

Spring 2019

General Chemistry 1: Fall 2015
Thursday 12:00pm – 1:50pm in Gillet 024
OR Friday 1:30pm – 3:20pm in Davis Hall 319



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Office Hours: Thurs, 4-6pm in 319 Davis Hall (or by appointment)

Goal of the course: This is the first semester of a 2-semester general chemistry sequence that begins to prepare you for a science-based career. General Chemistry I is a demanding course and while its primary objective is to introduce you to the fundamental principles that underlie the chemical sciences, to achieve success in this course you will need to organize large quantities of information in coherent ways so that you are able to recall and apply your knowledge. Organization of your time will be essential!

General Chemistry is run using a flipped classroom model. In this model you will watch videos and complete online homework at home and then come to class to complete workshop assignments (during your 1 hour recitation section) and participate in peer-learning activities using an iClicker (during our 2 hour lecture every Thursday).

You should plan to spend **at least 10-15 hours per week** watching videos, doing your online homework, engaging with your classmates and learning the material. It is your responsibility to prepare yourself for every topic before you come to class to engage in the workshop or iClicker activities. You must keep up with the material – it is unlikely that you will be able to catch up if you fall behind.

Text: For the purposes of this course you will be required to buy the General Chemistry 1: Let's Practice Workbook from the Lehman College Bookstore. You can however, use ANY General Chemistry textbook. We will not be working through a textbook in a chapter-by-chapter fashion; rather we will cover 18 chemistry topics and use the textbook as a reference. *If you feel the need to buy a recommended textbook Chemistry, 8th Ed., Zumdahl and Zumdahl is a wonderful choice.*

Web Site: As part of this course we will be using a new platform called GenChem. The GenChem platform will be ready for account registration on **Tuesday, August 25th**. You should log on to GenChem as soon as you can and register so that you can become familiar with the look and feel of the web interface. It is imperative that when we meet on Thursday August 27th (or Friday, August 28th if you are in the Friday section) that you are already registered on the GenChem website.

To claim your GenChem account:

1. Log on to <http://genchemlehman166.org> on or after August 25th.
2. Click Register and complete the registration process by entering your blackboard ID number, a working email address and a password that you create. It is very important that you use the same email address to claim your GenChem account and register both your iClicker and your Sapling homework account. This email address must be one that you check regularly as we will use it to communicate with you via the GenChem platform.

To find your Lehman College Blackboard ID number:

1. Log on to https://cunyportal.cuny.edu/cpr/authenticate/portal_login.jsp
2. Log into your account and Click on the Blackboard Tab in the "Applications/Resources" panel.
3. Click on the "Personal Information" tab on the top left side of the screen in the "Tools" panel.
4. Click on the "Edit personal Information" tab.
5. Here you will find your username followed by a 20-digit number. This 20-digit number is your Lehman College blackboard number.

The GenChem platform will be used in lieu of CUNY Blackboard and has been designed specifically for our course. This is where you will find ALL course documents including (but not limited to) the Learning Goal Analysis (LGA), Videos, Video PDF documents, iClicker sessions, links to online Sapling homework, Workshop assignments and old general Chemistry exams.

Email: Please make sure that you use the same email address to claim your GenChem account and register both your iClicker and your Sapling homework accounts. This should be an email address that you check frequently as we will be using email through the GenChem platform to communicate with the class. If you do not check your email regularly it is possible that you will miss important information - which is likely to have a negative impact your grade.

Grading policy: Every component of this course earns you points towards your final grade, but to earn your points you must complete each component by its due date. Please see the GenChem platform for more information on assignment due dates.

To earn full credit in this course you must accumulate 1400 points. 400 points come from your TOPIC grade and 1000 points come from your EXAM grades.

