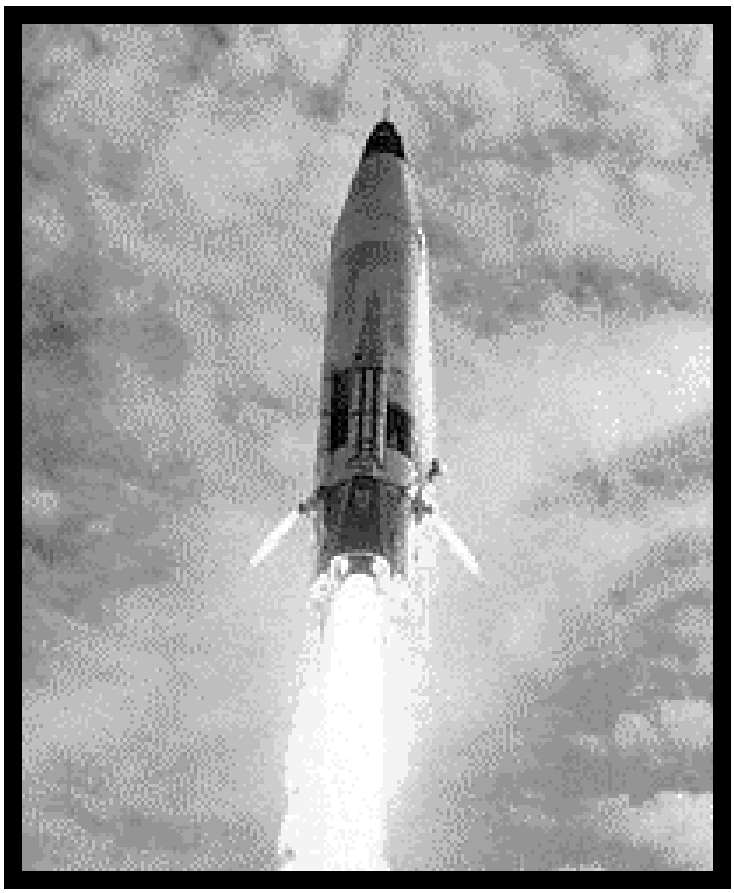
The Complete Book of Chemistry Quizzes and Practice Problems

Volume 1: The First Semester



Ian Guch

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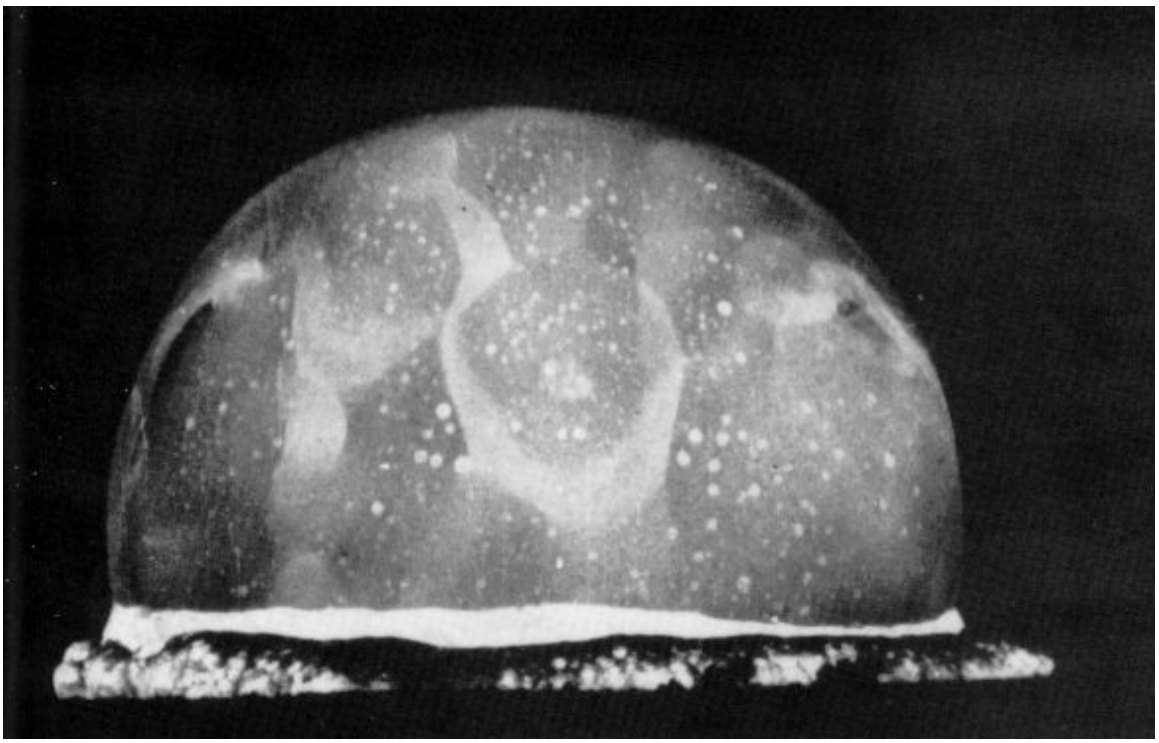

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Volume 1: The First Semester

Cavalcade Publishing

ISBN 0–9676509–2–5

Cover Photo:
The cover photo shows an Atlas missile lifting off from Cape Canaveral, date unknown. Atlas missiles were originally constructed for the delivery of hydrogen bombs to the Soviet Union, though they were eventually redesigned for the space program.

Frontispiece Photo:
During Operation Greenhouse, a non-weapons design nuclear device called "George" was detonated as a nuclear physics experiment. Exploded on the morning of 9 May 1951 at the Enewatak testing grounds with a power of 225 kt, this photo was taken 0.02 seconds after ignition on a 200-foot tower.

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Section 2: Major Quizzes

Introduction

Hi. Welcome to my book of pop quizzes, quizzes, and practice problems. I know you'll enjoy having your class do them as much as I enjoyed writing them. Probably more. Lots more.

Toward the end of this manuscript I lost a very close friend. It was the "1" button on my keyboard. Unfortunately, the only way I can put a "1" into this book is by cutting and pasting from somewhere else in the text. I also can't make exclamation marks at all, so if my emotion seems a little flat, it's because I can't add emphasis with the exclamation mark. John Grisham doesn't have this problem… he's got servants to go to Comp USA and buy him a new keyboard. I'm lucky if I can get my cat to get off of my hands long enough to type a sentence [exclamation point].

An explanation of the layout of this book:

The first section of this book consists of pop quizzes that you can use with your classes. Now, obviously you won't want to give your students 36 graded pop quizzes if for no other reason than you'd have to grade them all. An even better way to use them is as review problems – they should each take about ten minutes, making them ideal activities for if your lesson ends a little early one day.

The next section of the book consists of larger quizzes – each covers the equivalent of half a chapter of material. These quizzes are a little more in-depth and the questions have been written to reflect the most commonly asked questions your students might run into on the SAT, IB, AP, or state standardized exams.

One thing you'll notice when going over the two quiz sections is that the solutions to the pop quizzes are presented before the pop quiz and the solutions to the larger quizzes are presented after the quiz. This was done in the interest of making this book easier to navigate. You'll notice that in the pop quiz section, each set of facing pages contains the quiz and solutions. I couldn't do that for the larger quizzes, because it would require putting the quizzes on microfilm, and microfilm doesn't photocopy well.

The last section of the book is a semester exam that covers all of the material from the first two sections. This test has a multiple choice section and a short answer section. If you don't feel like grading much at the end of the semester, only give the first part. If you feel that multiple choice questions don't provide in-depth assessment, only give the second part. If you're a glutton for punishment, give both sections.

The grading scale:

At the end of each quiz, I've provided a suggested grading scale. The scale goes by the common 90% = A, 85% = B+, 80% = B, and so on down through 60% = D. If you've got a class of really smart kids, you might want to make this grading scale a little tighter, and if you teach students that are kind of slow, you might want to curve things a little. A good rule of thumb: If you can sleep well at night knowing that your students have been graded fairly, you've got a good grading scale.

Final words:

Well, that's it for me. I've run out of things to say after many, many weeks of writing this thing. I'll be back in a year or so with a second volume of assessment wisdom. Until then, there's one thing you can do for me: If you liked this book (or my others, for that matter), tell your friends about it. Cavalcade Publishing is an independent publishing company. Among other things, this means that I don't have any corporate juggernaut promoting my book for me. As a result, I can put whatever I want in my books and I can keep the cover price down since I don't have to pay lawyers to travel through the land spreading plague and pestilence. Buy independent [exclamation mark].

Enjoy the book and feel free to keep visiting my website for free worksheets. (www.chemfiesta.com)

Your friend,

Ian Guch
July 25, 2000

Acknowledgements

This book couldn't have been written without the help of lots and lots of people who give me moral and technical support.

Most of all, I want to thank my wife, Ingrid. I couldn't do any of this without her support and help. I'm continually puzzled why such a wonderful woman would put up with such a weirdo. Go figure.

I want to thank my family: Mom, dad, my grandparents, Matt and Cindy, Susan and Rich, and all of those other ones I never see. You guys are da bomb.

I've had a bunch of mentors who have helped me out with my chemistry and teaching. Thanks to Marcello DiMare (wherever he wandered off to), Nancy Levinger, Joy McManus, and Anita Ramsey for their help in making me a chemistry teaching machine.

I also want to thank some miscellaneous people for helping me out with some of the many projects I've been working on lately: The folks at the post office for helping me out with all of my shipping needs, my neighbors for being cool and letting me play with their dogs, my cats (Maalox and Catnose) for being friendly, my friend Donna for helping out with the very worst parts of Cavalcade Publishing as well as being really cool, James Squeaky for help with the 'zine (as well as those who write for it), the guy who keeps calling my house during the day asking for Pablo (he must be lonely to keep calling when he knows I'll answer), and Rudy at Office Depot (or Staples, I can't tell them apart) for being the photocopy guru.

Last, but certainly not least, I want to thank everybody who ever started an independent business or project (record label, publishing company, 'zine, family business) for giving me the confidence to go through with Cavalcade Publishing. If you have a choice between purchasing items from an independent business or a large corporation (Wal-Mart, etc.), please buy from the independent business.

Section 1

Pop Quizzes

Lab Equipment Pop Quiz

1) Heating a chemical to a temperature of 1500^0 C requires the following equipment (1.5 points each):
   - ring stand
   - ring
   - Bunsen burner
   - flint striker
   - clay triangle (or wire gauze)
   - crucible (or evaporating dish)
   - crucible tongs
   - goggles

2) The equipment which can accurately measure the volume of a liquid include (2 points each):
   - graduated cylinder
   - volumetric flask
   - volumetric pipet

3) To tell if a piece of glassware is too hot to touch, splash a little bit of water on it. If the water sizzles, the glassware is too hot to touch. This should be done whenever glassware has been heated over a Bunsen burner or hot plate. (3 points)

Suggested Grading Scale

21 = A+
19 – 20.5 = A
18 – 18.5 = B+
17 – 17.5 = B
16 – 16.5 = C+
15 – 15.5 = C
14 – 14.5 = D+
13 – 13.5 = D
<3 = F

Pop Quiz

Please answer all questions to the best of your abilities on a separate sheet of paper.

1) Describe all lab equipment which would be required if you wanted to heat a chemical to 1500^0 C. (12 points)

2) Describe all lab equipment that can be used to accurately measure the volume of a liquid. (6 points)

3) What should be done to determine if glassware is too hot to touch? (3 points)

Pop Quiz

Please answer all questions to the best of your abilities on a separate sheet of paper.

1) Describe all lab equipment which would be required if you wanted to heat a chemical to 1500^0 C. (12 points)

2) Describe all lab equipment that can be used to accurately measure the volume of a liquid. (6 points)

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3) What should be done to determine if glassware is too hot to touch? (3 points)

Scientific Method Pop Quiz

Your students will have a wide variety of answers for this quiz, depending on the problems they cite in their use of the scientific method. However, this should be a straightforward quiz to grade because kids usually get the whole thing right or the whole thing wrong.

If your students mention the six steps of the scientific method (purpose, hypothesis, materials, procedure, results, conclusion), give them one point for each of them. If the steps are listed in order, give them an additional three points.

If your students correctly apply the six steps of the scientific method, give them one point for each step they get correct. For example, the hypothesis should be an "if ___, then ___" statement and the materials list should be complete for the question.

Suggested Grading Scale

15 = A+
14 = A
13 = B+
12 = B
11 = C+
10 = D+
9 = D
< 9 = F

Pop Quiz

Please answer this question on a separate sheet of paper.

The scientific method has been described in this class as being the way that scientists solve problems. However, the scientific method isn't only useful for scientists – it's useful for everybody.

For this quiz you will think back to an experience where you had a problem you needed to solve. List the six steps of the scientific method in order and use them to describe how you solved your problem.

Grading: 1 point for each step of the scientific method, 3 points for getting them in the right order, 1 point for your application of each step into your personal experiences.

Pop Quiz

Please answer this question on a separate sheet of paper.

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Grading: 1 point for each step of the scientific method, 3 points for getting them in the right order, 1 point for your application of each step into your personal experiences.

Elements, Compounds, and Mixtures Pop Quiz

1) A tuna sandwich is a heterogeneous mixture because the bread and tuna fish are easily distinguishable from one another. (1 point)

2) A silver bracelet is an element because silver is listed on the periodic table. (1 point)

3) Pudding is a homogeneous mixture because it contains many different components that are indistinguishable from one another. (1 point)

4) Heterogeneous mixtures are generally easier to separate than homogeneous mixtures because the different components are easily identified and frequently easy to pull apart manually. For example, the tuna sandwich in problem 1 is easy to separate (pull the tuna off of the bread). The pudding in problem 3 is far more difficult to separate because everything is so completely mixed. (7 points – Grade based on how complete their answer is)

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Determine whether each of the following are elements, compounds, heterogeneous mixtures, or homogeneous mixtures. (1 point each)

1) tuna sandwich _____

2) silver bracelet _____

3) pudding _____

4) Which is easier to separate, a homogeneous or heterogeneous mixture? Explain your reasoning (7 pts):

_____

_____

_____

_____

Pop Quiz

Determine whether each of the following are elements, compounds, heterogeneous mixtures, or homogeneous mixtures. (1 point each)

1) tuna sandwich _____

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3) pudding _____

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1) tuna sandwich _____

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3) pudding _____

4) Which is easier to separate, a homogeneous or heterogeneous mixture? Explain your reasoning (7 pts):

_____

_____

_____

_____

Scientific Notation Pop Quiz

Convert the following numbers into scientific notation. (1 point each)

1) 623,000 **6.23×10^{5}**

2) 230 **2.3×10^{2}**

3) 0.0034 **3.4×10^{-3}**

4) 12 **1.2×10^{1}**

5) 0.0000890 **8.90×10^{-5}**

Convert the following numbers back into standard notation. (1 point each)

6) 4.5×10^{-5} **0.000045**

7) 2.98×10^{3} **2,980**

8) 3.1×10^{0} **3.1**

9) 6.33×10^{-7} **0.000000633**

10) 1.1×10^{2} **110**

Suggested Grading Scale
10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Please answer each of the following questions on a separate sheet of paper.

Convert the following numbers into scientific notation. (1 point each)

1) 623,000
2) 230
3) 0.0034
4) 12
5) 0.0000890

Convert the following numbers back into standard notation. (1 point each)

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9) 6.33×10^{-7}
10) 1.1×10^{2}

Significant Figures Pop Quiz

How many significant figures are in each of the following numbers? (1 point each)

1) 340 **2**

2) 280,010 **5**

3) 0.0023 **2**

4) 102,000 **3**

5) 102,020 **5**

6) 0.00230 **3**

7) 0.0023020 **5**

8) 1,020.030 **7**

9) 2.3×10^{-3} **2**

10) 2.3010×10^{-6} **5**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

How many significant figures are in each of the following numbers? (1 point each)

1) 340 _____

2) 280,010 _____

3) 0.0023 _____

4) 102,000 _____

5) 102,020 _____

6) 0.00230 _____

7) 0.0023020 _____

8) 1,020.030 _____

9) 2.3×10^{-3} _____

10) 2.3010×10^{-6} _____

Pop Quiz

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9) 2.3×10^{-3} _____

10) 2.3010×10^{-6} _____

Significant Figures Calculations Pop Quiz

Write the answers to the following problems with the correct number of significant figures. (1 point each)

1) 20 + 3.6 = **20 (23.6 rounds to 20)**

2) 9002 – 800 = **8,200 (8,202 rounds to 8,200)**

3) 0.0023 x 0.0121 = **0.000028 (0.0000278 rounds to 0.000028)**

4) 98 / 0.003 = **30,000 (32,667 rounds to 30,000)**

5) 0.00011 – 78.22 = **–78.22 (–78.2199 rounds to –78.22)**

6) 45 + 6.871 = **52 (51.871 rounds to 52)**

7) 340 x 0.0005 = **0.2 (0.17 rounds to 0.2)**

8) 65.90 / 34.001 = **1.938 (1.93818 rounds to 1.938)**

9) 4 – 4.6 – 10 = **–10 (–10.6 rounds to –10)**

10) (3 x 9.1) + (14.02 / 10) = **30 (3 x 9.1 equals 27.3 which rounds to 30. 14.02 / 10 = 1.402 which rounds to 1. When you add 30 + 1, this equals 31, which rounds to 30)**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Write the answers to the following problems with the correct number of significant figures. (1 point each)

1) 20 + 3.6 = _____
2) 9002 – 800 = _____
3) 0.0023 x 0.0121 = _____
4) 98 / 0.003 = _____
5) 0.00011 – 78.22 = _____
6) 45 + 6.871 = _____
7) 340 x 0.0005 = _____
8) 65.90 / 34.001 = _____
9) 4 – 4.6 – 10 = _____
10) (3 x 9.1) + (14.02 / 10) = _____

Pop Quiz

Write the answers to the following problems with the correct number of significant figures. (1 point each)

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8) 65.90 / 34.001 = _____
9) 4 – 4.6 – 10 = _____
10) (3 x 9.1) + (14.02 / 10) = _____

Unit Conversions Pop Quiz

1) How many grams are there in 23.4 kilograms? (3 points)
23,400 grams

2) How many inches are there in 522 centimeters? *There are 2.54 centimeters in an inch.* (3 points)
206 inches (1325.88 without significant figures)

3) How many millimeters are there in 0.0045 decimeters? (5 points)
0.45 millimeters

4) How many inches are there in 4.2×10^{-5} miles? *There are 36 inches in a yard and 1760 yards in a mile.* (5 points)
2.7 inches

5) Convert 341^{0} C to Kelvins. (3 points)
614 Kelvins

6) Convert 881 centuries to days. *There are 1461 days in 4.00 years.* (6 points)
3.22×10^{7} days

Suggested Grading Scale

25 = A+
23 – 24 = A
22 = B+
20 – 21 = B
19 = C+
18 = C
17 = D+
15 – 16 = D
< 15 = F

Pop Quiz

Write the answers to the following problems on a separate sheet of paper.

1) How many grams are there in 23.4 kilograms? (3 points)
2) How many inches are there in 522 centimeters? *There are 2.54 centimeters in an inch.* (3 points)
3) How many millimeters are there in 0.0045 decimeters? (5 points)
4) How many inches are there in 4.2×10^{-5} miles? *There are 36 inches in a yard and 1760 yards in a mile.* (5 points)
5) Convert 341^0 C to Kelvins. (3 points)
6) Convert 881 centuries to days. *There are 1461 days in 4 years.* (6 points)

Pop Quiz

Write the answers to the following problems on a separate sheet of paper.

