbers, review, and examination preparation activities you will complete during each study period. While it is suggested that approximately 160–170 hours of study is required for this exam, each and every student may require different timelines based on their comfort with, and comprehension of, the material.

You now have a tentative personal long-term study plan. Keep in mind that you will have to adjust your study plan, perhaps several times, as you study. It is only by actually beginning to work systematically through the material, using the content outline, that you will be able to determine accurately how long you should allow for each unit.

## **What Learning Strategy Should I Use?**

The following guidelines are intended to help you acquire the grounding in the knowledge and skills required for successful completion of this examination.

### **1. Approach learning with a positive attitude.**

Most students are capable of learning subject content if they devote enough time and effort to the task. This devotion will give you a positive edge and a feeling of control.

### **2. Diligently complete the exact work you specified in your study plan.**

Your study plan is being designed for the specific purpose of helping you achieve the learning outcomes for this exam.

### **3. Be an active learner.**

You should actively engage in the learning process. Read critically, take notes, and continuously monitor your comprehension. Keep a written record of your progress, highlight content you find difficult to grasp, and seek assistance from someone in your learning community who can help you if you have difficulty understanding a concept.

### **4. Be patient: you may not understand everything immediately.**

When encountering difficulty with new material, be patient with yourself and don't give up. Understanding will come with time and further study. Sometimes you may need to take a break and come back to difficult material. This is especially true for any primary source material (original letters, documents, and so forth) that you may be asked to read. The content outline will guide you through the material and help you focus on key points. You will find that many concepts introduced in earlier sessions will be explained in more detail in later sessions.

### **5. Apply your learning to your daily life.**

Use insights you gain from your study to better understand the world in which you live. Apply the learning whenever you can. Look for instances that support or contradict your reading on the subject.

### **6. Accommodate your preferred way of learning.**

How do you learn best? Common ways to learn are reading, taking notes and making diagrams, and by listening to someone (on video or live). Others learn by doing. Do any of these descriptions apply to you? Or does your learning style vary with the learning situation? Decide what works for you and try to create a learning environment to accommodate your preferences.

## **Study Tips**

Become an active user of the resource materials. Aim for understanding rather than memorization. The more active you are when you study, the more likely you will be to retain, understand, and apply the information.

The following techniques are generally considered to be active learning:

- **preview or survey** each chapter

- **highlight or underline text** you believe is important
- **write questions or comments** in the margins
- **practice re-stating content** in your own words
- **relate what you are reading** to the chapter title, section headings, and other organizing elements of the textbook
- **find ways to engage** your eyes, your ears, and your muscles, as well as your brain, in your studies
- **study with a partner or a small group**
- **prepare your review notes** as flashcards or create recordings that you can use while commuting or exercising

When you feel confident that you understand a content area, review what you have learned. Take a second look at the material to evaluate your understanding. If you have a study partner, the two of you can review by explaining the content to each other or writing test questions for each other to answer. Review questions from textbook chapters may be helpful for partner or individual study, as well.

Study smart for your UExcel exam! Success starts with establishing a relationship with your advisor.

## Using UExcel Practice Exams

The official UExcel practice exams are highly recommended as part of your study plan. They can be taken using any computer with a supported web browser such as Google Chrome.

The practice exam package comes with two sets of questions. Please be aware that there will be fewer questions on the practice exams than there will be on the exam you take for credit. Generally, the practice questions will not be the same as the ones you will see when you take the actual exam for credit. They are intended to expose you to the types of questions you'll encounter in the actual exam. Practice questions are a tool, and do not provide a full exam experience. For example, the practice question sets do not have time limitations. Begin with the Content Guide, especially the detailed content outline. Memorizing specific questions and answers on the practice sets is not as effective as using the questions to practice, along with the content outline, to see which concepts you may need to study further. To register for the practice exam, visit [www.excelsior.edu](http://www.excelsior.edu) and log into your MyExcelsior

account. **Please note: You must be registered for the corresponding credit-bearing exam before you can register for the practice exam.**

Practice exams are not graded. Rather, they are intended to help you make sure you understand the subject and give you a sense of what the questions will be like on the exam for credit. Ideally, you would check any questions you got wrong, look at the explanations, and go back to the textbook to reinforce your understanding. After taking both forms of the practice exam, you should feel confident in your answers and confident that you know the material listed in the content outline.

Practice exams are one of the most popular study resources. Practice exams are typically shorter than the credit-bearing exam. Since the questions are drawn from the same pool of questions that appear on the credit-bearing exam, what you will see when you sit for the graded exam will be roughly the same. Used as intended, these practice exams will enable you to:

- Review the types of questions you may encounter on the actual exam.
- Practice testing on a computer in a timed environment.
- Practice whenever and wherever it is convenient for you.

Take two different forms of a practice exam within a 180-day period. (We highly recommend that you take the first form of the practice exam as a pretest, early in the study period. Use the results to identify areas to further study and carry out a plan. Then take the second form as a post-test and see how much you have improved.)

Although there is no guarantee, our research suggests that exam takers who do well on the practice exams are more likely to pass the actual exam than those who do not take advantage of the opportunity. Note that since the practice exams are not graded (calibrated) the same way as the scores on the credit-bearing exam, it will be hard for you to use the practice exams as a way to predict your score on the credit-bearing exam. The main purpose of the practice exams is for you to check your knowledge and to become comfortable with the types of questions you are likely to see in the actual, credit-bearing exam.

## About Test Preparation Services

Preparation for UExcel® exams and Excelsior College® Examinations, though based on independent study, is supported by Excelsior College with a comprehensive set of exam learning resources and services designed to help you succeed. These learning resources are prepared by Excelsior College so you can be assured that they are current and cover the content you are expected to master for the exams. These resources, and your desire to learn, are usually all that you will need to succeed.

There are test-preparation companies that will offer to help you study for our examinations. Some may imply a relationship with Excelsior College and/or make claims that their products and services are all that you need to prepare for our examinations.

Excelsior College does not endorse the products and services of any tutorial or test preparation firm. We do not review the materials provided by these firms for the content or compatibility of their material and resources with UExcel® exams or Excelsior College Examinations®. No test preparation vendor is authorized to provide admissions counseling or academic advising services, or to collect any payments, on behalf of Excelsior College. Excelsior College does not send authorized representatives to a student's home nor does it review the materials provided by test preparation companies for content or compatibility with Excelsior College examinations.

To help you become a well-informed consumer, we suggest that before you make any purchase decision regarding study materials provided by organizations other than Excelsior College, you consider the points outlined on our website at [www.excelsior.edu/testprep](http://www.excelsior.edu/testprep).

## Exam Preparation Strategies

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Each learner is different. However, all learners should read the content outline in the exam's Content Guide and ensure that they have mastered the concepts. For someone with no prior knowledge of the subject, a rule of thumb is 135 hours of study for a 3-credit exam—this number is just to give you an idea of the level of effort you will need, more or less.

## Content Guides

This content guide is the most important resource. It lists the outcomes, a detailed content outline of what is covered, and textbooks and other study resources. It also has sample questions and suggestions for how to study. Content guides are updated periodically to correspond with changes in particular examinations and in textbook editions. Examinees can download any of the latest free UExcel content guides by visiting the individual exam page or from the list at [www.excelsior.edu/contentguides](http://www.excelsior.edu/contentguides).

