MATH SKILLS TRANSPARENCY WORKSHEETS

Answer Key

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 1

Interpreting and Drawing Graphs

Use with Chapter 2, Section 2.4

1. What kind of graph is shown on the transparency?

The graph shown is a circle graph.

2. What does the circle represent?

The circle represents the total number of people aged 18–21 who responded to the survey.

3. Based on the data shown, what percentage of 18- to 21-year-olds think of themselves as Republicans? As Democrats?

19% think of themselves as Republicans; 25% think of themselves as Democrats

4. Which group do most 18- to 21-year-olds say they belong to?

Most 18- to 21-year-olds (50%) say they are independent.

5. The data on the right shows the political affiliations for the general population. Make a graph that compares the political affiliations of 18- to 21-year-olds with those of the general population. Label the appropriate parts of your graph.

Students might make a bar graph that uses bars of two colors: one to represent 18- to 21-year-olds and one to represent the general population.

Political Supporters

Political affiliation	Percent of general population who identify with the affiliation
Republican	25
Democrat	31
Independent	36
Other party	8

Source: *The Economist,* July 15, 2000

Use the graph you made in question 5 to answer the following questions.

6. What kind of graph did you make?

Answers may vary, but a bar graph would be a clear way of presenting the comparison of data.

7. Compare the responses of the general population with those of 18- to 21-year-olds. How are they alike? How are they different?

Both groups are divided among affiliations in a similar manner: most say they are independent. However, a smaller portion of the general population says they are independent.

8. What is the greatest difference between the responses of the general population and those of 18- to 21-year-olds?

The greatest difference is the decrease in the percentage of people in the general population who say they are independent.

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MATH SKILLS TRANSPARENCY WORKSHEET 2

Visualizing the Conservation of Mass

Use with Chapter 3, Section 3.2

1. How many potassium atoms are in the reactants of the chemical reaction shown? How many are in the products? **2; 2**

2. How many oxygen atoms are in the reactants of the chemical reaction shown? How many are in the products? **2; 2**

3. How many hydrogen atoms are in the reactants of the chemical reaction shown? How many are in the products? **4; 4**

4. Assume that the chemical reaction shown started out having a total of 15 g of potassium and water. How much potassium hydroxide and hydrogen gas will be produced by the chemical reaction? Show your work.

$Mass_{reactants} = Mass_{products}$

If the reactants total 15 g, then the products will total 15g.

5. Assume that the chemical reaction shown started out having 6 atoms of potassium and 6 molecules of water. How many molecules of potassium hydroxide will be produced by the chemical reaction? How many hydrogen atoms will result?

$Mass_{reactants} = Mass_{products}$

There will be 6 molecules of potassium hydroxide and 12 atoms of hydrogen.

6. Assume that you are working with a chemical reaction that decomposes water into hydrogen and oxygen. You begin with 36 grams of water and end with 32 grams of oxygen. If all of the water decomposes, how many grams of hydrogen gas will result?

$Mass_{reactants} = Mass_{products}$

$Mass_{water} = Mass_{hydrogen} + Mass_{oxygen}$

$Mass_{hydrogen} = Mass_{water} - Mass_{oxygen}$

$Mass_{hydrogen} = 36\ g - 32\ g = 4\ g$

7. Assume that you are working with a chemical reaction that synthesizes salt from sodium and chlorine. You begin with 70.9 g of chlorine. You synthesize 116.90 grams of salt. If all of the reactants were used up, how many grams of sodium did you begin with?

$Mass_{reactants} = Mass_{products}$

$Mass_{sodium} + Mass_{chloride} = Mass_{sodium\ chloride}$

$Mass_{sodium} = Mass_{sodium\ chloride} - Mass_{chloride}$

$Mass_{sodium} = 116.90\ g - 70.9\ g = 46.0\ g$

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MATH SKILLS TRANSPARENCY WORKSHEET 3

Finding Percent by Mass

Use with Chapter 3, Section 3.4

1. What percentage of the 20.0 g sample does sugar (sucrose) represent? **100%**

2. What is the percent by mass of oxygen in sugar? Of carbon? Of hydrogen?
51.30% oxygen; 42.2% carbon; 6.50% hydrogen

3. How many grams of oxygen are in 100 g of sucrose?
Mass percentage of oxygen = mass of oxygen/mass of sucrose × 100
51.30% = (mass of oxygen/100) × 100
(mass of oxygen = 51.30 × 100)/100 = 51.30 g

4. How many grams of carbon are in 30.0 g of sucrose? Show your work.
Mass percentage of carbon = mass of carbon/mass of sucrose × 100
42.2% = mass of carbon/30.0 × 100
mass of oxygen = 42.2/30.0 × 100 = 140.7 g = 141 g

5. A sample of baking soda contains 34.48 g of sodium, 1.51 g of hydrogen, 18.02 g of carbon, and 72.00 g of oxygen.

a. What is the total mass of the sample?
34.48 g + 1.51 g + 18.02 g + 72.00 g = 126.01 g

b. What is the mass by percent of each element in baking soda?
Sodium **27.36%**
Hydrogen **1.20%**
Carbon **14.30%**
Oxygen **57.14%**

Mass percentage of element = mass of element/mass of baking soda × 100
Mass percentage of sodium = (34.48/126.01) × 100 = 27.36%
Mass percentage of hydrogen = (1.51/126.01) × 100 = 1.20%
Mass percentage of carbon = (18.02/126.01) × 100 = 14.30%
Mass percentage of oxygen = (72.00/126.01) × 100 = 57.14%

6. Draw a circle graph to represent your answer to question 7.
Students should show a circle graph divided into four wedges: sodium, 27.36%; hydrogen, 1.20%; carbon, 14.30%; and oxygen, 57.14%.

