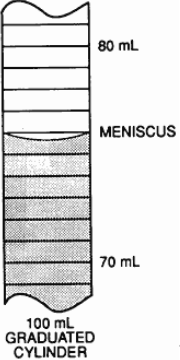# Unit 1: Getting Ready for Chemistry

If you can do all the things listed below, you are ready for the Unit 1 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can list five important lab safety rules.	5 important lab safety rules are: 1. 2. 3. 4. 5.
_____2. I can identify the most common laboratory tools such as: beaker, graduated cylinder, Erlenmeyer flask, scoop, beaker tongs, test tube, test tube rack, test tube holder, crucible tongs, Bunsen burner, striker, stirring rod, funnel, dropper pipette (aka eye dropper)	Draw and label as many of the common laboratory tools as you can!
_____3. I can determine the independent and dependent variable in a lab experiment.	A farmer wants to know what the effect the amount of fertilizer has on the amount of fruit an apple tree produces. What is the independent variable? What is the dependent variable?
_____4. I can determine the number of significant figures in a measurement.	How many significant figures are there in 30.50 cm? How many significant figures are there in 400.0 sec?
_____5. I can determine the answer to a math problem to the correct number of significant figures.	To the correct number of significant figures, what is the answer to 5.93 mL + 4.6 mL? To the correct number of significant figures, what is the answer to 5.93 cm * 4.6 cm?

_____6. I can read the meniscus on a graduated cylinder to the correct number of significant figures.	 80 mL MENISCUS 70 mL 100 mL GRADUATED CYLINDER The volume is_____ mL.
_____7. I can use dimensional analysis to solve math problems.	To the correct number of significant figures, determine how many meters there are in 15.4 ft. To the correct number of significant figures, determine how many minutes there are in 2.7 years.
_____8. I can convert numbers into scientific notation from standard notation.	Convert 87,394,000,000,000 to scientific notation. Convert 0.0000040934 to scientific notation.
_____9. I can convert numbers into standard notation from scientific notation.	Convert 5.8×10^9 to standard notation. Convert 4.3×10^{-5} to standard notation.
_____10. I can use my calculator to input numbers in scientific notation using the "2nd function & EE keys.	Enter the number 5.67×10^{52} on your calculator and show Mrs. S. She'll initial this box, if you've done it correctly!
_____11. I can convert between different metric units by using "King Henry died by drinking chocolate milk".	9.3 km = ? m 39,983 mL = ?kL
_____12. I can convert between different metric units by using Reference Table C and dimensional analysis.	1.5×10^{-3} km = ? μm 4.67×10^{13} pm = ?dm

_____13. I can determine which equation to use from Reference Table T by looking at the given information.	**Which equation** would you use to solve the following problem? (Don't solve it. Just tell me WHICH equation to use.) *Problem:* How many grams of LiBr (gram-formula mass = 87 g/mol) would 3.5 moles of LiBr be?
_____14. I can solve for "x" when it's in the denominator of a fraction.	What is the volume, in cm^3, of 54.6 g of beryllium (density = 1.85 g/cm^3)
_____15. I can convert ^oC to degrees kelvin and degrees kelvin to ^oC.	What kelvin temperature is equal to 200^oC? What Celsius temperature is equal to 200K?
_____16. Given the symbol I can write the name for any element in Group 1, Group 2, Group 13, Group 14, Group 15, Group 16, Group 17 or Group 18 without using a Periodic Table.	Al_____ Ca_____ Ne_____ N_____ Na_____ S_____ Br_____ Ge_____
_____17. Given the symbol or the name, I can determine the Group for any element in Group 1, Group 2, Group 13, Group 14, Group 15, Group 16, Group 17 or Group 18 without using a Periodic Table.	Al_____ Ca_____ Ne_____ N_____ Na_____ S_____ Br_____ Ge_____
_____18. I can define gram-formula mass (AKA molar mass).	**Definition:**

_____19.Given the chemical symbol/formula, I can determine how many atoms are present.	How many moles of atoms are in N_2? What is the total # of moles of atoms in $Pb(C_2H_3O_2)_2$? How many moles of C atoms are in $Pb(C_2H_3O_2)_2$?
_____20. I can determine the gram-formula mass for any element or compound.	What is the gfm for N_2? What is the gfm for $Pb(C_2H_3O_2)_2$?
_____21. I can define a mole as it pertains to chemistry.	**Definition:**
_____22. I can find the number of moles of substance if I am given the mass and formula for the substance.	94.3 g is how many moles of $NaCl$?
_____23. I can determine the percent composition of an element in a compound.	What is the percent by mass of Mg in $Mg(NO_3)_2$?
_____24. I can convert between moles and numbers of particles using Avogadro's number?	How many moles of carbon atoms are there in 4.8×10^{24} atoms of C?
_____25. I can convert between moles and L (assuming STP).	How many L does 4.60 moles of O_2 occupy assuming STP?

Unit 2: Introduction to Matter

If you can do all the things listed below, you are ready for the Unit 2 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can define the following: atom, element, compound, mixture	**Definitions:** atom element compound mixture

_____3. I can draw particle diagrams to represent an atom, an element, a molecule, a compound, a mixture	2 Atoms of 1 Element	2 Molecule of 1 Compound
	Mixture of 2 elements	Mixture of 2 compounds
	Mixture of an element and a compound	

	Put each of the following examples into the correct column. Examples: $C_{12}H_{22}O_{11}$, $NaCl$, Fe, salt water, air, CO_2, H_2, Ar, soda
_____4. I can classify substances as a pure substance (element or compound) or as a mixture.	<table><tr><td>*Element*</td><td>*Compound*</td><td>*Mixture*</td></tr><tr><td></td><td></td><td></td></tr></table>
_____5. I can define homogeneous mixture and heterogeneous mixture in terms of particle distribution.	**Definitions:** homogeneous mixture heterogeneous mixture
_____6. I can give an example of homogeneous and heterogeneous mixtures.	Two examples of homogeneous mixtures: a. b. Two examples of heterogeneous mixtures: a. b.
_____7. I can classify a property as physical or chemical.	Write "P" for physical or "C" for chemical on the line provided. _____copper (II) sulfate is blue. _____copper reacts with oxygen. _____copper can be made into wire. _____copper has a density of 8.96 g/cm^3. _____ copper melts at 1358K. _____copper reacts with nitric acid. _____copper doesn't dissolve in water.

_____8. I can classify a change as physical or chemical.	Write "P" for **physical** or "C" for **chemical** on the line provided. _____copper (II) sulfate dissolves in water. _____copper reacts with oxygen to form solid copper (I) oxide. _____solid copper is melted. _____a chunk of copper is pounded flat. _____copper and zinc are mixed to form brass. _____a large piece of copper is chopped in half. _____copper reacts with bromine to form copper (II) bromide.
_____9. In a particle diagram, I can distinguish between a physical change and a chemical change.	 **Substance A** Circle the particle diagram that best represents Substance A after a physical change has occurred.
_____10. I can define: solute, solvent, solution, and solubility.	**Definitions:** solute solvent solution solubility
_____11. I can describe the trend in solubility for solids as the temperature changes.	As the temperature increases, the solubility of a solid _____.

_____12. I can describe the trend in solubility for gases as the temperature changes.	As the temperature increases, the solubility of a gas _____.
_____13. I can use Reference Table F to determine if a substance will be soluble in water.	Write "S" for **soluble** and "NS" for **not soluble**. Use Reference Table F to determine the solubility of the following compounds: _____potassium chlorate _____silver bromide _____lithium carbonate _____calcium carbonate
_____14. I can use Table G to determine how much solute to add at a given temperature to make a saturated solution.	How many grams of $KClO_3$ must be dissolved in 100 grams of water at 20^OC to make a saturated solution?
_____15. I can use Table G to determine if a solution is saturated, unsaturated, or supersatured.	If 20.0 g of $NaNO_3$ are dissolved in 100.0 g of water at 25.0^OC, will the resulting solution be saturated, unsaturated, or supersaturated?
_____16. I can define: dilute, concentrated, concentration, and electrolyte.	**Definitions:** dilute concentrated concentration electrolyte
_____17. I can interpret Table G to determine which solution is the most concentrated or the most dilute.	Which solution is most concentrated? A) 125.0 g of KI dissolved in 100.0 g of water at 10^OC B) 70.0 g of NH_4Cl dissolved in 100.0 g of water at 70^OC C) 120.0 g of KNO_3 dissolved in 100.0 g of water at 70^OC D) 30.0 g of SO_2 dissolved in 100.0 g of water at 90^OC
_____18. I can use Reference Table T to calculate the concentration of a solution in ppm.	What is the concentration, in ppm, of a 2600 g of solution containing 0.015 g of CO_2?
_____19. I can use Reference Table T to calculate the concentration of a solution in molarity.	What is the molarity of 3.5 moles of $NaBr$ dissolved in 500 mL of water?