### Using the Content Outline

Each content area in the content outline includes the most important sections of the recommended resources for that area. These annotations are not intended to be comprehensive. You may need to refer to other chapters in the recommended textbooks. **Chapter numbers and titles may differ among textbook editions.**

This content outline contains examples of the types of information you should study. Although these examples are many, do not assume that everything on the exam will come from these examples. Conversely, do not expect that every detail you study will appear on the exam. Any exam is only a broad sample of all the questions that could be asked about the subject matter.

### Using the Sample Questions and Rationales

Each content guide provides sample questions to illustrate those typically found on the exam. These questions are intended to give you an idea of the level of knowledge expected and the way questions are typically phrased. The sample questions do not sample the entire content of the exam and are not intended to serve as an entire practice test.

# Recommended Resources for the UExcel Exam in General Chemistry I

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The resources listed below were selected by the faculty members on the examination committee for use in developing this exam.

Resources listed under “Strongly Recommended” were used by the committee to verify all the questions on the exam. Please refer to the Content Outline to see which parts of the exam are cross-referenced to these resources.

Resources listed under “Optional” provide additional material that may deepen or broaden your understanding of the subject, or that may provide an additional perspective on the exam content. Textbook resources, both Strongly Recommended and Optional, may be purchased from the Excelsior College bookstore at [www.excelsior.edu/bookstore](http://www.excelsior.edu/bookstore).

You should allow ample time to obtain the necessary resources and to study sufficiently before taking the exam, so plan appropriately, with an eye towards your own personal learning needs. See the sections in this guide on the Excelsior College Bookstore and the Excelsior College Library, and under Reducing Textbook Costs, to help you secure the Strongly Recommended resources successfully.

## Textbook Editions

Textbook editions listed in the UExcel content guides may not be the same as those listed in the bookstore. Textbook editions may not exactly match up in terms of table of contents and organization, depending upon the edition. However, our team of exam developers checks exam content against every new textbook edition to verify that all subject areas tested in the exam are still adequately available in the study materials. If needed, exam developers will list additional Strongly Recommended resources to ensure that all topics in the exam are still sufficiently covered. Public libraries may have the textbooks you need, or may be able to obtain them for you through interlibrary loan to reduce textbook costs. You may also consider financial aid, if you qualify, to further help defray the steep cost of textbooks. A section on open educational

resources (OER) has been included in this guide to help you locate additional, possibly free resources to augment your study.

## Strongly Recommended

Tro, N.J. (2020). *Principles of Chemistry: A molecular approach* (4th ed.). Upper Saddle River, NJ: Pearson Education, Inc.

An enhanced digital product is available for this textbook. Enhanced products usually include an e-book and may contain audio, video, assessments, or other interactive content to enhance student learning. Access codes come either free as part of a bundled textbook package or the codes may be purchased separately for an additional price. If you bought an enhanced product, please contact [excelsior.edu.exams](mailto:excelsior.edu.exams) to receive instructions on how to register, log in, and access your digital textbook product.

The study materials may be purchased from the [Excelsior College Bookstore](#).

## Optional Resources

The examination development committee did not identify any specific optional resources for this exam. If you would like to explore topics in more depth, we encourage you to refer to available Open Educational Resources (OER).

## Reducing Textbook Costs

Many students know it is less expensive to buy a used textbook, and buying a previous edition is also an option. The Excelsior College bookstore includes a buyback feature and a used book marketplace, as well as the ability to rent digital versions of textbooks for as long as students need them. Students are encouraged to explore these and the many other opportunities available online to help defray textbook costs.

## Open Educational Resources

There are many resources available online free of charge that may further enhance your study for the exam. Known as Open Educational Resources (OER), these may be textbooks, courses, tutorials, or encyclopedias. Any additional OER that you find independently should be used to augment study—not as replacements for the Strongly Recommended resources.

Most sites for university-based OER can be searched through [www.ocwconsortium.org](http://www.ocwconsortium.org) and/or [www.oercommons.org](http://www.oercommons.org).

Sites that specialize in web courses designed by college professors under contract with the website sponsor, rather than in web versions of existing college courses, include:

[www.education-portal.com](http://www.education-portal.com)

[www.opencourselibrary.org](http://www.opencourselibrary.org) (abbreviated as OCL)

We have included specific courses that cover material for one or more UExcel® exams from the sites in the listings above. It's worth checking these sites frequently to see if new courses have been added that may be more appropriate or may cover an exam topic not currently listed.

Sites like Khan Academy ([www.khanacademy.com](http://www.khanacademy.com)) and iTunes U feature relatively brief lessons on very specific topics rather than full courses. Full courses are also available on iTunes U (<http://www.apple.com/education/ipad/itunes-u>). We have chosen a few courses and collections for this listing.

### **Open Online Textbooks**

BookBoon

<http://bookboon.com/en/textbooks-ebooks>

Flatworld Knowledge

<http://catalog.flatworldknowledge.com/#our-catalog>

### **College Readiness**

Khan Academy

<http://www.khanacademy.org/>

Hippocampus

<http://www.hippocampus.org/>

Open Course Library

<http://opencourselibrary.org/collg-110-college-success-course/>

### **Study Aids**

Education Portal

<http://education-portal.com/>

Khan Academy

<http://www.khanacademy.org/>

Annenberg Learner

<http://www.learner.org/>

OpenCourseWare

<http://ocwconsortium.org/en/courses/search>

OER Commons

<http://www.oercommons.org/>

Open Course Library

<http://www.opencourselibrary.org/>

To achieve academic success, rate yourself at Excelsior College's Self-Regulated Learning Lab. Visit the Diagnostic Assessment & Achievement of College Skills site at <https://srl.daacs.net/>

It's free!

## SECTION TWO

# Content Outline

### General Description of the Examination

The UExcel General Chemistry I examination is based on material typically taught in a one-semester, three-credit, lower-level undergraduate course in chemistry.

The examination measures knowledge and understanding of theory and problem solving in chemical reactions, atomic structures and periodic trends, chemical bonding, states of matter, gases, and energy.

Those beginning to study for this exam should have an understanding of college-level algebra.

### Learning Outcomes

After you have successfully worked your way through the recommended study materials, you should be able to demonstrate the following learning outcomes:

1. Identify and balance chemical reactions. (Aligns to GECC 2.1)
2. Classify types of matter and explain their related properties. (Aligns to GECC 2.1)
3. Solve problems in chemistry using SI measurements, scientific notation, and significant figures. (Aligns to GECC 2.2)
4. Describe the formation of covalent bonds using Lewis structure, valence bond, and molecular orbital theories. (Aligns to GECC 2.1)
5. Predict molecular geometry and polarity using valence shell electron pair repulsion (VSEPR) Theory. (Aligns to GECC 2.1)
6. Describe the arrangement and trends of the periodic table. (Aligns to GECC 2.1)
7. Distinguish the gas laws and use them to perform calculations. (Aligns to GECC 2.2)
8. Describe the law of conservation of energy and use it in heat and work problems. (Aligns to GECC 2.2)

### General Education Career Competencies Addressed in this Exam

GECC-2: Mathematical and Scientific Problem Solving: Apply scientific knowledge and reasoning to make evidence-based decisions. Apply mathematical concepts and reasoning to solve problems that involve quantitative information.