TOPIC	LGA ¹	Videos ¹	Workshop	i-Clicker	Homework ²	TOPIC TOTAL ³	In-Class Exams ⁴	Final Exam ⁴
Topic 1	2	2	0	0	5	9	Exam 1 (200 pts)	400 pts
Topic 2	2	2	W1: 10	0	5	19		
Topic 3	2	2	0	C1: 11	5	20		
Topic 4	2	2	W2: 10	0	5	19		
Topic 5	2	2	0	C2: 11	5	20		
Topic 6	2	2	W3: 10	C3: 11	5	19		
Topic 7	2	2	0	0	10	14	Exam 2 (200 pts)	
Topic 8	2	2	W4: 10	C4: 11	10	35		
Topic 9	2	2	0	0	10	14		
Topic 10	2	2	W5: 10	C5: 11	10	35		
Topic 11	2	2	0	0	10	14		
Topic 12	2	2	W6: 10	C6: 11	10	35		
Topic 13	2	2	0	0	5	9	Exam 3 (200 pts)	
Topic 14	2	2	W7: 10	C7: 11	10	35		
Topic 15	2	2	W8: 10	C8: 11	10	35		
Topic 16	2	2	W9: 10	C9: 11	10	35		
Topic 17	2	2	W10: 10	0	10	24		
Topic 18	2	2	W11: 10	C10: 11	10	35		
TOTALS	36	36	110	110	145	437	600	400
Total Topic Grade Required = 400 out of a total of 437 possible points							Total Exam Grade = 1000	
Total number of points to be earned in the course: 400 + 1000 = 1400								

- The points for an LGA is an all or nothing score. 2 points are earned for completion of an assignment and zero points are earned for an incomplete assignment.
- The points for each workshop, iClicker and homework assignment are scaled to the totals indicated.
- The total score for each topic is computed by summing the topic components. There are 437 total TOPIC points, but only the first 400 points count. Think of the extra 37 points as extra points that you can accumulate and use if you miss an assignment. You cannot earn more than 400 TOPIC points. These extra points cannot be applied to your exam score.
- If you miss an in-class exam the final exam will count for 600 points instead of 400 points. There are NO make-up exams.

The total number of points you earn will be normalized to a score out of 100.00 and then assigned a letter grade according to the table shown to the right. Letter grades will be determined based on a score to 2 decimal places. There will be no rounding of scores to determine letter grades.

Exams: There will be three equally weighted in-class exams (200 points each for a total of 600 points) given during the course of the semester. There will also be a Comprehensive Final Exam (400 points) given during finals week. If your final exam grade is higher than your lowest in-class exam grade your final grade will count for 600 points and your lowest in-class exam grade will be dropped.

Letter Grade	Course Requirement
A+	97.50
A	92.50
A-	90.00
B+	87.50
B	82.50
B-	80.00
C+	77.50
C	70.00
D	60.00
F	<60

For your exams you will be required to bring a pencil and a calculator to class. All other materials (e.g. periodic table and/or other necessary information such as a formula sheet) will be provided for you. Exams must be taken during the designated class period. *NO MAKE-UP EXAMS will be given.* If you miss one in-class exam you will earn a grade of zero for that exam. This grade will then be dropped as your lowest in-class exam grade and your final exam grade will automatically be counted for 600 points. If you miss more than one in-class exam you will receive a grade of ZERO for the second missed exam.

Detailed Course Outline: Please see the GenChem platform for a detailed course schedule that includes all your assignments and exam dates. In addition, we have created a video table of contents to help you organize your time effectively.

Exam schedule:

- **EXAM 1: Thursday, October 1st or Friday, October 2nd**
Think of this exam is a Chem 166 placement exam. Your score on this exam determines whether or not you have gained the knowledge required to continue in the course. If you fail this exam you should consider withdrawing from the course. If you decide to remain in the course you should meet with one of the teaching team to discuss options for success. You will need to make a drastic change to your study habits!
- **EXAM 2: Thursday, October 29th or Friday, October 30th**
This exam is more difficult than exam 1. If you failed exam 1 and you also fail this exam you should definitely withdraw from the course. The last day to withdraw from the course is *Monday, November 9th*.
- **EXAM 3: Thursday, December 10th or Friday, December 11th**
This is your last and most difficult in-class exam. In general student grades drop by 10% from exam 2 to exam 3 so make sure you put in enough time to prepare for this exam.
- **FINAL EXAM: Thursday, December 17th**