7. Complete the following statement by underlining the correct words in parentheses.
To calculate percent by mass, you first divide (a part, a whole) by (a part, the whole). Then you multiply by 100%.

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MATH SKILLS TRANSPARENCY WORKSHEET 4

Calculating Atomic Mass

Use with Chapter 4, Section 4.3

1. Look at the data table. What do the numbers 6 and 7 in ^{6}X and ^{7}X represent?
The numbers are the mass number of each isotope. The mass numbers refer to the sum of each isotope's protons and neutrons, which make up most of the mass of an atom.

2. Look at step 1. What does amu stand for? What does it mean?
It stands for atomic mass unit. The mass of 1 amu is defined as 1/12 the mass of a carbon-12 atom.

3. Look at step 2. Why is each isotope's mass multiplied by the isotope's percent abundance?
Atomic mass is a weighted average of the masses of an atom's isotopes. This means that ^{7}X, which occurs 92.5% of the time, has a larger effect in determining the element's atomic mass than does ^{6}X, which occurs 7.5% of the time.

4. In step 3, why isn't the answer a whole number?
Accept either of the following answers: The mass of 1 amu is slightly less than the mass of a proton or a neutron. The atomic mass is a weighted average.

5. Assume that a new lithium isotope, ^{8}Li, is identified. It is a trace isotope, meaning that it exists in a very tiny quantity. How will this discovery affect the atomic mass of lithium?
The discovery of ^{8}Li will have a very small effect on lithium's atomic mass because the percent abundance of ^{8}Li is so small.

6. Calculate the atomic mass of the unknown element. Then identify the element.

Isotope	Mass (amu)	Percent abundance
^{185}X	184.953	37.40
^{187}X	186.956	62.60

Mass contribution = (mass)(percent abundance)
^{185}X: (184.953 amu)(0.3740) = 69.17 amu
^{187}X: (186.956 amu)(0.6260) = 117.0 amu

Atomic mass of X = 69.17 amu + 117.0 amu = 186.2 amu
The element is rhenium.

7. Calculate the atomic mass of the unknown element. Then identify the element.

Isotope	Mass (amu)	Percent abundance
^{113}X	112.904	4.30
^{115}X	114.904	95.70

Mass contribution = (mass)(percent abundance)
^{113}X: (112.904 amu)(0.0430) = 4.86 amu
^{115}X: (114.904 amu)(0.9570) = 110.0 amu

Atomic mass of X = 4.86 amu + 110.0 amu = 114.9 amu
The element is indium.

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MATH SKILLS TRANSPARENCY WORKSHEET 5

Interpreting Waves

Use with Chapter 5, Section 5.1

1. Look at the two waves shown. What is the speed of each wave?

All electromagnetic waves travel at the speed of light, *c*. ($c = 3.00 \times 10^8$ m/s)

2. Look at the two waves shown. Which wave has a higher frequency? Which wave has a longer wavelength?

B has a higher frequency. A has a longer wavelength.

3. Assume that wave A has a wavelength of 699 nm. Calculate the frequency of the wave. Show your work.

4.29×10^{14} s^{-1}

Solution:

First, convert 699 nm to meters: (699 ~~nm~~) × (1 meter/10^9 ~~nm~~) = 6.99×10^{-7} m

$c = \lambda\nu$, where $c = 3.00 \times 10^8$ m/s

$\nu = c/\lambda = (3.00 \times 10^8$ ~~m~~/s)/(6.99×10^{-7} ~~m~~) = 4.29×10^{14} s^{-1}

4. Assume that wave B has a wavelength of 415 nm. Calculate the frequency of the wave. Show your work.

7.23×10^{14} s^{-1}

Solution:

First, convert 415 nm to meters: (415 ~~nm~~) × (1 meter/10^9 ~~nm~~) = 4.15×10^{-7} m

$c = \lambda\nu$, where $c = 3.00 \times 10^8$ m/s

$\nu = c/\lambda = (3.00 \times 10^8$ ~~m~~/s)/(4.15×10^{-7} ~~m~~) = 7.23×10^{14} s^{-1}

5. Compare your calculations in question 4 with your answer to question 3. Do your calculations support your answer in question 2?

Answers to question 3 should be supported by students' calculations. Wave B has a higher frequency than Wave A does.