## Content Outline

The content outline describes the various areas of the test, similar to the way a syllabus outlines a course. To fully prepare requires self-direction and discipline. Study involves careful reading, reflection, and systematic review.

The major content areas on the General Chemistry I examination, the percent of the examination, and the hours to devote to each content area are listed below.

Content Area	Percent of the Examination	Hours of Study*
I. Chemical Reactions and Problem Solving	25%	34
II. Atomic Structures and Periodic Trends	25%	34
III. Chemical Bonding	20%	27
IV. Liquids, Solids, and Attractive Forces	10%	14
V. Gases	10%	14
VI. Energy Balance	10%	14
<b>Total</b>	<b>100%</b>	

Cognitive Activity	Percent
I. Knowledge	30
II. Comprehension	35
III. Application and Higher-Level Abilities	35
<b>Total</b>	<b>100%</b>

\*Approximate: For those examinees who know the topic well, less time may be needed to learn the subject matter. For those who are new to the subject matter, more time may be required for study.

NOTE: Occasionally, examples will be listed for a content topic to help clarify that topic. However, the content of the examination is not limited to the specific examples given.

### I. Chemical Reactions and Problem Solving

**25 PERCENT OF EXAM**

#### Tro (2013)

- Ch. 1, Matter, Measurement, and Problem Solving
- Ch. 3, Molecules and Compounds (except organic compounds)
- Ch. 4, Chemical Reactions and Chemical Quantities
- Ch. 5, Introduction to Solutions and Aqueous Reactions

- A. Scientific method (for example: observation, hypothesis formulation, data collection/analysis)

## B. Measurements

1. System of measurements
2. Scientific notation
3. Significant digits

## C. Matter

1. Classification
2. Physical and chemical properties

## D. Chemical equations

1. Formulas and names
2. Balance and classify
3. Molar mass and the mole concept

## E. Aqueous solutions and reaction calculations

1. Limiting reactant
2. Yield calculations
3. Concentration and dilution
4. Solubility and precipitation reactions
5. Ionic equations
6. Acid-base and redox reactions

## II. Atomic Structures and Periodic Trends

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### 25 PERCENT OF EXAM

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#### Tro

[Ch. 2, Atoms and Elements](#)

[Ch. 8, The Quantum-Mechanical Model of the Atom](#)

[Ch. 9, Periodic Properties of the Elements](#)

---

### A. Composition of the atom

1. Subatomic particles
2. Isotopes
3. Average atomic mass

### B. The Bohr model

### C. Electromagnetic spectrum and atomic spectroscopy

### D. Wave-particle duality and the uncertainty principle

### E. Quantum numbers and atomic orbitals

1. Principle quantum number ( $n$ )

2. Angular momentum quantum number ( $l$ )

3. Magnetic quantum number ( $m_l$ )

4. Spin quantum number ( $m_s$ )

5. Shapes of atomic orbitals ( $s, p, d, f$ )

## F. Electronic configuration

1. Pauli exclusion principle

2. Aufbau principle

3. Hund's rule

4. Orbital diagram

## G. Periodic table and trends

1. Effective and nuclear charge

2. Atomic and ionic radii

3. Ionization energy

4. Electron affinity

5. Electronegativity

6. Magnetic properties

## III. Chemical Bonding

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### 20 PERCENT OF EXAM

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#### Tro

[Ch. 10, Chemical Bonding I: The Lewis Model](#)

[Ch. 11, Chemical Bonding II: Molecular Shapes, Valence Bond Theory, and Molecular Orbital Theory](#)

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### A. Types of bonds (for example: covalent, ionic, and metallic)

### B. Ionic bonding and lattice energy (for example: Born-Haber cycle)

### C. Covalent bonding and Lewis theory

1. Valence electrons
2. Writing Lewis structures
3. Octet rule and exceptions
4. Resonance and formal charge
5. Bond polarity and dipole moment

### D. Valence shell electron pair repulsion (VSEPR) theory

1. Basic electron group geometry

2. Lone pairs, molecular shape, and molecular polarity

#### E. Valence bond theory

1. Hybridization
2. Sigma ( $\sigma$ ) and pi ( $\pi$ ) bonding

#### F. Molecular orbital theory

1. Bonding and antibonding
2. Linear combination of atomic orbitals (LCAO)
3. Lowest unoccupied molecular orbital (LUMO) and highest occupied molecular orbital (HOMO)

### IV. Liquids, Solids, and Attractive Forces

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#### 10 PERCENT OF EXAM

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##### Tro

##### Ch. 12, Liquids, Solids, and Intermolecular Forces

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#### A. Three states of matter

#### B. Intermolecular interactions

1. London dispersion force
2. Dipole-dipole force
3. Hydrogen bonding

#### C. Properties of liquids

1. Surface tension
2. Viscosity
3. Vapor pressure and heat of vaporization ( $\Delta H_{\text{vap}}$ )
4. Boiling point

#### D. Properties of Solids

1. Crystal structures and unit cells
2. Types of crystals (for example: ionic, molecular, and metallic)
3. X-ray diffraction and Bragg's Law
4. Other types of solids (for example: glass, network, and polymers)
5. Melting point and sublimation

#### E. Phase changes

1. Relationship between three states of matter (for example: heating and cooling curves)

2. Phase diagram (for example: critical point and triple point)

### V. Gases

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#### 10 PERCENT OF EXAM

---

##### Tro

##### Ch. 6, Gases

---

#### A. Properties of gases

#### B. Simple gas laws (for example: Boyle's, Charles's, and Avogadro's)

#### C. Ideal gas law and related calculations

#### D. Mole fraction and Dalton's law of partial pressures

#### E. Kinetic Molecular Theory

1. Root mean square velocity
2. Graham's law of effusion

#### F. Real gases

### VI. Energy Balance

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#### 10 PERCENT OF EXAM

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##### Tro

##### Ch. 7, Thermochemistry

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#### A. Types of energy (for example: kinetic, potential, chemical)

#### B. First Law of Thermodynamics

1. Internal energy (E)
2. Work (w)
3. Heat (q)

#### C. Enthalpy (H)

1. Endothermic processes
2. Exothermic processes
3. Stoichiometry problems

#### D. Hess's Law and standard heat of formation ( $\Delta H_{\text{of}}$ )

#### E. Calorimetry, heat capacity and specific heat

## SECTION THREE

# Sample Questions

The sample questions give you an idea of the level of knowledge expected in the exam and how questions are typically phrased. They are not representative of the entire content of the exam and are not intended to serve as a practice test.

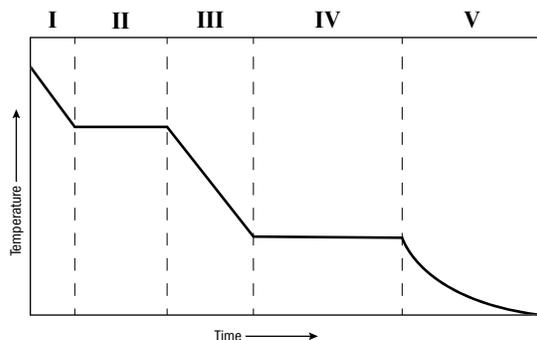
Rationales for the questions can be found on pages 16–19 of this guide. In that section, the correct answer is identified and each answer is explained. The number in parentheses at the beginning of each rationale refers to the corresponding section of the content outline. For any questions you answer incorrectly, return to that section of the content outline for further study.

