Norfolk Public Schools
Science Learning in Place Plan: Chemistry Lessons

Week 10: May 18 – 22, 2020 (Unit 10)

Monday	Tuesday	Wednesday	Thursday	Friday
Unit 7.10: Experimental		**Unit 1.10: Elements and the Periodic Table** **Unit 2.10: Compounds and Bonding** **Unit 3.10: Kinetic Theory** **Unit 4.10: The Mole and Stoichiometry** **Unit 5.10: Chemical Reactions** **Unit 6.10: Solutions** **Unit 7.10: Experimental** **U10: Mastery Knowledge**		
Unit 10 Packet pages 9 – 10 Greatest Scientists in Chemistry Unit 10 Practice		**Unit 10 Packet page 11** Unit 10 Review Continued	**Unit 10 Packet pages 12 – 13** Unit 10 Review	

Week 11: May 25 – 29, 2020 (Review Part 1)

Monday	Tuesday	Wednesday	Thursday	Friday
Unit 1.10: Elements and the Periodic Table		**Unit 2.10: Compounds and Bonding**		**Unit 5.10: Chemical Reactions**
Review Packet pages 1 – 2		Review Packet pages 3 – 4		Review Packet page 5

Week 12: June 1 – 5, 2020 (Review Part 2)

Monday	Tuesday	Wednesday	Thursday	Friday
Unit 3.10: Kinetic Theory		**Unit 6.10: Solutions**	**Unit 4.10: The Mole and Stoichiometry**	
Review Packet pages 6 – 7		Review Packet page 8	Review Packet pages 9 – 10	

Great Scientists of Chemistry - Atomic History

Use any chemistry text as a source to find the contributions made by each of the scientists listed below.

Name Bank:
Aristotle, Henry Becquerel, Niels Bohr, Louis de Broglie, James Chadwick, Marie Curie. John Dalton, Democritus, Werner Heisenberg, Antoine Lavoisier, Dmitri Mendeleev, Lothar Meyer, Robert Millikan, Henry Mosely, John Newlands, Joseph Proust, Ernest Rutherford, Erwin Schrodinger, and J.J. Thomson.

Match the Scientist's name with the contribution:

1. _____ – First to use the term atom
2. _____ – Defined matter as composed of hot, cold, wet, and dry
3. _____ – Modern Atomic Theory and Law of Multiple Proportions
4. _____ – Law of Conservation of Mass
5. _____ – Law of Definite Proportions
6. _____ – Discovered the charge/mass of the electron using the Oil Drop Experiment
7. _____ – Discovered the nucleus using the Gold Foil Experiment
8. _____ – Discovered the neutron
9. _____ – Discovered radiation emitted by uranium
10. _____ – Discovered two other elements that emitted radiation (polonium and radium)
11. _____ – Proposed energy levels and the Planetary Model of the atom
12. _____ – Proposed the Wave-Particle Duality of Nature
13. _____ – Proposed the Uncertainty Principle
14. _____ – Proposed electron cloud model (Quantum Mechanical Model) of an atom
15. _____ – Noticed a pattern when elements were arranged by atomic mass. He used the word periodic to describe this pattern and named it the Law of Octaves
16. _____ – Made a connection between atomic mass and properties of elements and made the Periodic Table
17. _____ – Made a connection between atomic mass and properties of elements and made the Periodic Table while predicting unknown elements
18. _____ – Discovered the electron with cathode ray experiment and proposed Plum Pudding Model
19. _____ – Arranged the Periodic Table by atomic number and gave us the Periodic Law

Unit 10 Practice

Balance and classify the following types of chemical reactions: **(re-write as a net ionic equation)

1. $Cl_2 + KI \rightarrow KCl + I_2$
2. $Al(OH)_3 + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2O$
3. $KClO_3 \rightarrow O_2 + KCl$
4. $Na + P \rightarrow Na_3P$
5. $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$
6. $Na_2SO_4 + BaCl_2 \rightarrow NaCl + BaSO_4$ **
7. $CaCO_3 \rightarrow Ca + CO_2$
8. $HNO_3 + Mg(OH)_2 \rightarrow H_2O + Mg(NO_3)_2$
9. $Na + BaF_2 \rightarrow NaF + Ba$
10. $Fe + O_2 \rightarrow Fe_2O_3$

Draw the Lewis dot structures for the following molecules and identify the shape & direction of the dipole.