6. If wave A has a frequency of 4.60×10^{14} s^{-1}, what is its wavelength in nanometers? Show your work.

652 nm

Solution:

$c = \lambda\nu$, where $c = 3.00 \times 10^8$ m/s

$\lambda = c/\nu = (3.00 \times 10^8$ m/~~s~~)/(4.60×10^{14} ~~s^{-1}~~) = 6.52×10^{-7} m

Convert meters to nanometers: (6.52×10^{-7} ~~m~~)(10^9 nm/1 ~~m~~) = 652 nm

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MATH SKILLS TRANSPARENCY WORKSHEET 6

Using the Periodic Table

Use with Chapter 6, Section 6.2

1. Identify the number of valence electrons in each of the following elements.

a. Ne **8** **e.** O **6**

b. K **1** **f.** Cl **7**

c. B **3** **g.** P **5**

d. Mg **2** **h.** Si **4**

2. Identify the energy level of the valence electrons in each of the following elements.

a. Br **fourth energy level**

b. N **second energy level**

c. Ra **seventh energy level**

d. H **first energy level**

e. Ar **third energy level**

f. I **fifth energy level**

3. Use the periodic table to write the electron configurations (using noble gas notation) for each of the following elements.

a. Li **[He]$2s^1$**

b. F **[He]$2s^2 2p^5$**

c. As **[Ar]$4s^2 3d^{10} 4p^3$**

d. Sr **[Kr]$5s^2$**

e. Bi **[Xe]$6s^2 4f^{14} 5d^{10} 6p^3$**

4. Determine the group, period, and block of the elements having the following electron configurations.

a. $1s^2$ **group 8A, period 1, s-block**

b. $[Ne]3s^2 3p^1$ **group 3A, period 3, p-block**

c. $[Ar]4s^1$ **group 1A, period 4, s-block**

d. $[Kr]5s^2 4d^1$ **group 3B, period 5, d-block**

e. $[Xe]6s^2 4f^{14} 5d^{10} 6p^4$ **group 6A, period 6, p-block**

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MATH SKILLS TRANSPARENCY WORKSHEET 7

Calculating Numbers of Electrons and Predicting Ionic Change

Use with Chapter 8, Section 8.1

1. What happens to a neutral atom if it loses one electron? Why?

The atom becomes a cation with a charge of 1+ because it then has one fewer negatively charged particle than it has protons, which are positively charged.

2. What happens to a neutral atom if it gains two electrons? Why?

The atom becomes an anion with a charge of 2− because it then has two more negatively charged particles than it has protons.

3. Write a simple word equation that shows how you can figure out the charge of an ion, given its numbers of electrons and protons.

Charge of ion = Number of protons − Number of electrons

4. What is the electron configuration of each of the following, given its position in the periodic table? In each case, also tell what charge the atom is likely to take on if it bonds, and explain why. Write the electron configuration of the ion that is formed.

a. beryllium (Be)

$1s^2 2s^2$; it is likely to form an ion with a 2+ charge because by losing its two valence electrons, it achieves the stable noble-gas configuration $1s^2$.

b. fluorine (F)

$1s^2 2s^2 2p^5$; it is likely to form an ion with a 1− charge because by gaining one electron, it achieves the stable noble-gas configuration $1s^2 2s^2 2p^6$.

c. argon (Ar)

$1s^2 2s^2 2p^6 3s^2 3p^6$; it is not likely to bond or form ions because it already has a stable noble-gas configuration.

d. sulfur (S)

$1s^2 2s^2 2p^6 3s^2 3p^4$; it is likely to form an ion with a 2− charge because by gaining two electrons, it achieves the stable noble-gas configuration $1s^2 2s^2 2p^6 3s^2 3p^6$.

e. sodium (Na)

$1s^2 2s^2 2p^6 3s^1$; it is likely to form an ion with a 1+ charge because by losing its one valence electron, it achieves the stable noble-gas configuration $1s^2 2s^2 2p^6$.

f. nitrogen (N)

$1s^2 2s^2 2p^3$; it is likely to form an ion with a 3− charge because by gaining three electrons, it achieves the stable noble-gas configuration $1s^2 2s^2 2p^6$.

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MATH SKILLS TRANSPARENCY WORKSHEET 8

Determining Numbers of Ions

Use with Chapter 8, Section 8.3

1. Write a simple word equation that illustrates what must be true of total positive charge and total negative charge in an ionic compound.

Total positive charge + Total negative charge = Zero

2. How many potassium ions (group 1) would be related to balance the charge of each of the following in a compound?

a. one cyanide ion **one**

b. one sulfite ion **two**

c. one arsenate ion **three**

3. How many iodate ions would be needed to balance the charge of each of the following in a compound?

a. one Fe^{3+} ion **three**

b. one lithium ion (group 1) **one**

c. one barium ion (group 2) **two**

4. What is the formula of the ionic compound formed by each of the following in combination? Demonstrate that each result is correct by figuring out total positive charge and total negative charge.

a. ammonium ions and sulfate ions

$(NH_4)_2SO_4$; (2 × 1+) + (1 × 2−) = 0

b. sodium ions (group 1) and phosphate ions

Na_3PO_4; (3 × 1+) + (1 × 3−) = 0

c. magnesium ions (group 2) and hydrogen sulfate ions

$Mg(HSO_4)_2$; (1 × 2+) + (2 × 1−) = 0

d. aluminum ions (group 13) and carbonate ions

$Al_2(CO_3)_3$; (2 × 3+) + (3 × 2−) = 0

e. ammonium ions and arsenate ions

$(NH_4)_3AsO_4$; (3 × 1+) + (1 × 3−) = 0

f. calcium ions (group 2) and acetate ions

$Ca(C_2H_3O_2)_2$; (1 × 2+) + (2 × 1−) = 0

g. ammonium ions and nitrite ions

NH_4NO_2; (1 × 1+) + (1 × 1−) = 0

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MATH SKILLS TRANSPARENCY WORKSHEET 9