You will be provided with an erasable white board to use during your exam. During your exam, a periodic table, as well as other essential tables, formulas, and diagrams, will be available for your reference, and you will have access to a scientific calculator. The calculator button is in the top left hand corner of the page as each question is presented and the tables and formulas are in the Formulas button located in the lower left hand corner as each question is presented. Copies of the materials available during the exam and a picture of a typical scientific (nongraphing) calculator are provided at the back of this content guide.

1. What is the order of the steps of the scientific method?
  - A. conclusion
  - B. data collection
  - C. experiment
  - D. hypothesis
  - E. data analysis
  - 1) DCBEA
  - 2) BCEDA
  - 3) DBCEA
  - 4) EDBCA
2. Which substance is a molecular compound?
  - 1) ammonium chloride ( $\text{NH}_4\text{Cl}$ )
  - 2) calcium oxide ( $\text{CaO}$ )
  - 3) methanol ( $\text{CH}_3\text{OH}$ )
  - 4) potassium iodide ( $\text{KI}$ )
3. What is the estimated molar mass of carbon dioxide ( $\text{CO}_2$ ) that you would find using the periodic table?
  - 1) 12 g/mol
  - 2) 16 g/mol
  - 3) 28 g/mol
  - 4) 44 g/mol
4. How many grams of iron ( $\text{Fe}$ ) are produced if 159.7 g of ferric oxide ( $\text{Fe}_2\text{O}_3$ ) reacts with 100 g of carbon ( $\text{C}$ ) and the percent yield of  $\text{Fe}$  produced in this reaction is 45%? (Hint: the reaction is not balanced.)
$$\text{Fe}_2\text{O}_3(s) + \text{C}(s) \rightarrow \text{Fe}(s) + \text{CO}(g)$$
  - 1) 25.1 g
  - 2) 50.2 g
  - 3) 55.85 g
  - 4) 111.70 g
5. Which type of reaction is shown by the equation below?
$$\text{NH}_3(l) + \text{H}_2\text{O}(l) \rightleftharpoons \text{NH}_4^+(aq) + \text{OH}^-(aq)$$
  - 1) acid-base
  - 2) combustion
  - 3) oxidation-reduction
  - 4) precipitation

6. Which atom is represented by the symbol "X"?
- $${}^A_ZX$$
- "A" is 235 and the atom contains 143 neutrons.
- 1) nobelium
  - 2) thorium
  - 3) uranium
  - 4) zirconium
7. Which set of quantum numbers describes an electron in a 3d atomic orbital?
- 1)  $n = 2, l = 0, m_l = 0, m_s = +\frac{1}{2}$
  - 2)  $n = 3, l = 1, m_l = +1, m_s = -\frac{1}{2}$
  - 3)  $n = 3, l = 2, m_l = -2, m_s = +\frac{1}{2}$
  - 4)  $n = 4, l = 3, m_l = +3, m_s = -\frac{1}{2}$
8. Which element has the following ground state electron configuration?
- $$1s^2 2s^2 2p^6 3s^2 3p^3$$
- 1) Ar
  - 2) He
  - 3) N
  - 4) P
9. Which orbital diagram represents the ground state electron configuration for a carbon atom?
- 1)  $\uparrow\downarrow \uparrow\downarrow \uparrow$
  - 2)  $\uparrow\downarrow \uparrow\downarrow \uparrow \uparrow$
  - 3)  $\uparrow \uparrow\downarrow \uparrow\downarrow \uparrow$
  - 4)  $\uparrow\downarrow \uparrow \uparrow\downarrow \uparrow$
10. Which number is the best estimation of the ionization energy of a hydrogen atom using the Bohr model?
- 1)  $5.45 \times 10^{-19} \text{ J}$
  - 2)  $1.63 \times 10^{-18} \text{ J}$
  - 3)  $1.94 \times 10^{-18} \text{ J}$
  - 4)  $2.18 \times 10^{-18} \text{ J}$
11. Which equation describes the lattice energy of cesium bromide (CsBr)?
- 1)  $\text{CsBr}(l) \rightarrow \text{CsBr}(s)$
  - 2)  $\text{CsBr}(g) \rightarrow \text{CsBr}(s)$
  - 3)  $\text{Cs}(s) + \text{Br}_2(g) \rightarrow \text{CsBr}(s)$
  - 4)  $\text{Cs}^+(g) + \text{Br}^-(g) \rightarrow \text{CsBr}(s)$
12. What is the Lewis structure of the chlorine (Cl) atom?
- 1)  $:\ddot{\text{Cl}}:$
  - 2)  $:\ddot{\text{Cl}}:$
  - 3)  $\cdot\ddot{\text{Cl}}\cdot$
  - 4)  $\cdot\ddot{\text{Cl}}:$
13. What is the electron group geometry if there are three electron groups around a central atom?
- 1) linear
  - 2) tetrahedral
  - 3) trigonal planar
  - 4) trigonal bipyramidal
14. What is the hybridization of the two carbon atoms in the acetonitrile molecule shown below?
- $$\overset{1}{\text{C}}\text{H}_3\overset{2}{\text{C}}\text{N}$$
- 1)  $\text{C}_1 = sp^3, \text{C}_2 = sp^2$
  - 2)  $\text{C}_1 = sp^3, \text{C}_2 = sp$
  - 3)  $\text{C}_1 = sp^2, \text{C}_2 = sp$
  - 4)  $\text{C}_1 = sp, \text{C}_2 = sp^3$
15. Which compound is expected to have the highest boiling point?
- 1)  $\text{CH}_3\text{CH}_2\text{CH}_3$
  - 2)  $\text{CH}_3\text{OCH}_3$
  - 3)  $\text{CH}_3\text{CHO}$
  - 4)  $\text{CH}_3\text{CN}$

16. The figure below shows a cooling curve of a typical molecular compound:



Which phase(s) of matter is (are) present in region II?

- 1) gas, only
  - 2) liquid, only
  - 3) gas and liquid, only
  - 4) liquid and solid, only
17. A sample of gas has initial volume of 3.26 L and a pressure of 1.3 atm at 27 °C. The gas is reduced to a final volume of 1.40 L at a pressure of 4000 mm of Hg. What is the final temperature?