A Required Learning Goal Analysis (LGA): Before you begin a new topic you will be required to complete a Learning Goal Analysis on the GenChem platform. This analysis asks you to read each learning goal for that topic and assess how comfortable you feel with the content presented. There is no wrong answer to an LGA question. The goal is to help you begin accurately self-assessing your own content understanding and focus your attention on the learning goals to drive your learning. These learning goals serve as both an outline for the course and a tool to help you prepare for your exams. USE the LGA to study for your exams. Every single Exam question is based on at least 1 learning goal (although some will contain multiple learning goals). There is also an LGA document in the resources tab on GenChem – use this to review the learning goals after you have completed the LGA.

Required 1-hour Recitation Workshops: In addition to completing the videos and LGA assignments, you are responsible for submitting a weekly recitation assignment called a workshop. Workshops are to be completed in groups of 3 or 4 students and must be submitted to your recitation instructor. You may submit your workshop in person during your assigned recitation period or electronically (using the GenChem website) no later than 5:00pm every Sunday.

There are 12 required workshop assignments this semester. Each workshop is worth 10 points. You must attend the recitation section that you registered for every week in order to earn these points. If you miss a workshop you do not earn the points for that workshop. Remember that there are 35 extra points built into your topic grade so if you miss a workshop you can use 10 of these extra points to make up the loss. Please see the Workshop Grading Policy on GenChem for more Information.

During exam weeks recitation sections will be classed as “OPEN SECTION”. This means that there will be no workshop due that week and recitation attendance is optional. During “OPEN SECTION” you may attend ANY workshop to ask questions or get individual help from one of the TA’s.

Required iClicker: As part of this course we will be making use of a personal response device called an iClicker. You will use the iClicker to respond to in-class questions during lecture every Friday. This will serve a dual purpose: 1) Your responses will provide me with real-time feedback about student understanding of course content and 2) Your participation will help you practice the material and grow as a chemistry student.

There will be 10 required 2 hour iClicker sessions, each worth a total of 11 points. You earn 1 point for attending a session and then 1 point for every question that you answer correctly during the session. Some sessions will have only 10 questions and some will have more than 10 questions. The maximum number of points you can earn per session is 11 so only 10 correct responses will be counted for each session. If your iClicker malfunctions or when you forget it at home you will not earn the points for that session. Please do NOT ask for points if you fail to have a functioning iClicker. Once again, remember that there are 35 extra points built into your topic grade so if you do not earn the points for an iClicker session you can use 11 of these extra points to make up the loss.

iClickers can be purchased at the Lehman College Bookstore or online at: <http://www.iclicker.com/> If you continue as a chemistry student you will use this iClicker again during General Chemistry II. If you already own an iClicker from a previous course it can be used again for this course. Once you have purchased your iClicker you will need to register it. *To register your iClicker:*

1. Log on to <http://www.iclicker.com/dnn/Support/RegisterYouriclicker/tabid/174/Default.aspx>
2. Complete the registration questions. **Note:** You must register using your full first and last name and your Lehman College Blackboard ID number. Your blackboard number will be used to link your iClicker responses to our online student roster.

Required Homework: This semester we will be using an on-line homework system called Sapling. While links to your homework will be provided in the GenChem platform, you will need to buy an access code through the Sapling Website and register for our course in order to access and complete your Sapling assignments. **Sapling will be available on Tuesday, August 25th**

To register for Sapling:

1. Log on to <https://www.saplinglearning.com/ibiscms/login/>
2. Click on the blue "create an account" tab and follow the online instructions to create a user profile (choose a username and password) Please make sure that you use the same email address to claim your GenChem account and register for your Sapling homework account.
3. Select **CUNY, Lehman College** as your school
4. Select **CUNY Lehman - Chem 166 - Fall 15 - McGregor** as your course.
5. Follow the online instructions to purchase an Access Code.

The cost for ONE semester of access is \$47.00, and the cost for TWO semesters of access is \$78.00. If you plan to take both CHE 166 and CHE 168 we suggest you buy access for TWO semesters, as we will be using Sapling again in CHE 168.