Determining the Names of Binary Compounds and Their Numbers of Atoms

Use with Chapter 9, Section 9.2

1. The table shows the prefixes used in naming binary compounds. Notice that each prefix corresponds to a certain number of atoms. These prefixes are also used in naming many geometric figures with which you probably are familiar. For example, a triangle has three sides. The prefix *tri-* signifies *three*. How many sides does a pentagon have? A hexagon? An octagon?

five; six; eight

2. Look at the drawings of molecules (labeled a–e) below the table. For each molecule, tell how many atoms of each kind are present. Then write the name of the compound, using the prefixes in the table. In each case, the central atom is named first.

a. **one nitrogen, three iodine; nitrogen triiodide**

b. **one carbon, two sulfur; carbon disulfide**

c. **two nitrogen, four oxygen; dinitrogen tetroxide**

d. **one silicon, six fluorine; silicon hexafluoride**

e. **one oxygen, two fluorine; oxygen difluoride**

3. For each compound listed below, tell how many of each kind of atom are present in a molecule of the compound and the total number of atoms per molecule. Then name the compound.

a. P_4O_{10} **four phosphorus, ten oxygen, a total of 4 + 10 = 14 atoms; tetraphosphorus decoxide**

b. S_2O_7 **two sulfur, seven oxygen, a total of 2 + 7 = 9 atoms; disulfur heptoxide**

c. Si_3H_8 **three silicon, eight hydrogen, a total of 3 + 8 = 11 atoms; trisilicon octahydride**

4. What is the formula for each compound listed below?

a. tetrasulfur dinitride **S_4N_2**

b. dichlorine monoxide **Cl_2O**

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MATH SKILLS TRANSPARENCY WORKSHEET 10

Determining Electronegativity Difference and Percent Ionic Character

Use with Chapter 9, Section 9.5

1. The electronegativities of the period-3 elements are listed on the transparency. Calculate the electronegativity differences for the following pairs of bonded period-3 atoms.

a. Na and Cl **3.16 − 0.93 = 2.23**

b. Mg and S **2.58 − 1.31 = 1.27**

c. Al and P **2.19 − 1.61 = 0.58**

d. Si and Cl **3.16 − 1.90 = 1.26**

e. Si and S **2.58 − 1.90 = 0.68**

2. An electronegativity difference greater than 1.70 generally corresponds to a bond that is considered ionic. For which of the bonded-atoms combinations from question 1 would the bonds be considered ionic according to this rule?

Na and Cl only

3. Bonds are rarely completely covalent or completely ionic. Rather, they have a percent ionic character. The graph illustrates that fact. What two variables are plotted on the graph, and what is the overall relationship between the variables?

Percent ionic character and electronegativity difference; as electronegativity difference increases, percent ionic character increases.

4. Use the graph to find the approximate percent ionic character for the five pairs of bonded atoms listed in question 1.

a. Na and Cl **70%**

b. Mg and S **32%**

c. Al and P **10%**

d. Si and Cl **32%**

e. Si and S **12%**

5. Given what you know about percentages in general, what must be the relationship between the percent ionic character and the percent covalent character for a given bond?

% ionic character + % covalent character = 100%

6. Calculate the percent covalent character for the five pairs of bonded atoms listed in question 1.

a. Na and Cl **100% − 70% = 30%**

b. Mg and S **100% − 32% = 68%**

c. Al and P **100% − 10% = 90%**

d. Si and Cl **100% − 32% = 68%**

e. Si and S **100% − 12% = 88%**

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MATH SKILLS TRANSPARENCY WORKSHEET 11

Order of Operations

Use with Chapter 10, Section 10.1

1. Follow the correct order of operations to solve these problems.

a. $4 + 2(9 + 1)$ **24**

b. $9 \times 14 - (4 - 3)$ **125**

c. $7(2 + 14/2) + 23$ **86**

d. $12/4(2 - 1 + 4 \times 6)$ **75**

e. $19 - 42/6 \times 2(3 + 4 - 3 \times 2)$ **5**

2. Compare the answers to the following problems. Why is it important that parentheses be used?

a. $16/4 + 4 = ?$ **b.** $16/(4 + 4) = ?$

The answer to part a is 4 + 4, or 8; part b is 16/8, or 2. The parentheses clarify the order in which the operations are to be completed.

3. For each of the following formulas, place parentheses where you think they should be. Explain your answers. If no parentheses are needed, write *NP*.

a. $CaOH_2$ **$Ca(OH)_2$; two hydroxide ions combine with one calcium ion.**

b. Na_3PO_4 **NP**

c. $AlNO_{33}$ **$Al(NO_3)_3$; one aluminum ion combines with three nitrate ions.**

d. $NH_{42}SO_4$ **$(NH_4)_2SO_4$; two ammonium ions combine with one sulfate ion.**

e. $NiCO_3$ **NP**

4. For each of the following formulas, list the number of each type of atom present and find the total number of atoms represented.

a. KBr **1 K, 1 Br; 2**

b. Na_2O **2 Na, 1 O; 3**

c. $Au(OH)_3$ **1 Au, 3 O, 3 H; 7**

d. NH_4NO_3 **2 N, 4 H, 3 O; 9**

e. $(NH_4)_3PO_4$ **3 N, 12 H, 1 P, 4 O; 20**

f. $3K_2SO_4$ **6 K, 3 S, 12 O; 21**

g. $10C_6H_{12}O_6$ **60 C, 120 H, 60 O; 240**

h. $6Mg_3(PO_4)_2$ **18 Mg, 12 P, 48 O; 78**

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MATH SKILLS TRANSPARENCY WORKSHEET 12

Simplifying Equations

Use with Chapter 10, Section 10.3

1. Examine the following problem. Apply the rules for working with mathematical equations to correctly sequence the steps used to solve the problem. Write the numbers 1 through 6 in the blanks to show the correct order of the steps.