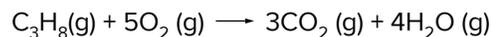
- 1) 46.9 °C
  - 2) 172 °C
  - 3) 248 °C
  - 4) 521 °C
18. Under which condition does a gas behave in the least ideal manner?
- 1)  $T = 100 \text{ K}; P = 1.0 \text{ atm}$
  - 2)  $T = 100 \text{ K}; P = 20 \text{ atm}$
  - 3)  $T = 500 \text{ K}; P = 1.0 \text{ atm}$
  - 4)  $T = 500 \text{ K}; P = 20 \text{ atm}$
19. What amount of heat would be released if 310 g of  $\text{NH}_3$  is completely reacted according to the chemical reaction below?

$$\Delta H_{\text{rxn}} = -906 \text{ kJ}$$



- 1)  $-4.13 \times 10^3 \text{ kJ}$
- 2)  $-1.65 \times 10^4 \text{ kJ}$
- 3)  $-6.61 \times 10^4 \text{ kJ}$
- 4)  $-2.81 \times 10^5 \text{ kJ}$

20. What is the change in enthalpy for the reaction below?



Formula	$\Delta H_f^\circ$ (KJ/mol)
$\text{C}_3\text{H}_8(\text{g})$	-103
$\text{O}_2(\text{g})$	0
$\text{CO}_2(\text{g})$	-393
$\text{H}_2\text{O}(\text{g})$	-241

- 1) -2043
- 2) -531
- 3) +531
- 4) +2043

## SECTION FOUR

# Rationales

## 1. (IA)

## \*1) DCBEA

The first step of the scientific method is to formulate a hypothesis. This is a potential explanation for a phenomenon. The second step is experimentation when controlled testing procedures are implemented. The third step is data collection whereby observations are generated and the fourth step, data analysis, serves to support or disprove a hypothesis. The final step is the conclusion, whereby the hypothesis is confirmed or revised based on the data analysis.

## 2. (IC1)

- 1) Ammonium chloride is an ionic compound because it is formed from ammonium cations ( $\text{NH}_4^+$ ) and chloride anions ( $\text{Cl}^-$ ).
- 2) Calcium oxide is an ionic compound because it is formed from calcium cations ( $\text{Ca}^{2+}$ ) and oxide anions ( $\text{O}^{2-}$ ).
- \*3) Methanol is made up of covalent bonds among carbon, hydrogen, and oxygen atoms. There are no ions in the methanol molecule.
- 4) Potassium iodide is an ionic compound because it is formed from potassium cations ( $\text{K}^+$ ) and iodide anions ( $\text{I}^-$ ).

## 3. (ID3)

- 1) This answer results from using only the atomic mass of one carbon (C) atom.
- 2) This answer results from using only the atomic masses of two oxygen (O) atoms.
- 3) This answer results from using only the atomic masses of one carbon atom and one oxygen atom.
- \*4) Molar mass of all the atomic masses (rounded to nearest whole number) of all the atoms in a chemical formula.  
The calculation formula is:  
 $(1 \times 12) + (2 \times 16) = 44 \text{ g/mol}$

## 4. (IE2)

- 1) The equation must be balanced and then calculated, so the amount of Fe must be doubled due to the balanced coefficient of 2 for Fe.
- \*2) There are 100 g of carbon and only one mole of ferric oxide; therefore, ferric oxide must be the limiting reactant. Since the balanced equation produces two moles or 111.7 g of Fe and percent yield is only 45%, that should give 50.2 g of Fe.

$$m_{\text{Fe}} = 159.7 \text{ g Fe}_2\text{O}_3 \left( \frac{1 \text{ mol Fe}_2\text{O}_3}{159.7 \text{ g Fe}_2\text{O}_3} \right) \left( \frac{2 \text{ mol Fe}}{\text{mol Fe}_2\text{O}_3} \right) \left( \frac{55.8 \text{ g Fe}}{1 \text{ mol Fe}} \right) (45\%) = 50.2 \text{ g Fe}$$

- 3) The equation must be balanced first, then the limiting reactant determined. If percent yield is 100% it will produce 111.7 g.
- 4) This reaction produces only 45% yield of Fe. Therefore, further calculation of 45% of 111.70 g is required.

\*correct answer

5. (IE6)

- \*1) Ammonia ( $\text{NH}_3$ ), a base, gains a proton to form its conjugate acid, the ammonium ion ( $\text{NH}_4^+$ ). In addition, water ( $\text{H}_2\text{O}$ ), an acid, loses a proton to form its conjugate base, the hydroxide ion ( $\text{OH}^-$ ).
- 2) A combustion reaction requires oxygen to be a reactant.
- 3) The oxidation state for nitrogen and oxygen did not change after the reaction.
- 4) The reaction did not produce a solid as a reactant.

6. (IIA1)

- 1) The number of protons in nobelium is 102.
- 2) The number of protons in thorium is 90.
- \*3) The number of protons ( $Z$ ) is equal to the atomic mass ( $A$ ) minus the number of neutrons. Therefore,  $Z = 235 - 143 = 92$  and element "X" is uranium.
- 4) The number of protons in zirconium is 40.

7. (IIE)

- 1) This set of quantum numbers describes an electron in a  $2s$  orbital.  $n = 2$  describes the energy level of the orbital;  $l = 0$  describes the shape of the  $s$  orbital.
- 2) This set of quantum numbers describes an electron in a  $3p$  orbital.  $n = 3$  describes the energy level of the orbital;  $l = 1$  describes the shapes of the  $p$  orbitals.
- \*3) This set of quantum numbers describes an electron in a  $3d$  orbital.  $n = 3$  describes the energy level of the orbital;  $l = 2$  describes the shapes of the  $d$  orbitals.
- 4) This set of quantum numbers describes an electron in a  $4f$  orbital.  $n = 4$  describes the energy level of the orbital;  $l = 3$  describes the shapes of the  $f$  orbitals.

8. (IIF)

- 1) Argon has a ground state electron configuration of  $1s^2 2s^2 2p^6 3s^2 3p^6$ .
- 2) Helium has a ground state electron configuration of  $1s^2$ .
- 3) Nitrogen has a ground state electron configuration of  $1s^2 2s^2 2p^3$ .

- \*4) This is the electron configuration for phosphorus.

9. (2F4)

- 1) According to Hund's rule, both  $2p$  electrons need to occupy separate orbitals to maximize their spin.
- \*2) Hund's rule states that the two electrons in the  $p$  orbitals should occupy two individual orbitals.
- 3) The  $1s$  orbital should be filled in the ground state before placing electrons in higher energy states.
- 4) The  $2s$  orbital should be filled in the ground state before filling the  $2p$  orbitals.

10. (IIG3)

- 1) This is the energy required to promote the electron from  $n = 2$  to  $n = \infty$ .  $\Delta E = E_\infty - E_2$  where  $E_n = -2.18 \times 10^{-18} \text{ J } (1/n^2)$ .
- 2) This is the energy required to promote the electron from  $n = 1$  to  $n = 2$ .  $\Delta E = E_2 - E_1$  where  $E_n = -2.18 \times 10^{-18} \text{ J } (1/n^2)$ .
- 3) This is the energy required to promote the electron from  $n = 1$  to  $n = 3$ .  $\Delta E = E_3 - E_1$  where  $E_n = -2.18 \times 10^{-18} \text{ J } (1/n^2)$ .
- \*4) The ionization of a hydrogen atom is equal to the energy that is required to promote the electron from a hydrogen atom from  $n = 1$  to  $n = \infty$ . Therefore,

$$\Delta E = E_\infty - E_1 \text{ where } E_n = -2.18 \times 10^{-18} \text{ J } (1/n^2)$$

$$\Delta E_{\text{ionization}} = E_\infty - E_1 = -2.18 \times 10^{-18} \text{ J } \left( \frac{1}{\infty^2} - \frac{1}{1^2} \right)$$

$$\Delta E_{\text{ionization}} = -2.18 \times 10^{-18} \text{ J } (0 - 1) = +2.18 \times 10^{-18} \text{ J}$$

11. (IIIB)

- 1) This is the heat of fusion for cesium bromide.
- 2) This is the heat of sublimation for cesium bromide.
- 3) This is the enthalpy of formation for cesium bromide.
- \*4) The lattice energy of cesium bromide is defined as the amount of energy gained when gaseous  $\text{Cs}^+$  and  $\text{Br}^-$  ions combined to form the crystal lattice of the ionic solid of cesium bromide.