Academic Dishonesty: While honest scholarship is time-consuming and often requires hard work, it is also the primary process by which students learn to think for themselves. Faculty members must teach respect for methods of inquiry within the various disciplines and make assignments that will encourage honest scholarship; students in turn must uphold a standard of honesty within the College, thereby affirming the value and integrity of their Lehman degree.

Academic dishonesty (e.g., cheating, plagiarism, obtaining unfair advantage and falsification of records and official documents) is prohibited in The City University of New York. Penalties for academic dishonesty include academic sanctions, such as failing or otherwise reduced grades, and/or disciplinary sanctions, including suspension or expulsion.

Academic dishonesty is a serious violation of the accepted values of the College. Students who are caught cheating on an exam in this course will automatically obtain a grade of ZERO for that exam and will be reported for Academic Dishonesty. This grade of ZERO cannot be used as your lowest exam score to be dropped in the course. More information about the Lehman College Policy on Academic dishonesty can be found here: <http://www.lehman.edu/undergraduate-bulletin/academicintegrity.htm>

Accommodating Disabilities: Lehman College is committed to providing access to all programs and curricula to all students. Students with disabilities who may need classroom accommodations are encouraged to register with the Office of Student Disability Services. For more information, please contact the Office of Student Disability Services, Shuster Hall Room 238, tel: 718-960-8441.

General Chemistry 1: Learning Goal Analysis

Read each learning goal and assess how comfortable you feel with the content presented. **Remember:** The goal here is to help you begin accurately self-assessing your own content understanding and learn to focus your attention on the learning goals specific to each topic

Use the Leikert scale below to choose the appropriate responses to each question:

- A. I feel very confident about his learning goal. I recognize the content and know that I could answer any questions about this subject.
- B. I feel pretty confident about this learning goal. I recognize the words and know that I have worked problems about this learning goal in the past. I am sure that I could answer most questions about this subject.
- C. I do not feel very confident about his learning goal. I recognize the words, but am not sure that I would be able to answer the questions about this topic.
- D. I do not feel at all confident about this learning goal. I do not recognize the words and am sure that I would NOT be able to answer any questions about this topic.

Topic 1: Matter, Models and Math

1	recognize that all matter is made of atoms	A	B	C	D
2	recognize that different types of atoms are called elements	A	B	C	D
3	recognize that all elements are organized on the periodic table	A	B	C	D
4	identify metals, non-metals and semi-metals on the periodic table - what are properties of metals that make them different from nonmetals	A	B	C	D
5	identify the name of the elements of the first two rows of the periodic table and attach the name to pictures	A	B	C	D
6	identify solids, liquids and gases on the periodic table	A	B	C	D
7	sketch particle pictures for solids, liquids, and gases	A	B	C	D
8	observe animations and describe the motion as translational, rotational, vibrational	A	B	C	D
9	observe animations and link the motions to the physical state of the matter (solid, liquid, gas)	A	B	C	D
10	predict how temperature changes the speed of particles	A	B	C	D
11	represent numbers using scientific notation	A	B	C	D
12	perform calculations with numbers when written in scientific notation	A	B	C	D
13	estimate orders of magnitude based on scientific notation	A	B	C	D
14	convert among the metric prefixes without being given the conversion factor	A	B	C	D
15	convert between any given set of units if given the conversion factors using proportions or dimensional analysis	A	B	C	D

Topic 2: Atoms and Orbitals

1	Draw a planetary picture of the atom and identify the component particles of an atom	A	B	C	D
2	use isotope notation to obtain the number of protons, neutrons and electrons for any atom or ion.	A	B	C	D
3	write and interpret the isotopic representation of an element.	A	B	C	D
4	use the periodic table to obtain the number of protons for a given atom or atom symbol OR given an atom name or symbol determine the number of protons.	A	B	C	D
5	articulate the principle that an atom's identity is determined by the number of protons	A	B	C	D
6	calculate the average mass number from the periodic table for any element based on isotope abundance and formula mass	A	B	C	D
7	identify the s, p, d, and f shapes of the atomic orbitals	A	B	C	D
8	break the periodic table into four distinct sections that refer to the orbital (s, p, d, f) of the valence electrons	A	B	C	D
9	write electronic configurations for any atom and its ions using the periodic table (both the long hand and noble gas configurations)	A	B	C	D
10	identify ionic charges based on the position of an element on the periodic table for atoms in Groups 1, 2, 15, 16, 17	A	B	C	D
11	Determine the magnetism (paramagnetic or diamagnetic) of any atom or ion based on its electron configuration.	A	B	C	D