1) How many grams are there in 23.4 kilograms? (3 points)
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Write the answers to the following problems on a separate sheet of paper.

1) How many grams are there in 23.4 kilograms? (3 points)
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5) Convert 341^0 C to Kelvins. (3 points)
6) Convert 881 centuries to days. *There are 1461 days in 4 years.* (6 points)

Periodic Table Pop Quiz

What family on the periodic table is most associated with each of the following properties? (1 point each)

1) All are diatomic: **Halogens**

2) Form +2 ions: **Alkaline earth metals**

3) Unreactive: **Noble gases**

4) Highest melting and boiling points: **Transition metals**

5) Why do elements in the same family have similar properties? (4 points)
Elements in the same family have similar properties because they have the same electron arrangements in their valence shells as other elements in their family.

Suggested Grading Scale
8 = A+
7 = B+
6 = C+
5 = D
< 5 = F

Pop Quiz

What family on the periodic table is most associated with each of the following properties? (1 point each)

1) All are diatomic: _____

2) Form +2 ions: _____

3) Unreactive: _____

4) Highest melting and boiling points:

_____

5) Why do elements in the same family have similar properties? (4 points)

Pop Quiz

What family on the periodic table is most associated with each of the following properties? (1 point each)

1) All are diatomic: _____

2) Form +2 ions: _____

3) Unreactive: _____

4) Highest melting and boiling points:

_____

5) Why do elements in the same family have similar properties? (4 points)

Pop Quiz

What family on the periodic table is most associated with each of the following properties? (1 point each)

1) All are diatomic: _____

2) Form +2 ions: _____

3) Unreactive: _____

4) Highest melting and boiling points:

_____

5) Why do elements in the same family have similar properties? (4 points)

Pop Quiz

What family on the periodic table is most associated with each of the following properties? (1 point each)

1) All are diatomic: _____

2) Form +2 ions: _____

3) Unreactive: _____

4) Highest melting and boiling points:

_____

5) Why do elements in the same family have similar properties? (4 points)

Periodic Trends Pop Quiz

Points should be assigned for this problem based on how well the students explain this concept based on what you've gone over in class. If you feel the distinction between electron affinity and electronegativity is an important one, all of the following material should be given. If you feel the distinction is less important, give points based on how well you feel the students have explained what you want them to know.

Briefly explain the difference(s) between electron affinity and electronegativity. (10 points)

Electron affinity is the energy change that occurs when an electron combines with a neutral atom. The more negative the electron affinity (the more exothermic the process is), the more the atom wants to grab electrons. As one might expect, the electron affinity decreases (becomes more negative) as you move across the periodic table and increases (becomes less negative) as you move down the periodic table.

Electronegativity is a measure of how much atoms tend to want to grab electrons from atoms that they're bonded to. Electronegativity is not measured in units of energy as electron affinity is. Rather, it's frequently measured according to a unitless Pauling electronegativity scale. The more electronegative an element is, the more it wants to grab electrons. Electronegativity tends to increase as you move across the periodic table and decrease as you move down the periodic table.

Electron affinity and electronegativity measure basically the same thing – the pull an atom has for electrons. The trends, while seeming to be exactly opposite of one another, both show the same thing. Elements at the far right of the periodic table grab electrons tightly, while elements at the far left don't grab electrons much at all.

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Briefly explain the difference(s) between electron affinity and electronegativity. (10 points)

Pop Quiz

Briefly explain the difference(s) between electron affinity and electronegativity. (10 points)

Pop Quiz

Briefly explain the difference(s) between electron affinity and electronegativity. (10 points)

Pop Quiz

Briefly explain the difference(s) between electron affinity and electronegativity. (10 points)

Dalton's Postulates Pop Quiz

Explain Dalton's five postulates of the atom: (10 points – give students two points for each correct postulate)

- **Matter is made of indestructible atoms. Simply put, this means that you can't break an atom.**
- **Atoms of different elements have different properties. Any two elements have different chemical and physical properties from one another.**
- **Atoms of the same element have the same properties. No matter where these atoms come from, the chemical and physical properties of these atoms are identical.**
- **Atoms of different elements combine in simple whole-number ratios to form chemical compounds. Chemical compounds always have the general form A_xB_y, where x and y are whole numbers.**
- **Atoms cannot be created or destroyed in a chemical reaction. This is the same thing as the Law of conservation of mass.**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Explain Dalton's five postulates of the atom: (10 points)

Pop Quiz

Explain Dalton's five postulates of the atom: (10 points)

Pop Quiz

Explain Dalton's five postulates of the atom: (10 points)

Pop Quiz

Explain Dalton's five postulates of the atom: (10 points)

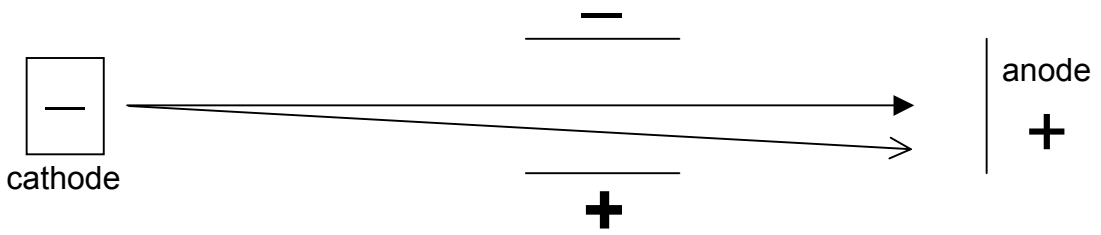
Thomson's Experiment Pop Quiz

Describe the experiment that proved the existence of the electron. (10 points)

Thomson's cathode ray experiment proved the existence of the electron. In this experiment, Thomson set up a cathode ray tube – in it, a beam of "cathode rays" move from the cathode (the negative electrode) toward the anode (the positive electrode).

To determine what the cathode rays were, Thomson did a variety of experiments. In one experiment he placed a small paddlewheel in the cathode ray tube and found that the cathode rays pushed the wheel toward the anode. From this, he determined that cathode rays were made of particles that had mass.

Thomson placed charged plates on the top and bottom of the cathode ray tube and found that the cathode rays tend to deflect toward the positive plate and deflect away from the negative plate. Since like charges repel and opposite charges attract, Thomson determined that the "cathode rays" consisted of particles with negative charge.



Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Describe the experiment that proved the existence of the electron. (10 points)

Pop Quiz

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Pop Quiz

Describe the experiment that proved the existence of the electron. (10 points)

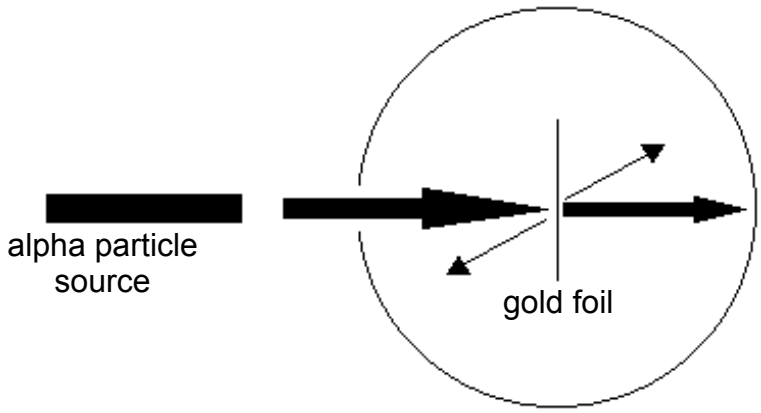
Rutherford's Experiment Pop Quiz

Describe the experiment proving the positive charge in an atom resides in the nucleus. (10 points)

Rutherford's gold foil experiment demonstrated that the positive charge in atoms resides in the nucleus. In this experiment, Rutherford set up an alpha particle emitter such that the particles would hit a very thin piece of gold foil. Alpha particles are the nucleus of the ^{4}He isotope and have a charge of +2.

When the experiment was started, most of the alpha particles passed directly through the gold foil. However, some of the alpha particles were deflected somewhat, with a very few actually bouncing off of the gold foil back toward the alpha emitter. Rutherford was shocked, stating that, "It was almost as if you fired a 15-inch shell into a piece of tissue paper and it came back and hit you."

Rutherford interpreted these results to mean that most of the atom was made of empty space, causing most of the alpha particles to pass directly through the gold foil. He also hypothesized that all of the positive charge in the atom was concentrated in the nucleus, causing positive alpha particles that passed very close to the nucleus to be deflected.



Suggested Grading Scale

10 = A+
9 = A
8 = B
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6 = D
< 6 = F

Pop Quiz

Describe the experiment proving the positive charge in an atom resides in the nucleus. (10 points)

Pop Quiz

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Pop Quiz

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Pop Quiz

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Light Emission Pop Quiz

Describe the process by which light is emitted from an atom (8 points)

Give two points for each of the following steps:

1) **The atom absorbs energy (usually as a photon).**
2) **If the added energy is the same as the difference in energy between the ground state and the excited state of the atom, an electron will be promoted from the ground state into the excited state.**
3) **Eventually the electron falls back down from the excited state into the ground state.**
4) **When the electron falls back into the ground state, the atom gives off exactly the same amount of energy as it absorbed before. This energy is given off as light.**

Suggested Grading Scale

8 = A+
7 = B+
6 = C
5 = D
< 5 = F

Pop Quiz

Describe the process by which light is emitted from an atom (8 points)

Pop Quiz

Describe the process by which light is emitted from an atom (8 points)

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Pop Quiz

Describe the process by which light is emitted from an atom (8 points)

Quantum Numbers Pop Quiz

Give the quantum numbers for the outermost electron in rubidium (Rb). (8 points)

Give students two points for each of the following:

- **n = 5 (The outermost electron is in the outermost energy level)**
- **l = 0 (The outermost electron is in an s-orbital)**
- **m_l = 0 (The only allowed value for m_l in an s-orbital is 0)**
- **m_s = +1/2 or –1/2 (Either value is fine)**

Suggested Grading Scale

8 = A+
7 = B+
6 = C
5 = D
< 5 = F

Pop Quiz

Give the quantum numbers for the outermost electron in rubidium (Rb). (8 points)

Pop Quiz

Give the quantum numbers for the outermost electron in rubidium (Rb). (8 points)

Pop Quiz

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Pop Quiz

Give the quantum numbers for the outermost electron in rubidium (Rb). (8 points)

Subatomic Particles Pop Quiz

Please fill in the following chart: (1 point per blank)

Isotope	Protons	Neutrons	Electrons
^{7}Li	3	4	3
^{27}Al	13	14	13
^{65}Zn	30	35	30
^{119}Sn	50	69	50
^{164}Dy	66	98	66
^{232}Th	90	142	90

Suggested Grading Scale

18 = A+
17 = A
16 = B+
15 = B
14 = C+
13 = C
12 = D+
11 = D
< 11 = F

Pop Quiz

Please fill in the following chart: (1 point per blank)

Isotope	Protons	Neutrons	Electrons
^{7}Li			
^{27}Al			
^{65}Zn			
^{119}Sn			
^{164}Dy			
^{232}Th			

Pop Quiz

Please fill in the following chart: (1 point per blank)

Isotope	Protons	Neutrons	Electrons
^{7}Li			
^{27}Al			
^{65}Zn			
^{119}Sn			
^{164}Dy			
^{232}Th			

Pop Quiz

Please fill in the following chart: (1 point per blank)

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^{7}Li			
^{27}Al			
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^{119}Sn			
^{164}Dy			
^{232}Th			

Pop Quiz

Please fill in the following chart: (1 point per blank)

Isotope	Protons	Neutrons	Electrons
^{7}Li			
^{27}Al			
^{65}Zn			
^{119}Sn			
^{164}Dy			
^{232}Th			

Electron Configurations Pop Quiz

Write the electron configurations for the following elements: (1 point each)

1) boron (B) **$1s^2 2s^2 2p^1$ or $[He]\ 2s^2 2p^1$**

2) phosphorus (P) **$1s^2 2s^2 2p^6 3s^2 3p^3$ or $[Ne]\ 3s^2 3p^3$**

3) zirconium (Zr) **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^2$ or $[Kr]\ 5s^2 4d^2$**

4) iridium (Ir) **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^7$ or $[Xe]\ 6s^2 4f^{14} 5d^7$**

5) plutonium (Pu) **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^6$ or $[Rn]\ 7s^2 5f^6$**

Suggested Grading Scale

5 = A+
4 = B
3 = D
<3 = F

Pop Quiz

Write the electron configurations for the following elements: (1 point each)

1) boron (B)

2) phosphorus (P)

3) zirconium (Zr)

4) iridium (Ir)

5) plutonium (Pu)

Pop Quiz

Write the electron configurations for the following elements: (1 point each)

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2) phosphorus (P)

3) zirconium (Zr)

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Pop Quiz

Write the electron configurations for the following elements: (1 point each)

1) boron (B)

2) phosphorus (P)

3) zirconium (Zr)

4) iridium (Ir)

5) plutonium (Pu)

Average Atomic Mass Pop Quiz

A sample of magnesium has the following isotopic abundances:

Isotope	Isotopic mass (amu)	Isotopic abundance (%)
^{24}Mg	23.99	78.99
^{25}Mg	24.99	10.00
^{26}Mg	25.98	11.01

What is the average atomic mass of this sample of magnesium?

Average atomic mass = (abundance of isotope 1)(mass of isotope 1) +
(abundance of isotope 2)(mass of isotope 2) + …

For this problem, the average atomic mass is equal to:
(23.99)(0.7899) + (24.99)(0.1000) + (25.98)(0.1101) = 24.31 amu

Suggested Grading Scale

- **If the equation showing how to calculate the average atomic mass is present, give a C.**
- **If the problem is answered correctly, give an A+.**

Pop Quiz

A sample of magnesium has the following isotopic abundances:

Isotope	Isotopic mass (amu)	Isotopic abundance (%)
^{24}Mg	23.99	78.99
^{25}Mg	24.99	10.00
^{26}Mg	25.98	11.01

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Pop Quiz

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What is the average atomic mass of this sample of magnesium?

Octet Rule Pop Quiz

Explain the relationship between the octet rule and the formation of ionic compounds from neutral atoms. (10 points)

Give students 2.5 points for each of the following. Give partial credit as necessary:

- **A statement of the octet rule: "All elements want to be like the nearest noble gas" OR "All elements want to have eight electrons in their outermost energy level" OR "All elements tend to react such that they end up with a completely filled outer energy level." The precise wording of the octet rule is not important. What is important is that the student articulates the meaning of the octet rule.**
- **When two elements have a very large difference in electronegativity, the less electronegative element transfers electrons to the more electronegative element so that both end up with a completely filled octet.**
- **The more electronegative element becomes the anion and the less electronegative element becomes the cation.**
- **Because opposite charges attract, an ionic compound is formed.**

Suggested Grading Scale

10 = A+
9 – 9.5 = A
8.5 = B+
8 = B
7.5 = C+
7 = C
6.5 = D+
6 = D
< 6 = F

Pop Quiz

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Pop Quiz

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Ionic Properties Pop Quiz

Explain why ionic compounds have the following properties: (10 points)

- hard and brittle
- high melting and boiling points

Give five points for each of these answers (assign partial credit based on how correct the answers are):

Ionic compounds are hard and brittle because the cations and anions are held so tightly to one another. Additionally, the cations and anions are located in a regular pattern, causing natural shear planes where the crystal can break. If you exert enough force on an ionic compound to move the ions, chances are that you've put so much energy into the lattice that it will shatter along these natural planes.

Ionic compounds have high melting and boiling points because of the strong attraction between the cations and anions. When you melt or boil a substance, this causes the particles to move freely with respect to one another. In ionic compounds it requires a very large amount of heat to cause this free movement because the cations and anions are so strongly attracted.

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Explain why ionic compounds have the following properties: (10 points)

- hard and brittle
- high melting and boiling points

Pop Quiz

Explain why ionic compounds have the following properties: (10 points)

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Pop Quiz

Explain why ionic compounds have the following properties: (10 points)

- hard and brittle
- high melting and boiling points

Naming Ionic Compounds Pop Quiz

Name the following ionic compounds (1 point each):

1) $AgBr$ **silver bromide**

2) $FeSO_4$ **iron (II) sulfate**

3) $Mg(OH)_2$ **magnesium hydroxide**

4) $TiCl_4$ **titanium (IV) chloride**

5) NH_4NO_3 **ammonium nitrate**

Write the formulas of the following ionic compounds (1 point each):

6) lithium acetate **$LiC_2H_3O_2$ OR $LiCH_3COO$**

7) zinc sulfide **ZnS**

8) chromium (VI) oxide **CrO_3**

9) nickel (III) phosphate **$NiPO_4$**

10) potassium nitrate **KNO_3**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

Name the following ionic compounds (1 point each):

1) AgBr _____

2) $FeSO_4$ _____

3) $Mg(OH)_2$ _____

4) $TiCl_4$ _____

5) NH_4NO_3 _____

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10) potassium nitrate _____

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Write the formulas of the following ionic compounds (1 point each):

6) lithium acetate _____

7) zinc sulfide _____

8) chromium (VI) oxide _____

9) nickel (III) phosphate _____

10) potassium nitrate _____

Mole Calculations Pop Quiz

1) How many grams are there in 3.9 moles of copper (II) sulfate? (3 pts)
620 grams (622.4 grams without significant figures)

2) How many moles are there in 9.43×10^{22} atoms of zinc? (3 pts)
0.157 moles

3) How many grams are there in 2.8×10^{24} molecules of lithium oxide? (5 pts)
140 grams (138.6 grams without significant figures)

4) How many molecules are there in 2.9 grams of lead (IV) acetate? (5 points)
3.9×10^{21} molecules

Suggested Grading Scale
16 = A+
15 = A
14 = B+
13 = B
12 = C+
11 = D+
10 = D
< 10 = F

Pop Quiz

Answer the following questions on a separate sheet of paper.

1) How many grams are there in 3.9 moles of copper (II) sulfate? (3 pts)

2) How many moles are there in 9.43×10^{22} atoms of zinc? (3 pts)

3) How many grams are there in 2.8×10^{24} molecules of lithium oxide? (5 pts)

4) How many molecules are there in 2.9 grams of lead (IV) acetate? (5 points)

Pop Quiz

Answer the following questions on a separate sheet of paper.

1) How many grams are there in 3.9 moles of copper (II) sulfate? (3 pts)

2) How many moles are there in 9.43×10^{22} atoms of zinc? (3 pts)

3) How many grams are there in 2.8×10^{24} molecules of lithium oxide? (5 pts)

4) How many molecules are there in 2.9 grams of lead (IV) acetate? (5 points)

Pop Quiz

Answer the following questions on a separate sheet of paper.

1) How many grams are there in 3.9 moles of copper (II) sulfate? (3 pts)

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4) How many molecules are there in 2.9 grams of lead (IV) acetate? (5 points)

Percent Composition Pop Quiz

3-hexene has a percent composition of 85.7% carbon and 14.3% hydrogen and a molar mass of 84.0 grams/mole. Using this information, find the empirical and molecular formulas of this compound.