_____20. I can determine how matter will be separated using filtration.	When a mixture of sand, salt, sugar, and water is filtered, what passes through the filter?
_____21. I can describe how matter can be separated using distillation.	Which physical property makes it possible to separate the components of crude oil by means of distillation?
_____23. I can state which separation process (decanting, filtering, distilling, chromatography, or evaporating) is best for a given situation.	To separate a mixture of salt and water, the best method of separation would be_____. To separate a mixture of ethanol and water, the best method of separation would be _____. To separate a mixture of food coloring dyes, the best method of separation would be _____. To separate a mixture of oil and water, the best method of separation would be_____.
_____24. I can define allotrope.	**Defintion:** allotrope
_____25. I can state the differences between two allotropes of the same element.	Two allotropes of the same element have different molecular structures and therefore have different _____ and _____ properties.

Unit 3: Matter & Energy

If you can do all the things listed below, you are ready for the Unit 3 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can define kinetic energy, potential energy, temperature, heat, endothermic, and exothermic.	**Defintions:** kinetic energy potential energy temperature heat endothermic exothermic
____4. I can use particle diagrams to show the arrangement and spacing of atoms/molecules in different phases.	Draw a particle diagram to represent atoms of Li in each phase. {| **Solid**	**Liquid**	**Gas** |}

Draw a particle diagram to represent atoms of Li in each phase.

Solid	Liquid	Gas

		Solid	Liquid	Gas
_____5. I can compare solids, liquids, and gases in terms of their relative kinetic energy, type of molecular motion, ability to completely fill a container, ability to change shape.	**Relative Kinetic Energy**			
	Type of Molecular Motion	vibrations, only	vibration and rotation	vibration, rotation, and translation
	Ability to Completely Fill a Container			
	Ability to Change Shape			

_____6. I can state the change of phase occurring in fusion, solidification, condensation, vaporization, melting, boiling, sublimation, deposition, and freezing.

During fusion a substance changes from _____ to _____.

During solidification a substance changes from _____ to _____.

During condensation a substance changes from _____ to _____.

During vaporization a substance changes from _____ to _____.

During melting a substance changes from _____ to _____.

During boiling a substance changes from _____ to _____.

During sublimation a substance changes from _____ to _____.

During deposition a substance changes from _____ to _____.

During freezing a substance changes from _____ to _____.

_____7. I can indicate if a phase change is exothermic or endothermic.

For each phase change listed, indicate whether the change is exothermic or endothermic.
fusion/melting_____

solidification/freezing_____

condensation_____

vaporization/boiling_____

sublimation_____

deposition_____

|	
_____8. Given a heating/cooling curve, I can determine the temperature at which a substance freezes/melts or condenses/vaporizes.
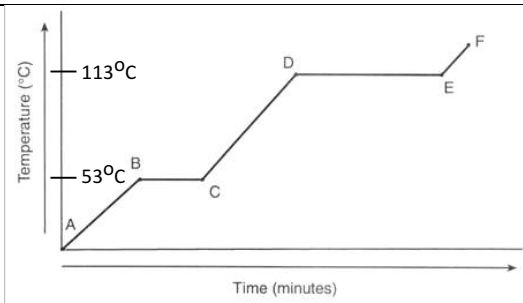
What is the freezing point of this substance?

What is the boiling point of this substance? |
| _____9. Given a heating/cooling curve, I can determine which sections of the curve show changes in potential energy. |
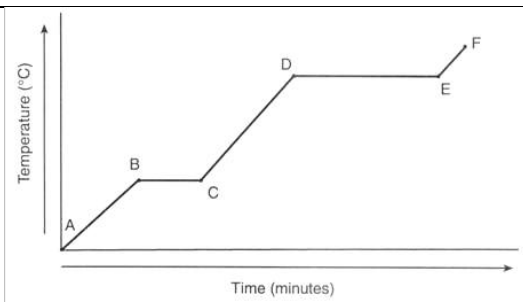
On the graph, circle the sections that show a change in potential energy. |
| _____10. Given a heating/cooling curve, I can determine which sections of the curve show changes in kinetic energy. |
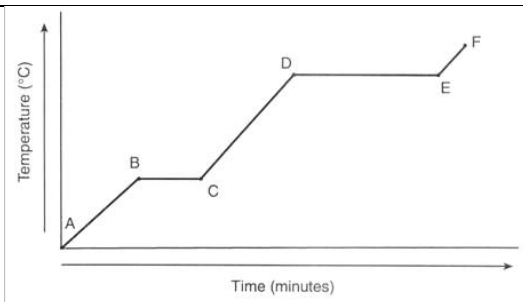
On the graph, circle the sections that show a change in kinetic energy. |
_____11. I can state the temperature at which water freezes in °C and K.	What is the freezing point of water in °C and K?
_____12. I can state the temperature at which water melts in °C and K.	What is the melting point of water in °C and K?
_____13. I can state the temperature at which water vaporizes/boils in °C and K.	What is the boiling point of water in °C and K?
_____14. I can state the temperature at which water condenses in °C and K.	What is the condensing point of water in °C and K?

_____15. I can use Reference Table T to determine which "heat" equation is needed for a given problem.	Which heat equation should be used in each of the following: a. How much heat is needed to vaporize 100.0 g of water at 100°C? b. How much heat is needed to raise the temperature of 100.0 g of water by 35°C? c. How much heat is needed to melt 100.0 g of ice at 0°C?
_____16. I can define specific heat capacity, heat of fusion, heat of vaporization.	**Definitions:** specific heat capacity heat of fusion heat of vaporization
_____17. I can use the "heat" equations to solve for any variable, if I am given the other variables.	How many grams of water can be heated by 15.0 ^{O}C using 13,500 J of heat? It takes 5210 J of heat to melt 50.0 g of ethanol at its melting point. What is the heat of fusion of ethanol?
_____18. I can state the 5 parts of the Kinetic Molecular Theory.	The five parts of the Kinetic Molecular Theory are: a. b. c. d. e.

_____19. I can define an ideal gas.	**Definition:** ideal gas
_____20. I can state the conditions of pressure and temperature under which a gas will act "ideally".	A gas will act most "ideally" under the conditions of _____ pressure and _____ temperature.
_____21. I can state the two elements that act ideally most of the time.	The two elements that act ideally most of the time are _____ & _____.
_____22. I can explain how pressure is created by a gas.	What causes gas molecules to create pressure?
_____23. I can state the relationship between pressure and volume for gases (assuming constant temperature).	At constant temperature, as the pressure on a gas increases, the volume _____.
_____24. I can state the relationship between temperature and volume for gases (assuming constant pressure).	At constant pressure, as the temperature on a gas increases, the volume _____.
_____25. I can state the relationship between temperature and pressure for gases (assuming constant volume).	In a fixed container (AKA "has constant volume), as the temperature on a gas increases, the pressure_____.
_____26. I can state Avogadro's Hypothesis.	Avogadro's Hypothesis says_____
_____27. I can remember to convert ^{O}C to K when using the Combined Gas Law to determine changes in V, P, or T of a gas.	A gas originally occupies 2.3L at 56°C and 101.3 kPa. What will its volume be at 100°C and 105.7 kPa?

	Definition:
_____28. I can define boiling point and vapor pressure.	boiling point vapor pressure
_____29. I can state the condition of pressure that is used for "normal" boiling points.	The normal boiling point of a substance occurs at a pressure of _____atm/_____kPa.
_____30. I can state the relationship between atmospheric pressure and boiling point.	As the atmospheric pressure increases, the boiling point _____.

Unit 4: Atomic Theory

If you can do all the things listed below, you are ready for the Unit 4 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can describe John Dalton's contribution to our understanding of the atom.	Dalton's Model: What it looked like:
_____5. I can describe JJ Thomson's contribution to our understanding of the atom.	Thomson's Experiment: Thomson's Model: What it looked like:
_____6. I can describe Ernest Rutherford's contribution to our understanding of the atom.	Rutherford's Experiment: Rutherford's Model: What it looked like:
_____7. I can describe Niels Bohr's contribution to our understanding of the atom.	Bohr's Model: What it looked like:

_____8. I can describe James Chadwick's contribution to our understanding of the atom.	What subatomic particle did Chadwick discover?
_____9. I can describe how Schrodinger, Heisenberg, Pauli, Dirac, and others contributed to our understanding of the atom.	What does the modern model of the atom look like? Where, in an atom, are electrons likely to be found according to the modern model?
_____10. I can state the chronological order of atomic models.	From oldest to newest, list the models that we have used to describe an atom.

	Particle #1	Particle #2	Particle #3
Name			
Charge			
Mass			
Location in Atom			

_____11. I can state the three subatomic particles, their location in an atom, their charges, and their masses (in amu).

_____12. I can explain why atoms are electrically neutral.	Atoms are electrically neutral because the number of _____ is equal to the number of _____.
_____13. I can define mass number and atomic number.	**Definitions:** mass number atomic number
_____14. Given the mass number, I can determine the number of protons, neutron, and electrons in an atom.	In an atom of ^{212}Po, how many protons are present? 84 In an atom of ^{212}Po, how many electrons are present? 84 In an atom of ^{212}Po, how many neutrons are present? 84

_____15. I can use the Periodic Table to determine the atomic number of an element.	How many protons are in an atom of selenium? How many protons are in an atom of silicon?
_____16. I can define isotope.	**Definition:** isotope
_____17. I can represent an atom in any of the four methods of isotopic notation.	Write the four different methods of isotopic notation for an atom of bromine that has 45 neutrons. Method 1 Method 2 Method 3 Method 4
_____18. I can calculate average atomic mass given the masses of the naturally occurring isotopes and the percent abundances.	Element Q has two isotopes. If 77% of the element has an isotopic mass of 83.7 amu and 23% of the element has an isotopic mass of 89.3 amu, what is the average atomic mass of the element?
_____19. I can define ion, cation, and anion.	**Definitions:** ion cation anion
_____20. Given the mass number and the charge, I can determine the number of protons, neutrons, and electrons in an ion.	How many protons are in $^{19}_{9}F^{1-}$? How many neutrons are in $^{19}_{9}F^{1-}$? How many electrons are in $^{19}_{9}F^{1-}$?