Topic 3: Basic Bonding Principles

1	recognize that all bonding occurs due to electrostatic interactions between electrons and the nucleus.	A	B	C	D
2	recognize that the <i>name</i> of the electrostatic interaction is Coulombs law and that the strength of attraction between charged particles increases as the particles get closer	A	B	C	D
3	recognize that like charges repel and opposite charges attract so that atomic nuclei without electrons would repel – no ability to make molecules! Electrons are needed to mediate the nuclear repulsions.	A	B	C	D
4	identify ionic bonded compounds by the positions of the atoms on the periodic table	A	B	C	D
5	balance the ionic charges to generate chemical formula for ionic compounds	A	B	C	D
6	identify binary compounds from the chemical formula and tell if the compound is ionic or covalent	A	B	C	D
7	name binary ionic and binary covalent compounds from the chemical formula	A	B	C	D
8	write the chemical formula from the chemical name of a binary ionic or binary covalent compound	A	B	C	D
9	recognize, recall and name all polyatomic ions in table of polyatomic ions. Know the formula and the charge for each ion	A	B	C	D
10	construct and name ionic compounds that contain polyatomic ions	A	B	C	D
11	identify ionic charges based on the position of an element on the periodic table for any atom.	A	B	C	D
12	write electronic configurations for any ion using the periodic table	A	B	C	D
13	identify the number of atoms of each atom type in a given chemical formula	A	B	C	D

Topic 4: Introduction to Covalent Bonding

1	identify molecules with covalent bonds by looking at the position of the atoms on the periodic table and comparing relative electronegativities.	A	B	C	D
2	use electronegativity to predict bond polarity	A	B	C	D
3	predict the number of valence electrons for any atom or ion based on its position on the periodic table.	A	B	C	D
4	sketch electronic distribution based on Lewis structure and bond polarity	A	B	C	D
5	assess the validity of a given Lewis structure	A	B	C	D
6	draw Lewis structures for simple covalently bonded molecules using atoms from the 1 st and 2 nd rows of the periodic table	A	B	C	D
7	use Lewis structures to predict trends in bond length and strength	A	B	C	D

Topic 5: The Chemical Equation

1	articulate the principle of conservation of matter and how balancing equations relates to that principle	A	B	C	D
2	balance the number of atoms in a chemical reaction on the reactant and product side	A	B	C	D
3	use the balanced chemical equation to compute the numbers of atoms or molecules produced or consumed in a chemical reaction	A	B	C	D

Topic 6: Energy Considerations

1	recognize the difference between potential and kinetic energy - know a couple of examples of potential energy - namely gravitational and electrostatic	A	B	C	D
2	write a clear statement defining the chemical potential energy	A	B	C	D
3	identify endo- or exothermic reactions from the position of heat in a chemical reaction or from the signs of ΔE and/or ΔH .	A	B	C	D
4	link changes in temperature of the surroundings to change in energy of a system for endothermic and exothermic reactions.	A	B	C	D
5	state whether energy is released or required (absorbed) when a bond breaks or is formed	A	B	C	D
6	use a table of bond energies to compute the total energy change for a chemical reaction and to predict the thermicity (endo or exo) of a reaction	A	B	C	D