To find the empirical formula, students should convert the percent values to grams and find the number of moles of each compound. In the case of carbon, 85.7 grams of carbon converts to 7.14 moles – for hydrogen, 14.3 grams is equivalent to 14.3 moles. The next step is to divide both of these mole values by the smallest one, yielding an empirical formula of C_1H_2.

To find the molecular formula, find the mass of the empirical formula, in this case, 14.0 grams. Next, divide the actual molar mass by the empirical mass (84.0 grams / 14.0 grams = 6.00). If you multiply the subscripts on the empirical formula by six, this yields a molecular formula of C_6H_{12}, which is the correct formula for 3-hexene.

Suggested Grading Scale

- **For correctly completing only the empirical formula, give a C.**
- **For correctly completing the entire problem, give an A+.**
- **Partial credit should be given where appropriate.**

Pop Quiz

3-hexene has a percent composition of 85.7% carbon and 14.3% hydrogen and a molar mass of 84.0 grams/mole. Using this information, find the empirical and molecular formulas of this compound.

Pop Quiz

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Pop Quiz

3-hexene has a percent composition of 85.7% carbon and 14.3% hydrogen and a molar mass of 84.0 grams/mole. Using this information, find the empirical and molecular formulas of this compound.

Octet Rule (Covalent Compounds) Pop Quiz

Explain the relationship between the octet rule and the formation of covalent compounds from neutral atoms. (9 points)

Give students three points for each of the following. Give partial credit as necessary:

- **A statement of the octet rule: "All elements want to be like the nearest noble gas" OR "All elements want to have eight electrons in their outermost energy level" OR "All elements tend to react such that they end up with a completely filled outer energy level." The precise wording of the octet rule is not important. What is important is that the student articulates the meaning of the octet rule.**
- **When two elements have a small difference in electronegativity, neither element is able to take electrons from the other. As a result, the atoms have to share electrons.**
- **When elements share electrons, this is called a covalent bond.**
- **Two bonus points if students mention anything about polar covalent bonds.**

Suggested Grading Scale
9 or greater = A+
8 = B+
7 = C+
6 = D+
< 6 = F

Pop Quiz

Explain the relationship between the octet rule and the formation of covalent compounds from neutral atoms. (9 points)

Pop Quiz

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Pop Quiz

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Pop Quiz

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Hydrogen Bonding Pop Quiz

Explain what hydrogen bonding is and give two examples of molecules in which hydrogen bonding is the main intermolecular force. (12 points)

- **Hydrogen bonding occurs when a hydrogen atom bonded to an electronegative atom (such as sulfur, nitrogen, or oxygen) is attracted to the lone pair electrons on an electronegative atom on a different molecule. (6 points)**
- **Hydrogen bonding is by far the strongest intermolecular force, affecting molecular properties more than dipole-dipole forces or London dispersion forces. (4 points)**
- **Any two molecules that undergo hydrogen bonding may be listed here for one point each. Common examples of molecules that undergo hydrogen bonding are hydrogen sulfide (H_2S), water, ammonia, hydrogen halides (HX, where X is a halogen), organic bases, organic acids, ethers, esters, alcohols, sugars, etc. (1 point each)**

Suggested Grading Scale

12 = A+
11 = A
10 = B
9 = C+
8 = D+
< 8 = F

Pop Quiz

Explain what hydrogen bonding is and give two examples of molecules in which hydrogen bonding is the main intermolecular force. (12 points)

Pop Quiz

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Pop Quiz

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Pop Quiz

Explain what hydrogen bonding is and give two examples of molecules in which hydrogen bonding is the main intermolecular force. (12 points)

Intermolecular Forces Pop Quiz

1) What are the main differences between an intermolecular force and a chemical bond? (5 points)

Give 2.5 points for each of the following:

- **Intermolecular forces consist of forces between different molecules and chemical bonds are forces between atoms in the same molecule.**
- **Intermolecular forces are far weaker than chemical bonds.**

2) List the three main intermolecular forces. (1 point each)

- **Hydrogen bonds**
- **dipole-dipole forces**
- **London dispersion forces**

Suggested Grading Scale

8 = A+
7 = B+
6 = C+
5 = D
< 5 = F

Pop Quiz

1) What are the main differences between an intermolecular force and a chemical bond? (5 points)

2) List the three main intermolecular forces. (1 point each)

-
-
-

Pop Quiz

1) What are the main differences between an intermolecular force and a chemical bond? (5 points)

2) List the three main intermolecular forces. (1 point each)

-
-
-

Pop Quiz

1) What are the main differences between an intermolecular force and a chemical bond? (5 points)

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-
-
-

Pop Quiz

1) What are the main differences between an intermolecular force and a chemical bond? (5 points)

2) List the three main intermolecular forces. (1 point each)

-
-
-

Covalent Compound Naming Pop Quiz

For problems 1-5, name the covalent compound: (1 point each)

1) NH_3 **ammonia**

2) AsF_5 **arsenic pentafluoride**

3) BrO_2 **bromine dioxide**

4) C_2Cl_4 **dicarbon tetrachloride**

5) HI **hydrogen iodide**

For problems 6-10, give the formula of the covalent compound: (1 point each)

6) dinitrogen trioxide **N_2O_3**

7) phosphorus trichloride **PCl_3**

8) diselenium dibromide **Se_2Br_2**

9) disilicon hexabromide **Si_2Br_6**

10) fluorine **F_2**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

For problems 1-5, name the covalent compound: (1 point each)

1) NH_3 _____
2) AsF_5 _____
3) BrO_2 _____
4) C_2Cl_4 _____
5) HI _____

For problems 6-10, give the formula of the covalent compound: (1 point each)

6) dinitrogen trioxide _____
7) phosphorus trichloride _____
8) diselenium dibromide _____
9) disilicon hexabromide _____
10) fluorine _____

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6) dinitrogen trioxide _____
7) phosphorus trichloride _____
8) diselenium dibromide _____
9) disilicon hexabromide _____
10) fluorine _____

Mixed Compound Naming Pop Quiz

For problems 1-5, name each compound: (1 point each)

1) CH_4 **methane**

2) Na_2SO_4 **sodium sulfate**

3) CO **carbon monoxide**

4) BrF_3 **bromine trifluoride**

5) $Fe(NO_3)_3$ **iron (III) nitrate**

For problems 6-10, give the formula of each compound: (1 point each)

6) titanium (IV) oxide **TiO_2**

7) hydrogen iodide **HI**

8) copper (I) hydroxide **CuOH**

9) potassium sulfide **K_2S**

10) tetrasulfur tetranitride **S_4N_4**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

For problems 1-5, name each compound: (1 point each)

1) CH_4 _____
2) Na_2SO_4 _____
3) CO _____
4) BrF_3 _____
5) $Fe(NO_3)_3$ _____

For problems 6-10, give the formula of each compound: (1 point each)

6) titanium (IV) oxide _____
7) hydrogen iodide _____
8) copper (I) hydroxide _____
9) potassium sulfide _____
10) tetrasulfur tetranitride _____

Pop Quiz

For problems 1-5, name each compound: (1 point each)

1) CH_4 _____
2) Na_2SO_4 _____
3) CO _____
4) BrF_3 _____
5) $Fe(NO_3)_3$ _____

For problems 6-10, give the formula of each compound: (1 point each)

6) titanium (IV) oxide _____
7) hydrogen iodide _____
8) copper (I) hydroxide _____
9) potassium sulfide _____
10) tetrasulfur tetranitride _____

Pop Quiz

For problems 1-5, name each compound: (1 point each)

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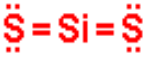
Lewis Structures Pop Quiz

1) Draw the Lewis structure of phosphorus trifluoride. (3 points)
Give the students one point for having the formula correct, one point for having the atoms bonded to each other in the correct positions with the correct number of bonds, and one point for having the correct number of valence electrons on each atom.

2) What shape is phosphorus trifluoride? (1 point)
trigonal pyramidal

3) Draw the Lewis structure of silicon disulfide. (3 points)
Give the students one point for having the formula correct, one point for having the atoms bonded to each other in the correct positions with the correct number of bonds, and one point for having the correct number of valence electrons on each atom.



4) What shape is silicon disulfide? (1 point)
linear

Suggested Grading Scale
8 = A+
7 = B+
6 = C+
5 = D
< 5 = F

Pop Quiz

1) Draw the Lewis structure of phosphorus trifluoride. (3 points)

2) What shape is phosphorus trifluoride? (1 point)

3) Draw the Lewis structure of silicon disulfide. (3 points)

4) What shape is silicon disulfide? (1 point)

Pop Quiz

1) Draw the Lewis structure of phosphorus trifluoride. (3 points)

2) What shape is phosphorus trifluoride? (1 point)

3) Draw the Lewis structure of silicon disulfide. (3 points)

4) What shape is silicon disulfide? (1 point)

Pop Quiz

1) Draw the Lewis structure of phosphorus trifluoride. (3 points)

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Pop Quiz

1) Draw the Lewis structure of phosphorus trifluoride. (3 points)

2) What shape is phosphorus trifluoride? (1 point)

3) Draw the Lewis structure of silicon disulfide. (3 points)

4) What shape is silicon disulfide? (1 point)

Balancing Equations Pop Quiz

Balance the following equations: (1 point each)

1) **2** $NaOH + $ **1** $Li_2SO_4 \rightarrow$ **1** $Na_2SO_4 + $ **2** $LiOH$

2) **3** $MgF_2 + $ **2** $(NH_4)_3N \rightarrow$ **1** $Mg_3N_2 + $ **6** NH_4F

3) **1** $Cr_2S_3 + $ **3** $Cu(NO_3)_2 \rightarrow$ **3** $CuS + $ **2** $Cr(NO_3)_3$

4) **2** $C_3H_8O + $ **7** $O_2 \rightarrow$ **6** $CO_2 + $ **8** H_2O

5) **6** $AgNO_2 + $ **1** $Ni_2O_3 \rightarrow$ **3** $Ag_2O + $ **2** $Ni(NO_2)_3$

Suggested Grading Scale
5 = A+
4 = B
3 = D
< 3 = F

Pop Quiz

Balance the following equations: (1 point each)

1) ___ $NaOH$ + ___ Li_2SO_4 →
___ Na_2SO_4 + ___ $LiOH$

2) ___ MgF_2 + ___ $(NH_4)_3N$ →
___ Mg_3N_2 + ___ NH_4F

3) ___ Cr_2S_3 + ___ $Cu(NO_3)_2$ →
___ CuS + ___ $Cr(NO_3)_3$

4) ___ C_3H_8O + ___ O_2 →
___ CO_2 + ___ H_2O

5) ___ $AgNO_2$ + ___ Ni_2O_3 →
___ Ag_2O + ___ $Ni(NO_2)_3$

Pop Quiz

Balance the following equations: (1 point each)

1) ___ $NaOH$ + ___ Li_2SO_4 →
___ Na_2SO_4 + ___ $LiOH$

2) ___ MgF_2 + ___ $(NH_4)_3N$ →
___ Mg_3N_2 + ___ NH_4F

3) ___ Cr_2S_3 + ___ $Cu(NO_3)_2$ →
___ CuS + ___ $Cr(NO_3)_3$

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Balance the following equations: (1 point each)

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___ Na_2SO_4 + ___ $LiOH$

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___ CuS + ___ $Cr(NO_3)_3$

4) ___ C_3H_8O + ___ O_2 →
___ CO_2 + ___ H_2O

5) ___ $AgNO_2$ + ___ Ni_2O_3 →
___ Ag_2O + ___ $Ni(NO_2)_3$

Writing Complete Equations Pop Quiz

Write complete, balanced equations for each of the following statements on a separate sheet of paper: (3 points each)

For these questions, give one point for each of the following:

- **The correct formulas for all reagents and products**
- **Correctly balancing the equation**
- **Having the correct symbols in the equation (aq, g, Δ, etc.)**

1) When solid sodium azide (NaN_3) decomposes in a car airbag, it gives off sodium nitride powder and nitrogen gas.

$$3\ NaN_{3(s)} \rightarrow 1\ Na_3N_{(s)} + 4\ N_{2(g)}$$

2) When oxygen gas reacts with iron metal, it forms iron (III) oxide (also known as rust).

$$3\ O_{2(g)} + 4\ Fe_{(s)} \rightarrow 2\ Fe_2O_{3(s)}$$

3) When gaseous ethane (C_2H_6) burns in oxygen, it forms carbon dioxide gas and water vapor.

$$2\ C_2H_{6(g)} + 7\ O_{2(g)} \xrightarrow{\Delta} 4\ CO_{2(g)} + 6\ H_2O_{(g)}$$

4) When an aqueous solution of nitric acid reacts with potassium hydroxide pellets, liquid water and an aqueous solution of potassium nitrate are formed.

$$1\ HNO_{3(aq)} + 1\ KOH_{(s)} \rightarrow 1\ H_2O_{(l)} + 1\ KNO_{3(aq)}$$

Suggested Grading Scale

12 = A+
11 = A
10 = B
9 = C+
8 = D+
< 8 = F

Pop Quiz

Write complete, balanced equations for each of the following statements on a separate sheet of paper: (3 points each)

1) When solid sodium azide (NaN_3) decomposes in a car airbag, it gives off sodium nitride powder and nitrogen gas.

2) When oxygen gas reacts with iron metal, it forms iron (III) oxide (also known as rust).

3) When gaseous ethane (C_2H_6) burns in oxygen, it forms carbon dioxide gas and water vapor.

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4) When an aqueous solution of nitric acid reacts with potassium hydroxide pellets, liquid water and an aqueous solution of potassium nitrate are formed.

Types of Reactions Pop Quiz

On a separate sheet of paper, indicate what type of reaction is taking place for each of the following: (1 point each)

1)	$2\ NaBr + Ca(OH)_2 \rightarrow 2\ NaOH + CaBr_2$	**Double displacement**
2)	$3\ Pb + 4\ Fe(NO_3)_3 \rightarrow 3\ Pb(NO_3)_4 + 4\ Fe$	**Single displacement**
3)	$S_8 + 24\ F_2 \rightarrow 8\ SF_6$	**Synthesis**
4)	$2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$	**Combustion**
5)	$2\ HNO_3 + Mg(OH)_2 \rightarrow 2\ H_2O + Mg(NO_3)_2$	**Acid-base**
6)	$B_2H_6 \rightarrow 2\ BH_3$	**Decomposition**
7)	$C_2H_2 + Cl_2 \rightarrow C_2H_2Cl_2$	**Synthesis**
8)	$2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	**Synthesis**
9)	$Al_2(SO_4)_3 + 6\ LiBr \rightarrow 2\ AlBr_3 + 3\ Li_2SO_4$	**Double displacement**
10)	$2\ C_6H_6 + 15\ O_2 \rightarrow 12\ CO_2 + 6\ H_2O$	**Combustion**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

On a separate sheet of paper, indicate what type of reaction is taking place for each of the following: (1 point each)

1) $2\ NaBr + Ca(OH)_2 \rightarrow 2\ NaOH + CaBr_2$
2) $3\ Pb + 4\ Fe(NO_3)_3 \rightarrow 3\ Pb(NO_3)_4 + 4\ Fe$
3) $S_8 + 24\ F_2 \rightarrow 8\ SF_6$
4) $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$
5) $2\ HNO_3 + Mg(OH)_2 \rightarrow 2\ H_2O + Mg(NO_3)_2$
6) $B_2H_6 \rightarrow 2\ BH_3$
7) $C_2H_2 + Cl_2 \rightarrow C_2H_2Cl_2$
8) $2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
9) $Al_2(SO_4)_3 + 6\ LiBr \rightarrow 2\ AlBr_3 + 3\ Li_2SO_4$
10) $2\ C_6H_6 + 15\ O_2 \rightarrow 12\ CO_2 + 6\ H_2O$

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2) $3\ Pb + 4\ Fe(NO_3)_3 \rightarrow 3\ Pb(NO_3)_4 + 4\ Fe$
3) $S_8 + 24\ F_2 \rightarrow 8\ SF_6$
4) $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$
5) $2\ HNO_3 + Mg(OH)_2 \rightarrow 2\ H_2O + Mg(NO_3)_2$
6) $B_2H_6 \rightarrow 2\ BH_3$
7) $C_2H_2 + Cl_2 \rightarrow C_2H_2Cl_2$
8) $2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
9) $Al_2(SO_4)_3 + 6\ LiBr \rightarrow 2\ AlBr_3 + 3\ Li_2SO_4$
10) $2\ C_6H_6 + 15\ O_2 \rightarrow 12\ CO_2 + 6\ H_2O$

Pop Quiz

On a separate sheet of paper, indicate what type of reaction is taking place for each of the following: (1 point each)

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2) $3\ Pb + 4\ Fe(NO_3)_3 \rightarrow 3\ Pb(NO_3)_4 + 4\ Fe$
3) $S_8 + 24\ F_2 \rightarrow 8\ SF_6$
4) $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$
5) $2\ HNO_3 + Mg(OH)_2 \rightarrow 2\ H_2O + Mg(NO_3)_2$
6) $B_2H_6 \rightarrow 2\ BH_3$
7) $C_2H_2 + Cl_2 \rightarrow C_2H_2Cl_2$
8) $2\ NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
9) $Al_2(SO_4)_3 + 6\ LiBr \rightarrow 2\ AlBr_3 + 3\ Li_2SO_4$
10) $2\ C_6H_6 + 15\ O_2 \rightarrow 12\ CO_2 + 6\ H_2O$

Predicting Reaction Products Pop Quiz

On a separate sheet of paper, write the products for the following equations and indicate what type of reaction is taking place. Make sure your final equations are balanced! (3 points each)

For each question, give one point for predicting the correct reaction products, one point for balancing the equation correctly, and one point for correctly determining the type of chemical reaction taking place.