	Definitions: principal energy level (PEL) orbital ground state excited state electron configuration bright line spectrum
_____21. I can define principal energy level, orbital, ground state, excited state, electron configuration, and bright line spectrum.	
_____22. I can state the maximum number of electrons that will fit into each of the first four principal energy levels.	PEL1 holds a maximum of _____ electrons. PEL2 holds a maximum of _____ electrons. PEL3 holds a maximum of _____ electrons. PEL4 holds a maximum of _____ electrons.
_____23. I can state the relationship between distance from the nucleus and energy of an electron.	As the distance between the nucleus and the electron increases, the energy of the electron _____.
_____24. I can state the relationship between the number of the principal energy level and the distance to the atom's nucleus.	As the number of the PEL increases, the distance to the nucleus _____.
_____25. I can explain, in terms of subatomic particles and energy states, how a bright line spectrum is created.	A brightline spectrum is created when

_____26. I can identify the elements shown in a bright line spectrum.	**Bright-Line Spectra** Element D Element E Element G Mixture 750 nm 360 nm Which element(s) is/are present in the mixture?
_____27. I can define valence electrons.	<u>**Definition:**</u> valence electron
_____28. I can locate and interpret an element's electron configuration on the Periodic Table.	How many valence electrons does an atom of rubidium have in the ground state? How many principal energy levels contain electrons in an atom of iodine in the ground state?
_____29. I can identify an electron configuration that shows an atom in the excited state.	Which electron configuration represents an atom of potassium in the excited state? A) 2-8-7-1 B) 2-8-8-1 C) 2-8-7-2 D) 2-8-8-2
_____30. I can draw Lewis electron dot diagrams for a given element.	Draw the Lewis electron dot diagram for the following atoms: Li Be B C N O F Ne
_____31. I can define and state the importance of "octet of valence electrons."	<u>**Definition:**</u> octet of valence electrons The importance of having a complete "octet of valence electrons" is

Unit 5: Nuclear Chemistry

If you can do all the things listed below, you are ready for the Unit 5 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	

_____5. I can compare types of radiation in terms of symbol, mass number, charge, penetrating power, shielding required, and biological hazard.	**Type**	**Symbol**	**Mass #**	**Charge**	**Penetrating Power**	**Shielding Required**	**Bio Hazard**
	alpha						
	beta						
	gamma						
	neutron						
	positron						

_____6. I can identify the three types of nuclear reactions.	The three types of nuclear reactions are: a. b. c.
_____7. I can define transmutation, fission, and fusion.	<u>Definitions:</u> transmutation fission fusion

_____8. I can state two synonyms for spontaneous decay.	Two synonyms for spontaneous decay are:_____ and _____.
_____9. I can show how mass number and electrical charge must be conserved in any nuclear reaction.	Complete the following nuclear equation: $^{42}_{19}\text{K} \rightarrow\ ^{42}_{20}\text{Ca} +$ _____
_____10. I can explain what makes a nucleus stable or unstable.	The stability of the nucleus is dependent on the _____ to _____ ratio.
_____11. I can explain the difference between natural transmutation and artificial transmutation.	The difference between natural transmutation and artificial transmutation is that in natural transmutation an_____ _____breaks apart on its own and in artificial transmutation a _____ _____ is made _____ by hitting it with a high energy particle (such as a proton, neutron, or gamma radiation).
_____12. I can identify a natural decay reaction from a list of reactions.	Which equation represents a natural decay? A) $^{9}_{4}\text{Be} +\ ^{1}_{1}\text{H} \rightarrow\ ^{6}_{3}\text{Li} +\ ^{4}_{2}\text{He}$ B) $^{27}_{13}\text{Al} +\ ^{4}_{2}\text{He} \rightarrow\ ^{30}_{15}\text{P} +\ ^{1}_{0}\text{n}$ C) $^{14}_{7}\text{N} +\ ^{4}_{2}\text{He} \rightarrow\ ^{17}_{8}\text{O} +\ ^{1}_{1}\text{H}$ D) $^{235}_{92}\text{U} \rightarrow\ ^{231}_{90}\text{Th} +\ ^{4}_{2}\text{He}$
_____13. I can identify an artificial transmutation reaction from a list of reactions.	Which equation represents artificial transmutation? A) $^{16}_{7}\text{N} \rightarrow\ ^{16}_{8}\text{O} +\ ^{0}_{-1}\text{e}$ B) $^{14}_{7}\text{N} +\ ^{4}_{2}\text{He} \rightarrow\ ^{17}_{8}\text{O} +\ ^{1}_{1}\text{H}$ C) $^{37}_{19}\text{K} \rightarrow\ ^{37}_{18}\text{Ar} +\ ^{0}_{+1}\text{e}$ D) $^{42}_{19}\text{K} \rightarrow\ ^{42}_{20}\text{Ca} +\ ^{0}_{+1}\text{e}$
_____14. I can identify a fission reaction from a list of reactions.	Which equation represents fission? A) $^{1}_{0}\text{n} +\ ^{235}_{92}\text{U} \rightarrow\ ^{142}_{56}\text{Ba} +\ ^{91}_{36}\text{Kr} + 3^{1}_{0}\text{n}$ B) $^{226}_{88}\text{Ra} \rightarrow\ ^{222}_{86}\text{Rn} +\ ^{4}_{2}\text{He}$ C) $^{6}_{3}\text{Li} +\ ^{1}_{0}\text{n} \rightarrow\ ^{3}_{1}\text{H} +\ ^{4}_{2}\text{He}$ D) $^{2}_{1}\text{H} +\ ^{3}_{1}\text{H} \rightarrow\ ^{4}_{2}\text{He} +\ ^{1}_{0}\text{n}$
_____15. I can identify a fusion reaction from a list of reactions.	Which equation represents fusion? A) $^{1}_{0}\text{n} +\ ^{235}_{92}\text{U} \rightarrow\ ^{142}_{56}\text{Ba} +\ ^{91}_{36}\text{Kr} + 3^{1}_{0}\text{n}$ B) $^{226}_{88}\text{Ra} \rightarrow\ ^{222}_{86}\text{Rn} +\ ^{4}_{2}\text{He}$ C) $^{6}_{3}\text{Li} +\ ^{1}_{0}\text{n} \rightarrow\ ^{3}_{1}\text{H} +\ ^{4}_{2}\text{He}$ D) $^{2}_{1}\text{H} +\ ^{3}_{1}\text{H} \rightarrow\ ^{4}_{2}\text{He} +\ ^{1}_{0}\text{n}$

_____16. I can state the conditions of temperature and pressure that are needed for a fusion reaction to happen.	The temperature and pressure conditions needed for fusion to happen are: _____ temperature and _____ pressure
_____17. I can explain why all nuclear reactions release LOTS more energy than chemical reactions do.	Nuclear reactions release LOTS more energy than chemical reactions do because
_____18. Given a list of reactions, I can differentiate a "nuclear" reaction from a "chemical" reaction.	Which of the following equations represent NUCLEAR reactions? A) $H_2O(g) \rightarrow H_2O(\ell)$ B) $C(s) + O_2(g) \rightarrow CO_2(g)$ C) $^2_1H + ^3_1H \rightarrow ^4_2He + ^1_0n$ D) $^{235}_{92}U + ^1_0n \rightarrow ^{142}_{56}Ba + ^{91}_{36}Kr + 3\,^1_0n$
_____19. I can define half-life.	**Definition:** half-life
_____20. Given the length of the half-life and the amount of time that has passed, I can determine the amount of radioactive sample.	Based on Reference Table N, what fraction of a radioactive sample of Au-198 will remain unchanged after 10.78 days? What was the original mass of a radioactive sample of K-37 if the sample decayed to 25.0 g after 4.92 seconds? The half-life of K-37 is 1.23 seconds)
_____21. Given the length of the half-life and the amount of radioactive sample, I can determine the amount of time that has passed.	A 100.0 g sample of Co-60 decays until only 12.5 g of it remains. Given that the half-life of Co-60 is 5.271 years, how long did the decay take?
_____22. Given the amount of time that has passed and the amount of radioactive sample, I can determine the length of the half-life.	What is the half-life of a radioisotope if 25.0 g of an original 200.0 g sample remains unchanged after 11.46 days?
_____23. Using Table N, I can determine the length of half-life and/or decay mode for a specific radioactive isotope.	Compared to K-37, the isotope K-42 has A) shorter half-life and the same decay mode B) shorter half-life and a different decay mode C) longer half-life and the same decay mode D) longer half-life and a different decay mode

_____24. I can state 5 beneficial uses for radioactive isotopes.	Five beneficial uses for radioactive isotopes are: a. b. c. d. e.
_____25. I can state the scientific use of 4 specific radioactive isotopes.	C-14 is used for _____ I-131 is used for_____ U-238 is used for _____ Co-60 is used for_____
_____26. I can state three risks associated with radioactivity and radioactive isotopes.	Three risks associated with radioactivity and radioactive isotopes are: a. b. c.