1. H_2
2. CO_2
3. CH_3COOH
4. O_2
5. NH_3
6. H_2O
7. CH_4
8. H_2CO
9. HCN

Limiting Reactant & % Yield

1. Calculate the maximum mass of ethyne (C_2H_2) that can be made from the reaction in which 14.0 grams of CaC_2 reacts with 12.5 grams of water to produce ethyne and calcium hydroxide, $Ca(OH)_2$.

2. Calculate the percent yield if 156 grams of sodium nitrate, $NaNO_3$, reacted to form 112 grams of sodium nitrite $NaNO_2$, according to the following equation. $2\ NaNO_{3\,(s)} \rightarrow 2\ NaNO_{2\,(s)} + O_{2\,(g)}$

Equilibrium and LCP

1. Write the equilibrium expression for the following reactions. (K_{eq} = ?)

a. $CaCl_{2\,(s)} \leftrightarrow Ca^{2+}{}_{(aq)} + 2Cl^-{}_{(aq)}$

b. $C_2H_5OH_{\,(l)} + O_{2\,(g)} \leftrightarrow CO_{2\,(g)} + H_2O_{\,(g)}$

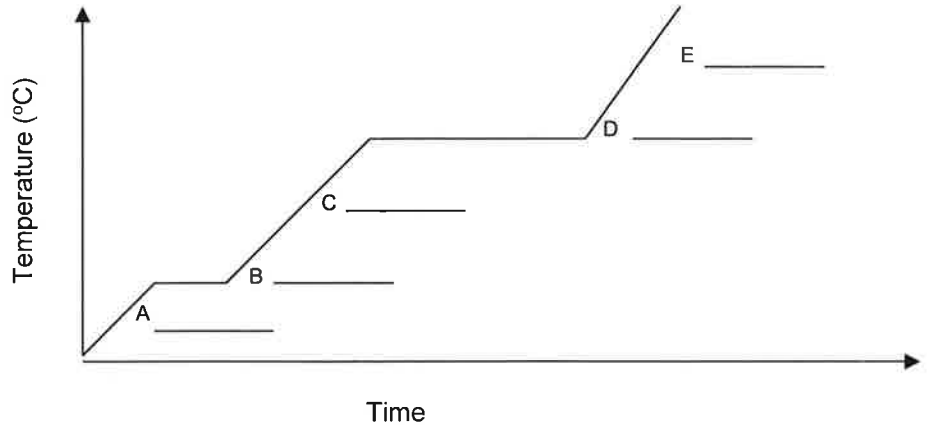
c. $C_{\,(s)} + O_{2\,(g)} \leftrightarrow CO_{2\,(g)}$

2. Given the following equation at equilibrium: $N_{2\,(g)} + 3H_{2\,(g)} \leftrightarrow 2NH_{3\,(g)}$ $\Delta H = -46kJ$
Use an arrow to show the direction in which the reaction will shift for each "stress" in order to reestablish equilibrium.

a) Add NH_3
b) Increase the temperature
c) Decrease the pressure
d) Remove N_2
e) Add H_2
f) Add a catalyst
g) Decrease the temperature
h) Remove NH_3

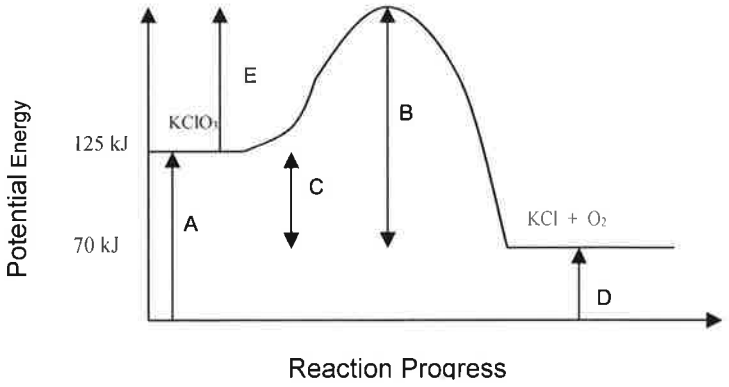
Unit 10 Review Continued

Heating Curve: Use the following heating curve for water to answer the following questions