Topic 7: Periodic Trends

1	use Coulomb's law to describe the source of potential energy in atoms (electrostatic potential energy) and the energy of motion of the electrons. Ignore the energy of motion of the nucleus itself.	A	B	C	D
2	note that energy of the atom typically means the electrostatic potential energy and the kinetic energy of the electrons.	A	B	C	D
3	recall the definition of atomic size, electronegativity, ionization energy and electron affinity	A	B	C	D
4	recognize the periodic trends based on the periodic table for elements and their ions	A	B	C	D
5	rationalize the periodic properties of the elements and ions	A	B	C	D
6	recall and rationalize the exceptions to the ionization energy trend	A	B	C	D
7	write electron configurations for a series of isoelectronic ions	A	B	C	D
8	predict the relative sizes of isoelectronic ions	A	B	C	D
9	interpret graphs of periodic properties as a function of atomic number	A	B	C	D

Topic 8: Atomic Spectroscopy

1	use (you do not need to memorize) the Rydberg equation to calculate energy levels	A	B	C	D
2	use the Rydberg equation to calculate energy differences for specific transitions or calculate specific transitions from energy differences	A	B	C	D
3	use the relationship between wavelength and frequency to compute wavelength from frequency and vice versa for light	A	B	C	D
4	relate the color of the light to a frequency or wavelength of light	A	B	C	D
5	identify the visible region of the EM spectrum and demonstrate that visible light is a miniscule fraction of the EM spectrum	A	B	C	D
6	use the Planck equation to relate energy of the photon to its frequency or wavelength.	A	B	C	D
7	identify the low energy vs the high energy end of the EM spectrum and relate this to wavelengths and frequency.	A	B	C	D
8	recognize how the electromagnetic spectrum is used to probe atomic structure.	A	B	C	D
9	Use an atomic spectrum to compute possible energy level transitions	A	B	C	D
10	Use atomic spectrum to compute the nuclear charge	A	B	C	D
11	relate the energy level differences of an atom to the wavelength of the corresponding photon.	A	B	C	D
12	Use Rydberg equation to compute a line spectrum	A	B	C	D

Topic 9: The Electron

1	describe the failure of the classical model to explain the hydrogen atom's stability	A	B	C	D
2	describe the duality of nature – what defines a particle (mass and position), what defines a wave (diffraction and interference)	A	B	C	D
3	calculate the mass of photon and recognize the Compton Effect as the primary experiment suggestion photons have mass and are therefore particles	A	B	C	D
4	use debroglie equation to calculate wavelengths of particles and therefore realize that particles can act as waves	A	B	C	D
5	be familiar with the double slit experiment and how it is used to demonstrate wave behavior	A	B	C	D
6	recognize that the s, p, d, f orbitals are the wavefunctions of the electrons and represent electron density and positional probability	A	B	C	D
7	relate the quantum number l to the orbital subshell notation (s, p, d, f).	A	B	C	D
8	recognize and determine the allowed quantum numbers for the n, l, m_l numbers	A	B	C	D
9	Identify the s, p, d, f block on the periodic table and use that to predict some quantum numbers (but not all – why not?)	A	B	C	D
10	interpret radial distributions of electrons—relate radial nodes to relate the radial picture to “3d” or angular pictures	A	B	C	D
11	identify the correct number of angular nodes for s, p and d orbitals	A	B	C	D
12	recognize the resulting electronic density from superimposed orbitals	A	B	C	D
13	relate radial distribution curves to energy level diagrams	A	B	C	D

Topic 10: Molecular Geometry

1	recognize that bond formation results in a lowering of energy	A	B	C	D
2	predict if a bond is a polar from the table of electronegativities	A	B	C	D
3	predict whether a molecule with a given shape has a dipole moment based on adding (pictorially) individual bond dipole moments or symmetry	A	B	C	D
4	looking at a picture, determine whether or not a molecule has a dipole moment or knowing the dipole moment, predict how the electrostatic potential might look	A	B	C	D
5	draw resonance structures for appropriate molecules	A	B	C	D
6	recognize that the bonding in resonance structures produces a non-integer bond order	A	B	C	D
7	calculate formal charges for each atom from a Lewis structure	A	B	C	D
8	evaluate resonance structures and determine the hybrid structure	A	B	C	D
9	relate bond length, bond strength, and bond order to particular resonance structures	A	B	C	D
10	draw Lewis structures for molecules that are exceptions to the octet rule	A	B	C	D
11	predict and name the electron geometries and corresponding bond angles for covalent molecules using VSEPR	A	B	C	D
12	predict molecular shapes from its name and/or chemical formula using Lewis structures and VSEPR rules	A	B	C	D