Unit 6: Periodic Table

If you can do all the things listed below, you are ready for the Unit 6 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can classify elements as metals, nonmetals, or metalloids based on their placement on the Periodic Table.	Classify each of the following elements as metals (M), nonmetals (NM), or metalloids (MTLD). _____B _____K _____Li _____C _____Ar _____Sb _____H _____Fe _____Au _____S _____F _____Si _____Fr _____He _____Rn _____Ge _____Al _____As _____Bi _____I
_____7. I can state the group names for elements in groups 1, 2, 17, and 18.	Group 1 is called the _____. Group 2 is called the _____. Group 17 is called the _____. Group 18 is called the _____.
_____8. I can explain why elements in the same group have similar chemical properties.	Elements in the same group have similar chemical properties because
_____9. I can explain why the elements in Group 18 don't usually react with other elements.	Elements in Group 18 don't usually react with other elements because
_____10. I can state the meaning of "STP" and the Reference Table on which it can be found.	STP stands for _____. The values can be found on Reference Table_____.
_____11. I can state the names/symbols for the two elements on the Periodic Table that are liquids at STP.	The two elements that are liquids at STP are: _____ and _____

	The 11 elements that are gases at STP are:
_____12. I can state the names/symbols of the 11 elements that are gases at STP.	_____, _____, _____, _____, _____, _____, _____, _____, _____, _____, and _____
_____13. I can state how the elements on the Periodic Table are arranged.	The elements on the Periodic Table are arranged by increasing _____ _____.
_____14. I can list the 7 diatomic elements.	The seven diatomic elements are:
_____15. I can define electronegativity, first ionization energy, atomic radius, ionic radius, metallic character, and activity/reactivity.	**Definitions:** electronegativity first ionization energy atomic radius ionic radius metallic character activity/reactivity

_____16. I can state the periodic trend for electronegativity and explain why it occurs.	As one reads down a group from top to bottom, electronegativity _____ because _____ _____. As one reads across a period from left to right, electronegativity _____ because _____ _____.
_____17. I can state the periodic trend for first ionization energy and explain why it occurs.	As one reads down a group from top to bottom, first ionization energy _____ because _____ _____. As one reads across a period from left to right, , first ionization energy _____ because _____ _____.
_____18. I can state the periodic trend for atomic radius and explain why it occurs.	As one reads down a group from top to bottom, atomic radius _____ because _____ _____. As one reads across a period from left to right, atomic radius _____ because _____ _____.
_____19. I can state the periodic trend for metallic character and explain why it occurs.	As one reads down a group from top to bottom, metallic character _____ because _____ _____. As one reads across a period from left to right, metallic character _____ because _____ _____.
_____20. I can state the trend for melting points and boiling point for METALS as one reads down a group.	As one reads down a group from top to bottom, the melting points and boiling points for METALS _____.
_____21. I can state the trend for melting points and boiling point for NONMETALS as one reads down a group.	As one reads down a group from top to bottom, the melting points and boiling points for NONMETALS _____.

_____22. I can state the trend for activity/reactivity for METALS as one reads down a group.	As one reads down a group from top to bottom, the activity/reactivity of METALS _____.
_____23. I can state the trend for activity/reactivity for NONMETALS as one reads down a group.	As one reads down a group from top to bottom, the activity/reactivity of NONMETALS _____.
_____24. I can explain how loss or gaining of electrons affects the radius of an element.	Metals tend to lose electrons (get oxidized). This loss of electrons causes cations to be _____ than the original atom. Nonmetals tend to gain electrons (get reduced). This gain of electrons causes anions to be _____ than the original atom.
_____25. I can list 10 properties of metals.	Ten properties of metals are: a. b. c. d. e. f. g. h. i. j.
_____26. I can list 8 properties of nonmetals.	Eight properties of non metals are: a. b. c. d. e. f. g. h.

Unit 7: Acids & Bases

If you can do all the things listed below, you are ready for the Unit 7 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can still do everything from Unit 6.	

		Arrhenius	"Alternate Method" (AKA Bronsted-Lowry)
_____7. I can use two different systems to define acids and bases.	acid		
	base		

_____8. I can define pH, [ ], hydronium ion, hydroxide ion, and electrolyte.	**Definitions:** pH [ ] hydronium ion hydroxide ion electrolyte

_____9. I can state another name for the hydronium ion.	The hydronium ion is also known as the _____ _____.
_____10. Given the hydronium ion concentration, I can determine the pH.	If the $[H_3O^+]$ is 1 x 10^{-8}, the pH of the solution will be_____. If the $[H_3O^+]$ is 1 x 10^{-1}, the pH of the solution will be_____. If the $[H_3O^+]$ is 1 x 10^{-14}, the pH of the solution will be_____. If the $[H_3O^+]$ is 1 x 10^{-7}, the pH of the solution will be_____.
_____11. Based on pH, I can determine if a solution is acidic, basic, or neutral.	If the pH of a solution is 4.5, the solution is _____. If the pH of a solution is 7.0, the solution is _____. If the pH of a solution is 11, the solution is _____. If the pH of a solution is 5.7, the solution is _____.
_____13. I can state the relationship between H^+ concentration and pH.	As the H^+ concentration decreases , the pH _____. As the H^+ concentration increases, the pH _____.
_____14. I can determine the change in pH when the H^+ concentration of a solution is changed.	If the H^+ concentration is increased by a factor of 10, the pH will decrease by _____. --- If the H^+ concentration is increased by a factor of 100, the pH will decrease by _____. --- If the H^+ concentration is decreased by a factor of 1000, the pH will increase by _____. ---
_____15. I can give examples of the chemical names of common acids and bases.	List the chemical names of three common acids and three common bases. <table><tr><th>Acids</th><th>Bases</th></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table>

	List the chemical formulas of three common acids and three common bases.

_____16. I can give examples of chemical formulas of common acids and bases.	Acids	Bases

_____17. I can define neutralization.	**Definition:** neutralization

_____18. I can identify a neutralization reaction from a list of reactions.	Which of the following equations is a neutralization reaction? A) $6Na + B_2O_3$ -----> $3Na_2O + 2B$ B) $Mg(OH)_2 + 2HBr$ -----> $MgBr_2 + 2HOH$ C) $2H_2 + O_2$ -----> $2H_2O$ D) $2KClO_3$ -----> $2KCl + 3O_2$

_____19. I can state the name of the laboratory equipment that is used to carry out a titration.	Which piece of laboratory equipment is used to carry out a titration?

_____20. I can state the purpose of titration.	Why do scientists do titrations?

_____21. I can solve for any variable in the titration equation from Reference Table T.	If it requires 56.95 mL of 0.0043 M HNO_3 to neutralize 34.56 mL of LiOH, what is the concentration of the LiOH?

_____22. I can state the three types of substances that are electrolytes.	_____, _____, and _____ are three classes of compounds that are electrolytes.

_____23. Given the pH, I can determine the color of acid-base indicators.	Which indicator is red in a solution that has a pH of 3.6? A) bromcresol green B) bromthymol blue C)litmus D) thymol blue

Unit 8: Redox & Electrochemistry

If you can do all the things listed below, you are ready for the Unit 8 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can still do everything from Unit 6.	
_____7. I can still do everything from Unit 7.	
_____8. I can define oxidation, reduction, oxidation number, and redox reaction	**Definitions:** oxidation reduction oxidation number redox reaction
_____9. I can assign oxidation numbers to any element.	Assign oxidation number to each of the elements below. O_2_____ Li_____ Si_____
_____10. I can assign oxidation numbers to the elements in a compound.	Assign oxidation numbers to each element in the compounds below. $MnCl_3$: Mn_____ Cl_____ H_2SO_4: H_____ S_____ O_____
_____11. I can assign oxidation numbers to the elements in a polyatomic ion.	Assign oxidation numbers to each element in the polyatomic ions below. $PO_4{}^{3-}$: P_____O_____ $ClO_3{}^-$: Cl_____O_____

	Which half-reaction equation represents the reduction of a potassium ion? A) $K^+ + e^- \text{-----}> K$ B) $K + e^- \text{-----}> K^+$ C) $K^+ \text{-----}> K + e^-$ D) $K \text{-----}> K^+ + e^-$
_____12. I can distinguish between an oxidation half-reaction and a reduction half-reaction.	Given the reaction: $$Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$$ Which half-reaction correctly shows the oxidation that occurs? A) $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$ B) $Fe(s) + 2e^- \rightarrow Fe^{2+}(aq)$ C) $Cu^{2+}(aq) \rightarrow Cu(s) + 2e^-$ D) $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
_____13. I can state the Law of Conservation of Charge.	The law of Conservation of Charge states
_____14. I can break a redox reaction into its two half-reactions.	The two half-reactions that come from the following equation are: $Li(s) + Ag+(aq) \text{-----}> Li+(aq) + Ag(s)$ oxidation half-reaction reduction half-reaction