Solve for x in the following equation: $3(2x + 4) - 6 = 3x + 18$.

3 $6x - 3x + 6 - 6 = 3x - 3x + 18 - 6$

1 $6x + 12 - 6 = 3x + 18$

2 $6x + 6 = 3x + 18$

5 $3x/3 = 12/3$

4 $3x = 12$

6 $x = 4$

2. Write balanced chemical, complete ionic, and net ionic equations for each of these chemical reactions.

a. Bubbles of carbon dioxide are released when nitric acid (HNO_3) is added to a sodium carbonate solution. Water and sodium nitrate also form.

$2HNO_3(aq) + Na_2CO_3(aq) \rightarrow 2NaNO_3(aq) + H_2O(l) + CO_2(g)$;

$2H^+(aq) + 2NO_3^-(aq) + 2Na^+(aq) + CO_3^{2-}(aq) \rightarrow 2Na^+(aq) + 2NO_3^-(aq) + H_2O(l) + CO_2(g)$; $2H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$

b. Bubbles of hydrogen sulfide are released when hydrochloric acid (HCl) is added to a solution of ammonium sulfide. Aqueous ammonium chloride also forms.

$2HCl(aq) + (NH_4)_2S(aq) \rightarrow H_2S(g) + 2NH_4Cl(aq)$;

$2H^+(aq) + 2Cl^-(aq) + 2NH_4^+(aq) + S^{2-}(aq) \rightarrow H_2S(g) + 2NH_4^+(aq) + 2Cl^-(aq)$;

$2H^+(aq) + S^{2-}(aq) \rightarrow H_2S(g)$

c. Potassium phosphate and water form when phosphoric acid (H_3PO_4) and potassium hydroxide react.

$H_3PO_4(aq) + 3KOH(aq) \rightarrow 3H_2O(l) + K_3PO_4(aq)$;

$3H^+(aq) + PO_4^{3-}(aq) + 3K^+(aq) + 3OH^-(aq) \rightarrow 3H_2O(l) + 3K^+(aq) + PO_4^{3-}(aq)$;

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

d. Solid calcium sulfate and aqueous magnesium nitrate form when solutions of magnesium sulfate and calcium nitrate are mixed.

$MgSO_4(aq) + Ca(NO_3)_2(aq) \rightarrow CaSO_4(s) + Mg(NO_3)_2(aq)$;

$Mg^{2+}(aq) + SO_4^{2-}(aq) + Ca^{2+}(aq) + 2NO_3^-(aq) \rightarrow CaSO_4(s) + Mg^{2+}(aq) + 2NO_3^-(aq)$; $SO_4^{2-}(aq) + Ca^{2+}(aq) \rightarrow CaSO_4(s)$

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MATH SKILLS TRANSPARENCY WORKSHEET 13

Calculations Involving the Molar Mass of an Element

Use with Chapter 11, Section 11.2

1. Determine the mass in grams of each of the following. Use the periodic table.

a. 1.00 mol silver (Ag)

1.00 ~~mol Ag~~ × 107.868 g Ag/1 ~~mol Ag~~ = 108 g Ag

b. 12.0 mol aluminum (Al)

12.0 ~~mol Al~~ × 26.982 g Al/1 ~~mol Al~~ = 324 g Al

c. 3.25 mol copper (Cu)

3.25 ~~mol Cu~~ × 63.546 g Cu/1 ~~mol Cu~~ = 207 g Cu

d. 1.93 mol xenon (Xe)

1.93 ~~mol Xe~~ × 131.293 g Xe/1 ~~mol Xe~~ = 253 g Xe

e. 5.34 mol vanadium (V)

5.34 ~~mol V~~ × 50.942 g V/1 ~~mol V~~ = 272 g V

2. Determine the number of moles in each of the following. Use the periodic table.

a. 10.0 g lithium (Li)

10.0 ~~g Li~~ × 1 mol Li/6.941 ~~g Li~~ = 1.44 mol Li

b. 367 g magnesium (Mg)

367 ~~g Mg~~ × 1 mol Mg/24.305 ~~g Mg~~ = 15.1 mol Mg

c. 72.1 g silicon (Si)

72.1 ~~g Si~~ × 1 mol Si/28.086 ~~g Si~~ = 2.57 mol Si

d. 4.87 g fluorine (F)

4.87 ~~g F~~ × 1 mol F/18.998 ~~g F~~ = 0.256 mol F

e. 1.56 kg lead (Pb)

1.56 ~~kg Pb~~ × 1000 ~~g~~/1 ~~kg~~ × 1 mol Pb/207.2 ~~g Pb~~ = 7.53 mol Pb

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MATH SKILLS TRANSPARENCY WORKSHEET 14

Calculating the Molar Mass of a Compound

Use with Chapter 11, Section 11.3

Determine the molar mass of each of the following compounds. Use the periodic table.