1) **1** Ca_3N_2 + **6** $AgNO_3$ → **3** $Ca(NO_3)_2$ + **2** Ag_3N — **Double displacement**

2) **1** HBr + **1** LiOH → **1** H_2O + **1** LiBr — **Acid-base**

3) **1** CH_4 + **2** O_2 → **1** CO_2 + **2** H_2O — **Combustion**

4) **2** Mg + **1** O_2 → **2** MgO — **Synthesis**

5) **1** H_2SO_4 + **1** $Zn(OH)_2$ → **1** $ZnSO_4$ + **2** H_2O — **Acid-base**

6) **1** H_2O + **1** SO_3 → **1** H_2SO_4 — **Synthesis**

7) **6** Li + **1** Fe_2O_3 → **3** Li_2O + **2** Fe — **Single displacement**

8) **3** O_2 + **1** C_2H_4 → **2** CO_2 + **2** H_2O — **Combustion**

Suggested Grading Scale

24 = A+
22 – 23 = A
21 = B+
20 = B
18 – 19 = C+
17 = C
16 = D+
15 = D
< 15 = F

Pop Quiz

On a separate sheet of paper, write the products for the following equations and indicate what type of reaction is taking place. Make sure your final equations are balanced! (3 points each)

1) $Ca_3N_2 + AgNO_3 \rightarrow ?$
2) $HBr + LiOH \rightarrow ?$
3) $CH_4 + O_2 \rightarrow ?$
4) $Mg + O_2 \rightarrow ?$
5) $H_2SO_4 + Zn(OH)_2 \rightarrow ?$
6) $H_2O + SO_3 \rightarrow ?$
7) $Li + Fe_2O_3 \rightarrow ?$
8) $O_2 + C_2H_4 \rightarrow ?$

Pop Quiz

On a separate sheet of paper, write the products for the following equations and indicate what type of reaction is taking place. Make sure your final equations are balanced! (3 points each)

1) $Ca_3N_2 + AgNO_3 \rightarrow ?$
2) $HBr + LiOH \rightarrow ?$
3) $CH_4 + O_2 \rightarrow ?$
4) $Mg + O_2 \rightarrow ?$
5) $H_2SO_4 + Zn(OH)_2 \rightarrow ?$
6) $H_2O + SO_3 \rightarrow ?$
7) $Li + Fe_2O_3 \rightarrow ?$
8) $O_2 + C_2H_4 \rightarrow ?$

Pop Quiz

On a separate sheet of paper, write the products for the following equations and indicate what type of reaction is taking place. Make sure your final equations are balanced! (3 points each)

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2) $HBr + LiOH \rightarrow ?$
3) $CH_4 + O_2 \rightarrow ?$
4) $Mg + O_2 \rightarrow ?$
5) $H_2SO_4 + Zn(OH)_2 \rightarrow ?$
6) $H_2O + SO_3 \rightarrow ?$
7) $Li + Fe_2O_3 \rightarrow ?$
8) $O_2 + C_2H_4 \rightarrow ?$

Pop Quiz

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2) $HBr + LiOH \rightarrow ?$
3) $CH_4 + O_2 \rightarrow ?$
4) $Mg + O_2 \rightarrow ?$
5) $H_2SO_4 + Zn(OH)_2 \rightarrow ?$
6) $H_2O + SO_3 \rightarrow ?$
7) $Li + Fe_2O_3 \rightarrow ?$
8) $O_2 + C_2H_4 \rightarrow ?$

Grams to Grams Stoichiometry Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

$$\underline{2}\ NaBr + \underline{1}\ Ca(NO_3)_2 \rightarrow \underline{2}\ NaNO_3 + \underline{1}\ CaBr_2$$

1) Balance the equation above. (1 point) **See equation above.**

2) How many grams of sodium nitrate can be formed from 25 grams of calcium nitrate? (3 points)
26 grams

3) If 11 grams of sodium nitrate were actually formed, what is the percent yield of this reaction? (3 points)
42 %

4) How many grams of sodium bromide would be needed to make 15 grams of sodium nitrate? (3 points)
18 grams

Suggested Grading Scale
10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

__ NaBr + __ $Ca(NO_3)_2$ →

__ $NaNO_3$ + __ $CaBr_2$

1) Balance the equation above. (1 point)

2) How many grams of sodium nitrate can be formed from 25 grams of calcium nitrate? (3 points)

3) If 11 grams of sodium nitrate were actually formed, what is the percent yield of this reaction? (3 points)

4) How many grams of sodium bromide would be needed to make 15 grams of sodium nitrate? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

__ NaBr + __ $Ca(NO_3)_2$ →

__ $NaNO_3$ + __ $CaBr_2$

1) Balance the equation above. (1 point)

2) How many grams of sodium nitrate can be formed from 25 grams of calcium nitrate? (3 points)

3) If 11 grams of sodium nitrate were actually formed, what is the percent yield of this reaction? (3 points)

4) How many grams of sodium bromide would be needed to make 15 grams of sodium nitrate? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

__ NaBr + __ $Ca(NO_3)_2$ →

__ $NaNO_3$ + __ $CaBr_2$

1) Balance the equation above. (1 point)

2) How many grams of sodium nitrate can be formed from 25 grams of calcium nitrate? (3 points)

3) If 11 grams of sodium nitrate were actually formed, what is the percent yield of this reaction? (3 points)

4) How many grams of sodium bromide would be needed to make 15 grams of sodium nitrate? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

__ NaBr + __ $Ca(NO_3)_2$ →

__ $NaNO_3$ + __ $CaBr_2$

1) Balance the equation above. (1 point)

2) How many grams of sodium nitrate can be formed from 25 grams of calcium nitrate? (3 points)

3) If 11 grams of sodium nitrate were actually formed, what is the percent yield of this reaction? (3 points)

4) How many grams of sodium bromide would be needed to make 15 grams of sodium nitrate? (3 points)

Stoichiometry Terms Pop Quiz

1) What is a “mole ratio”? (3 points)
A mole ratio is used in stoichiometry when making a gram-to-gram or mole-to-mole conversion. The mole ratio is equivalent to the coefficient in front of the compound you’re solving for divided by the coefficient in front of the compound you’ve been given in the problem.

2) What is the equation for “percent yield”? (3 points)
Percent yield = [(actual yield) / (theoretical yield)] x 100%

3) What is a “limiting reagent”? (3 points)
The limiting reagent is the reagent that limits the amount of product that can be formed in a chemical reaction. For example, if you were trying to make water from 10 grams of hydrogen gas and 1.0×10^{10} grams of oxygen gas, hydrogen would be your limiting reagent.

Suggested Grading Scale
9 = A+
8 = B+
7 = C+
6 = D+
< 6 = F

Pop Quiz

1) What is a “mole ratio”? (3 points)

2) What is the equation for “percent yield”? (3 points)

3) What is a “limiting reagent”? (3 points)

Pop Quiz

1) What is a “mole ratio”? (3 points)

2) What is the equation for “percent yield”? (3 points)

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Pop Quiz

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Pop Quiz

1) What is a “mole ratio”? (3 points)

2) What is the equation for “percent yield”? (3 points)

3) What is a “limiting reagent”? (3 points)

Limiting Reagent Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

$$\underline{3}\ HNO_3 + \underline{1}\ Fe(OH)_3 \rightarrow \underline{1}\ Fe(NO_3)_3 + \underline{3}\ H_2O$$

1) Balance the equation above. (1 point) **See equation above.**

2) If I start with 25 grams of nitric acid and 55 grams of iron (III) hydroxide, how many grams of iron (III) nitrate can be formed? (3 points)
32 grams

3) What is my limiting reagent in problem #2? (2 points)
nitric acid

4) How many grams of iron (III) nitrate could I make if I added a large excess of my limiting reagent? (3 points)
This question is essentially asking you how much iron (III) nitrate you could make if iron (III) hydroxide were your limiting reagent. From question #2, this should have been calculated to be 120 grams (124.5 without using significant figures).

Suggested Grading Scale

9 = A+
8 = B+
7 = C+
6 = D+
< 6 = F

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

__ HNO_3 + __ $Fe(OH)_3$ →

__ $Fe(NO_3)_3$ + __ H_2O

1) Balance the equation above. (1 point)
2) If I start with 25 grams of nitric acid and 55 grams of iron (III) hydroxide, how many grams of iron (III) nitrate can be formed? (3 points)
3) What is my limiting reagent in problem #2? (2 points)
4) How many grams of iron (III) nitrate could I make if I added a large excess of my limiting reagent? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

__ HNO_3 + __ $Fe(OH)_3$ →

__ $Fe(NO_3)_3$ + __ H_2O

1) Balance the equation above. (1 point)
2) If I start with 25 grams of nitric acid and 55 grams of iron (III) hydroxide, how many grams of iron (III) nitrate can be formed? (3 points)
3) What is my limiting reagent in problem #2? (2 points)
4) How many grams of iron (III) nitrate could I make if I added a large excess of my limiting reagent? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below:

__ HNO_3 + __ $Fe(OH)_3$ →

__ $Fe(NO_3)_3$ + __ H_2O

1) Balance the equation above. (1 point)
2) If I start with 25 grams of nitric acid and 55 grams of iron (III) hydroxide, how many grams of iron (III) nitrate can be formed? (3 points)
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Pop Quiz

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3) What is my limiting reagent in problem #2? (2 points)
4) How many grams of iron (III) nitrate could I make if I added a large excess of my limiting reagent? (3 points)

Gas Stoichiometry Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below. Assume STP.

$$\underline{1}\ C_2H_6O_{(l)} + \underline{3}\ O_{2(g)} \rightarrow \underline{2}\ CO_{2(g)} + \underline{3}\ H_2O_{(g)}$$

1) Balance the equation above. (1 point) **See equation above.**

2) How many liters of oxygen are required to make 12 liters of carbon dioxide? (3 points) **18 liters.**

3) How many liters of water vapor will be formed by the reaction of 15 grams of C_2H_6O and an excess of oxygen? (3 points) **7.3 liters.**

4) How many grams of carbon dioxide would be made in the reaction from problem #3? (3 points) **29 grams (28.7 grams without significant figures)**

Suggested Grading Scale

10 = A+
9 = A
8 = B
7 = C
6 = D
< 6 = F

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below. Assume STP.

__ $C_2H_6O_{(l)}$ + __ $O_{2(g)}$ →

__ $CO_{2(g)}$ + __ $H_2O_{(g)}$

1) Balance the equation above. (1 point)

2) How many liters of oxygen are required to make 12 liters of carbon dioxide? (3 points)

3) How many liters of water vapor will be formed by the reaction of 15 grams of C_2H_6O and an excess of oxygen? (3 points)

4) How many grams of carbon dioxide would be made in the reaction from problem #3? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below. Assume STP.

__ $C_2H_6O_{(l)}$ + __ $O_{2(g)}$ →

__ $CO_{2(g)}$ + __ $H_2O_{(g)}$

1) Balance the equation above. (1 point)

2) How many liters of oxygen are required to make 12 liters of carbon dioxide? (3 points)

3) How many liters of water vapor will be formed by the reaction of 15 grams of C_2H_6O and an excess of oxygen? (3 points)

4) How many grams of carbon dioxide would be made in the reaction from problem #3? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below. Assume STP.

__ $C_2H_6O_{(l)}$ + __ $O_{2(g)}$ →

__ $CO_{2(g)}$ + __ $H_2O_{(g)}$

1) Balance the equation above. (1 point)

2) How many liters of oxygen are required to make 12 liters of carbon dioxide? (3 points)

3) How many liters of water vapor will be formed by the reaction of 15 grams of C_2H_6O and an excess of oxygen? (3 points)

4) How many grams of carbon dioxide would be made in the reaction from problem #3? (3 points)

Pop Quiz

On a separate sheet of paper, answer the following questions using the equation below. Assume STP.

__ $C_2H_6O_{(l)}$ + __ $O_{2(g)}$ →

__ $CO_{2(g)}$ + __ $H_2O_{(g)}$

1) Balance the equation above. (1 point)

2) How many liters of oxygen are required to make 12 liters of carbon dioxide? (3 points)

3) How many liters of water vapor will be formed by the reaction of 15 grams of C_2H_6O and an excess of oxygen? (3 points)

4) How many grams of carbon dioxide would be made in the reaction from problem #3? (3 points)

Section 2

Major Quizzes

Safety Quiz

You must receive an A on this quiz before you will be allowed to do any labs in this class. All questions should be answered as "True" or "False".

1) _____ Acid should always be added to water when doing a dilution.

2) _____ Your laboratory partner should tell everybody in the class if somebody gets a cut on his or her finger.

3) _____ Gloves should be worn while working with toxic chemicals and hot glassware.

4) _____ Sandals should never be worn in the laboratory.

5) _____ Long, loose hair is a fire hazard.

6) _____ You should remove all jewelry before working in the laboratory.

7) _____ Chemical waste should be disposed of down the sink unless the teacher tells you otherwise.

8) _____ Long sleeves should be rolled up before working in the lab.

9) _____ It is a safety violation to leave your lab area dirty.

10) _____ It isn't hazardous to eat or drink in the lab if you've put all of the chemicals at your lab area away.

Safety Quiz Solutions

You must receive an A on this quiz before you will be allowed to do any labs in this class. All questions should be answered as "True" or "False".

(Note to teachers: Depending on your classroom policy, you may either want to add the requirement that students pass this safety quiz or you may simply choose to use it as an in-class drill.)

1) **True** Acid should always be added to water when doing a dilution.

2) **False** Your laboratory partner should tell everybody in the class if somebody gets a cut on his or her finger.

3) **False** Gloves should be worn when working with toxic chemicals and hot glassware.

4) **True** Sandals should never be worn in the laboratory.

5) **True** Long, loose hair is a fire hazard.

6) **True** You should remove all jewelry before working in the laboratory.

7) **False** Chemical waste should be disposed of down the sink unless the teacher tells you otherwise.

8) **True** Long sleeves should be rolled up before working in the lab.

9) **True** It is a safety violation to leave your lab area dirty.

10) **False** It isn't hazardous to eat or drink in the lab if you've put all of the chemicals at your lab area away.

Suggested Grading Key
10 = A+ (100%)
9 = A
8 = B
7 = C
6 = D
< 6 = F

Quiz: Lab Equipment and Safety

1) Identify the following ten pieces of laboratory equipment (1 point each):

a) _____

b) _____

c) _____

d) _____

e) _____

f) _____

g) _____

h) _____

i) _____

j) _____

2) What is the proper way to mix acid and water? (2 points)

3) Name the pieces of safety equipment in our lab (3 points):

4) Why shouldn't you pour chemical waste down the sink? (2 points)

5) When is it proper to take your goggles off in the laboratory? (2 points)

Quiz Key: Lab Equipment and Safety

1) Identify the following ten pieces of laboratory equipment (1 point each):
For this question, hold up ten pieces of laboratory equipment, one by one. This ensures that the kids are able to identify the lab equipment that you will be using most frequently in the lab.

2) What is the proper way to mix acid and water? (2 points)
Acid should always be added to water to avoid splattering.

3) Name the pieces of safety equipment in our lab (3 points):
All chemistry laboratories should have the following pieces of laboratory equipment: Eyewash, shower, fire extinguisher, fire blanket, first aid kit, acetic acid solution (for neutralizing base burns), sodium bicarbonate solution (for neutralizing acid burns), fume hood. If you don't have these in your classroom, RUN, don't walk, to your administrator and get them immediately! For this question, desperate students will frequently refer to the fire sprinklers as being safety equipment. Point out to them that fire extinguishers are not "equipment" as they are not intended to be operated by the students.

4) Why shouldn't you pour chemical waste down the sink? (3 points)
Chemicals poured down the sink may react with each other. It's also a serious environmental hazard to dispose of chemicals in this way.

5) When is it proper to take your goggles off in the laboratory? (2 points)
Never.

Suggested grading key:
20 = A+ (100%)
18-19 = A
17= B+
16 = B
15 = C+
14 = C
13 = D+
12 = D
<12 = F

Scientific Method Quiz

1) When I was in college I had some problems with an English class I was taking. I wanted to do better in this class, so I needed to figure out a way to improve my grade. Use the six steps of the scientific method to find a way to solve my problem. For the final steps, use your imagination to predict what would happen. Be sure to name the six steps of the scientific method in your answer!

Scoring: *6 points for naming the six steps of the scientific method correctly (1 point per step)*
3 points for putting the steps in the correct order (all or nothing)
6 points for proper use in this scenario (1 point per step)

2) Is the scientific method a good way of solving problems? Explain yourself in at least a paragraph, making sure to fully explain the reasons for your answer. (10 points)

Important scoring information: More points will be given to answers that show you understand the scientific method, regardless of whether or not you believe it's a good way of solving problems. I'm interested in your reasoning, NOT in how much you agree with what I think.

Scientific Method Quiz – Solutions

1) When I was in college I had some problems with an English class I was taking. I wanted to do better in this class, so I needed to figure out a way to improve my grade. Use the six steps of the scientific method to find a way to solve my problem. For the final steps, use your imagination to predict what would happen. Be sure to name the six steps of the scientific method in your answer!

Scoring: *6 points for naming the six steps of the scientific method correctly (1 point per step)*
3 points for putting the steps in the correct order (all or nothing)
6 points for proper use in this scenario (1 point per step)

One point should be given for each of the six steps of the scientific method, with a three-point bonus for putting them in order. The correct steps and order are: Purpose, hypothesis, materials, procedure, results, and conclusion.

For the other six points, the students should put a reasonable set of actions for each step of the scientific method. This may be somewhat difficult to grade, as some students will give strange or unusual answers. Give points based on whether or not they are technically correct and not on how likely they are to occur.

Sample answers:

Purpose: I need to improve my English grade
Hypothesis: If I drink more coffee right before the test, my score will improve.
Materials: Coffee cup, coffee, cream, sugar, stirring stick
Procedure:
1) Make a big cup of coffee
2) Add one spoon of sugar and a little splash of cream
3) Stir with the stirring stick
4) Drink coffee
5) Repeat steps 1-4 until the test.
Results: I did poorly on the test because I kept having to leave to use the restroom.
Conclusion: Drinking coffee right before the test is not a good way to achieve higher scores.

2) Is the scientific method a good way of solving problems? Explain yourself in <u>at least</u> a paragraph, making sure to fully explain the reasons for your answer. (10 points)

<u>Important scoring information</u>: More points will be given to answers that show you understand the scientific method, regardless of whether or not you believe it's a good way of solving problems. I'm interested in your reasoning, NOT in how much you agree with what I think.

This problem is more difficult to score than problem #1 because there is more than one correct answer.

Most students will say something along the lines of, "The scientific method is the most marvelous way in the entire world to solve problems!" This answer is fine, but to receive credit there should be justification for this statement. Good reasons include that the scientific method changes only one variable at a time, it requires you to keep good records about your experiments, and it's methodical and rigorous. Other answers may be appropriate – you make the call.

Some students will say things like, "The scientific method is not a very good way of solving problems!" This is also fine, but there should be good justification for making this statement. One compelling argument is that the scientific method isn't realistic and that most discoveries are made intuitively. This answer is hard to refute, as it is correct. Another answer you'll see a lot is that the scientific answer takes too long and requires a lot of writing. This is a much less convincing argument. For all answers, use your best judgement and make sure to keep an open mind if the students disagree with what you think. Remember, the idea is to make sure that they understand the concepts, not that they agree with everything we say.

<u>Suggested Grading Scale</u>

25 = A+
23 – 24 = A
22 = B+
20 – 21 = B
19 = C+
18 = C
17 = D+
15 – 16 = D
< 15 = F

Elements, Compounds, and Mixtures Quiz

For problems 1-6, indicate whether the substance named is an element, a compound, a heterogeneous mixture, or a homogeneous mixture (1 pt. each):

1) hamburger _____

2) sodium chloride (table salt) _____

3) iced tea _____

4) gold bar _____

5) pony _____

6) air _____

Please answer the following questions about elements, compounds, and mixtures (4 points each):

7) Which is easier to separate, a homogeneous or heterogeneous mixture? Explain your answer, giving a specific example.

8) We often talk about separating mixtures. Why don't we ever talk about separating elements or compounds?

9) What is the main difference between an atom and a molecule?

Elements, Compounds, and Mixtures Quiz - Solutions

For problems 1-6, indicate whether the substance named is an element, a compound, a heterogeneous mixture, or a homogeneous mixture (1 pt. each):

1) hamburger **heterogeneous mixture**

2) sodium chloride (table salt) **compound**

3) iced tea **homogeneous mixture**

4) gold bar **element**

5) pony **heterogeneous mixture**

6) air **homogeneous mixture**

Please answer the following questions about elements, compounds, and mixtures (4 points each):

7) Which is easier to separate, a homogeneous or heterogeneous mixture? Explain your answer, giving a specific example.

Heterogeneous mixtures are easier to separate because you can see the different components in the mixture. For example, it is easy to separate a mixture of candies because you can detect the different colors and physically sort them. On the other hand, it's difficult to separate a homogeneous mixture because it's difficult to tell what components are present, or even if it's a mixture at all. An example of this would be salt water. In salt water, you need to boil the water away to separate the water and salt because they are so closely connected.