	Given the reaction:
	_____$Cl_2(g)$ + _____$Fe^{2+}(aq)$ -----> _____$Fe(s)$ + _____$Cl^-(aq)$
	When the equation is correctly balanced using smallest whole numbers, the coefficient of Cl^- will be
	A) 1 B) 2 C) 6 D) 7
	....
	Which simple oxidation-reduction reaction is *not* correctly balanced?
_____15. I can balance a redox reaction.	A) $Sn(s) + Cu^{2+}(aq) \rightarrow Cu(s) + Sn^{2+}(aq)$ B) $Ni(s) + Sn^{2+}(aq) \rightarrow Sn(s) + Ni^{2+}(aq)$ C) $2 I^-(aq) + Fe^{3+}(aq) \rightarrow Fe^{2+}(aq) + I_2(s)$ D) $2 I^-(aq) + Hg^{2+}(aq) \rightarrow Hg(\ell) + I_2(s)$
	....
	Given the balanced equation:
	$3 Fe^{3+}(aq) + Al(s) \rightarrow 3 Fe^{2+}(aq) + Al^{3+}(aq)$
	What is the total number of moles of electrons lost by 2 moles of Al(s)?
	A) 1 mole B) 6 moles C) 3 moles D) 9 moles
_____16. I can identify a redox reaction from a list of chemical reactions.	Which balanced equation represents a redox reaction? A) $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$ B) $H_2CO_3(aq) \rightarrow H_2O(\ell) + CO_2(g)$ C) $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(\ell)$ D) $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$ .... Which balanced equation represents a redox reaction? A) $PCl_5 \rightarrow PCl_3 + Cl_2$ B) $KOH + HCl \rightarrow KCl + H_2O$ C) $LiBr \rightarrow Li^+ + Br^-$ D) $Ca^{2+} + SO_4{}^{2-} \rightarrow CaSO_4$
_____17. From a list of given list of elements, I can determine which element is most active.	Which of the following elements is most likely to react? A) Cu B) Al C) Li D) Mg

_____18. I can state the two types of electrochemical cells.	The two types of electrochemical cells are: _____ and _____

		Voltaic	Electrolytic
_____19. I can compare the two types of electrochemical cells in terms of: components, location of oxidation, location of reduction, direction of electron flow, conversion between electrical and chemical energy, and spontaneity of reaction.	Components		
	Oxidation occurs at the		
	Reduction occurs at the		
	Electrons flow from		
	Energy conversion that occurs in this cell		
	Is this reaction spontaneous or does it require an outside power source to happen?		

_____20. I can state the purpose of the salt bridge in a voltaic cell.	The purpose of the salt bridge is

_____21. Given an electrochemical cell, I can predict the direction of electron flow.	The diagram below represents an electrochemical cell. What occurs when the switch is closed? A) Zn is reduced. B) Cu is oxidized. C) Electrons flow from Cu to Zn. D) Electrons flow from Zn to Cu.

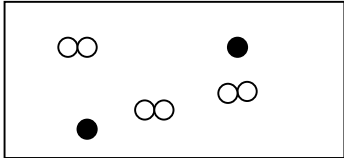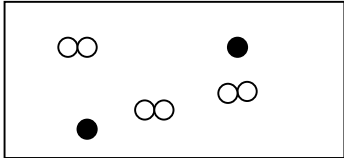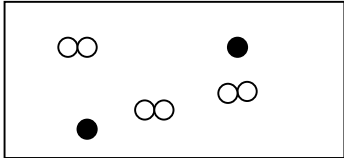|	
_____22. I can explain, in terms of atoms and ions, the changes in mass that take place at the anode and cathode of an electrochemical cell.	Explain, in terms of atoms and ions, why the mass of the cathode increases during the operation of an electrochemical cell. Explain, in terms of atoms and ions, why the mass of the anode decreases during the operation of an electrochemical cell.

Unit 10: Chemical Reactions

If you can do all the things listed below, you are ready for the Unit 10 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can still do everything from Unit 6.	
_____7. I can still do everything from Unit 7.	
_____8. I can still do everything from Unit 8.	
_____9. Given the IUPAC name, I can write the chemical formula for binary compounds.	Write the chemical formula for the following compounds: sodium bromide_____ lithium selenide_____ iron (III) fluoride_____ vanadium (V) oxide_____
_____10. Given the chemical formula, I can write the IUPAC name for binary compounds.	Write the IUPAC name for the following compounds: CrO_____ MgI_2_____
_____11. Given the IUPAC name, I can write the chemical formula for ternary compounds.	Write the chemical formula for the following compounds: calcium oxalate_____ nickel (II) thiosulfate_____
_____12. Given the chemical formula, I can write the IUPAC name for ternary compounds.	Write the IUPAC name for the following compounds: $Sn(C_2H_3O_2)_2$_____ $(NH_4)_3PO_4$_____
_____13. I can state the three types of chemical formulas.	The three types of chemical formulas are: _____, _____, & _____

_____14. I can define empirical formula, molecular formula, and hydrate.	**Definitions:** empirical formula molecular formula hydrate
_____15. Given the empirical formula and the molar mass, I can determine the molecular formula of a compound.	What is the molecular formula of a compound that has the empirical formula of CH and a molar mass of 78 g/mol.
_____16. I can use particle diagrams to show conservation of mass in a chemical equation.	Using the symbols shown below, complete the equation below to illustrate conservation of mass. ● = Al ○○ = Br $2Al$ + $3Br_2$ -----> $2AlBr_3$
_____17. I can balance a chemical equation showing conservation of mass using the lowest whole number coefficients.	Balance the following chemical equation using the lowest whole number coefficients. _____$Al_2(SO_4)_3$ + _____$Ca(OH)_2$ -----> _____$Al(OH)_3$ + _____$CaSO_4$
_____18. Given a partially balanced equation, I can predict the missing reactant or product.	Use the law of conservation of mass to predict the missing product. $2NH_4Cl$ + CaO -----> $2NH_3$ + _____ + $CaCl_2$
_____19. Given a list of chemical reactions, I can classify them as being a synthesis reaction, decomposition reaction, single replacement reaction, or double replacement reaction.	Classify the following reactions as synthesis, decomposition, single replacement, or double replacement. A) $Mg + 2AgNO_3 \rightarrow Mg(NO_3)_2 + 2Ag$ _____ B) $2Mg + O_2 \rightarrow 2MgO$ _____ C) $MgCO_3 \rightarrow MgO + CO_2$ _____ D) $MgCl_2 + 2AgNO_3 \rightarrow 2AgCl + Mg(NO_3)_2$ _____

	Given the following balanced equation, state the mole ratios between the requested substances.
	$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$
_____20. Given a balanced equation, I can state the mole ratios between any of the reactants and/or products.	The mole ratio between C_3H_8 and O_2 is _____C_3H_8:_____O_2.
	The mole ratio between C_3H_8 and CO_2 is _____C_3H_8:_____CO_2.
	The mole ratio between C_3H_8 and H_2O is _____C_3H_8:_____H_2O.
	The mole ratio between CO_2 and O_2 is _____CO_2:_____O_2.
	The mole ratio between H_2O and CO_2 is _____H_2O:_____CO_2.
_____21. I can define stoichiometry.	**Definition:** stoichiometry
_____22. Given the number of moles of one of the reactants or products, I can determine the number of moles of another reactant or product that is needed to completely use up the given reactant/product.	Using the equation from question #20, determine how many moles of O_2 are needed to completely react with 7.0 moles of C_3H_8. Using the equation from question #20, determine how many moles of CO_2 are produced when 7.0 moles of C_3H_8 completely react.
_____23. Given the mass or volume of one of the reactants or products, I can determine the mass or volume of another reactant or product that is needed to completely use up the given reactant/product.	Using the equation from question #20, determine how many liters of O_2 at STP are needed to react completely with 88.0 g of C_3H_8. Using the equation from question #20, determine how many grams of H_2O are produced when 88.0 g of C_3H_8 completely react.