1. On the lines provided, indicate the states of matter represented by A, C, and E. Then indicate the changes in state that are occurring at B and D.
2. On the y-axis, label the appropriate temperatures of the melting and boiling points.
3. Explain what is happening to the average kinetic energy of the molecules during B and D.
4. Calculate the energy needed to convert 50.0 grams of ice at -10.0 °C to steam at 115.0 °C. ($C_{p\ (ice)}$ = 2.11 J/g°C, $C_{p\ (water)}$ = 4.18 J/g°C, $C_{p\ (steam)}$ = 1.99 J/g°C; ΔH_{fus} = 6.0 kJ/mol, ΔH_{vap} = 40.7 kJ/mol) Show all steps.

Potential Energy Diagram: Use the following potential energy diagram to answer the following questions:



1. Write a balanced equation for the reaction depicted. (be sure to include the energy)
2. Is the forward reaction endothermic or exothermic? How do you know?
3. What letter represents the ΔH? Calculate its value.
4. What letter represents the activation energy of the forward reaction?
5. How would a catalyst affect this reaction? Redraw the diagram to show a catalyst's effect.

Name:

Unit 10: Chemistry

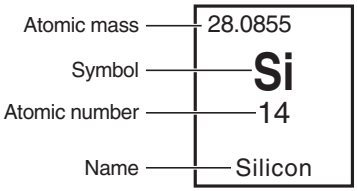
(Quiz)

Choose the best answer that either answers the question or completes the statement and explain WHY you chose your answer in the space provided.

a b c d ○ ○ ○ ○ 1.10	**1. Which of the following is true?** a) Small nonmetals have high ionization energy and high electronegativity. b) Large metals have high ionization energy and low electronegativity. c) Small nonmetals have low ionization energy and low electronegativity. d) Large metals have low ionization energy and high electronegativity.
a b c d ○ ○ ○ ○ 1.10 & 1.9	**2. Which of the following is a correct formula for a compound composed of an alkaline earth metal and a halogen? Explain completely.** a) NaBr b) CaCl c) KNe d) MgF_2
a b c d ○ ○ ○ ○ 2.10	**3. Half-life is:** a) the time it take for one half of a radioactive sample to decay. b) a reaction in which one element turns into another element. c) the reactant used up in a chemical reaction. d) a reversible reaction in which the rate of the forward reaction equals the rate of the reverse reaction.
a b c d ○ ○ ○ ○ 2.10	**4. Polonium-218 has a half-life of 3.00 minutes. If you start with 16 mg, how long will it take have only 1.0 mg remaining?** a) 48 minutes b) 12 minutes c) 9 minutes d) 6 minutes
a b c d ○ ○ ○ ○ 3.10	**5. Based on the Collision Theory, particle size and reaction rate are: (explain why)** a) Indirectly related b) Directly related c) Not related d) Sometimes related
a b c d ○ ○ ○ ○ 3.10	**6. According to the collision theory, the colliding particles must have what in order to react and form product?** a) activation energy b) kinetic energy c) potential energy d) a catalyst
a b c d ○ ○ ○ ○ 4.10	**7. What is the limiting reactant and how much ammonia will be produced when 10.0g of nitrogen gas reacts with 10.0g of hydrogen gas?** $N_2 + 3H_2 \rightarrow 2NH_3$ a) Nitrogen gas, 0.357 moles of ammonia b) Nitrogen gas, 0.714 moles of ammonia c) Hydrogen gas, 3.33 moles of ammonia d) Hydrogen gas, 5.00 moles of ammonia
a b c d ○ ○ ○ ○ 4.10	**8. If 5.0 grams of solid sodium metal reacts with excess water, 1.45 grams of sodium hydroxide (NaOH) and an unknown amount of hydrogen gas (H_2) are formed. What is the percent yield?** a) 16.7 % b) 42.2 % c) 59.3 % d) 83.3 %