Topic 11: Valence Bond Theory

1	recognize sp , sp^2 , sp^3 , dsp^3 , d^2sp^3 hybridization	A	B	C	D
2	state the hybridization of carbon's atomic orbitals when given a valid Lewis structure	A	B	C	D
3	recognize sigma and pi bonds and relate those to bond order	A	B	C	D
4	sketch sigma and pi bonds from the overlap of hybrid orbitals	A	B	C	D
5	explain why there is rotation around a single bond but not multiple bonds	A	B	C	D

Topic 12: Molecular Orbital Theory

1	draw the resulting bonding and anti-bonding orbitals when: <ul style="list-style-type: none"> Two s orbitals overlap Two p orbitals overlap head-on Two p orbitals overlap sideways 	A	B	C	D
2	distinguish among sigma (σ), pi (π), σ^* , and π^* (bonding and anti-bonding) orbitals in molecular orbital theory	A	B	C	D
3	identify nodes in a molecular orbital	A	B	C	D
4	given an energy diagram, predict observable properties like bond order, magnetism, bond length, and electron density	A	B	C	D

Topic 13: The Mole

1	recall and apply the basic rules of scientific notation, rounding, metric units and dimensional analysis	A	B	C	D
2	rearrange a basic algebraic expression to isolate any variable in the expression (i.e. mass = moles x molar mass)	A	B	C	D
3	revisit balancing a chemical equation and use the coefficients to predict the number of <i>atoms or molecules</i> produced or used in a chemical reaction	A	B	C	D
4	articulate that the atomic mass in the periodic table is the number of grams in a mole of the element. Alternatively the atomic mass in the periodic table is the number of grams in an Avogadro's number of atoms	A	B	C	D
5	memorize Avogadro's number: 6.023×10^{23} particles/mol	A	B	C	D
6	use the periodic table to determine the mass (in grams) of a given mole of different substances	A	B	C	D
7	interpret the chemical formula to be able to compute the molar mass	A	B	C	D
8	convert between moles and masses for an arbitrary amount of matter	A	B	C	D
9	convert between numbers of particles, moles and grams	A	B	C	D
10	scale up the coefficients to realize that they can refer to the number of atoms and molecules or even to the number of moles	A	B	C	D
11	balance chemical equations and recognize that coefficients can represent mole numbers	A	B	C	D

Topic 14: Stoichiometry Calculations

1	identify the limiting and excess reagents in a chemical reaction based on given amounts of reactants	A	B	C	D
2	use the chemical equation to compute the maximum amount (theoretical yield) of products produced	A	B	C	D
3	use the chemical equation to compute the amount of reactants needed to produce a 100% yield	A	B	C	D
4	use the chemical equation to predict all masses of all components after a reaction has run to 100% completion: i.e. amount of reactant reacted, amount of reactant unreacted (excess), amount of product produced	A	B	C	D
5	recognize the actual yield in a chemical reaction based on the wording of a problem	A	B	C	D
6	compute percent yields for any chemical reaction from actual yields and theoretical yields	A	B	C	D
7	incorporate limiting reagent calculations into <i>all</i> stoichiometric calculations starting with given amounts of reactants or given amounts of products	A	B	C	D
8	for any given set of conditions compute the amount of reactants and products in the reaction vessel (including mole, mass, % yield and or number of particles)	A	B	C	D

Topic 15: Empirical and Molecular Formula

1	compute % composition for any element based on the chemical formula of a compound	A	B	C	D
2	obtain the empirical formula from mass measurements, % composition and chemical reactions	A	B	C	D
3	obtain molecular formulas from empirical formulas and molecular weight data	A	B	C	D
4	determine empirical and molecular formula from combustion reactions	A	B	C	D