Unit 11: Bonding & IMF

If you can do all the things listed below, you are ready for the Unit 11 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can still do everything from Unit 6.	
_____7. I can still do everything from Unit 7.	
_____8. I can still do everything from Unit 8.	
_____9. I can still do everything from Unit 10.	
_____10. I can state the three types of chemical bonds.	The three types of chemical bonds are: _____, _____, and _____.
_____11. I can state the number of valence electrons that an atom attains to be most stable.	Atoms are most stable when they have _____ valence electrons.
_____12. I can state the two types of compounds.	The two types of compounds are _____ and _____.
_____13. I can define ionic bond, covalent bond, and metallic bond in terms of the types of elements (metals, nonmetals) from which they are formed.	**Definition:** ionic bond covalent bond metallic bond

_____14. I can define ionic and covalent bonds based on what happens to the valence electrons.	**Definition:** In an <u>ionic bond</u>, the valence electrons of the _____are _____ to the _____ so that each atom attains a stable octet (like noble gases). In a <u>covalent bond</u>, the valence electrons of the two _____ are _____ so that each atom attains a stable octet (like noble gases).
_____15. I can explain TICS as it relates to chemical bonding.	TICS stands for _____. It helps me remember what happens to the electrons in each type of bond.
_____16. In terms of valence electrons, I can find similarities and differences between the bonding in several substances.	Explain, in terms of valence electrons, why the bonding in methane (CH_4) is similar to the bonding in water (H_2O). .... Explain, in terms of valence electrons, why the bonding in HCl is different than that bonding in $NaCl$.
_____17. I can draw a Lewis dot diagram to represent an ionic compound.	Draw Lewis dot diagrams for the following ionic compounds. LiBr $CaCl_2$
_____18. I can draw a Lewis dot diagram to represent a molecular (covalently bonded) compound.	Draw Lewis dot diagrams for the following molecular substances. H_2O CO_2 I_2 CH_4

_____ 19. I can state the number of electrons that are shared in single and multiple covalent bonds.	In a single covalent bond, _____ electrons are shared. In a double covalent bond, _____ electrons are shared. In a triple covalent bond, _____ electrons are shared.
_____20. I can explain why the Lewis dot diagrams of ionic compounds have brackets and the Lewis dot diagrams of molecular compounds do not.	Lewis dot diagrams for ionic compounds have brackets because _____. Lewis dot diagrams for molecular compounds do NOT have brackets because _____.
_____21. I can state the type of bonding that occurs in the polyatomic ions (Reference Table E) and explain why they have that type of bonding.	Polyatomic ions have _____ bonding because _____.
_____22. Given the chemical formula for a compound, I can determine the type(s) of bonding in the compound.	State the type(s) of bonding in the following compounds: NaCl_____ CO_____ Hg_____ Na$_3$PO$_4$_____&_____
_____ 23. I can explain and apply the meaning of BARF as is applies to chemical bonding.	BARF stands for _____ This means that when a bond is FORMED, energy is _____ and when a bond is BROKEN, energy is _____. - Given the balanced equation: $$N + N \longrightarrow N_2$$ Which statement describes the process represented by this equation? A) A bond is formed as energy is absorbed. B) A bond is formed as energy is released. C) A bond is broken as energy is absorbed. D) A bond is broken as energy is released.
_____24. I can explain the difference between a polar covalent bond and a nonpolar covalent bond in terms of the types of nonmetals involved.	Polar covalent bonds are formed when _____ nonmetals share electrons unevenly. Nonpolar covalent bonds form when _____ nonmetals share electrons evenly.
_____25. I can explain how to determine the degree of polarity of a covalent bond.	The degree of polarity of a covalent bond is determined by the _____ between the elements. .

_____26. I can explain why one covalent bond is more or less polar than another covalent bond, based on electronegativity difference.	Explain, in terms of electronegativity difference, why the bond between carbon and oxygen in a carbon dioxide molecule is less polar than the bond between hydrogen and oxygen in a water molecule.
_____27. I can define symmetrical and asymmetrical.	**Definition:** symmetrical asymmetrical
_____28. I can state, in order, the three questions that are asked to determine if a MOLECULE is polar or nonpolar.	When determining if a MOLECULE is polar or non-polar, the first question to ask is_____ When determining if a MOLECULE is polar or non-polar, the second question to ask is_____ When determining if a MOLECULE is polar or non-polar, the third question to ask is_____
_____29. I can explain and apply the meaning of SNAP as it applies to determining molecule polarity.	SNAP means_____ - Why is a molecule of CH_4 nonpolar even though the bonds between the carbon and hydrogen are polar? A) The shape of the CH_4 molecule is symmetrical. B) The shape of the CH_4 molecule is asymmetrical. C) The CH_4 molecule has an excess of electrons. D) The CH_4 molecule has a deficiency of electrons. - Explain, in terms of charge distribution, why a molecule of water (H_2O) is polar.

_____30. I can determine if a molecular is polar or nonpolar.	Determine which molecules are polar and which are nonpolar. Justify your answer. H_2O CO_2 I_2 CH_4
_____31. I can explain and apply the expression "like dissolves like" and give an example.	"Like dissolves like" means An example of "like dissolving like" is _____ _____ - Explain, in terms of molecular polarity, why ammonia is more soluble than methane in water at 20^OC at standard pressure.
_____32. I can define intramolecular forces and intermolecular forces and give examples of each.	**Definition:** Intramolecular forces Examples: Intermolecular forces Examples:
_____33. I can list the intramolecular forces from STRONGEST to WEAKEST.	**Strongest**_____bonds>_____bonds **Weakest**

_____34. I can list the intermolecular forces from STRONGEST to WEAKEST.	**Strongest**_____> _____> _____ **Weakest**
_____35. I can state 8 physical properties of substances that are dependent on the type of bonding in the substance and the strength of the IMF.	Eight physical properties that are dependent on the type of bonding and the strength of the IMF are: 1._____ 2._____ 3._____ 4._____ 5._____ 6._____ 7._____ 8._____
_____36. I can state the relationship between polarity and IMF strength.	As the polarity of the molecule _____, the strength of the IMF _____.
_____37. I can state the relationship between size of the molecule and IMF strength.	As the size of the molecule_____, the strength of the IMF _____.
_____38. Given the physical state of some substances, I can compare the relative strength of the IMF.	At STP, iodine (I_2) is a crystal and fluorine (F_2) is a gas. Compare the strength of the IMF in a sample of I_2 at STP to the strength of the IMF in a sample of F_2 at STP.
_____39. Given the boiling points (or freezing points) of some substances, I can compare the relative strength of the IMF.	At STP, CF_4 boils at -127.8ºC and NH_3 boils at -33.3ºC. Which substance has stronger IMF? Justify your answer.
_____40. I can explain and apply the meaning of "Hydrogen bonding is FON".	"Hydrogen bonding is FON" means_____ _____ Which compound has hydrogen bonding between its molecules? A) CH_4 B) CaH_2 C) KNO_3 D) H_2O

_____41. I can define normal boiling point, vapor pressure, volatile, and nonvolatile.	**Definition:** normal boiling point vapor pressure volatile nonvolatile
_____42. I can determine the vapor pressure of ethanol, ethanoic acid, propane, or water at a given temperature.	What is the vapor pressure of ethanol at 56°C?
_____43. I can state the relationship between the strength of IMF and vapor pressure.	As the strength of IMF _____, vapor pressure _____.
_____44. I can explain the how adding a nonvolatile solute to a pure solvent affects the freezing point of the solvent.	When a nonvolatile solute is added to a solvent, the freezing point of the solvent _____ because the solute _____ _____ The more solute that is added, the _____ the feeezing point gets.
____45. I can explain the how adding a nonvolatile solute to a pure solvent affects the boiling point of the solvent.	When a nonvolatile solute is added to a solvent, the boiling point of the solvent _____ because the solute _____ _____ The more solute that is added, the _____ the boiling point gets.

_____46. I can state 5 physical properties of ionic substances.	Five physical properties of ionic substances are: 1._____ 2._____ 3._____ 4._____ 5._____
_____47. I can identify a substance as "ionic" based on its properties.	A solid substance was tested in the laboratory. The results are shown below. *dissolves in water *is an electrolyte * has a high melting point Based on these results, the solid substance could be A) Hg B) AuCl C) CH_4 D) $C_{12}H_{22}O_{11}$ Based on bond type, which compound has the highest melting point? A) CH_4 B) $C_{12}H_{22}O_{11}$ C)NaCl D) C_5H_{12}
_____48. I can state 5 physical properties of molecular substances.	Five physical properties of molecular substances are: 1._____ 2._____ 3._____ 4._____ 5._____

| | **49. I can identify a substance as "molecular" based on its properties.** |

A chemist performs the same tests on two homogeneous white crystalline solids, *A* and *B*. The results are shown in the table below.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H_2O (grams per 100.0 g H_2O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

A) both solids contain only ionic bonds

B) both solids contain only covalent bonds

C) solid *A* contains only covalent bonds and solid *B* contains only ionic bonds

D) solid *A* contains only ionic bonds and solid *B* contains only covalent bonds

Which terms describe a substance that has a low melting point and poor electrical conductivity?