5.10	**9. Write the complete and net ionic equations for the reaction in which aqueous solutions of barium nitrate and potassium sulfate react:**
a b c d ○ ○ ○ ○ 5.10	**10. In the reaction above, which is a possible spectator ion?** a) Barium ion b) Nitrate ion c) Sulfate ion d) Barium sulfate
a b c d ○ ○ ○ ○ 6.10	**11. Which of the following factors would increase the rate of the forward reaction (→) according to the following equation?** $N_{2\,(g)} + 3H_{2\,(g)} \leftrightarrow 2NH_{3\,(g)} +$ heat a) Removing N_2 b) Increasing the concentration of NH_3 c) Increasing the pressure d) Adding heat
a b c d ○ ○ ○ ○ 6.10	**12. For the following reaction, what is the correct equilibrium expression?** K_{eq}= $P_{4\,(s)} + 6NO_{(g)} \leftrightarrow P_4O_{6\,(s)} + 3N_{2\,(g)}$ a) $[P_4O_6][N_2]^3 / [P_4][NO]^6$ b) $[P_4][NO]^6/ [P_4O_6][N_2]^3$ c) $[NO]^6/[N_2]^3$ d) $[N_2]^3/ [NO]^6$
a b c d ○ ○ ○ ○ 7.10	**13. Which scientist was given credit for the development of the periodic table?** a) Bohr b) Dalton c) Mendeleev d) Rutherford
a b c d ○ ○ ○ ○ 7.10	**14. Bohr discovered:** a) the atom. b) the nucleus is dense and positively charged. c) the electron has a negative charge. d) the electron is found in energy levels.
a b c d ○ ○ ○ ○ MK	**15. Gibbs free energy, ΔG, determines whether a reaction will occur spontaneously. There are two factors that affect ΔG. They are entropy and enthalpy. What kind of reactions are <u>always</u> spontaneous?** a) Exothermic and increasing entropy. b) Endothermic and increasing entropy. c) Exothermic and decreasing entropy. d) Endothermic and decreasing entropy.

Periodic Table of the Elements



Period	Group 1																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.00794 H 1 Hydrogen																	4.00260 He 2 Helium
2	6.941 Li 3 Lithium	9.01218 Be 4 Beryllium	Transition Elements										10.81 B 5 Boron	12.0111 C 6 Carbon	14.0067 N 7 Nitrogen	15.9994 O 8 Oxygen	18.998403 F 9 Fluorine	20.179 Ne 10 Neon
3	22.98977 Na 11 Sodium	24.305 Mg 12 Magnesium											26.98154 Al 13 Aluminum	28.0855 Si 14 Silicon	30.97376 P 15 Phosphorus	32.06 S 16 Sulfur	35.453 Cl 17 Chlorine	39.948 Ar 18 Argon
4	39.0983 K 19 Potassium	40.08 Ca 20 Calcium	44.9559 Sc 21 Scandium	47.88 Ti 22 Titanium	50.9415 V 23 Vanadium	51.996 Cr 24 Chromium	54.9380 Mn 25 Manganese	55.847 Fe 26 Iron	58.9332 Co 27 Cobalt	58.69 Ni 28 Nickel	63.546 Cu 29 Copper	65.39 Zn 30 Zinc	69.72 Ga 31 Gallium	72.59 Ge 32 Germanium	74.9216 As 33 Arsenic	78.96 Se 34 Selenium	79.904 Br 35 Bromine	83.80 Kr 36 Krypton
5	85.4678 Rb 37 Rubidium	87.62 Sr 38 Strontium	88.9059 Y 39 Yttrium	91.224 Zr 40 Zirconium	92.9064 Nb 41 Niobium	95.94 Mo 42 Molybdenum	(98) Tc 43 Technetium	101.07 Ru 44 Ruthenium	102.906 Rh 45 Rhodium	106.42 Pd 46 Palladium	107.868 Ag 47 Silver	112.41 Cd 48 Cadmium	114.82 In 49 Indium	118.71 Sn 50 Tin	121.75 Sb 51 Antimony	127.60 Te 52 Tellurium	126.905 I 53 Iodine	131.29 Xe 54 Xenon
6	132.905 Cs 55 Cesium	137.33 Ba 56 Barium	138.906 La 57 Lanthanum	178.49 Hf 72 Hafnium	180.948 Ta 73 Tantalum	183.85 W 74 Tungsten	186.207 Re 75 Rhenium	190.2 Os 76 Osmium	192.22 Ir 77 Iridium	195.08 Pt 78 Platinum	196.967 Au 79 Gold	200.59 Hg 80 Mercury	204.383 Tl 81 Thallium	207.2 Pb 82 Lead	208.980 Bi 83 Bismuth	(209) Po 84 Polonium	(210) At 85 Astatine	(222) Rn 86 Radon
7	(223) Fr 87 Francium	226.025 Ra 88 Radium	227.028 Ac 89 Actinium	(261) Rf 104 Rutherfordium	(262) Db 105 Dubnium	(263) Sg 106 Seaborgium	(262) Bh 107 Bohrium	(265) Hs 108 Hassium	(266?) Mt 109 Meitnerium	(269?) 110								

Mass numbers in parentheses are those of the most stable or most common isotope.