1. carbon dioxide (CO_2)

1 ~~mol CO_2~~ × 1 ~~mol C~~/1 ~~mol CO_2~~ × 12.011 g C/1 ~~mol C~~ = 12.011 g C

1 ~~mol CO_2~~ × 2 ~~mol O~~/1 ~~mol CO_2~~ × 15.999 g O/1 ~~mol O~~ = 31.998 g O

molar mass CO_2 = 44.009 g/mol CO_2

2. mercury(I) fluoride (Hg_2F_2)

1 ~~mol Hg_2F_2~~ × 2 ~~mol Hg~~/1 ~~mol Hg_2F_2~~ × 200.59 g Hg/1 ~~mol Hg~~ = 401.18 g Hg

1 ~~mol Hg_2F_2~~ × 2 ~~mol F~~/1 ~~mol Hg_2F_2~~ × 18.998 g F/1 ~~mol F~~ = 37.996 g F

molar mass Hg_2F_2 = 439.18 g/mol Hg_2F_2

3. magnesium thiotellurite (Mg_3TeS_5)

1 ~~mol Mg_3TeS_5~~ × 3 ~~mol Mg~~/1 ~~mol Mg_3TeS_5~~ × 24.305 g Mg/1 ~~mol Mg~~ = 72.915 g Mg

1 ~~mol Mg_3TeS_5~~ × 1 ~~mol Te~~/1 ~~mol Mg_3TeS_5~~ × 127.60 g Te/1 ~~mol Te~~ = 127.60 g Te

1 ~~mol Mg_3TeS_5~~ × 5 ~~mol S~~/1 ~~mol Mg_3TeS_5~~ × 32.066 g S/1 ~~mol S~~ = 160.330 g S

molar mass Mg_3TeS_5 = 360.85 g/mol Mg_3TeS_5

4. copper(II) cyanide ($Cu(CN)_2$)

1 ~~mol $Cu(CN)_2$~~ × 1 ~~mol Cu~~/1 ~~mol $Cu(CN)_2$~~ × 63.546 g Cu/1 ~~mol Cu~~ = 63.546 g Cu

1 ~~mol $Cu(CN)_2$~~ × 2 ~~mol C~~/1 ~~mol $Cu(CN)_2$~~ × 12.011 g C/1 ~~mol C~~ = 24.022 g C

1 ~~mol $Cu(CN)_2$~~ × 2 ~~mol N~~/1 ~~mol $Cu(CN)_2$~~ × 14.007 g N/1 ~~mol N~~ = 28.014 g N

molar mass $Cu(CN)_2$ = 115.582 g/mol $Cu(CN)_2$

5. cobalt(II) orthophosphate ($Co_3(PO_4)_2$)

1 ~~mol $Co_3(PO_4)_2$~~ × 3 ~~mol Co~~/1 ~~mol $Co_3(PO_4)_2$~~ × 58.933 g Co/1 ~~mol Co~~ = 176.799 g Co

1 ~~mol $Co_3(PO_4)_2$~~ × 2 ~~mol P~~/1 ~~mol $Co_3(PO_4)_2$~~ × 30.974 g P/1 ~~mol P~~ = 61.948 g P

1 ~~mol $Co_3(PO_4)_2$~~ × 8 ~~mol O~~/1 ~~mol $Co_3(PO_4)_2$~~ × 15.999 g O/1 ~~mol O~~ = 127.992 g O

molar mass $Co_3(PO_4)_2$ = 366.739 g/mol $Co_3(PO_4)_2$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 15

Determining Mole Ratios

Use with Chapter 12, Section 12.1

Determine the mole ratios for each of the following balanced chemical equations.

1. $2C(s) + O_2(g) \rightarrow 2CO(g)$

1 mol O_2/2 mol C **2 mol CO/2 mol C**
2 mol C/1 mol O_2 **2 mol CO/1 mol O_2**
2 mol C/2 mol CO **1 mol O_2/2 mol CO**

2. $WO_3(s) + 3H_2(g) \rightarrow W(s) + 3H_2O(g)$

3 mol H_2/1 mol WO_3 **1 mol W/1 mol WO_3** **3 mol H_2O/1 mol WO_3**
1 mol WO_3/3 mol H_2 **1 mol W/3 mol H_2** **3 mol H_2O/3 mol H_2**
1 mol WO_3/1 mol W **3 mol H_2/1 mol W** **3 mol H_2O/1 mol W**
1 mol WO_3/3 mol H_2O **3 mol H_2/3 mol H_2O** **1 mol W/3 mol H_2O**

3. $2IrCl_3(aq) + 3NaOH(aq) \rightarrow Ir_2O_3(s) + 3HCl(aq) + 3NaCl(aq)$

3 mol NaOH/2 mol $IrCl_3$ **1 mol Ir_2O_3/2 mol $IrCl_3$**
3 mol HCl/2 mol $IrCl_3$ **3 mol NaCl/2 mol $IrCl_3$**

2 mol $IrCl_3$/3 mol NaOH **1 mol Ir_2O_3/3 mol NaOH**
3 mol HCl/3 mol NaOH **3 mol NaCl/3 mol NaOH**

2 mol $IrCl_3$/1 mol Ir_2O_3 **3 mol NaOH/1 mol Ir_2O_3**
3 mol HCl/1 mol Ir_2O_3 **3 mol NaCl/1 mol Ir_2O_3**

2 mol $IrCl_3$/3 mol HCl **3 mol NaOH/3 mol HCl**
1 mol Ir_2O_3/3 mol HCl **3 mol NaCl/3 mol HCl**

2 mol $IrCl_3$/3 mol NaCl **3 mol NaOH/3 mol NaCl**
1 mol Ir_2O_3/3 mol NaCl **3 mol HCl/3 mol NaCl**

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 16

Using Mole Ratios

Use with Chapter 12, Section 12.2

For each of the following problems, write the balanced chemical equation that represents the reaction. Then complete the table below by identifying the known substance, the unknown substance, and the mole ratio that you would use to solve each problem correctly.