Topic 16: Phase Change and IMF

1	be able to draw particle diagrams that distinguish gas and liquid phases; be able to describe the motion in the phases	A	B	C	D
2	identify the 6 phase transitions (evaporation, condensation, freezing, melting, sublimation, deposition)	A	B	C	D
3	identify the different phases and phase transitions on a heating curve and phase diagram	A	B	C	D
4	recognize the phase transitions that require the most energy	A	B	C	D
5	interpret a phase diagram and identify the normal boiling point and normal freezing point, the triple point, and the vapor pressure at different temperatures	A	B	C	D
6	recognize that heat and temperature are different concepts; that temperature is a measure of kinetic energy of the particles and heat is a type of transfer of energy from one body to another	A	B	C	D
7	define vapor pressure and the trends in vapor pressure as a function of temperature	A	B	C	D
8	draw a particle diagram representing vapor pressure	A	B	C	D
9	define the normal boiling point in terms of vapor pressure	A	B	C	D
10	describe the difference between intermolecular forces and intramolecular forces	A	B	C	D
11	describe the following 3 intermolecular forces (IMF) and rank their relative strengths	A	B	C	D
12	london dispersion, dipole-dipole and hydrogen bonding	A	B	C	D
13	recognize and predict IMF present in a substance when given its name or chemical structure	A	B	C	D

Topic 17: Gases

1	list the ideal gas postulates and relate them to the motion of gas molecules	A	B	C	D
2	identify the four variables used to characterize a gas quantitatively (P, T, V and n)	A	B	C	D
3	describe pressure as an average Force/Area	A	B	C	D
4	recognize when the average force increases due to momentum changes or frequency changes	A	B	C	D
5	realize that the pressure of a gas is proportional to the mole number of the gas (at constant P,T,V) thus gas pressure can be used in place of mole in stoichiometry calculations.	A	B	C	D
6	assign the proper units to each of the variables: expressing P in atm, n in moles, T in Kelvin, and V in liters and use $R = 0.0821 \text{ Latm/mol K}$	A	B	C	D
7	convert among units of V (milliliter, liter, cm^3); units of P (torr, atm, kPa); and units of T (C and K)	A	B	C	D
8	write down the ideal gas law and use algebra to rearrange $PV=nRT$ to isolate each variable.	A	B	C	D
9	identify problems as single state and then set up the single state equation with one variable	A	B	C	D
10	identify problems as two state problems and then can find the variables that are changing and those that are not changing	A	B	C	D
11	modify the single state equation to explicitly solve for density, mass, or molar mass	A	B	C	D
12	solve the double state problem for an unknown and for relative changes in volume and pressure	A	B	C	D
13	relate the speeds of the particles to their kinetic energy and use a graph to show that different particles have different energies at one temperature	A	B	C	D
14	remember and write down the relationship between PV and KE and between T and KE	A	B	C	D
15	use the PV and KE equations to relate speed and mass (and molar mass) to temperature	A	B	C	D
16	predict relative average speeds and relative diffusion rates of gaseous particles	A	B	C	D
17	predict relative speeds of effusion and diffusion	A	B	C	D

Topic 18: Applications of Stoichiometry

1	draw particles diagrams for dissolving an ionic solid in water or for dissolving a polar covalent compound in water	A	B	C	D
2	identify the solute and the solvent in a solution	A	B	C	D
3	use molarity formula to compute mass, moles, volume, or molarity	A	B	C	D
4	use the dilution formula to compute molarity and volume after dilution	A	B	C	D
5	identify and name the 3 types of reactions: Combustion Synthesis and decomposition Precipitation/dissolution	A	B	C	D
6	predict products of combustion reactions from known oxides	A	B	C	D
7	predict products of synthesis and decomposition reactions	A	B	C	D
8	predict products of precipitation reactions using solubility rules	A	B	C	D
9	write molecular and net ionic equations for precipitation and dissolution reactions	A	B	C	D
10	demonstrate knowledge of nomenclature rules, types of reactions, and predicting products of reactions by <u>performing stoichiometric calculations</u> for reactions containing solids, liquids, gases, or solutions	A	B	C	D