Metals ← → Nonmetals

Lanthanoid Series	140.12 Ce 58 Cerium	140.908 Pr 59 Praseodymium	144.24 Nd 60 Neodymium	(145) Pm 61 Promethium	150.36 Sm 62 Samarium	151.96 Eu 63 Europium	157.25 Gd 64 Gadolinium	158.925 Tb 65 Terbium	162.50 Dy 66 Dysprosium	164.930 Ho 67 Holmium	167.26 Er 68 Erbium	168.934 Tm 69 Thulium	173.04 Yb 70 Ytterbium	174.967 Lu 71 Lutetium
Actinoid Series	232.038 Th 90 Thorium	231.036 Pa 91 Protactinium	238.029 U 92 Uranium	237.048 Np 93 Neptunium	(244) Pu 94 Plutonium	(243) Am 95 Americium	(247) Cm 96 Curium	(247) Bk 97 Berkelium	(251) Cf 98 Californium	(252) Es 99 Einsteinium	(257) Fm 100 Fermium	(258) Md 101 Mendelevium	(259) No 102 Nobelium	(260) Lr 103 Lawrencium

Revised May 2011

Background: We need to use the periodic table to identify elements and compounds.

How to identify these:

Staircase: The staircase is a zigzag pattern that leads down in a stair shape starting at Boron.

Metals: Any element to the left of the staircase, ***except*** H (H is a nonmetal)

Nonmetals: Any element to the right of the staircase

Metalloids: The elements that fall on the staircase: Symbols: B, Si, Ge, As, Sb, Te, At

Element: Is identified by only a single capital letter in the symbol. The symbol can have a single capital alone or it can have a lowercase letter as well.

Compound: Is identified by two or more different capital letters in a symbol.

Ionic compounds: made of a metal and a nonmetal

Covalent compounds: made of only nonmetals.

Polyatomic Ions: can be present when there are 3 capital letters.

Use your periodic table to identify the following:

Formula	Element or Compound	If element, what type?	If compound, Ionic or Covalent	Polyatomic Ion present? Yes or no
H_2O				
Mo				
$CaCO_3$				
CO_2				
Xe				
NaOH				
U				
NH_3				
Ge				
LiBr				

1. What type of compounds have polyatomic ions? _____
2. Explain the difference between Co and CO.

Review Topic 1: Elements and PTOE

Part 1. Directions: In the chart, fill in the following information for each element:

Element	Group	Period	# of Valence electrons	Electron Configuration	Lewis Dot structure
C					
P					
Xe					
Ba					
Al					
Cl					
K					
He					

Part 2. Directions: Match the following. Each element can have more than one match.

a. Li
b. Ne
c. F
d. Cs
e. I_2

_____1. Smallest
_____2. Highest ionization energy
_____3. Highest electronegativity
_____4. Lowest ionization energy
_____5. Largest
_____6. Lowest electronegativity
_____7. Most reactive metal
_____8. Least reactive metal
_____9. Least reactive nonmetal
_____10. Most reactive nonmetal

Review Topic 2: Compounds and Bonding

Name each of the following:

1. Mg_3P_2 _____
2. CO_2 _____
3. $(NH_4)_2SO_4$ _____
4. HBr _____
5. $Ca_3(PO_4)_2$ _____
6. $Fe(OH)_3$ _____
7. CCl_4 _____
8. HNO_3 _____
9. Cu_3PO_4 _____
10. P_4O_{10} _____

Write the formula for the following compounds:

1. Aluminum hydroxide _____
2. Sodium oxide _____
3. Calcium phosphide _____
4. Magnesium nitrate _____
5. Copper (II) chloride _____
6. Ammonium sulfate _____
7. Potassium fluoride _____
8. Chromium (III) nitride _____
9. Carbon dioxide _____
10. Dinitrogen monoxide _____
11. Sulfur hexafluoride _____
12. Tetraphosphorus decoxide _____

Give an example of the following kinds of compounds:

1. ionic compound	
2. base	
3. acid (inorganic)	
4. organic alcohol	
5. diatomic molecule	
6. organic acid	
7. polar covalent compound	
8. covalent compound that has polar bonds but is a non-polar molecule	

Review Topic 2: Compounds and Bonding

Draw the Lewis dot structures for the following molecules and identify the shape and type of intermolecular force.