A) covalent and metallic

B) covalent and molecular

C) ionic and molecular

D) ionic and metallic

Unit 12: Reaction Rates & Equilibrium

If you can do all the things listed below, you are ready for the Unit 12 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can still do everything from Unit 6.	
_____7. I can still do everything from Unit 7.	
_____8. I can still do everything from Unit 8.	
_____9. I can still do everything from Unit 10.	
_____10. I can still do everything from Unit 11.	
_____11. I can define effective collision and collision theory	**Definition:** effective collision collision theory
_____12. I can state and apply the relationship between temperature and reaction rate in terms of collision theory.	As the temperature _____, the reaction rate for most chemical reactions _____ because there are _____ effective collisions between particles. --- Given the reaction: $2Mg(s) + O_2(g) \ \text{-----}> \ 2MgO(s)$ At which temperature would the reaction occur at the greatest rate? A) $0^O C$ B) $15^O C$ C) $95^O C$ D) 273K

_____13. I can state and apply the relationship between surface area and reaction rate in terms of collision theory.	As the surface area _____, the reaction rate _____ because there are _____ effective collisions between particles. - At STP, which 4.0 g sample of $Zn(s)$ will react most quickly with dilute hydrochloric acid? A) lump B) bar C) powdered D) sheet metal
_____14. I can state and apply the relationship between concentration and reaction rate in terms of collision theory.	As the concentration _____, the reaction rate _____ because there are _____ effective collisions between particles. - At 20^OC, a reaction between powdered $Zn(s)$ and hydrochloric acid will occur most quickly if the concentration of the HCl is A) 1.0 M B) 1.5 M C) 2.5 M D) 2.8 M
_____15. I can state the unit used to measure energy.	Energy is measured in _____.
_____16. Based on the location of the energy term, I can determine if the reaction is exothermic or endothermic.	Given the following balanced equation: I + I -----> I_2 + 146.3 kJ Is this reaction exothermic or endothermic? Justify your answer.
_____17. I can use Table I to determine if a reaction is exothermic or endothermic.	Which balanced equation represents an endothermic reaction? A) $C(s) + O_2(g) \rightarrow CO_2(g)$ B) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$ C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ D) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

_____19. I can define potential energy diagram, reaction coordinate, PE$_{reactant}$, PE$_{product}$, heat of reaction (ΔH), activation energy, catalyst.	**Definitions:** potential energy diagram reaction coordinate PE$_{reactant}$ PE$_{product}$ heat of reaction (ΔH) activation energy catalyst entropy
_____20. Given a potential energy diagram, I can determine if the reaction is exothermic or endothermic.	Give the potential energy diagram below, determine if the reaction is exothermic or endothermic. Justify your answer. A + D ⟶ G
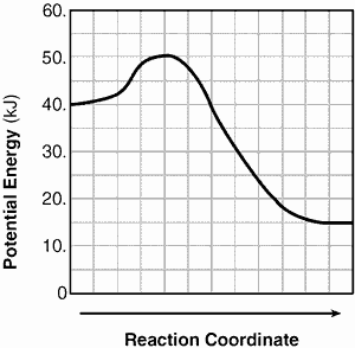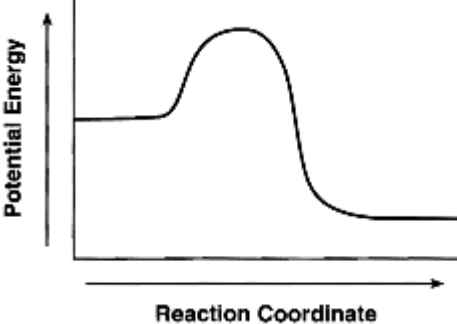
_____21. **Given a potential energy diagram, I can determine the PE$_{reactant}$, PE$_{product}$, ΔH, and activation energy.**	Given the potential energy diagram below, determine the PE$_{reactant}$, PE$_{product}$, ΔH, and the activation energy. PE$_{reactant}$ = PE$_{product}$ = ΔH = activation energy =
_____22. **Given a potential energy diagram for an uncatalyzed reaction diagram, I can how the diagram will change when a catalyst is been added.**	Draw a dotted line on the potential energy diagram shown below to indicate how it will change if a catalyst is added.
_____23. **I can rank the three phases of matter from least entropy to most entropy.**	Least entropy Most entropy _____<_____<_____
_____24. **I can state the trends in nature for entropy and energy.**	In nature most systems in nature tend to undergo reactions that have a(n) _____ in entropy and a(n) _____ in energy. As Mrs. S says, nature is like a teenager ---- lazy and messy!

_____25. Given a balanced equation, I can determine if the reaction results in an overall increase or decrease in entropy.	Which reaction results in an increase in entropy?
	
	A) $CO_2(g) \rightarrow CO_2(s)$
	B) $H_2O(\ell) \rightarrow H_2O(s)$
	C) $Ca(s) + 2 H_2O(\ell) \rightarrow Ca(OH)_2(aq) + H_2(g)$
	D) $NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$
	
	Which equation shows an increase in entropy?
	
	A) $CO_2(g) \rightarrow CO_2(s)$
	B) $CO_2(\ell) \rightarrow CO_2(g)$
	C) $CH_3OH(\ell) \rightarrow$
	         $CH_3OH(s)$
	D) $CH_3OH(g) \rightarrow$
	         $CH_3OH(\ell)$
	
	Which reaction has the greatest increase in entropy?
	
	A) $2 H_2O(\ell) \rightarrow 2 H_2(g) + O_2(g)$
	B) $2 H_2O(g) \rightarrow 2 H_2(g) + O_2(g)$
	C) $H_2O(g) \rightarrow H_2O(\ell)$
	D) $H_2O(\ell) \rightarrow H_2O(s)$

_____26. I can define forward reaction, reverse reaction, reversible reaction, and closed system	**Definitions:** forward reaction reverse reaction reversible reaction closed system
_____27. I can state the three types of equilibrium.	The three types of equilibrium are: _____ equilibrium _____ equilibrium and _____ equilibrium
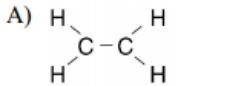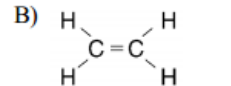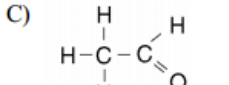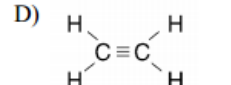
_____28. I can state two conditions that apply to all systems at equilibrium.	In a system at equilibrium the _____ of the forward and reverse reaction must be _____ and the _____ of the reactants and products must be _____.
_____29. Given a list of reactions, I can identify reactions that show equilibrium (chemical, phase, or solution).	Which balanced equation represents phase equilibrium? A) $H_2(g) + I_2(s) \longleftrightarrow 2HI(g)$ B) $I_2(s) \longleftrightarrow I_2(g)$ C) $KCl(s) \xrightarrow{H_2O} KCl(aq)$ D) $2KCl(s) + 3O_2(g) \longrightarrow 2KClO_3$ - Which balanced equation represents solution equilibrium? A) $H_2(g) + I_2(s) \longleftrightarrow 2HI(g)$ B) $I_2(s) \longleftrightarrow I_2(g)$ C) $KCl(s) \xrightarrow{H_2O} KCl(aq)$ D) $2KCl(s) + 3O_2(g) \longrightarrow 2KClO_3$ - Which balanced equation represents chemical equilibrium? A) $H_2(g) + I_2(s) \longleftrightarrow 2HI(g)$ B) $I_2(s) \longleftrightarrow I_2(g)$ C) $KCl(s) \xrightarrow{H_2O} KCl(aq)$ D) $2KCl(s) + 3O_2(g) \longrightarrow 2KClO_3$
_____30. In terms of saturation, I can describe a solution that is at equilibrium.	In terms of saturation, a solution that is at equilibrium must be _____.
_____31. I can state LeChatelier's Principle.	LeChatelier's Principle states
_____32. Given a balanced equation at equilibrium, I can predict the direction of shift in the equilibrium when the temperature, concentration, or pressure is changed or if a catalyst is added.	Given the reaction at equilibrium: $2SO_2(g) + O_2(g) \longleftrightarrow 2SO_3(g) + 392kJ$ Predict the direction of shift in the equilibrium (right, left, no shift) when the following changes are made to the system.

Change	Direction of Shift
Increase concentration of SO_2	
Increase concentration of SO_3	
Increase temperature	
Increase pressure	
Add a catalyst	

Unit 13: Organic Chemistry

If you can do all the things listed below, you are ready for the Unit 13 test.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can still do everything from Unit 6.	
_____7. I can still do everything from Unit 7.	
_____8. I can still do everything from Unit 8.	
_____9. I can still do everything from Unit 10.	
_____10. I can still do everything from Unit 11.	
_____11. I can still do everything from Unit 12.	
_____12. I can define organic compound, saturated hydrocarbon, unsaturated hydrocarbon, and isomer.	**Definitions:** organic compound saturated hydrocarbon unsaturated hydrocarbon isomer

_____13. I can expand a condensed structural formula to show the structural formula of an organic compound.	Draw the complete structural formula for $CH_3CH_2CH_2CH_2CH_3$. Draw the complete structural formula for $CH_3CHCHCH_3$.
_____14. I can state the name and symbol of the element that is capable of forming rings, chains, and networks.	The element that is capable of forming rings, chains, and networks is _____. Its symbol is_____.
_____15. I can explain the meaning of and apply HONC1234.	HONC1234 tells me that Which structural formula *correctly* represents a hydrocarbon molecule? A) H, H, C–C, H, H B) H, H, C=C, H, H C) H, H, H–C–C, O, H D) H, H, C≡C, H, H
_____16. Given the formula, I can determine if a compound is a hydrocarbon or not.	Which formula represents a hydrocarbon? A) $CH_3CH_2CH_2CHO$ B) $CH_3CH_2CH_2CH_3$ C) $CH_3CH_2CH_2COOH$ D) $CH_3CH_2COOCH_3$
_____17. Given the name, I can use Reference Table P to determine how many carbons atoms are in a compound.	Determine how many carbon atoms are in each of the following compounds: decane_____ ethene_____ 3-nonene_____ 1-pentyne_____
_____18. Given the name, I can use Reference Table Q to determine to which class of hydrocarbons a compound belongs.	Determine the homologous series of hydrocarbons to which each of the following belongs: decane_____ 2-decene_____ 3-nonene_____ 1-pentyne_____
_____19. Given the name, I can determine if the hydrocarbon is saturated or unsaturated.	Determine if each of the following is a saturated or unsaturated hydrocarbon. decane_____ ethene_____ 3-nonene_____ 1-pentyne_____

	Determine the homologous series of hydrocarbons to which each of the following belongs:
	belongs to the _____ series.
_____20. Given the formula, I can determine to which homologous series a hydrocarbon belongs.	
	belongs to the _____ series.
	belongs to the _____ series.
_____21. Given the formula, I can determine if a hydrocarbon is saturated or unsaturated.	Determine if each of the following is a saturated or unsaturated hydrocarbon. $CH_3CH_2CH_2CH_3$_____ $CH_3CHCHCH_3$_____
_____22.Given the name, I can use Reference Table Q to determine how many hydrogen atoms the hydrocarbon contains.	Determine the number of hydrogen atoms in each of the following. decane_____ 1-butene_____ 3-nonene_____ 1-pentyne_____
_____23. Given a list of compounds, I can determine which ones are isomers.	Given a formula representing a compound: Which formula represents an isomer of this compound? A) B) C) D)

Which structural formula represents a ketone?