## 12. (IIIC2)

- \*1) Chlorine has 7 valence electrons in its outer shell.
- 2) In period 3, argon has 8 valence electrons in its outer shell.
- 3) In period 3, phosphorus has 5 valence electrons in its outer shell.
- 4) In period 3, sulfur has 6 valence electrons in its outer shell.

## 13. (IIID1)

- 1) Linear is the geometry for two electron groups around a central atom.
- 2) Tetrahedral is the geometry for four electron groups around a central atom.
- \*3) The geometry for three electron groups is trigonal planar.
- 4) Trigonal bipyramidal is the geometry for five electron groups around a central atom.

## 14. (IIIE2)

- 1) The second carbon has a triple bond with nitrogen; therefore, it should be  $sp$  hybridized.
- \*2) The first carbon has four sigma bonds and it is  $sp^3$  hybridized. The second carbon has a triple bond and it is  $sp$  hybridized.
- 3) The first carbon has four sigma bonds and it is  $sp^3$  hybridized, not  $sp^2$ .
- 4) This answer results from reversing the two carbons.

## 15. (IVC4)

- 1) Propane is non-polar; therefore, it should have a low boiling point.
- 2) Dimethyl ether is slightly polar; therefore, it should have a higher boiling point than propane.
- 3) Acetaldehyde is more polar than dimethyl ether; therefore, it should have a higher boiling point than dimethyl ether.
- \*4) The dipole moment of acetonitrile is strongest among the four substances and is the most polar molecule; therefore, it should have the highest boiling point.

## 16. (IVE1)

- 1) Region I has only gas phase, as the gas is being cooled to its boiling point.
- 2) Region III has only liquid phase as the liquid is being cooled to its melting point.
- \*3) In region II, the gas is being condensed at the boiling temperature. In this region, the gas and the liquid are in dynamic equilibrium. Both phases are present.
- 4) Region IV has both liquid and solid phases present. The liquid and solid are in dynamic equilibrium at the melting temperature.

## 17. (VB)

- 1) This results when the absolute temperature for the calculation is not used.
- 2) This results when the initial and final pressures and volumes are reversed.
- \*3) Solution:

$$n = \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad T_2 = T_1 \left( \frac{P_2 V_2}{P_1 V_1} \right)$$

$$T_2 = (27 + 273.15)K \times \left[ \frac{(4000\text{mmHg}) \left( \frac{1\text{atm}}{760\text{mmHg}} \right) (1.4\text{L})}{(1.3\text{atm})(3.26\text{L})} \right] = 521\text{K}$$

$$T_2 = (512 - 273.15)K = 248^\circ\text{C}$$

- 4) This results when the temperature is not converted from Kelvin to Celsius.

## 18. (VF)

- 1) Gas particles at high temperatures have high kinetic energy; therefore, they tend to behave like an ideal gas. Gas particle volume does not affect the overall volume of the gas at low pressures.
- \*2) At low temperatures, attractive forces among the gas particles cause the gas pressure to be lower than ideal. At higher pressures, the gas particle volume causes the gas pressure to be higher than ideal.
- 3) Gas particle volume does not affect the overall volume of the gas at low pressures.
- 4) Gas particles at high temperatures have high kinetic energy; therefore, they tend to behave like an ideal gas.

\*correct answer

## 19. (VIC3)

\*1) Solution:

$$\Delta H_{\text{rxn}} = 310\text{g NH}_3 \left( \frac{1\text{mol}}{17\text{g}} \right) \left( \frac{-906\text{ kJ}}{4\text{mol NH}_3} \right) = -4130.3\text{ kJ}$$

- 2) This results from forgetting to divide by 4 moles of  $\text{NH}_3$  from the chemical reaction.
- 3) This results from forgetting to convert the mass of  $\text{NH}_3$  to numbers of moles of  $\text{NH}_3$ .
- 4) This results from forgetting to convert from mass to moles and not dividing by 4 moles  $\text{NH}_3$ .

## 20. (VID)

\*1) Solution:

$$\Delta H^{\circ}_{\text{Rxn}} = \sum n_p \Delta H^{\circ}_f \text{ products} - \sum n_r \Delta H^{\circ}_f \text{ reactants}$$

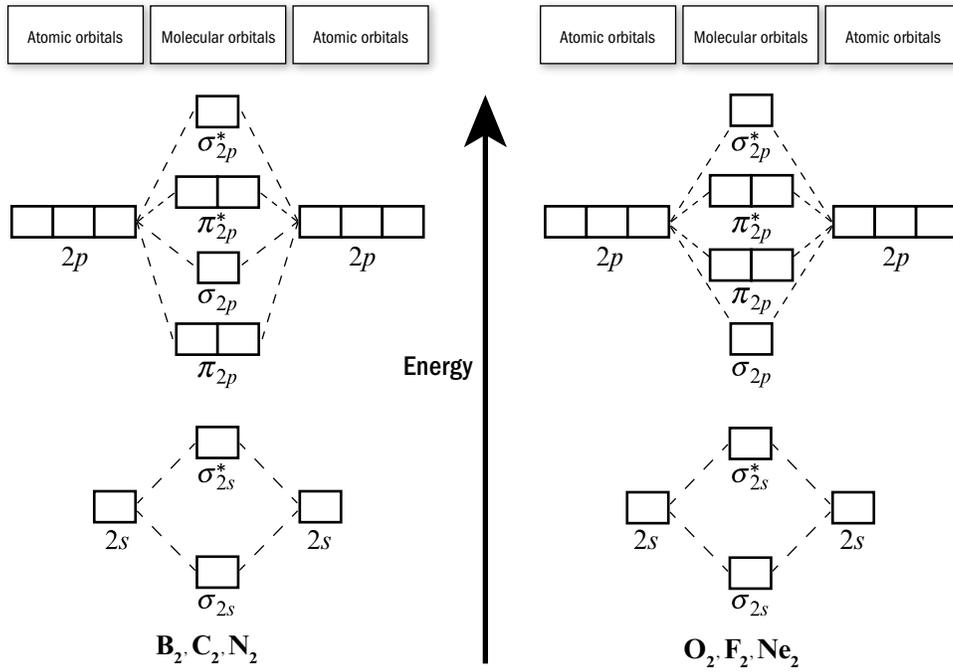
$$\Delta H^{\circ}_{\text{Rxn}} = [3(-393\text{ kJ/mol}) + 4(-241\text{ kJ/mol})] - (-103\text{ kJ})$$

$$\Delta H^{\circ}_{\text{Rxn}} = 2043\text{ kJ}$$

- 2) This results from forgetting to include the coefficients in the calculations.
- 3) This results from forgetting to include the coefficients and switching the products and reactants.
- 4) This results from switching the products and reactants heats of formation.