8) We often talk about separating mixtures. Why don't we ever talk about separating elements or compounds?

Elements and compounds are pure substances – there are no different components to separate. Elements consist of all the same type of atom. Compounds contain different elements, but they're chemically bonded, making them impossible to physically separate.

9) What is the main difference between an atom and a molecule?

Atoms are the simplest units of an element that retain the properties of that element. Molecules are the simplest units of a compound that retain the properties of that compound. Whereas atoms cannot be broken down using chemical methods, compounds can be broken into their component atoms if a chemical change occurs.

Suggested Grading Scale

18 = A+
17 = A
16 = B+
15 = B
14 = C+
13 = C
12 = D+
11 = D
< 11 = F

Scientific Notation, Significant Figures, and Unit Conversions Quiz

Convert the following numbers into scientific notation (1 point each):

1) 9,870 _____

2) 45,000 _____

3) 0.0012 _____

4) 8,900,000,000 _____

Convert the following numbers into standard notation (1 point each):

5) 7.54×10^{4} _____

6) 9.11×10^{-3} _____

7) 8.776×10^{-6} _____

8) 1.42×10^{5} _____

How many significant figures are in the following numbers? (1 point each)

9) 120 _____

10) 0.001010 _____

11) 100.10 _____

12) 2.10×10^{4} _____

Do the following unit conversions. All necessary conversion factors are provided to you in the problem:

13) Convert 376 inches into centimeters. *There are 2.54 centimeters in 1 inch. (3 points)*

14) Convert 0.761 meters into millimeters. *(3 points)*

15) Convert 3.42×10^{3} minutes into hours. *(3 points)*

16) Convert 47 miles into centimeters. *There are 0.61 miles in 1 kilometer. (6 points)*

17) Convert 8.91×10^{-6} years into seconds. *1 year has 365 days. (6 points)*

18) Convert 245^{0} C to Kelvins (3 points)

19) What is the main difference between precision and accuracy? Your answer should give specific examples of each. (6 points)

Scientific Notation, Significant Figures, and Unit Conversions Quiz - Solutions

Convert the following numbers into scientific notation (1 point each):

1) 9,870 **9.87×10^{3}**

2) 45,000 **4.5×10^{4}**

3) 0.0012 **1.2×10^{-3}**

4) 8,900,000,000 **8.9×10^{9}**

Convert the following numbers into standard notation (1 point each):

5) 7.54×10^{4} **75,400**

6) 9.11×10^{-3} **0.00911**

7) 8.776×10^{-6} **0.000008776**

8) 1.42×10^{5} **142,000**

How many significant figures are in the following numbers? (1 point each)

9) 120 **2**

10) 0.001010 **4**

11) 100.10 **5**

12) 2.10×10^{4} **3**

Do the following unit conversions. All necessary conversion factors are provided to you in the problem:

13) Convert 376 inches into centimeters. *There are 2.54 centimeters in 1 inch. (3 points)*
955 centimeters

14) Convert 0.761 meters into millimeters. *(3 points)*
761 millimeters

15) Convert 3.42×10^{3} minutes into hours. *(3 points)*
57 hours

16) Convert 47 miles into centimeters. *There are 0.61 miles in 1 kilometer. (6 points)*
7.7×10^6 centimeters, or 7,700,000 centimeters

17) Convert 8.91×10^{-6} years into seconds. *1 year has 365 days. (6 points)*
281 seconds

18) Convert 245^0 C to Kelvins (3 points)
518 K (a common incorrect answer will be –28 K. This is what the answer is if you subtract 273 from the temperature in Celsius rather than adding it)

19) What is the main difference between precision and accuracy? Your answer should give examples of each. (6 points)
Accuracy is a measurement of how close an experimental reading is to the actual answer. For example, I am 178 cm tall. If I used a ruler that said I'm 179 cm tall, that's a reasonably accurate answer.

Precision is a measurement of how repeatable an experimental reading is, and is usually denoted by an increase in the number of significant figures shown in the number. If I find my wife's height to be 168.001 cm tall with three repeated measurements, then the reading is said to be precise.

Accuracy and precision are usually aligned with each other. In other words, accurate readings are usually precise. However, this isn't always true. For example, if my wife is actually 155.000 cm tall, the measurement device in the paragraph above is still very precise (it's very repeatable) but it's not very accurate (close to the true value). Measurements that are precise but not accurate are usually the result of miscalibration.

Suggested Grading Scale

42 = A+
38 – 41 = A
36 – 37 = B+
34 – 35 = B
32 – 33 = C+
30 – 31 = C
28 – 29 = D+
26 – 27 = D
< 26 = F

Periodic Table Quiz

List as many of the main properties of each of the following groups as you can (2 points each):

1) alkali metals:

2) alkaline earth metals:

3) halogens:

4) noble gases:

5) transition metals:

6) metals:

7) metalloids:

8) nonmetals:

9) hydrogen:

For each of the following, give the periodic trend for each of the following as well as a reason for this trend. (5 points each)

<u>Example</u>: Atomic number
Correct answer: It increases as you move across the periodic table and also increases as you move down the periodic table. This is because every element has one more proton than the one before it.

10) electronegativity:

11) atomic radius:

12) ionization energy:

13) What does the word “diatomic” mean? What elements on the periodic table do we associate with the word “diatomic”? (5 points)

Periodic Table Quiz - Solutions

List as many of the main properties of each of the following groups as you can (2 points each):

1) alkali metals: **Form ions with a charge of +1, soft, reactive with water and oxygen, form basic solutions, low density, low electronegativity, low melting and boiling points.** ***(0.5 points each for a maximum of 2 points)***

2) alkaline earth metals: **Form ions with a charge of +2, soft (but less so than the alkali metals), low density (but less so than alkali metals), reactive with water and oxygen (but less so than alkali metals), low electronegativity, low melting and boiling points (but less so than alkali metals).** ***(0.5 points each for a maximum of 2 points)***

3) halogens: **High reactivity (particularly with metals to form compounds with the general formula MX_n and hydrogen to form HX), high electronegativity, diatomic, strong oxidizers, form ions with a –1 charge.** ***(0.5 points each for a maximum of 2 points, though for lower level classes you may wish to give 1 point each for a maximum of two points)***

4) noble gases: **Extremely unreactive.** ***(2 points)***

5) transition metals: **Hard, less reactive than other metals, have more than one possible positive charge, dense, high melting and boiling points.** ***(0.5 points each for a maximum of 2 points)***

6) metals: **malleable, ductile, lustrous, thermal and electrical conductors, form basic oxides, high density, generally solid, form cations.** ***(0.5 points each for a maximum of 2 points)***

7) metalloids: **electrical semiconductors, have properties between those of the metals and nonmetals.** ***(1 point each, though you may want to give 0.5 points each if they specify what properties of metals and nonmetals they have)***

8) nonmetals: **nonlustrous (many are colored), may be solids, liquids, or gases, poor conductors of heat and electricity, form anions, solid nonmetals are brittle, form acidic oxides.** ***(0.5 points each for a maximum of 2 points)***

9) hydrogen: **Can form ions with a +1 (hydronium) or –1 (hydride) charge, diatomic, gas, reacts with the halogens to form HX, extremely flammable.** ***(0.5 points each for a maximum of 2 points)***

For each of the following, give the periodic trend for each of the following as well as a reason for this trend. (5 points each)

10) electronegativity:
- **Increases as you move across the periodic table because the energy of each electron in the sublevel is the same even though the amount of positive charge in the nucleus increases. This causes a higher effective nuclear charge ($Z_{effective}$) that attracts electrons.**
- **Decreases as you move down the periodic table because of the shielding effect (inner electrons cause a decrease in the effective nuclear charge, causing it to attract electrons less well).**

11) atomic radius:
- **Decreases as you move across the periodic table because the energy of each electron in the sublevel is the same even though the amount of positive charge in the nucleus increases. This causes a higher effective nuclear charge ($Z_{effective}$) that causes these electrons to be bound more tightly to the nucleus.**
- **Increases as you move down the periodic table because each sublevel has more energy than the one before it.**

12) ionization energy:
- **Increases as you move across the periodic table because increased nuclear charge causes the electrons to be held more tightly. As a result, it takes more energy to pull them off to ionize the atom.**
- **Decreases as you move down the periodic table because the shielding effect causes outer electrons to be bound less tightly.**

13) What does the word "diatomic" mean? What elements on the periodic table do we associate with the word "diatomic"? (5 points)
"Diatomic" means that elements form molecules consisting of two atoms of that element bound together. The diatomic elements on the periodic table are hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine, and iodine. (2.5 points for defining "diatomic", 2.5 points for correctly naming the seven diatomic elements).

Suggested Grading Scale

38 = A+
34.5 – 37 = A
32.5 – 34 = B+
30.5 – 32 = B
28.5 – 30 = C+
27 – 28 = C
25 – 26 = D+
23 – 24 = D
< 23 = F

Atomic Theories Quiz

1) John Dalton discussed an early model of the atom. His model consisted of five basic postulates. List each of these postulates and explain what they mean. No points will be deducted if these postulates are listed in an order different than we learned in class. (3 points each)

- Postulate 1:

- Postulate 2:

- Postulate 3:

- Postulate 4:

- Postulate 5:

2) Which of the postulates above have been disproved? (2 points)

1 **2** **3** **4** **5** (circle as many as are appropriate)

3) Explain Thomson's cathode ray experiment and describe its significance. You may draw a diagram if it will help you to answer this question (10 points).

4) Explain Rutherford's gold foil experiment and describe its significance. You may draw a diagram if it will help you to answer this question (10 points).

5) List the main differences and similarities between the Bohr model of the atom and the quantum mechanical model of the atom. Make sure your answers are complete. (15 points)

Atomic Theories Quiz - Solutions

1) John Dalton discussed an early model of the atom. His model consisted of five basic postulates. List each of these postulates and explain what they mean. No points will be deducted if these postulates are listed in an order different than we learned in class. (3 points each)

- Postulate 1: **All matter is made of indestructible atoms. This means that atoms are as small as matter gets, like tiny unbreakable billiard balls.**

- Postulate 2: **All atoms of an element have identical chemical and physical properties. This means that if you know the properties of one atom of an element you can predict what the properties of all atoms of that element are.**

- Postulate 3: **Atoms of different elements have different chemical and physical properties. This means that the properties of each element define that element, and that no two elements can be identical in how they behave.**

- Postulate 4: **Atoms of different elements always combine in whole-number ratios when they form chemical compounds. This means that all chemical formulas have the general form A_xB_y, where x and y are whole numbers. This is, in effect, the same thing as the law of multiple proportions.**

- Postulate 5: **Atoms are never created or destroyed during chemical reactions. This is the same thing as the law of conservation of mass.**

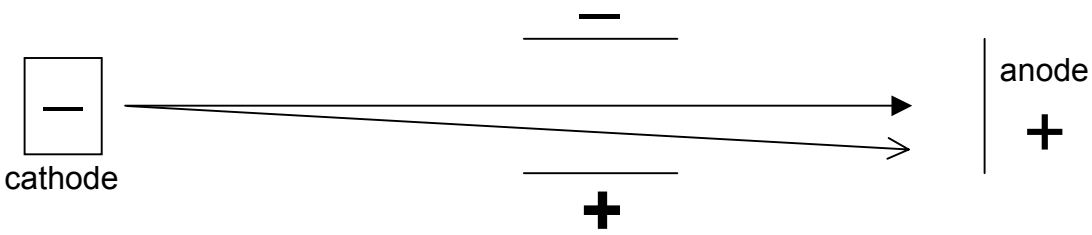
2) Which of the postulates above have been disproved? (2 points)

(1) **2** **3** **4** **5** (circle as many as are appropriate)

Atoms are not indestructible because they can be broken during nuclear reactions. However, it is true that atoms are indestructible during chemical reactions (the making and breaking of bonds).

3) Explain Thomson's cathode ray experiment and describe its significance. You may draw a diagram if it will help you to answer this question (10 points).

Thomson's experiment involved a cathode ray tube, where "cathode rays" traveled across a partially evacuated tube, from the negative electrode (cathode) to the positive electrode (anode). When charged plates were placed to the sides of this beam, they would either attract the cathode ray (if they were positive) or attract the cathode ray (if they were negative). From this experiment, Thomson was able to determine that it had a negative charge. Of course, we now know that cathode rays are the same thing as electrons.



The above diagram shows the Thomson cathode ray apparatus. The arrow with the solid head represents the path of the "cathode rays" in the absence of an external electric field. The open head represents the path when the electric field is applied.

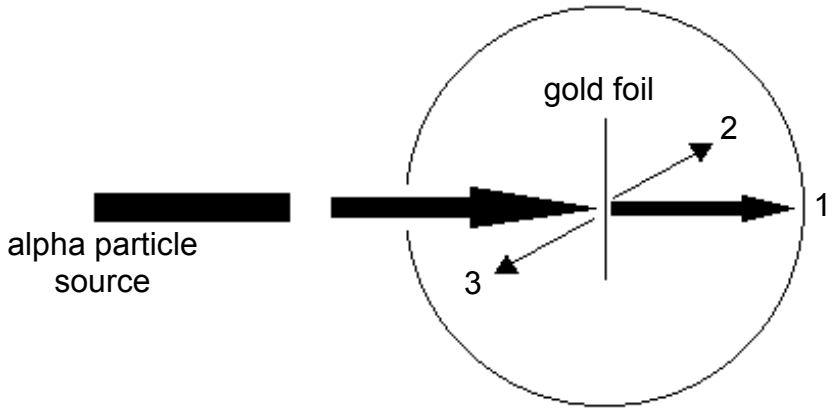
From this experiment, Thomson inferred that atoms are great big balls of positive charge with electrons embedded in it. This model is frequently referred to as the "plum-pudding" model of the atom because the dessert has small bits of plum stuck into a big ball of bread.

4) Explain Rutherford's gold foil experiment and describe its significance. You may draw a diagram if it will help you to answer this question (10 points).

Rutherford shot a beam of alpha particles at a thin piece of gold foil. Because the foil was so thin, most of the positively charge alpha particles passed directly through the foil onto a luminescent screen. However, some of the particles were deflected so they hit different locations on the screen. Rutherford interpreted this result to mean that most of the space in an atom consists of empty space (explaining why most of the particles passed directly through the foil) but that there is a central nucleus of the atom where all of the positive charge is located (explaining why some of the positively charged alpha particles were deflected). He hypothesized that the electrons traveled around the nucleus at a distance.

Diagram of Rutherford's experiment on the next page.

Rutherford's experimental setup:



During the gold foil experiment, alpha particles were focused on a very thin piece of gold foil surrounded by a phosphorescent screen. He observed that most of the alpha particles passed through the foil undeflected (1), but that some were slightly deflected (2) and others bounced back (3).

5) List the main differences and similarities between the Bohr model of the atom and the quantum mechanical model of the atom. Make sure your answers are complete. (15 points)

Similarities:

- **Electrons are located outside the nucleus in orbitals.**
- **The energy levels in an atom are quantized.**
- **Orbitals close to the nucleus have lower energies than orbitals farther away.**

Differences:

- **The Bohr atom has electrons in spherical orbits around the nucleus and the quantum mechanical model has electrons in regions of space with varying shapes and sizes.**
- **The energy of the orbitals in the Bohr atom is based mainly on the distance from the nucleus, while the energy and location of the orbitals in the quantum model is based on the wavefunction.**
- **The quantum model has four quantum numbers, the Bohr model does not.**
- **The quantum model has the Pauli Exclusion principle, Hund's rule, and the Aufbau principle.**

Suggested Grading Scale

52 = A+
47 – 51 = A
45 – 46 = B+
42 – 44 = B
39 – 41 = C+
37 – 38 = C
34 – 36 = D+
31 – 33 = D
< 31 = F

Atom Quiz

1) Sketch a simple diagram of the ^{9}Be atom and label the following parts: orbitals, nucleus, protons, neutrons, electrons (10 points)

2) Fill out the following chart. Round the atomic masses to the nearest whole number. (0.5 point per blank)

Atomic symbol	Atomic mass	Atomic number	Number of protons	Number of neutrons	Number of electrons
Li					
Si					
Mn					
I					
Ra					
Bk					

3) Write the electron configurations of the following elements: (2 points each)

a) nitrogen _____

b) potassium _____

c) silver _____

d) plutonium _____

4) A sample of silver has the following isotopic abundances:

Isotope	Isotopic mass (amu)	Isotopic abundance (%)
^{107}Ag	106.905	50.958
^{109}Ag	108.905	49.042

What is the average atomic mass of this sample of silver? Note: It may not be the same as the mass given on the periodic table! (8 points)

Atom Quiz – Solutions

1) Sketch a simple diagram of the ^{9}Be atom and label the following parts: orbitals, nucleus, protons, neutrons, electrons (10 points)

To receive full credit, this diagram should show each of the following (two points each):

- **Two orbitals around the nucleus. The orbital nearest to the nucleus should be labeled "1s" and the other should be labeled "2s".**
- **Four electrons – Two in the 1s orbital and two in the 2s orbital. The electrons should be labeled or have the symbol "e^-".**
- **The nucleus should be labeled.**
- **The nucleus should contain four protons, each labeled either with a plus sign or as "p^+".**
- **The nucleus should contain five neutrons, each labeled either with a zero or as "n^0".**

2) Fill out the following chart. Round the atomic masses to the nearest whole number. (0.5 point per blank)

Atomic symbol	Atomic mass	Atomic number	Number of protons	Number of neutrons	Number of electrons
Li	7	3	3	4	3
Si	28	14	14	14	14
Mn	55	25	25	30	25
I	127	53	53	74	53
Ra	226	88	88	138	88
Bk	247	97	97	150	97

3) Write the electron configurations of the following elements: (2 points each)

a) nitrogen **$1s^2 2s^2 2p^3$ OR [He] $2s^2 2p^3$**

b) potassium **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ OR [Ar] $4s^1$**

c) silver **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^9$ OR [Kr] $5s^2 4d^9$**

d) plutonium
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^6$
OR
[Rn] $7s^2 5f^6$

4) A sample of silver has the following isotopic abundances:

Isotope	Isotopic mass (amu)	Isotopic abundance (%)
^{107}Ag	106.905	50.958
^{109}Ag	108.905	49.042

What is the average atomic mass of this sample of silver? Note: It may not be the same as the mass given on the periodic table! (8 points)
To solve this problem, they will need to show the following equation:

Isotopic mass = (Abundance of isotope 1)(Mass of isotope 1) +
(Abundance of isotope 2)(Mass of isotope 2)

Which in this case is:
(0.50958)(106.905 amu) + (0.49042)(108.905 amu) =
54.477 amu + 53.409 amu = 107.886 amu

This answer is slightly different from the value of 107.868 amu on the periodic table.

Note: Slight differences in isotopic abundances may exist in some elements for a variety of reasons and can be useful in determining the date of very old artifacts.