1. H_2	6. O_2
2. CO_2	7. NH_3
3. CH_3COOH*	8. N_2
4. H_2O	9. CH_4
5. HCN	10. CHF_3

Review Topic 5: Types of Chemical Reactions

Balance and classify the following types of chemical reactions:

1. $Cl_2 + KI \rightarrow KCl + I_2$
2. $Al(OH)_3 + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2O$
3. $KClO_3 \rightarrow O_2 + KCl$
4. $Na + P \rightarrow Na_3P$
5. $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$
6. $Na_2SO_4 + BaCl_2 \rightarrow NaCl + BaSO_4$
7. $C_5H_{12} + O_2 \rightarrow H_2O + CO_2$
8. $HNO_3 + Mg(OH)_2 \rightarrow H_2O + Mg(NO_3)_2$
9. $Na + BaF_2 \rightarrow NaF + Ba$
10. $Fe + O_2 \rightarrow Fe_2O_3$

Write a balanced equation for the following:

1. the synthesis of sodium chloride

2. the neutralization of sulfuric acid and sodium hydroxide

3. the D.R. reaction between aluminum hydroxide and calcium chloride

4. the S.R. reaction between copper(II) sulfate and potassium metal

5. the combustion of octane (C_8H_{18})

6. the decomposition of water

7. the dissociation of barium chloride

Review Topic 3: Kinetic Theory

Phase Diagram: Use the phase diagram to answer the following questions.

1. What is the triple point of this substance?

2. What does A, B, & C represent? How do you know?

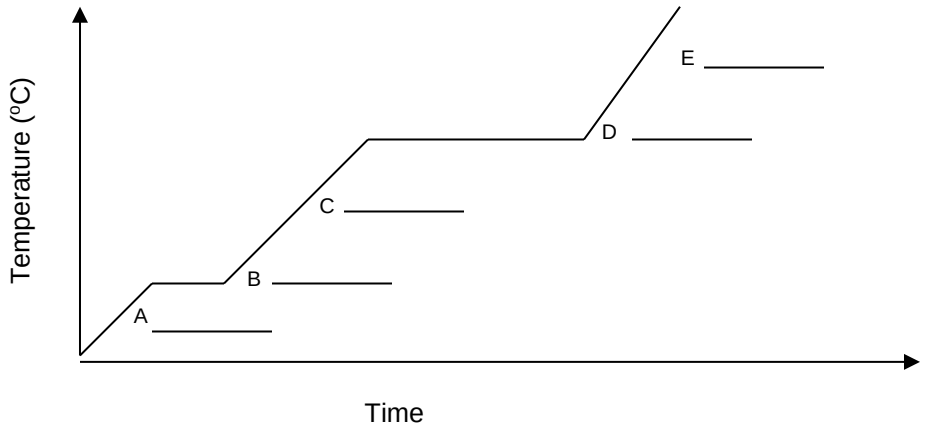
3. What phase change will occur at 0.30 atm, if the temperature is increased from -25 ^{o}C to 50 ^{o}C?

4. What phase change will occur at 75 ^{o}C, if the pressure is decreased from 1.0 atm to 0.5 atm?

5. What phase change will occur at standard atmospheric pressure, if the temperature is decreased from 50 ^{o}C to -25 ^{o}C?

6. What phase change will occur when pressure is dropped from 0.75 atm to 0.25 atm at 270 K?

Heating Curve: Use the following heating curve for water to answer the following questions.