\*correct answer

### Diatomic Molecular Orbital Energy Level Diagrams



### PERIODIC TABLE OF THE ELEMENTS

IA																						VIII A	
1 <b>H</b> 1.01																							2 <b>He</b> 4.00
IIA													III A	IV A	V A	VIA	VII A						
3 <b>Li</b> 6.94	4 <b>Be</b> 9.01												5 <b>B</b> 10.81	6 <b>C</b> 12.01	7 <b>N</b> 14.01	8 <b>O</b> 16.00	9 <b>F</b> 19.00	10 <b>Ne</b> 20.18					
IIIB		IVB	VB		VIB		VIIB		VIII B			IB	IIB										
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.30																						
19 <b>K</b> 39.10	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.96	22 <b>Ti</b> 47.87	23 <b>V</b> 50.94	24 <b>Cr</b> 52.00	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.70	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.64	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.80						
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.71	51 <b>Sb</b> 121.76	52 <b>Te</b> 127.60	53 <b>I</b> 126.90	54 <b>Xe</b> 131.29						
55 <b>Cs</b> 132.91	56 <b>Ba</b> 137.33	57-71 <b>La-Lu</b> Lanthanides	72 <b>Hf</b> 178.49	73 <b>Ta</b> 180.95	74 <b>W</b> 183.84	75 <b>Re</b> 186.21	76 <b>Os</b> 190.23	77 <b>Ir</b> 192.22	78 <b>Pt</b> 195.08	79 <b>Au</b> 196.97	80 <b>Hg</b> 200.59	81 <b>Tl</b> 204.38	82 <b>Pb</b> 207.20	83 <b>Bi</b> 208.98	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)						
87 <b>Fr</b> (223)	88 <b>Ra</b> (226)	89-103 <b>Ac-Lr</b> Actinides	104 <b>Rf</b> (261)	105 <b>Db</b> (262)	106 <b>Sg</b> (266)	107 <b>Bh</b> (264)	108 <b>Hs</b> (277)	109 <b>Mt</b> (268)	110 <b>Uun</b> (281)	111 <b>Uuu</b> (272)	112 <b>Uub</b> (285)			114 <b>Uuq</b> (289)									

Lanthanides	57 <b>La</b> 138.91	58 <b>Ce</b> 140.12	59 <b>Pr</b> 140.91	60 <b>Nd</b> 144.24	61 <b>Pm</b> (145)	62 <b>Sm</b> 150.36	63 <b>Eu</b> 151.96	64 <b>Gd</b> 157.25	65 <b>Tb</b> 158.93	66 <b>Dy</b> 162.50	67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.93	70 <b>Yb</b> 173.04	71 <b>Lu</b> 174.97
Actinides	89 <b>Ac</b> (227)	90 <b>Th</b> 232.04	91 <b>Pa</b> 231.04	92 <b>U</b> 238.03	93 <b>Np</b> (237)	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (252)	100 <b>Fm</b> (257)	101 <b>Md</b> (258)	102 <b>No</b> (259)	103 <b>Lr</b> (262)

### ELECTRONEGATIVITY CHART

H																						He	
2.1																							
Li													B	C	N	O	F	Ne					
1.0	1.5												2.0	2.5	3.0	3.5	4.0						
Na													Al	Si	P	S	Cl	Ar					
0.9	1.2												1.5	1.8	2.1	2.5	3.0						
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr						
0.8	1.0	1.3	1.5	1.6	1.6	1.5	1.8	1.8	1.8	1.9	1.6	1.6	1.8	2.0	2.4	2.8							
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe						
0.8	1.0	1.2	1.4	1.6	1.8	1.9	2.2	2.2	2.2	1.9	1.7	1.7	1.8	1.9	2.1	2.5							
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn						
0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.2	2.2	2.2	2.4	1.9	1.8	1.9	1.9	2.0	2.2							
Fr	Ra	Ac																					
0.7	0.9	1.1																					

## Equations and Constants

$$N_A = 6.022 \times 10^{23} \quad R = 8.314 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \quad \text{or} \quad R = 0.08206 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$$1 \text{ atm} = 760 \text{ torr} = 1.01325 \text{ bar} = 1.01325 \times 10^5 \text{ Pa} = 14.7 \text{ psi}$$

$$PV = nRT \quad P_A = \chi_A P_{\text{Total}} \quad \rho = d = \frac{PM}{RT} \quad u_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$\frac{\text{effusion rate (A)}}{\text{effusion rate (B)}} = \sqrt{\frac{d_B}{d_A}} = \sqrt{\frac{M_B}{M_A}} \quad \left( P_{\text{meas}} + \frac{n^2 a}{V^2} \right) (V_{\text{meas}} - nb) = nRT$$

$$\text{Boltzmann Constant: } k_B = R/N_A \quad 1\text{D} = 3.34 \times 10^{-30} \text{ C} \cdot \text{m}$$

$$m_e = 9.10939 \times 10^{-31} \text{ kg} \quad c = 2.998 \times 10^8 \text{ m/s} \quad h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$\frac{1}{\lambda} = R_H \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \quad R_H = 1.096776 \times 10^7 \text{ m}^{-1}$$

$$E = hv \quad c = v\lambda \quad E_n = -(2.18 \times 10^{-18} \text{ J})/n^2 \quad (\text{Hydrogen Atom})$$

$$\text{Momentum: } p = mu \quad KE = \frac{mu^2}{2} = \frac{p^2}{2m} \quad (\text{note } u = \text{velocity, } v = \text{frequency})$$

$$\lambda = \frac{h}{p} = \frac{h}{mu} \quad \mu = q(r) \quad q(\text{electron}) = 1.6 \times 10^{-19} \text{ C}$$

$$KE_{\text{electron}} = hv - \Phi$$

$$q = C\Delta T = m \times C_s \times \Delta T = nC_m \quad \text{where} \quad m = \text{mass; } n = \text{moles; } C = \text{heat capacity; } C_s = \text{specific heat; } C_m = \text{molar heat capacity;}$$

$$\Delta E = q + w \quad w = -P\Delta V \quad H = \Delta E + P\Delta V$$

$$\Delta H_{\text{rxn}}^\circ = \sum m\Delta H_{\text{f(products)}}^\circ - \sum n\Delta H_{\text{f(reactants)}}^\circ$$

## SECTION FIVE

# Taking the Exam

## Registering for Your Exam

### Register Online

[www.excelsior.edu/examregistration](http://www.excelsior.edu/examregistration)

Follow the instructions and pay by Visa, MasterCard, American Express, or Discover Card.

### Examination Administration

Pearson Testing Centers serve as the administrator for all Excelsior College computer-delivered exams.

### Accessibility Services

Excelsior College is committed to the principle that every individual should have an equal opportunity to enroll in an Excelsior College degree program, to register for courses or examinations in order to demonstrate their knowledge and skills under appropriate conditions, and to complete a degree.

The Accessibility Services Office at Excelsior College is responsible for considering requests for reasonable accommodations for individuals with verifiable, documented disabilities. If you are requesting an accommodation due to a disability/condition, complete a [Request for Accommodation form](#).