Suggested Grading Scale
41 = A+
37 – 40.5 = A
35 – 36.5 = B+
33 – 34.5 = B
31 – 32.5 = C+
29 – 30.5 = C
27 – 28.5 = D+
24.5 – 26.5 = D
< 24.5 = F

Ionic Compounds Overview Quiz

1) Explain what happens when a neutral atom of sodium combines with a neutral atom of fluorine to become a molecule of sodium fluoride. Make sure your answer is *complete*. (8 points)

2) What is the octet rule and why is it important for atoms forming ionic bonds? (6 points)

3) What are the four main properties of ionic compounds? (8 points)

-
-
-
-

4) Why do ionic compounds have each of the four general properties you listed in problem three? You should explain how the method of bonding causes each of the properties you listed. (8 points)

Ionic Compounds Overview Quiz – Solutions

1) Explain what happens when a neutral atom of sodium combines with a neutral atom of fluorine to become a molecule of sodium fluoride. Make sure your answer is *complete*. (8 points)

To get this answer correct, each of the following steps should be listed (2 points each):

- **Sodium wants to lose one electron so it will have the same electron configuration as neon.**
- **Fluorine wants to gain one electron so it will have the same electron configuration as neon.**
- **As a result, sodium will give one of its electrons to fluorine, giving sodium a +1 charge and fluorine a –1 charge.**
- **Because opposite charges attract one another, the positively charged sodium ion and negatively charged fluoride ion stick to one another to form sodium fluoride.**

2) What is the octet rule and why is it important for atoms forming ionic bonds? (6 points)

The octet rules states that all atoms tend to react such that they end up with eight electrons in its outermost valence shell. (An easier way for your students to remember this: "All atoms want to be like the nearest noble gas"). This is important for atoms forming ionic bonds because atoms wanting to gain electrons will pull electrons from atoms wanting to lose electrons, resulting in the formation of oppositely charged ions. When oppositely charged ions are formed near one another, the ions stick together to form ionic compounds.

3) What are the four main properties of ionic compounds? (8 points)

- **Ionic compounds are hard and brittle**
- **Ionic compounds have high melting and boiling points**
- **Ionic compounds form crystal lattices**
- **Ionic compounds conduct electricity when dissolved in water**

4) Essay question: What affect does the type of bonding present in ionic compounds have on the properties of ionic compounds? Pick three of the four properties you gave in problem three and explain how the nature of ionic bonding is responsible for the presence of these properties. (15 points)

Many of the properties of ionic compounds stem from the strong bonding interactions between cations and anions.

This strong bonding makes ionic compounds hard and brittle because it takes a very large amount of force to move ions in relation to one another. In fact, it takes so much force that the applied force causes the entire crystal to shatter before it will dent or bend. Because the cations and anions are arranged in regular patterns, crystals tend to break along planes. (5 points)

High melting and boiling point can also be attributed to these strong ionic bonds. When you melt or boil a substance, this causes the particles in the substance to move freely with respect to one another. In ionic compounds it requires a very large amount of heat to cause this free movement because cations and anions are so strongly attracted that they spontaneously tend to stick together. (5 points)

Ionic compounds form crystals because crystals are a very efficient way of packing together ions such that the attraction between oppositely charged ions is maximized. For example, if you look at a cubic lattice you can see that each cation is in direct contact with six anions, and vice-versa. (5 points)

The fact that ionic compounds are electrolytes in water cannot be easily explained by the interactions between cations and anions. As a result, they should not have picked this property from problem three to answer this essay.

Suggested Grading Scale

37 = A+
34 – 36 = A
32 – 33 = B+
30 – 31 = B
28 – 29 = C+
26 – 27 = C
24 – 25 = D+
22 – 23 = D
< 22 = F

Naming Ionic Compounds Quiz

Give the formulas for the following compounds (1 point each):

1) potassium carbonate _____

2) magnesium sulfide _____

3) nickel (III) oxide _____

4) aluminum phosphide _____

5) sodium nitrite _____

6) manganese (IV) sulfate _____

7) chromium (VI) sulfite _____

8) calcium phosphate _____

9) chromium (II) phosphide _____

10) lithium permanganate _____

11) titanium (III) acetate _____

12) iron (III) selenide _____

13) zinc hydroxide _____

14) copper (I) carbonate _____

15) beryllium bromide _____

16) lead (IV) bicarbonate _____

Given the following formulas, name the ionic compound (1 point each):

17) $FeSO_3$ _____

18) CrF_3 _____

19) $Mn(OH)_7$ _____

20) $Ti_3(PO_4)_2$ _____

21) $(NH_4)_3As$ _____

22) $NiCO_3$ _____

23) $Mn(NO_2)_3$ _____

24) K_2S _____

25) TiN _____

26) $CaSO_4$ _____

27) CoP _____

28) $Mg(OH)_2$ _____

29) V_2O_3 _____

30) $Zn(NO_3)_2$ _____

31) $Ga(HCO_3)_3$ _____

32) $Ag_2C_2O_4$ _____

Naming Ionic Compounds Quiz - Solutions

Give the formulas for the following compounds (1 point each):

1)	potassium carbonate	**K_2CO_3**
2)	magnesium sulfide	**MgS**
3)	nickel (III) oxide	**Ni_2O_3**
4)	aluminum phosphide	**AlP**
5)	sodium nitrite	**$NaNO_2$**
6)	manganese (IV) sulfate	**$Mn(SO_4)_2$**
7)	chromium (VI) sulfite	**$Cr(SO_3)_3$**
8)	calcium phosphate	**$Ca_3(PO_4)_2$**
9)	chromium (II) phosphide	**Cr_3P_2**
10)	lithium permanganate	**$LiMnO_4$**
11)	titanium (III) acetate	**$Ti(C_2H_3O_2)_3$ OR $Ti(CH_3COO)_3$**
12)	iron (III) selenide	**Fe_2Se_3**
13)	zinc hydroxide	**$Zn(OH)_2$**
14)	copper (I) carbonate	**Cu_2CO_3**
15)	beryllium bromide	**$BeBr_2$**
16)	lead (IV) bicarbonate	**$Pb(HCO_3)_4$**

Given the following formulas, name the ionic compound (1 point each):

17) $FeSO_3$ **iron (II) sulfite**

18) CrF_3 **chromium (III) fluoride**

19) $Mn(OH)_7$ **manganese (VII) hydroxide**

20) $Ti_3(PO_4)_2$ **titanium (II) phosphate**

21) $(NH_4)_3As$ **ammonium arsenide**

22) $NiCO_3$ **nickel (II) carbonate**

23) $Mn(NO_2)_3$ **manganese (III) nitrite**

24) K_2S **potassium sulfide**

25) TiN **titanium (III) nitride**

26) $CaSO_4$ **calcium sulfate**

27) CoP **cobalt (III) phosphide**

28) $Mg(OH)_2$ **magnesium hydroxide**

29) V_2O_3 **vanadium (III) oxide**

30) $Zn(NO_3)_2$ **zinc nitrate**

31) $Ga(HCO_3)_3$ **gallium bicarbonate**

32) $Ag_2C_2O_4$ **silver oxalate**

Suggested Grading Scale

32 = A+
29 – 31 = A
28 = B+
26 – 27 = B
25 = C+
23 – 24 = C
21 – 22 = D+
20 = D
< 20 = F

Molecular Calculations Quiz

1) How many grams of copper (II) sulfate are there in 2.50 moles? (3 points)

2) How many moles of silver acetate are there in 4.90×10^{22} molecules? (3 points)

3) How many grams of lithium oxide are there in 7.40×10^{24} molecules? (5 points)

4) How many molecules are there in 223 grams of iron (III) iodide? (5 points)

5) When 1,1-dimethylcyclobutane undergoes an elemental analysis, it is found to contain 85.7% carbon and 14.3% hydrogen (by mass). Based on this information, what is the empirical formula of 1,1-dimethylcyclobutane? (6 points)

6) After other tests were done, the molecular mass of 1,1-dimethylcyclobutane was found to be 84 grams/mole. Based on this information, what is the molecular formula of 1,1-dimethylcyclobutane? (6 points)

7) An unknown compound was analyzed and found to have an elemental composition of 65.4% carbon, 5.5% hydrogen, and 29.1% oxygen. Based on the information in the following chart, what is the name of the unknown compound? (10 points)

Name of compound	**Molecular Formula**
Acetone	C_3H_6O
Oxalic acid	$C_2H_2O_4$
4-hydroxyphenol	$C_6H_6O_2$

Molecular Calculations Quiz – Solutions

1) How many grams of copper (II) sulfate are there in 2.50 moles? (3 points)
399 grams (multiply the molecular mass of copper (II) sulfate, 159.6 grams, by the number of moles)

2) How many moles of silver acetate are there in 4.90×10^{22} molecules? (3 points)
0.0814 moles (divide 4.90×10^{22} by 6.02×10^{23}; when converting between molecules and moles, the identity of the compound being used is not important)

3) How many grams of lithium oxide are there in 7.40×10^{24} molecules? (5 points)
366 grams (convert molecules to moles by dividing my 6.02×10^{23}, then multiply by the molar mass of lithium oxide)

4) How many molecules are there in 223 grams of iron (III) iodide? (5 points)
3.21×10^{23} molecules (convert grams to moles by dividing by the molar mass, then multiply by Avogadro's number)

5) When 1,1-dimethylcyclobutane undergoes an elemental analysis, it is found to contain 85.7% carbon and 14.3% hydrogen (by mass). Based on this information, what is the empirical formula of 1,1-dimethylcyclobutane? (6 points)
CH_2 (To solve, assume you have 100. grams of the compound – this essentially changes the percent values to grams. Next, divide each of these masses by the atomic masses of each element. This results in an answer of 7.14 moles of carbon and 14.3 moles of hydrogen. Next, divide each value by the smallest, in this case, 7.14. This causes the number of carbons to equal one and the number of hydrogens to equal ~2. Using these numbers, the empirical formula is CH_2.)

6) After other tests were done, the molecular mass of 1,1-dimethylcyclobutane was found to be 84 grams/mole. Based on this information, what is the molecular formula of 1,1-dimethylcyclobutane? (6 points)
C_6H_{12} (Divide the actual molecular mass of the compound by the mass of the empirical formula, 14 grams/mole. This yields the number six. When the subscripts in the empirical formula are each multiplied by this number, you get the molecular formula.)

7) An unknown compound was analyzed and found to have an elemental composition of 65.4% carbon, 5.5% hydrogen, and 29.1% oxygen. Based on the information in the following chart, what is the name of the unknown compound? (10 points)

Name of compound	Molecular Formula
Acetone	C_3H_6O
Oxalic acid	$C_2H_2O_4$
4-hydroxyphenol	$C_6H_6O_2$

4-hydroxyphenol (Solving this problem in the same manner as question five, you find that the empirical formula of the unknown is C_3H_3O. Of the three compounds listed, the only compound that has that empirical formula is 4-hydroxyphenol.)

Suggested Grading Scale

38 = A+
35 – 37 = A
33 – 34 = B+
31 – 32 = B
29 = C+
27 – 28 = C
25 – 26 = D+
23 – 24 = D
< 23 = F

Covalent Compounds Overview Quiz

1) Explain what happens when two neutral atoms of fluorine combine to form a molecule of F_2. Make sure your answer is *complete*. (6 points)

2) When ionic compounds are formed, electrons are transferred from one atom to another resulting in the formation of cations and anions that stick to each other. Explain why doesn't this transfer of electrons doesn't take place when covalent compounds are formed. (6 points)

3) Many covalent compounds have a "squishy" texture. Explain this property in terms of how bonding occurs in covalent compounds. (6 points)

4) Describe each of the major intermolecular forces that are important for covalent compounds and explain why they occur. You should list them in order of increasing strength, giving examples of compounds that experience these forces. (18 points)

Covalent Compounds Overview Quiz – Solutions

1) Explain what happens when two neutral atoms of fluorine combine to form a molecule of F_2. Make sure your answer is *complete*. (6 points)

Give two points for each of the following steps:

- **Both atoms of fluorine need to gain one electron to become like the nearest noble gas and obey the octet rule.**
- **Because both atoms have identical electronegativities, neither one can pull an electron away from the other.**
- **As a result, the atoms will need to share electrons to get their full octet, resulting in a covalent bond.**

2) When ionic compounds are formed, electrons are transferred from one atom to another resulting in the formation of cations and anions that stick to each other. Explain why doesn't this transfer of electrons doesn't take place when covalent compounds are formed. (6 points)

In ionic compounds, electrons are transferred from one atom to the other because one atom has a much higher electronegativity than the other does. In covalent compounds, the electronegativity difference between the atoms is very small. As a result, neither atom will accept or give up electrons. For both atoms to fill their octets, they must share the electrons.

3) Many covalent compounds have a "squishy" texture. Explain this property in terms of how bonding occurs in covalent compounds. (6 points)

Recall that ionic compounds are hard and brittle because every ion has strong interactions with adjacent counterions. In covalent compounds each molecule has only very weak intermolecular interactions with adjacent molecules. As a result, covalent molecules can easily slide around each other.

As an analogy, think of Lego™ building blocks. These are like ionic compounds because there are very strong interactions holding every block to the ones around it. Covalent compounds, on the other hand, are more like those rooms full of plastic balls that you occasionally see at fast food restaurants. Each half of every ball is held tightly to the other half but the balls have very little interaction with one another.

4) Describe each of the major intermolecular forces that are important for covalent compounds and explain why they occur. You should list them in order of increasing strength, giving examples of compounds that experience these forces. (18 points)

- **London dispersion forces are very weak attractions most important for nonpolar molecules or noble gases. Occasionally, the electrons in a nonpolar molecule will be unequally distributed, causing an instantaneous and very small dipole in the molecule. This, in turn, induces a very small dipole in a neighboring molecule. Because both molecules are very slightly polar, they attract one another. It should be noted, however, that this interaction is very short-lived and very weak.**
- **Dipole-dipole forces occur when two polar molecules interact with one another. When two molecules are polar, they align themselves such that the positive side of one molecule sticks to the negative side of the other. This force is stronger than London dispersion forces because the dipoles involved are permanent and significantly stronger than accidental dipoles. Dipole-dipole forces are significant for alkyl halides (R-X), hydrohalic acids (H-X), and other molecules containing the halogens.**
- **Hydrogen bonding occurs when a hydrogen atom bonded to an electronegative atom is attracted to the lone pair electrons on an electronegative atom on a different molecule. This is a very strong interaction that can last for a significant period of time, particularly in solids. The most important example of a molecule that experiences hydrogen bonding is water. However, amines, alcohols, carboxylic acids, ethers, and other related molecules all experience hydrogen bonding.**

Suggested Grading Scale

36 = A+
33 – 35 = A
31 – 32 = B+
29 – 30 = B
28 = C+
26 – 27 = C
24 – 25 = D+
22 – 23 = D
< 22 = F

Lewis Structures and VSEPR Quiz

1) Name the following covalent compounds (1 point each):

   a) CS_2 _____

   b) NH_3 _____

   c) PBr_5 _____

   d) N_2O_3 _____

   e) SF_6 _____

   f) P_4 _____

2) Give the formulas of the following covalent compounds (1 point each):

   a) methane _____

   b) nitrogen _____

   c) boron trichloride _____

   d) bromine monoxide _____

   e) tetrasulfur tetranitride _____

   f) iodine pentafluoride _____

3) Explain why carbon tetrachloride has a tetrahedral shape rather than a square planar (all atoms arranged like a plus sign) shape. (5 points)

4) Explain why the bonds in carbon dioxide are stronger and shorter than the bonds in carbon tetrachloride. (5 points)

5) Fill in the following chart: (2 points for each Lewis structure, one point for each of the other blanks)

Formula	Lewis structure	Shape	Bond angle
F_2O			
PBr_3			
CO_2			
BH_3			

Lewis Structures and VSEPR Quiz - Solutions

1) Name the following covalent compounds (1 point each):

a) CS_2 **carbon disulfide**

b) NH_3 **ammonia**

c) PBr_5 **phosphorus pentabromide**

d) N_2O_3 **dinitrogen trioxide**

e) SF_6 **sulfur hexafluoride**

f) P_4 **phosphorus**

2) Give the formulas of the following covalent compounds (1 point each):

a) methane **CH_4**

b) nitrogen **N_2**

c) boron trichloride **BCl_3**

d) bromine monoxide **BrO**

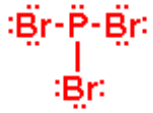
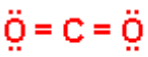
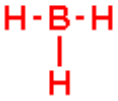
e) tetrasulfur tetranitride **S_4N_4**

f) iodine pentafluoride **IF_5**

3) Explain why carbon tetrachloride has a tetrahedral shape rather than a square planar (all atoms arranged like a plus sign) shape. (5 points)
VSEPR theory states that atoms arrange themselves so all substituents are as far away from one another as possible. A tetrahedral shape results in a bond angle of 109.5^0, which is greater than the 90^0 bond angle in a square planar molecule. As a result, carbon tetrachloride has a tetrahedral geometry.

4) Explain why the bonds in carbon dioxide are stronger and shorter than the bonds in carbon tetrachloride. (5 points)
Carbon dioxide has double bonds and carbon tetrachloride has single bonds. Multiple bonds are harder to break and shorter than single bonds because there is more orbital overlap between the atoms involved in the bonding.