A)
$$H-\overset{\overset{\displaystyle H}{|}}{C}-\overset{\overset{\displaystyle H}{|}}{C}=O$$

B)
$$H-\overset{\overset{\displaystyle H}{|}}{C}-C=O$$
(H OH)

C)
$$H-\overset{\overset{\displaystyle H}{|}}{C}-\overset{\overset{\displaystyle O}{\|}}{C}-\overset{\overset{\displaystyle H}{|}}{C}-H$$

D)
$$H-\overset{\overset{\displaystyle H}{|}}{C}-\overset{\overset{\displaystyle O}{\|}}{C}-O-\overset{\overset{\displaystyle H}{|}}{C}-H$$
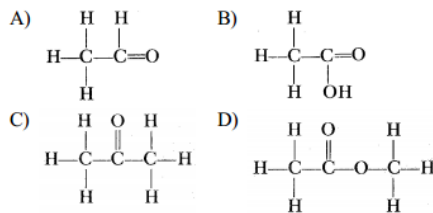
Given the structural formula:
$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-O-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-H$$

The compound represented by this formula can be classified as an
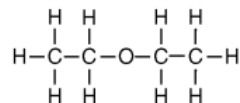
A) organic acid   B) ether
C) ester   D) aldehyde

_____24. Given a structural formula, I can use Reference Table R to identify to which class of organic compounds a substance belongs.
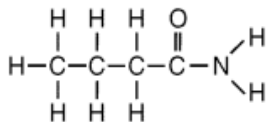
Given the formula:
$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle O}{\|}}{C}-N\overset{\diagup H}{\diagdown H}$$
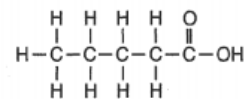
This compound is classified as

A) an aldehyde   B) an amide
C) an amine   D) a ketone

Given the formula for an organic compound:
$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle O}{\|}}{C}-OH$$
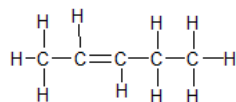
This compound is classified as an

A) aldehyde   B) amine
C) ester   D) organic acid

Which structural formula represents an alcohol?
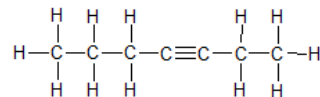
A)
$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle O}{\|}}{C}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-H$$

B)
$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-OH$$

C)
$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-C\overset{\diagup\diagup O}{\diagdown H}$$

D)
$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-C\overset{\diagup\diagup O}{\diagdown OH}$$
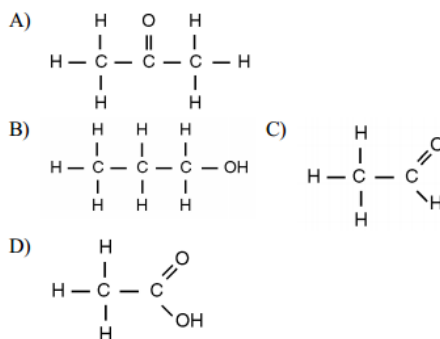
_____25. I can use Reference Tables P & Q and IUPAC nomenclature to name simple hydrocarbons.

Name the following hydrocarbons.

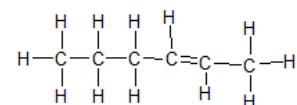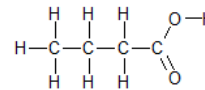$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{C}=C-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-H$$

_____

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-C\equiv C-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-H$$

_____

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-H$$

_____

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{C}=C-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-H$$

_____
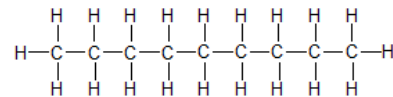
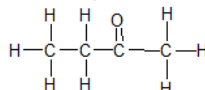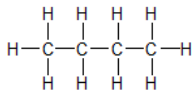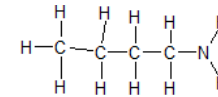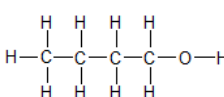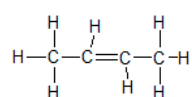|	
	Name the following organic compounds.
_____26. I can use Reference Tables P & R and IUPAC nomenclature to name simple compounds in any of the classes of organic compounds.	(structural formulas of organic compounds with blank lines for naming, arranged in a grid)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____
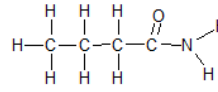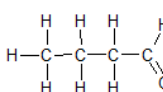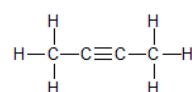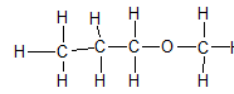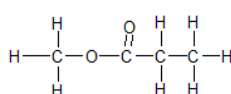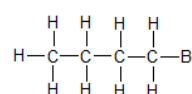
_____27. I can use F-SCAPES to list and describe the 7 types of organic reactions.

F stands for_____. This type of organic

reaction results from a reaction of _____ to form

_____ and _____. It
typically requires a catalyst, in the form of an enzyme to occur.

S stands for _____. This type of organic

reaction happens when _____ hydrocarbons

replace one of the _____ for some other element (often a
halide).

C stands for _____. In this type of organic

reaction a _____ reacts with

_____ to form _____ and

_____. It is an exothermic reaction.

A stands for _____. In this type of organic
reaction

an _____ becomes a

_____ when the double bond
breaks and two atoms of another element (often a halide) are added.

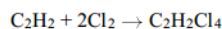|	
	P stands for _____. In this type of organic reaction many _____ are linked together to form a _____. A generalized form of this reaction looks like this…..
	Note: N and n are very large numbers equal to about 2000.
_____27. I can use F-SCAPES to list and describe the 7 types of organic reactions. (continued)	**E** stands for _____. In this type of organic reaction an _____ reacts with a _____ to form an _____ and _____. The products of this reaction are typically fragrant.
	S stands for _____. In this type of organic reaction a _____ reacts with a _____ to form _____. You can really "clean up" if you remember this organic reaction.
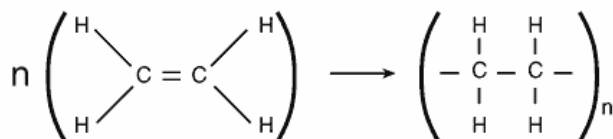
|	
	Given the balanced equation for an organic reaction: $C_2H_2 + 2Cl_2 \rightarrow C_2H_2Cl_4$ This reaction is best classified as A) addition B) esterification C) fermentation D) substitution
	Given the equation: $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$ This reaction is best described as A) addition involving a saturated hydrocarbon B) addition involving an unsaturated hydrocarbon C) substitution involving a saturated hydrocarbon D) substitution involving an unsaturated hydrocarbon
_____28. Given an equation, I can identify the type of organic reaction that is occurring.	Which equation represents fermentation? A) $C_2H_6 + Cl_2 \rightarrow C_2H_6Cl + HCl$ B) $C_6H_{12}O_6 \rightarrow 2 C_2H_5OH + 2 CO_2$ C) $CH_3COOH + CH_3OH \rightarrow CH_3COOCH_3 + H_2O$ D) $nC_2H_4 \rightarrow (C_2H_4)n$
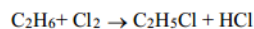
Given the equation:
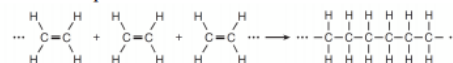
Which type of reaction is represented by this equation?

A) combustion B) esterification
C) polymerization D) substitution

Given the reaction:
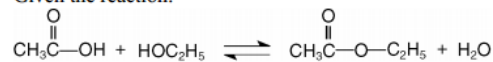
This reaction is an example of

A) fermentation B) saponification
C) hydrogenation D) esterification

Which reaction best represents the complete combustion of ethene?

A) $C_2H_4 + HCl \rightarrow C_2H_5Cl$
B) $C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2$
C) $C_2H_4 + 3 O_2 \rightarrow 2 CO_2 + 2 H_2O$
D) $C_2H_4 + H_2O \rightarrow C_2H_5OH$