### Computer-Delivered Testing

The UExcel exams are delivered by computer. You can take this exam either in a [Pearson VUE testing center](#) or at your home or office with an online proctor. If you are interested in remote proctoring, visit [PearsonVUE OnVUE online proctoring](#).

The system is designed to be as user-friendly as possible, even for those with little or no computer experience. On-screen instructions are similar to those you would see in a paper examination booklet. You will use either the keyboard or the mouse to submit your answers, depending upon the type of question.

Before taking your exam, we strongly encourage you to go on a virtual tour of the testing center. To access this tour, click the What to Expect in a Pearson VUE test center at the following link: [home.pearsonvue.com/test-taker/security.aspx](http://home.pearsonvue.com/test-taker/security.aspx)

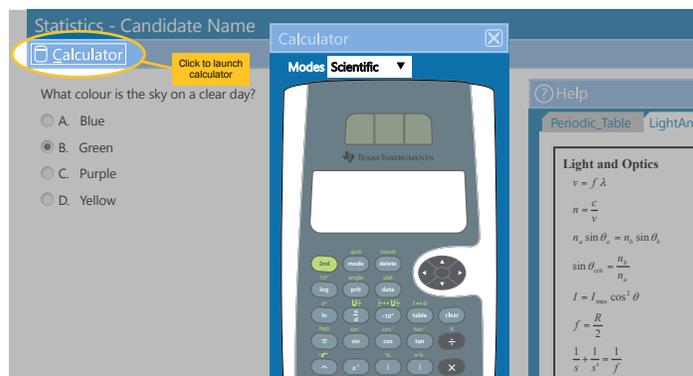
You also will receive a small, erasable whiteboard if you need one.

### Whiteboards

Examinees cannot bring scratch paper to the exam. Instead, one will be provided for you to write notes or calculations on: a small whiteboard if you are testing at a Pearson Testing Center, and an on-screen “whiteboard” if you are testing online. You can see what the [on-screen “whiteboard”](#) looks like, and even try it out.

### Calculator

You will have access to a scientific calculator on the testing screen. The calculator button will be located in the top left-hand corner of the screen as each question is displayed. A picture of the scientific calculator is provided.



## Breaks

Breaks are only permitted for exams taken at Pearson VUE Testing Centers, and are not permitted during exams delivered via online proctoring.

## Online Proctoring

As of spring 2021, Excelsior is offering an [online delivery option for UExcel exams](#), using OnVUE, Pearson VUE's online delivery and proctoring service.

You must use a personal (vs. an employer's) computer if you want to take the exam online and not in a testing center, so the exam can be effectively delivered to you.

Breaks are not allowed during an exam taken online from home. You may not leave your seat during an online-proctored exam, so be prepared to sit for two or three hours. If you need extra time, the exam will have to be taken at a PearsonVUE Testing Center, and an accommodation formally requested.

NOTE: English Composition, Spanish, Music, and College Writing will NOT be available for online proctoring.

## On the Day of Your Exam

### Important Reminders

On the day of your exam, remember to:

- dress comfortably: the computer will not mind that you're wearing your favorite relaxation outfit
- arrive at the test site rested and prepared to concentrate for an extended period
- allow sufficient time to travel, park, and locate the test center
- be prepared for possible variations in temperature at the test center due to weather changes or energy conservation measures
- bring your ID, but otherwise, don't weigh yourself down with belongings that will have to be kept in a locker during the test.

## Academic Integrity Nondisclosure Statement

- All examinees must agree to the terms of the Excelsior College Academic Integrity Policy before taking an examination. The agreement will be presented on screen at the Pearson VUE Testing Center before the start of your exam.
- Once the examinee agrees to the terms of the Academic Integrity Nondisclosure Agreement (NDA), the exam will begin.

If you choose not to accept the terms of the agreement

- your exam will be terminated
- you will be required to leave the testing center
- you will not be eligible for a refund. For more information, review the Student Policy Handbook at [www.excelsior.edu/studentpolicyhandbook](http://www.excelsior.edu/studentpolicyhandbook).

Student behavior is monitored during and after the exam. Electronic measures are used to monitor the security of test items and scan for illegal use of intellectual property. This monitoring includes surveillance of Internet chat rooms, websites, and other public forums.

### UExcel Grade Report

After you complete the exam, you will be issued a UExcel Grade Report for Examinations. See the [sample UExcel Grade Report](#) in this content guide.

### Grade Appeals

If you believe that your score grade is incorrect, you may appeal your grade to [examcredit@excelsior.edu](mailto:examcredit@excelsior.edu). Details about the appeals process are in the [Student Handbook](#).

### What If I Miss My Appointment?

If you don't cancel or reschedule your testing appointment 24 hours before your test appointment, you will have to pay the full fee of the exam, even if you don't show up.

### Late Arrivals

You will also forfeit the exam fee if you arrive to the test center more than 15 minutes late.

## Information About UExcel Exams for Colleges and Universities

A committee of teaching faculty and practicing professionals determines the learning outcomes to be tested on each exam. Excelsior College Center for Educational Measurement staff oversee the technical aspects of test construction in accordance with current professional standards. To promote fairness in testing, we take special care to ensure that the language used in the exams and related materials is consistent, professional, and user friendly. Editorial staff perform systematic quantitative and qualitative reviews to ensure accuracy, clarity, and compliance with conventions of bias-free language usage.

Excelsior College, the test developer, recommends granting three (3) semester hours of lower-level undergraduate credit to students who receive a letter grade of C or higher on this examination. The examination may be used to help fulfill a science requirement or as a free elective for all Excelsior College Degree programs that allow for free electives. Other colleges and universities also recognize this exam as a basis for granting credit or advanced standing. Individual institutions set their own policies for the amount of credit awarded and the minimum acceptable score.

## General Chemistry I Exam Development Committee

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Bal Barot, PhD

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(Peking University, Chemistry, 1993)  
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Helene Maire-Afeli, PhD

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Lab Manager/Instructor, University of South Carolina

# Sample Grade Report

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Excelsior College  
GRADE REPORT FOR EXAMINATIONS

Contact ID:

Test Date: 11/21/2020

Letter Grade: C

Examination Code and Title: 210 Statistics

Recommended Credit:  
3 Lower Level

Your examination results are expressed as a Letter Grade of A, B, C, or F. Your results are automatically verified when they are received at Excelsior College. If an error is detected, you will be notified immediately.

**Recommended Credit** is the number of semester hours credit that Excelsior College awards and recommends for your grade. Excelsior College awards and recommends credit for letter grades of C or better.

**If you plan to take another examination**, you may download free content guides and the User's Guide by visiting our website at [www.excelsior.edu/exams/content-guides/](http://www.excelsior.edu/exams/content-guides/).

**If you need an Excelsior College Official Examinations Transcript** to document the credit you have earned for this examination for another institution, the request can be made online by accessing the Excelsior College website ([www.excelsior.edu](http://www.excelsior.edu)), logging into your MyExcelsior account, and scrolling down to the For Exams Takers box and clicking on the Request transcripts link. If you do not already have a MyExcelsior username and password, you can obtain one at no cost by accessing the Excelsior College website, clicking the Log In to MyExcelsior button, and then clicking the link "Create a MyExcelsior User Account."





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[excelsior.edu/exams](https://excelsior.edu/exams)