5) Fill in the following chart: (2 points for each Lewis structure, one point for each of the other blanks)

F_2O		bent	104.5°
PBr_3		trigonal pyramidal	107.5°
CO_2		linear	180°
BH_3		trigonal planar	120°

Suggested Grading Scale

38 = A+
35 – 37 = A
33 – 34 = B+
31 – 32 = B
29 – 30 = C+
27 – 28 = C
25 – 26 = D+
23 – 24 = D
< 23 = F

Compound Naming Quiz

Name the following chemical compounds: (1 point each)

1) $LiCl$ _____

2) KNO_3 _____

3) PBr_5 _____

4) SF_6 _____

5) Fe_2O_3 _____

6) N_2O_3 _____

7) $CuOH$ _____

8) CF_4 _____

9) $Al(NO_2)_3$ _____

10) $MgSO_4$ _____

11) Se_2Br_2 _____

12) MnS_2 _____

13) S_8 _____

14) $Ti_2(CO_3)_3$ _____

15) $AgC_2H_3O_2$ _____

16) SF_6 _____

17) $Cr(PO_4)_2$ _____

18) SiO _____

19) Na_3P _____

20) $FeSO_3$ _____

Write the formulas for the following compounds: (1 point each)

21) beryllium cyanide _____

22) methane _____

23) cobalt (III) iodide _____

24) silver nitrate _____

25) potassium permanganate _____

26) nitrogen _____

27) carbon disulfide _____

28) lithium phosphate _____

29) iron (III) acetate _____

30) copper (II) chloride _____

31) sulfur dibromide _____

32) diselenium dichloride _____

33) vanadium (III) oxide _____

34) calcium hydroxide _____

35) manganese (VI) selenide _____

36) phosphorus trifluoride _____

37) silicon carbide _____

38) zinc sulfite _____

39) nitrogen trioxide _____

40) carbon tetrachloride _____

Compound Naming Quiz – Solutions

Name the following chemical compounds: (1 point each)

1) $LiCl$ **lithium chloride**
2) KNO_3 **potassium nitrate**
3) PBr_5 **phosphorus pentabromide**
4) SF_6 **sulfur hexafluoride**
5) Fe_2O_3 **iron (III) oxide**
6) N_2O_3 **dinitrogen trioxide**
7) $CuOH$ **copper (I) hydroxide**
8) CF_4 **carbon tetrafluoride**
9) $Al(NO_2)_3$ **aluminum nitrite**
10) $MgSO_4$ **magnesium sulfate**
11) Se_2Br_2 **diselenium dibromide**
12) MnS_2 **manganese (IV) sulfide**
13) S_8 **sulfur**
14) $Ti_2(CO_3)_3$ **titanium (III) carbonate**
15) $AgC_2H_3O_2$ **silver acetate**
16) SeF_6 **selenium hexafluoride**
17) $Cr(PO_4)_2$ **chromium (VI) phosphate**
18) SiO **silicon monoxide**
19) Na_3P **sodium phosphide**
20) $FeSO_3$ **iron (II) sulfite**

Write the formulas for the following compounds: (1 point each)

21) beryllium cyanide **$Be(CN)_2$**
22) methane **CH_4**
23) cobalt (III) iodide **CoI_3**
24) silver nitrate **$AgNO_3$**
25) potassium permanganate **$KMnO_4$**

26) nitrogen **N_2**

27) carbon disulfide **CS_2**

28) lithium phosphate **Li_3PO_4**

29) iron (III) acetate **$Fe(C_2H_3O_2)_3$**

30) copper (II) chloride **$CuCl_2$**

31) sulfur dibromide **SBr_2**

32) diselenium dichloride **Se_2Cl_2**

33) vanadium (III) oxide **V_2O_3**

34) calcium hydroxide **$Ca(OH)_2$**

35) manganese (VI) selenide **$MnSe_3$**

36) phosphorus trifluoride **PF_3**

37) silicon carbide **SiC**

38) zinc sulfite **$ZnSO_3$**

39) nitrogen trioxide **NO_3**

40) carbon tetrachloride **CCl_4**

Suggested Grading Scale

40 = A+
36 – 39 = A
34 – 35 = B+
32 – 33 = B
30 – 31 = C+
28 – 29 = C
26 – 27 = D+
24 – 25 = D
< 24 = F

Chemical Equations Quiz

1) Balance the following equations: (1 point each)

___ $LiCl$ + ___ K_2O → ___ Li_2O + ___ KCl

___ KNO_3 + ___ Fe_2O_3 → ___ K_2O + ___ $Fe(NO_3)_3$

___ $CuOH$ + ___ $Al(NO_2)_3$ → ___ $CuNO_2$ + ___ $Al(OH)_3$

___ $NaHCO_3$ → ___ Na_2CO_3 + ___ H_2O + ___ CO_2

___ $Pb(OH)_2$ + ___ $Cr(CO_3)_3$ → ___ $PbCO_3$ + ___ $Cr(OH)_6$

___ C_4H_8 + ___ O_2 → ___ CO_2 + ___ H_2O

___ $Ti_2(CO_3)_3$ + ___ $AgC_2H_3O_2$ → ___ $Ti(C_2H_3O_2)_3$ + ___ Ag_2CO_3

___ S_8 + ___ F_2 → ___ SF_6

___ $MgSO_4$ + ___ MnS_3 → ___ MgS + ___ $Mn(SO_4)_3$

___ $Be(CN)_2$ + ___ $(NH_4)_3P$ → ___ Be_3P_2 + ___ NH_4CN

___ CoI_3 + ___ $KMnO_4$ → ___ $Co(MnO_4)_3$ + ___ KI

___ $CuCl_2$ + ___ V_2O_3 → ___ CuO + ___ VCl_3

___ Ag + ___ $FePO_4$ → ___ Ag_3PO_4 + ___ Fe

___ $Cr_2(CO_3)_3$ + ___ $Ca(OH)_2$ → ___ $Cr(OH)_3$ + ___ $CaCO_3$

___ $NiSO_4$ + ___ $Ca(NO_3)_2$ → ___ $CaSO_4$ + ___ $Ni(NO_3)_2$

2) Write equations for the following chemical reactions: (3 points each)

- When copper wire reacts with an aqueous solution of silver nitrate, silver crystals and aqueous copper (I) nitrate are formed.

- When ethane gas (C_2H_6) is burned in the presence of oxygen, carbon dioxide gas and water vapor are formed.

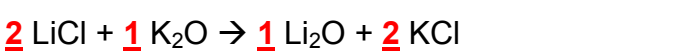
- When calcium hydroxide pellets react with hydrogen chloride gas, calcium chloride powder and liquid water are formed.

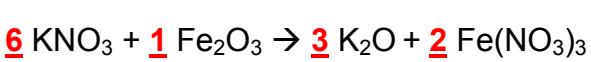
- When calcium carbonate powder is heated to 1200^0 C, calcium oxide powder and carbon dioxide gas are formed.

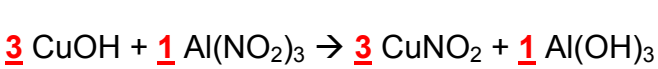
- When nitrogen gas and oxygen gas react, they form nitrogen trioxide gas.

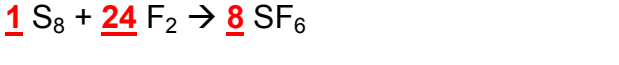
Chemical Equations Quiz – Solutions

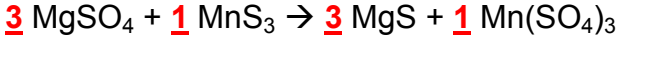
1) Balance the following equations: (1 point each)

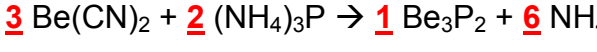


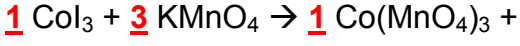


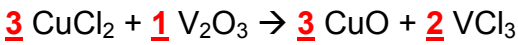


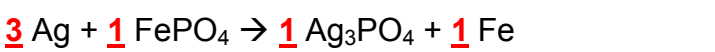


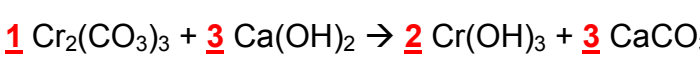












2) Write equations for the following chemical reactions: (3 points each)

Give students one point for writing the reagents correctly, one point for the correct coefficients, and one point for using the correct symbols (aq, l, Δ, etc.)

- When copper wire reacts with an aqueous solution of silver nitrate, silver crystals and aqueous copper (I) nitrate are formed.

$$1\ Cu_{(s)} + 1\ AgNO_{3(aq)} \rightarrow 1\ Ag_{(s)} + 1\ CuNO_{3(aq)}$$

- When ethane gas (C_2H_6) is burned in the presence of oxygen, carbon dioxide gas and water vapor are formed.

$$2\ C_2H_{6(g)} + 7\ O_{2(g)} \xrightarrow{\Delta} 4\ CO_{2(g)} + 6\ H_2O_{(g)}$$

- When calcium hydroxide pellets react with hydrogen chloride gas, calcium chloride powder and liquid water are formed.

$$1\ Ca(OH)_{2(s)} + 2\ HCl_{(g)} \rightarrow 1\ CaCl_{2(s)} + 1\ H_2O_{(l)}$$

- When calcium carbonate powder is heated to 1200^0 C, calcium oxide powder and carbon dioxide gas are formed.

$$1\ CaCO_{3(g)} \xrightarrow{1200^\circ C} 1\ CaO_{(s)} + 1\ CO_{2(g)}$$

- When nitrogen gas and oxygen gas react, they form nitrogen trioxide gas.

$$N_{2(g)} + 3\ O_{2(g)} \rightarrow 2\ NO_{3(g)}$$

Suggested Grading Scale

30 = A+
27 – 29 = A
26 = B+
24 – 25 = B
23 = C+
21 – 22 = C
20 = D+
18 – 19 = D
< 18 = F

Types of Reactions Quiz

For questions 1 – 8, balance the equation and indicate what type of reaction is taking place. (1 point for correctly balancing each equation, 1 point for correctly identifying each type of reaction.)

1) ____ H_3PO_4 + ____ NaOH → ____ H_2O + ____ Na_3PO_4

Type of reaction: _____

2) ____ C_4H_{10} + ____ O_2 → ____ H_2O + ____ CO_2

Type of reaction: _____

3) ____ $Fe(OH)_2$ + ____ NaCl → ____ $FeCl_2$ + ____ NaOH

Type of reaction: _____

4) ____ Pb + ____ NO_3 → ____ $Pb(NO_2)_4$ + ____ O_2

Type of reaction: _____

5) ____ SO_3 → ____ S_8 + ____ O_2

Type of reaction: _____

6) ____ Ca + ____ H_2O → ____ $Ca(OH)_2$ + ____ H_2

Type of reaction: _____

7) ____ H_2O + ____ SO_3 → ____ H_2SO_4

Type of reaction: _____

8) ____ $MgSO_4$ → ____ MgO + ____ SO_3

Type of reaction: _____

For questions 9-15, predict the products of the reaction and identify the type of reaction taking place. (1 point for correctly predicting the products, 1 point for balancing each equation, 1 point for identifying the type of reaction)

9) ____ C_3H_6 + ____ O_2 →

Type of reaction: _____

10) ____ Cu + ____ $Pb(NO_3)_2$ →

Type of reaction: _____

11) ____ H_2SO_4 + ____ KOH →

Type of reaction: _____

12) ____ $GaBr_3$ + ____ CoF_3 →

Type of reaction: _____

13) ____ $Ti(OH)_3$+ ____ HNO_3 →

Type of reaction: _____

14) ____ Li + ____ I_2 →

Type of reaction: _____

15) ____ $FeSO_3$ + ____ VS_2 →

Type of reaction: _____

Types of Reactions Quiz - Solutions

For questions 1 – 8, balance the equation and indicate what type of reaction is taking place. (1 point for correctly balancing each equation, 1 point for correctly identifying each type of reaction.)

1) **1** H_3PO_4 + **3** NaOH → **3** H_2O + **1** Na_3PO_4

Type of reaction: **acid-base**

2) **2** C_4H_{10} + **13** O_2 → **10** H_2O + **8** CO_2

Type of reaction: **combustion**

3) **1** $Fe(OH)_2$ + **2** NaCl → **1** $FeCl_2$ + **2** NaOH

Type of reaction: **double displacement**

4) **1** Pb + **4** NO_3 → **1** $Pb(NO_2)_4$ + **2** O_2

Type of reaction: **single displacement**

5) **8** SO_3 → **1** S_8 + **12** O_2

Type of reaction: **decomposition**

6) **1** Ca + **2** H_2O → **1** $Ca(OH)_2$ + **1** H_2

Type of reaction: **single displacement**

7) **1** H_2O + **1** SO_3 → **1** H_2SO_4

Type of reaction: **synthesis**

8) **1** $MgSO_4$ → **1** MgO + **1** SO_3

Type of reaction: **decomposition**

For questions 9-15, predict the products of the reaction and identify the type of reaction taking place. (1 point for correctly predicting the products, 1 point for balancing the equation, 1 point for identifying the type of reaction)

9) **2** C_3H_6 + **9** O_2 → **6** CO_2 + **6** H_2O

Type of reaction: **combustion**

10) **1** Cu + **1** $Pb(NO_3)_2$ → **1** $Cu(NO_3)_2$ + **1** Pb

Type of reaction: **single displacement**

11) **1** H_2SO_4 + **2** KOH → **2** H_2O + **1** K_2SO_4

Type of reaction: **acid-base**

12) **1** $GaBr_3$ + **1** CoF_3 → **1** $CoBr_3$ + **1** GaF_3

Type of reaction: **double displacement**

13) **1** $Ti(OH)_3$+ **3** HNO_3 → **1** $Ti(NO_3)_3$ + **3** H_2O

Type of reaction: **acid-base**

14) **2** Li + **1** I_2 → **2** LiI

Type of reaction: **synthesis**

15) **2** $FeSO_3$ + **1** VS_2 → **2** FeS + **1** $V(SO_3)_2$

Type of reaction: **double displacement**

Suggested Grading Key

37 = A+
34 – 36 = A
32 – 33 = B+
30 – 31 = B
28 – 29 = C+
26 – 27 = C
25 = D+
23 – 24 = D
< 23 = F

Stoichiometry Quiz

Answer the following questions for the reaction:

$$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O$$

1) How many grams of sodium sulfate can be made if I start with 50.0 grams of sodium hydroxide and an excess of sulfuric acid? (4 points)

2) If I actually made 20.0 grams of sodium sulfate, what would my percent yield be for this reaction? Is this a reasonable yield? (4 points)

3) How many grams of sulfuric acid would be required to make 2.5 moles of water? (4 points)

4) How many grams of sodium sulfate would also be formed in the reaction described in problem #3? Assume an excess of sodium hydroxide. (4 points)

For the problems on this page, use the following equation:

$$Fe_2(SO_4)_3 + 6\ LiNO_3 \rightarrow 3\ Li_2SO_4 + 2\ Fe(NO_3)_3$$

5) If I do the following reaction with 115 grams of iron (III) sulfate and 145 grams of lithium nitrate, how many grams of lithium sulfate will be formed? (6 points)

6) What is the limiting reagent in problem #5? (2 points)

7) How many grams of lithium sulfate would be formed if there were an excess of the limiting reagent? (4 points)

8) If 115 grams of lithium sulfate were formed in the reaction from problem #7, what is the percent yield of this reaction? Is this a reasonable yield? (4 points)

Stoichiometry Quiz - Solutions

Answer the following questions for the reaction:

$$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O$$

1) How many grams of sodium sulfate can be made if I start with 50.0 grams of sodium hydroxide and an excess of sulfuric acid? (4 points)
88.8 grams

2) If I actually made 20.0 grams of sodium sulfate, what would my percent yield be for this reaction? Is this a reasonable yield? (4 points)
Since percent yield = (actual yield/theoretical yield) x 100, the percent yield for this reaction would be (20.0 grams / 88.8 grams) x 100 = 22.5%. This is a reasonable, though low, yield.

3) How many grams of sulfuric acid would be required to make 2.5 moles of water? (4 points)
120 grams (122.1 grams without significant figures)

4) How many grams of sodium sulfate would also be formed in the reaction described in problem #3? Assume an excess of sodium hydroxide. (4 points)
180 grams if you convert between moles of water and moles of sodium sulfate. (Without significant figures, 177.69 grams)

For the problems on this page, use the following equation:

$$Fe_2(SO_4)_3 + 6\ LiNO_3 \rightarrow 3\ Li_2SO_4 + 2\ Fe(NO_3)_3$$

5) If I do the following reaction with 115 grams of iron (III) sulfate and 145 grams of lithium nitrate, how many grams of lithium sulfate will be formed? (6 points)
94.8 grams

6) What is the limiting reagent in problem #5? (2 points)
iron (III) sulfate

7) How many grams of lithium sulfate would be formed if there were an excess of the limiting reagent? (4 points)
Adding an excess of the limiting reagent essentially makes the reagent that was not the limiting reagent in problem #5 into the limiting reagent. Since students should have computed the amount of lithium sulfate that would be formed in problem #5 – 116 grams.

8) If 115 grams of lithium sulfate were formed in the reaction from problem #7, what is the percent yield of this reaction? Is this a reasonable yield? (4 points)
115 / 116 x 100 = 99.1% yield. This is a reasonable and very high yield.

Suggested Grading Scale

32 = A+
29 – 31 = A
28 = B+
26 – 27 = B
24 – 25 = C+
23 = C
21 – 22 = D+
20 = D
< 20 = F

Gas Stoichiometry Quiz

1) Write a balanced equation for the combustion of methane. (2 points)

2) How many liters of methane gas are required to make 15 grams of water at standard temperature and pressure? (4 points)

3) How many liters of carbon dioxide can be formed from 12 liters of oxygen at STP? (4 points)

4) If 17.5 liters of methane react with 22.5 liters of oxygen, how many liters of carbon dioxide will be formed at STP? (6 points)

Gas Stoichiometry Quiz – Solutions

1) Write a balanced equation for the combustion of methane. (2 points)

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$$

2) How many liters of methane gas are required to make 15 grams of water at standard temperature and pressure? (4 points)
11 liters

3) How many liters of carbon dioxide can be formed from 12 liters of oxygen at STP? (4 points)
6 liters (atmospheric temperature and pressure are not important in solving this problem)

4) If 17.5 liters of methane react with 22.5 liters of oxygen, how many liters of carbon dioxide will be formed at STP? (6 points)
11.3 liters (Again, atmospheric temperature and pressure are not important to this problem, as both the products and reagents are under the same reaction conditions.)

Suggested Grading Scale

16 = A+
15 = A
14 = B+
13 = B
12 = C+
11 = D+
10 = D
< 10 = F

Section 3

Semester Exam

Semester Exam

For each of the following questions, determine which of the following answers is correct and fill in the corresponding blank on your answer sheet. There is only one correct answer for every problem.

1) Which of the following is NOT a safety rule for the laboratory?
   a) Long hair must be tied back
   b) Dilute acids by adding water to acid
   c) All jewelry must be removed before conducting a lab
   d) Sandals are not allowed footwear for the laboratory

2) Which piece of laboratory equipment is NOT useful for measuring out exactly 10.00 mL of a liquid?
   a) beaker
   b) graduated cylinder
   c) volumetric pipet
   d) volumetric flask

3) Which of the following is NOT a step of the scientific method?
   a) retest
   b) procedure
   c) conclusion
   d) materials

4) Which of the following is the best example of a hypothesis?
   a) When pigeons fly they seem to go in circles.
   b) If the pigeons start flying, then they will go in a circle.
   c) Feeding pigeons makes them fly.
   d) Pigeons like to fly.

5) Which of these is most easily separated?
   a) solution
   b) compound
   c) homogeneous mixture
   d) heterogeneous mixture

6) What is the difference between an element and a compound?
   a) Elements are composed more than one atom stuck together, compounds are composed of only one type of atom.
   b) Compounds consist of one type of molecule and elements consist of many types of molecule.
   c) Elements are composed of only one type of atom and compounds are composed of more than one type of atom.
   d) None of these adequately describes the difference between an element and compound.

7) How many significant figures does the number 50.6010 have?
   a) three
   b) four
   c) five
   d) six

8) Which of the following numbers has four significant figures?
   a) 3400
   b) 3.40×10^4
   c) 34.000
   d) none of these numbers has four significant figures

9) How many inches are present in 45.0 centimeters? There are 2.54 centimeters in 1.00 inches.
   a) 0.564 inches
   b) 6.45 inches
   c) 17.7 inches
   d) 114 inches

10) If I wanted to convert a temperature in degrees Celsius to Kelvins, how would I do it?
   a) add 273 to the temperature in degrees Celsius
   b) subtract 273 from the temperature in degrees Celsius
   c) multiply 273 to the temperature in degrees Celsius
   d) divide 273 by the temperature in degrees Celsius

11) Which of the following is true for an accurate measurement?
   a) repeated measurements will all yield answers with similar values
   b) the measurement will have a lot of decimal places
   c) the measurement will contain the right number of significant figures
   d) the measurement is very close to the correct value

12) Which family in the periodic table is very reactive in air and water and forms ions with a charge of +2?
   a) alkali metals
   b) alkaline earth metals
   c) transition metals
   d) halogens

13) What family in the periodic table consists of elements that are strong oxidizers?
   a) alkali metals
   b) alkaline earth metals
   c) halogens
   d) noble gases

14) An element that was hard, brittle, and was able to conduct only a small amount of electricity would most likely be:
   a) metallic
   b) nonmetallic
   c) a metalloid
   d) hydrogen

15) Which of the following properties is a measurement of an element's ability to pull electrons away from an atom it has bonded to?
   a) electronegativity
   b) electron affinity
   c) ionization energy
   d) atomic radius

16) How many elements are diatomic?
   a) 4
   b) 6
   c) 7
   d) 9

17) Which of the following is NOT one of Dalton's postulates about the nature of atoms?
   a) Atoms can be broken only at very high energies.
   b) Atoms of different elements have different properties.
   c) All atoms of a given element have identical properties.
   d) Atoms are never created or destroyed during a chemical process.