1. Copper(II) oxide (CuO) decomposes into copper (Cu) and oxygen (O_2) gas. What mass of copper will be produced by the decomposition of 1.25 kg CuO?
$2CuO \rightarrow 2Cu + O_2$

2. Ammonia (NH_3) is produced by the reaction of nitrogen (N_2) and hydrogen (H_2) gases. How much ammonia will be produced if 22.0 g H_2 reacts with excess N_2?
$N_2 + 3H_2 \rightarrow 2NH_3$

3. The reaction of sodium (Na) and water (H_2O) produces sodium hydroxide (NaOH) and hydrogen (H_2) gas. What mass of hydrogen gas is produced if 17.54 g NaOH is produced by the reaction?
$2Na + 2H_2O \rightarrow 2NaOH + H_2$

4. The combustion of acetic acid ($HC_2H_3O_2$) produces carbon dioxide (CO_2) and water (H_2O). What mass of carbon dioxide will be produced from the combustion of 25.0 g $HC_2H_3O_2$?
$HC_2H_3O_2 + 2O_2 \rightarrow 2CO_2 + 2H_2O$

5. 20.0 g of iron(III) sulfide (Fe_2S_3) was prepared by heating iron (Fe) and excess sulfur (S). What mass of iron was used in the preparation?
$2Fe + 3S \rightarrow Fe_2S_3$

Problem	Chemical Formula of Known Substance	Chemical Formula of Unknown Substance	Mole Ratio
1	CuO	Cu	2 mol Cu/2 mol CuO
2	H_2	NH_3	2 mol NH_3/3 mol H_2
3	NaOH	H_2	1 mol H_2/2 mol NaOH
4	$HC_2H_3O_2$	CO_2	2 mol CO_2/1 mol $HC_2H_3O_2$
5	Fe_2S_3	Fe	2 mol Fe/1 mol Fe_2S_3

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 17

Solving Stoichiometric Mass-to-Mass Conversion Problems

Use with Chapter 12, Section 12.2

1. The reaction of iron(III) oxide (Fe_2O_3) and hydrogen (H_2) is represented by the following unbalanced chemical equation.

_____ $Fe_2O_3(s)$ + _____ $H_2(g) \rightarrow$ _____ $Fe(s)$ + _____ $H_2O(l)$

Determine the mass in grams of hydrogen gas needed to react completely with 33.5 g Fe_2O_3.

Step 1. $Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O$

Step 2. 1 ~~mol Fe_2O_3~~ × 2 ~~mol Fe~~/1 ~~mol Fe_2O_3~~ × 55.85 g Fe/1 ~~mol Fe~~ = 111.7 g Fe
1 ~~mol Fe_2O_3~~ × 3 ~~mol O~~/1 ~~mol Fe_2O_3~~ × 16.00 g O/1 ~~mol O~~ = 48.00 g O
Molar mass Fe_2O_3 = 159.7 g/mol Fe_2O_3
33.5 ~~g Fe_2O_3~~ × 1 mol Fe_2O_3/159.7 ~~g Fe_2O_3~~ = 0.210 mol Fe_2O_3

Step 3. 0.210 ~~mol Fe_2O_3~~ × 3 mol H_2/1 ~~mol Fe_2O_3~~ = 0.630 mol H_2

Step 4. 1 ~~mol H_2~~ × 2 ~~mol H~~/1 ~~mol H_2~~ × 1.01 g H/1 ~~mol H~~ = 2.02 g H
Molar mass H_2 = 2.02 g/mol H_2
0.630 ~~mol H_2~~ × 2.02 g H_2/1 ~~mol H_2~~ = 1.27 g H_2

2. Determine the mass in grams of copper(II) sulfide (Cu_2S) formed when 15.0 g copper(I) chloride (CuCl) reacts with excess hydrogen sulfide (H_2S) according to the following unbalanced chemical equation.

_____ $CuCl(aq)$ + _____ $H_2S(g) \rightarrow$ _____ $Cu_2S(s)$ + _____$HCl(aq)$

Step 1. $2CuCl(aq) + H_2S \rightarrow Cu_2S + 2HCl$

Step 2. 1 ~~mol CuCl~~ × 1 ~~mol Cu~~/1 ~~mol CuCl~~ × 63.55 g Cu/1 ~~mol Cu~~ = 63.55 g Cu
1 ~~mol CuCl~~ × 1 ~~mol Cl~~/1 ~~mol CuCl~~ × 35.45 g Cl/1 ~~mol Cl~~ = 35.45 g Cl
Molar mass CuCl = 99.00 g/mol CuCl
15.0 ~~g CuCl~~ × 1 mol CuCl/99.00 ~~g CuCl~~ = 0.152 mol CuCl

Step 3. 0.152 ~~mol CuCl~~ × 1 mol Cu_2S/2 ~~mol CuCl~~ = 0.0760 mol Cu_2S

Step 4. 1 ~~mol Cu_2S~~ × 2 ~~mol Cu~~/1 ~~mol Cu_2S~~ × 63.55 g Cu/1 ~~mol Cu~~ = 127.10 g Cu
1 ~~mol Cu_2S~~ × 1 ~~mol S~~/1 ~~mol Cu_2S~~ × 32.07 g S/1 ~~mol S~~ = 32.07 g S
Molar mass Cu_2S = 159.17 g/mol Cu_2S
0.0760 ~~mol Cu_2S~~ × 159.17 g Cu_2S/1 ~~mol Cu_2S~~ = 12.1 g Cu_2S

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 18

Unit Cells of Crystals

Use with Chapter 13, Section 13.3

1. Explain what a crystalline solid is.
A crystalline solid is a solid with an orderly, geometric, three-dimensional structure.