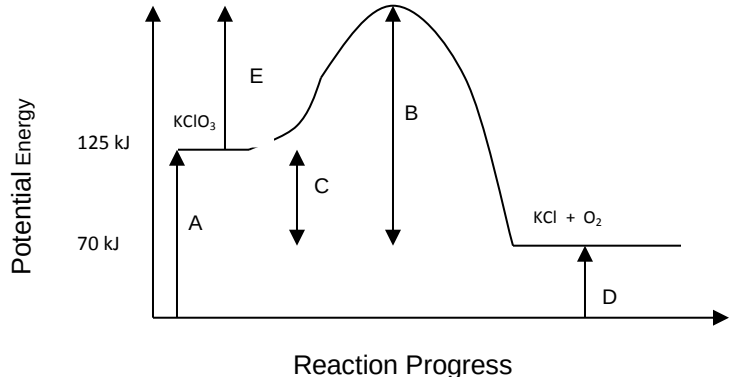
1. On the lines provided, indicate the states of matter represented by A, C, and E. Then indicate the changes in state that are occurring at B and D.
2. On the y-axis, label the appropriate temperatures of the melting and boiling points.
3. Explain what is happening to the average kinetic energy of the molecules during B and D.

4. To the righ of the heating curve, draw a picture of what a cooling curve would look like.

5. How much energy (in joules) are necessary to raise the temperature of 200 g of water from 20^{o}C to its boiling point?

Review Topic 3: Kinetic Theory

Potential Energy Diagram: Use the following potential energy diagram to answer the following questions:



1. Write a balanced equation for the reaction depicted. (be sure to include the energy)

2. Is the forward reaction endothermic or exothermic? How do you know?

3. What letter represents the ΔH? Calculate its value.

4. What letter represents the activation energy of the forward reaction?

5. How would a catalyst affect this reaction? Redraw the diagram to show a catalyst's effect.

Vapor Pressure Curve: Use the vapor pressure curve provided to answer the following questions.

1. Which of the substances has the highest vapor pressure at 30 ^{o}C?

2. Which of the substances has the highest boiling point at standard pressure?

3. Which one these substances have the strongest intermolecular attractions? Why?

Review Topic 6: Solutions and Equilibrium

Solubility Curve: Use the solubility curve provided to answer the following questions. **(topic 6)**

1. What is the relationship between the solubility of a solid and temperature? and of a gas and temperature?
2. What substances on the graph are gases and how do you know?
3. What substance is the most soluble at 50 ^{O}C? Which is the least soluble at 80 ^{o}C?
4. What is the solubility of the sodium nitrate in 100 grams of water at 70 ^{o}C?
5. What is the solubility of ammonia in 200 grams of water at 50 ^{o}C?

Le Chatelier's Principle:

1. Define and use an example to explain equilibrium.

2. Given the following equation at equilibrium:

$$N_{2\,(g)} + 3H_{2\,(g)} \leftrightarrow 2NH_{3\,(g)} \quad \Delta H=-46kJ$$

Use an arrow to show the direction in which the reaction will shift for each "stress" in order to reestablish equilibrium.

a) Add NH_3
b) Increase the temperature
c) Decrease the pressure
d) Remove N_2
e) Add H_2
f) Add a catalyst
g) Remove NH_3
h) Decrease the temperature

Review Topic 4: Random Stoichiometry

Show all work!

1. What is the density of an unknown object if its mass was found to be 10.58 g and its volume is 4.6mL? *(Sig Fig's)

2. What is the pressure of 16 grams of oxygen gas (O_2) that has a volume of 5.6 L and a temperature of 45^{o}C? (R = 0.0821 L atm/mol K)

3. How many grams is one mole of NH_4OH? Two moles? 0.25 moles?

4. How many moles is 404 g of KNO_3?

5. What is the molarity of a solution in which 0.40 grams of NaOH is dissolved in water so that the final volume of the solution is 100 mL? What is the resulting solution's pH?

6. What volume in <u>liters</u> of 12 M HCl must be used to make 500 mL of a 3 M solution?

Review Topic 4: Stoichiometry

Show all work!

Use the balanced equation to answer the following questions: $N_{2\,(g)} + 3\,H_{2\,(g)} \leftrightarrow 2\,NH_{3\,(g)}$

a. How many moles of nitrogen would be needed to react completely with 6 moles of hydrogen gas?

b. How many moles of nitrogen gas would be needed to make 8.5 g of ammonia gas?

c. How many grams of ammonia would be made if 56 grams of nitrogen reacted completely?

d. How many liters of hydrogen at STP are necessary to produce 17 grams of ammonia?