18) Which of the answers for problem #16 above are NOT correct?
   a) a
   b) b
   c) c
   d) All of the answers above are correct.

19) "Cathode rays" are now better known as:
   a) protons
   b) neutrons
   c) electrons
   d) positrons

20) Rutherford's gold foil experiment showed that:
   a) The positive charge in an atom is located in the electrons.
   b) The negative charge in an atom is located in the electrons.
   c) The positive charge in an atom is located in the nucleus.
   d) The negative charge in an atom is located in the nucleus.

21) Which of the following did Bohr believe?
   a) The plum-pudding model of the atom.
   b) That neutrons have negative charge.
   c) That electrons are located in orbitals with distinct energy levels.
   d) That protons have distinct energy levels and determine the rate of nuclear decay.

22) The atomic number of an element is the same as the number of:
   a) protons
   b) neutrons
   c) electrons
   d) more than one of the above is correct.

23) What type of orbital does NOT contain electrons for an iron atom in the ground state?
   a) s
   b) p
   c) d
   d) f

24) The symbol for the angular momentum quantum number is:
   a) n
   b) l
   c) m_l
   d) m_s

25) Which of the following electron configurations is incorrect?
   a) For copper: [Ar] $4s^2 4d^9$
   b) For fluorine: [He] $2s^2 2p^5$
   c) For boron: $1s^2 2s^2 2p^1$
   d) For potassium: [Ar] $4s^1$

26) The octet rule states that:
   a) All elements want to have eight electrons.
   b) All elements want to have eight valence electrons.
   c) All elements will share electrons such that they have eight electrons in their outermost valence shell.
   d) All elements will gain or lose electrons such that they have eight electrons in their outermost valence shell.

27) Which of the following is NOT a property of an ionic compound?
   a) hard
   b) brittle
   c) low melting point
   d) conducts electricity when dissolved in water

28) Which of the following is NOT a property of a covalent compound?
   a) soft texture
   b) can be a solid, liquid, or gas at room temperature
   c) ductile and malleable
   d) formed when two nonmetals bond to one another

29) If I wanted to keep a cup of coffee hot for a very long time, what type of material should I make the mug with?
   a) metal
   b) ionic compound
   c) covalent compound
   d) diatomic element

30) $Ca_3(PO_4)_2$ is named:
   a) calcium phosphate
   b) calcium (II) phosphate
   c) calcium (III) phosphate
   d) calcium phosphide

31) Which of the following is a polyatomic anion?
   a) oxide
   b) ammonium
   c) hydride
   d) hydroxide

32) Which of the following is the correct formula for iron (III) nitrate?
   a) $Fe_2(NO_3)_3$
   b) $Fe(NO_3)_3$
   c) $FeNO_3$
   d) $Fe(NO_2)_1$

33) How many grams of $Cu(OH)_2$ are there in 2.10 moles?
   a) 38.8 grams
   b) 46.4 grams
   c) 171 grams
   d) 205 grams

34) How many grams of CH_4 are present in 5.14×10^{23} molecules of CH_4?
a) 13.7 grams
b) 21.1 grams
c) 1.72×10^{46} grams
d) 5.57×10^{48} grams

35) When cyclopropane undergoes elemental analysis, it is found to contain 85.7% carbon and 14.3% hydrogen. What is the empirical formula of cyclopropane?
a) C_2H_3
b) CH_3
c) C_3H_6
d) CH_2

36) The molar mass of cyclohexane is 84.0 grams per mole. If the empirical formula of cyclohexane is CH_2, what is its molecular formula?
a) CH_2
b) C_5H_{10}
c) C_6H_{12}
d) $C_{12}H_{24}$

37) In which of the following are the intermolecular forces listed in correct order, from weakest to strongest?
a) dipole-dipole, London dispersion, hydrogen bond
b) London dispersion, hydrogen bond, dipole-dipole
c) London dispersion, dipole-dipole, hydrogen bond
d) hydrogen bond, dipole-dipole, London dispersion

38) carbon tetrahydride is a compound better known as:
a) ammonia
b) methane
c) carbon hydroxide
d) None of these are good names for carbon tetrahydride

39) Which of the following molecules is trigonal pyramidal?
a) BH_3
b) CH_4
c) NH_4^+
d) PCl_3

40) Which of the following molecules has the strongest bonds between its atoms?
a) silicon tetrachloride
b) boron trifluoride
c) oxygen difluoride
d) carbon disulfide

41) What bond angle is most commonly associated with the "bent" molecular geometry?
   a) 180^0
   b) 120^0
   c) 109.5^0
   d) 104.5^0

42) Which of the following equations is NOT balanced correctly?
   a) 2 LiCl + 1 K_2O → 1 Li_2O + 2 KCl
   b) 1 C_4H_8 + 8 O_2 → 4 CO_2 + 8 H_2O
   c) 1 Ti_2O_3 + 6 AgOH → 2 $Ti(OH)_3$ + 6 AgO_3
   d) 3 $CuCl_2$ + 1 V_2O_3 → 3 CuO + 2 VCl_3

43) The symbol "Δ" means:
   a) A reagent is dissolved in water
   b) The reaction mixture needs to be heated
   c) The reaction mixture needs to be burned in oxygen
   d) The reagents form insoluble products

44) Which of the following reactions is NOT correctly identified?

a)	Pb + 4 NO_3 → $Pb(NO_2)_4$ + 2 O_2	single displacement
b)	2 HBr + $Ca(OH)_2$ → 2 H_2O + $CaBr_2$	acid-base
c)	$MgSO_4$ → MgO + SO_3	decomposition
d)	Ca + 2 H_2O → $Ca(OH)_2$ + H_2	synthesis

45) What are the most likely products of the following reaction? (Equation and products are all shown unbalanced)

$NaOH + PbSO_4$ → ?

   a) NaPb + HSO_5
   b) $NaSO_4$ + PbOH
   c) Na_2SO_4 + $Pb(OH)_4$
   d) PbO_2 + $NaHSO_4$

46) The products of a combustion reaction are always:
   a) methane and water
   b) water and carbon dioxide
   c) ammonia and carbon dioxide
   d) heat and smoke

47) How many grams of NaBr will be formed in the following chemical reaction if I start with 65.5 grams of sodium hydroxide and an excess of calcium bromide?

$$\mathbf{2\ NaOH + CaBr_2 \rightarrow Ca(OH)_2 + 2\ NaBr}$$

a) 0.00593 grams
b) 25.5 grams
c) 168 grams
d) 6.94×10^5 grams

48) A limiting reagent is:
a) The reagent which determines how much product can be formed in a chemical reaction.
b) The reagent which runs out first when doing a chemical reaction.
c) The reagent which weighs the least in a reaction.
d) A and B

49) What is the limiting reagent for the following chemical reaction if 25 grams of hydrogen and 45 grams of oxygen react to form water?

$$\mathbf{2\ H_2 + O_2 \rightarrow 2\ H_2O}$$

a) hydrogen
b) oxygen
c) water
d) this reaction has no limiting reagent

50) How many liters of carbon monoxide will be formed in the following reaction if 35 liters of oxygen gas reacts with an excess of carbon?

$$\mathbf{2\ C_{(s)} + O_{2(g)} \rightarrow 2\ CO_{(g)}}$$

a) 17.5 liters
b) 35 liters
c) 70 liters
d) none of these

STOP:

You have finished part one of your semester exam. Please turn to the short answer section of the exam and begin. You may come back and recheck your answers on this section if you have time at the end of the test.

Short Answer Section

When answering the following questions, please show all work for full credit.

1) List the six steps of the scientific method. (1 point each)

-
-
-
-
-
-

2) Describe the main differences between an element, compound, heterogeneous mixture, and homogeneous mixture. (1 point each)

3) Convert the following numbers into scientific notation: (1 point each)

a) 6,700 _____

b) 0.00348 _____

4) Convert the following numbers into standard notation: (1 point each)

a) 4.5×10^5 _____

b) 9.10×10^0 _____

5) Convert 34 millimeters into decimeters. (5 points)

6) What are the main differences between the properties of the alkali metals and the alkaline earth metals? (3 points)

7) Define “atomic radius”. (3 points)

8) Fill in the following chart. Round the atomic masses to the nearest whole number. (0.5 point per blank)

Atomic symbol	Atomic mass	Atomic number	Number of protons	Number of neutrons	Number of electrons
Al					
Ca					
Pd					
Es					

9) Write the electron configuration of germanium. (1 point)

10) A sample of gallium has the following isotopic abundances:

Isotope	Isotopic mass (amu)	Isotopic abundance (%)
^{69}Ga	68.93	60.25
^{71}Ga	70.92	39.75

What is the average atomic mass of this sample of gallium? Note: It may not be the same as the mass given on the periodic table. (8 points)

11) Compare and contrast the type of bonding that takes place in covalent vs. ionic compounds. Your answer should explain the reasons why the bonding type is different. (6 points)

12) Name the following compounds. (1 point each)

a) $NaOH$ _____

b) CBr_4 _____

c) Cr_3N_2 _____

d) SF_2 _____

e) NH_3 _____

f) $CoSO_4$ _____

13) How many grams of copper (II) carbonate are present in 4.30×10^{24} molecules? (5 points)

14) Describe the differences between empirical, molecular, and structural formulas, giving examples of each. (6 points)

15) Explain why the dipole-dipole force is able to hold molecules together. (6 points)

16) Draw the Lewis structure for phosphorus trichloride: (3 points)

17) What are the shape and bond angles for phosphorus trichloride? (1 point each)

Shape: _____

Bond angle: _____

18) Balance the following equations and indicate the type of reaction that's taking place: (1.5 point each)

___ $Ca(OH)_2$ + ___ $Fe_2(CO_3)_3$ → ___ $Fe(OH)_3$ + ___ $CaCO_3$

Type of reaction: _____

___ NaBr + ___ H_2SO_4 → ___ Na_2SO_4 + ___ HBr

Type of reaction: _____

___ C_3H_6O + ___ O_2 → ___ CO_2 + ___ H_2O

Type of reaction: _____

___ Fe + __ $Cr(NO_3)_6$ → ___ Cr + ___ $Fe(NO_3)_2$

Type of reaction: _____

___ $NiSO_3$ + ___ MgF_2 → ___ $MgSO_3$ + ___ NiF_2

Type of reaction: _____

___ P_4 + ___ F_2 → ___ PF_3

Type of reaction: _____

___ H_3PO_4 + ___ $Be(OH)_2$ → ___ H_2O + ___ $Be_3(PO_4)_2$

Type of reaction: _____

___ AgCN → ___ Ag + ___ C + ___ N_2

Type of reaction: _____

Answer the following questions for the reaction:

$$1\ H_2SO_{4(l)} + 2\ NaCN_{(s)} \rightarrow 2\ HCN_{(g)} + 1\ Na_2SO_{4(s)}$$

19) How many grams of sodium cyanide would be required to make 55 grams of sodium sulfate? (4 points)

20) If 35 grams of sulfuric acid were to react with 45 grams of sodium cyanide, how many grams of sodium sulfate would be formed? (8 points)

21) If the reaction in problem 20 resulted in the formation of 25 grams of sodium sulfate, what would be the percent yield of this reaction? (3 points)

22) If 25 grams of sodium sulfate was formed in this reaction, how many liters of hydrogen cyanide would be formed at standard temperature and pressure? (4 points)

Semester Exam – Solutions

Multiple Choice Section

1. B
2. A
3. A
4. B
5. D
6. C
7. D
8. D
9. C
10. A
11. D
12. B
13. C
14. C
15. A
16. C
17. A
18. D
19. C
20. C
21. C
22. D
23. D
24. B
25. A
26. B
27. C
28. C
29. C
30. A
31. D
32. B
33. D
34. A
35. D
36. C
37. C
38. B
39. D
40. D
41. D
42. C
43. B
44. D
45. C
46. B
47. C
48. D
49. B
50. C

Short Answer Section - Solutions

When answering the following questions, please show all work for full credit.

1) List the six steps of the scientific method. (1 point each)
   - **Purpose**
   - **Hypothesis**
   - **Materials**
   - **Procedure**
   - **Results**
   - **Conclusion**

2) Describe the main differences between an element, compound, heterogeneous mixture, and homogeneous mixture. (1 point each)
   - **elements contain only one type of atom.**
   - **compounds contain only one type of molecule.**
   - **homogeneous mixtures have the same composition everywhere in the mixture.**
   - **heterogeneous mixtures have varying composition throughout the mixture.**

3) Convert the following numbers into scientific notation: (1 point each)

   a) 6,700 **6.7×10^{3}**

   b) 0.00348 **3.48×10^{-3}**

4) Convert the following numbers into standard notation: (1 point each)

   a) 4.5×10^{5} **450,000**

   b) 9.10×10^{0} **9.10**

5) Convert 34 millimeters into decimeters. (5 points)
   0.34 dm

6) What are the main differences between the properties of the alkali metals and the alkaline earth metals? (3 points)
   - **Alkali metals have a +1 charge and alkaline earth metals, +2.**
   - **Alkaline earth metals are less reactive than alkali metals.**
   - **Alkali metals are less dense than alkaline earth metals.**

7) Define “atomic radius”. (3 points)
One half the distance between the nuclei of two atoms of the same element that are bonded to one another.

8) Fill in the following chart. Round the atomic masses to the nearest whole number. (0.5 point per blank)

Atomic symbol	Atomic mass	Atomic number	Number of protons	Number of neutrons	Number of electrons
Al	**27**	**13**	**13**	**14**	**13**
Ca	**40**	**20**	**20**	**20**	**20**
Pd	**106**	**46**	**46**	**60**	**46**
Es	**252**	**99**	**99**	**153**	**99**

9) Write the electron configuration of germanium. (1 point)
[Ar] $4s^2 3d^{10} 4p^2$ OR $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$

10) A sample of gallium has the following isotopic abundances:

Isotope	Isotopic mass (amu)	Isotopic abundance (%)
^{69}Ga	68.93	60.75
^{71}Ga	70.92	39.25

What is the average atomic mass of this sample of gallium? Note: It may not be the same as the mass given on the periodic table. (8 points)
69.71 amu

11) Compare and contrast the type of bonding that takes place in covalent vs. ionic compounds. Your answer should explain the reasons why the bonding type is different. (6 points)

- **In ionic bonds, electrons are transferred from the less electronegative atom to the more electronegative atom. Ionic compounds are primarily formed when nonmetals bond with metals.**
- **In covalent bonds, electrons are shared between the bonded atoms. This occurs because both elements have nearly the same electronegativity. Covalent compounds are formed when two nonmetals bond to one another.**

12) Name the following compounds. (1 point each)

a) $NaOH$ **sodium hydroxide**

b) CBr_4 **carbon tetrabromide**

c) Cr_3N_2 **chromium (II) nitride**

d) SF_2 **sulfur difluoride**

e) NH_3 **ammonia**

f) $CoSO_4$ **cobalt (II) sulfate**

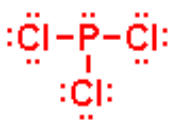
13) How many grams of copper (II) carbonate are present in 4.30×10^{24} molecules? (5 points)
882 grams

14) Describe the differences between empirical, molecular, and structural formulas, giving examples of each. (6 points)

- **Empirical formulas show only the ratios of each element to each other in a compound. For ethane, the empirical formula is CH_3.**
- **Molecular formulas tell us all of the atoms of each element present in a molecule. The molecular formula of ethane is C_2H_6.**
- **Structural formulas show the positions of each of the atoms in the molecule. Any Lewis structure is a good example of a structural formula.**

15) Explain why the dipole-dipole force is able to hold molecules together. (6 points)
The dipole-dipole force arises from the alignment of the positive end of a polar molecule with the negative end of another. Because opposite charges attract one another, the molecules are weakly held together.

16) Draw the Lewis structure for phosphorus trichloride: (3 points)



17) What are the shape and bond angles for phosphorus trichloride? (1 point each)

Shape: **trigonal bipyramidal**

Bond angle: **107.5^0**

18) Balance the following equations and indicate the type of reaction that's taking place: (1.5 point each)

3 $Ca(OH)_2$ + **1** $Fe_2(CO_3)_3$ → **2** $Fe(OH)_3$ + **3** $CaCO_3$

Type of reaction: **double displacement**

2 NaBr + **1** H_2SO_4 → **1** Na_2SO_4 + **2** HBr

Type of reaction: **double displacement**

1 C_3H_6O + **4** O_2 → **3** CO_2 + **3** H_2O

Type of reaction: **combustion**

3 Fe + **1** $Cr(NO_3)_6$ → **1** Cr + **3** $Fe(NO_3)_2$

Type of reaction: **single displacement**

1 $NiSO_3$ + **1** MgF_2 → **1** $MgSO_3$ + **1** NiF_2

Type of reaction: **double displacement**

1 P_4 + **6** F_2 → **1** PF_3

Type of reaction: **synthesis**

2 H_3PO_4 + **3** $Be(OH)_2$ → **6** H_2O + **1** $Be_3(PO_4)_2$

Type of reaction: **acid-base**

2 AgCN → **2** Ag + **2** C + **1** N_2

Type of reaction: **decomposition**

Answer the following questions for the reaction:

$$1\ H_2SO_{4(l)} + 2\ NaCN_{(s)} \rightarrow 2\ HCN_{(g)} + 1\ Na_2SO_{4(s)}$$

19) How many grams of sodium cyanide would be required to make 55 grams of sodium sulfate? (4 points)
38 grams

20) If 35 grams of sulfuric acid were to react with 45 grams of sodium cyanide, how many grams of sodium sulfate would be formed? (8 points)
51 grams (sulfuric acid is the limiting reagent)

21) If the reaction in problem 20 resulted in the formation of 25 grams of sodium sulfate, what would be the percent yield of this reaction? (3 points)
49%

22) If 25 grams of sodium sulfate was formed in this reaction, how many liters of hydrogen cyanide would be formed at standard temperature and pressure? (4 points)
7.9 L

Semester Exam Grading Scale

171 = A+
153 – 170 = A
145 – 152 = B+
137 – 144 = B
128 – 136 = C+
119 – 127 = C
111 – 118 = D+
102 – 110 = D
< 102 = F

About the Author

Mr. Guch is a man of many interests. Depending on what day you catch him, he might be wrestling alligators, chasing squirrels, or swimming with the fishes. He's been known to sky-dive, build forged antique furniture, and go over Niagara Falls in a barrel of his own design. He's a master chef, a licensed masseur, and able to fix fourteen brands of photocopy machine. Though shaken by the death of Jerry Garcia, Mr. Guch is now an avid supporter of the Insane Clown Posse, taking off for weeks at a time to follow their tour. Mr. Guch is currently hard at work on his fourth book, a series of articles and stories about Bootsy Collins tentatively titled Bootsy: A Profile in Greatness.

A History of the Type

The text of this book is set in *Humidor Britannica*, a typeface based on the 1753 *Humidor Botswana* font which was used in the first deck of risque playing cards. Since that groundbreaking work, Mr. *Botswana* has been seen jet-setting around the playgrounds of the rich and famous, both in the United States and abroad. Mr. *Botswana* is currently working on his long-anticipated second work, a game of internet solitaire involving risque playing cards.