2. How many surfaces, or faces, do most crystal unit cells have? Which type of unit cell has a different number of faces? What is that number?
six; hexagonal system; eight

3. How many corners do most unit cells have? Which type of unit cell has a different number of corners? What is that number?
eight; hexagonal system; twelve

4. What do the letters a, b, and c in the transparency represent?
The letters represent the edges of the faces of a unit cell.

5. What do the symbols α, β, and γ represent?
The symbols represent the angles between the faces of a unit cell.

6. How many dimensions (length, width, depth) are needed to classify a unit cell?
three

7. How many faces are needed to determine the dimensions of a unit cell? **two**

8. How many angle measurements are needed to classify a unit cell? **three**

9. Identify the types of unit cells that have three equal dimensions.
cubic and rhombohedral

10. Identify the types of unit cells that have equal angles.
cubic, tetragonal, and orthorhombic

11. How does the cubic unit cell differ from the rhombohedral unit cell?
The three equal angles in the cubic unit cell are right angles; in the rhombohedral unit cell, the two equal angles are right angles.

12. Which unit cells meet the requirements a = b and α = β?
cubic, tetragonal, hexagonal, and rhombohedral

13. How does the triclinic unit cell differ from all the other unit cells?
In a triclinic unit cell, no angles are equal and no dimensions are equal.

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 19

Solving Gas Problems Using Boyle's Law

Use with Chapter 14, Section 14.1

1. What two variables are inversely proportional, as stated in Boyle's law?
Volume and pressure are inversely proportional.

2. What variable must be kept constant if you are solving a problem using Boyle's law?
Temperature must be kept constant.

3. What is the first step in solving pressure-volume gas problems?
Analyze the problem, and list the known variables and the unknown variable.

4. What is the equation for Boyle's law?
$P_1V_1 = P_2V_2$

5. How is the equation for Boyle's law rearranged before solving it?
The unknown variable is isolated on one side of the equation; that is, $P_2 = P_1(V_1/V_2)$

6. What is done to similar units in the numerator and the denominator in the final solving step?
Similar units in the numerator and the denominator are cancelled out.

7. What unit remains at the end? Is this the desired unit? Of what quantity is it a unit?
The remaining unit is kPa, which is the desired unit, describing pressure.

8. If the volume is almost doubled in a container at a fixed temperature, what will happen to the pressure?
If the volume is almost doubled, the pressure will be decreased by almost half if the temperature does not change.

9. In step 3, how would you evaluate the answer to see whether or not it is reasonable?
When the volume is approximately doubled, the pressure is expected to decrease by approximately half. The calculated value of 110 kPa is reasonable. The unit in the answer is kPa, a pressure unit.

10. If the known variables in a new problem are V_1, P_1, and P_2, rewrite the equation for Boyle's law to solve for the unknown variable.
To solve for the unknown variable V_2**, use** $V_2 = V_1(P_1/P_2)$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 20

Solving Gas Problems Using the Combined Gas Law

Use with Chapter 14, Section 14.2

1. Describe how pressure relates to volume and temperature in the combined gas law.
Pressure is inversely proportional to volume and directly proportional to temperature.

2. How does volume relate to temperature in the combined gas law?
Volume is directly proportional to temperature.

3. What is the equation for the combined gas law?
$P_1V_1/T_1 = P_2V_2/T_2$

4. Kelvin temperature is used in the combined gas law, not Celsius. How are Celsius degrees converted to Kelvin degrees?
Use the equation, $T_K = 273 + T_C$.

5. What is the first step in solving a combined gas law problem?
Analyze the problem, and list the known variables and the unknown variable.

6. How is the equation for the combined gas law rearranged before solving it?
The unknown variable is isolated on one side of the equation; that is, $V_2 = V_1(P_1/P_2)(T_2/T_1)$

7. What is done to similar units in the numerator and the denominator in the final solving step?
Similar units in the numerator and the denominator are cancelled out.

8. What unit remains at the end? Is this the desired unit? Of what quantity is it a unit?
The remaining unit is L, which is the desired unit, describing volume.

9. In step 3, how would you evaluate the answer to see whether or not it is reasonable?
Increasing the temperature causes the volume to increase, but increasing pressure causes the volume to decrease. Because the greater pressure change is much greater than the temperature change, the volume undergoes a net decrease. The calculated answer agrees with this. The unit is liters, a volume unit.

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 21

Solving Gas Problems Using the Ideal Gas Law

Use with Chapter 14, Section 14.3

1. What four variables does the ideal gas law describe?
The ideal gas law describes pressure, volume, temperature, and the number of moles.

2. What is the equation for the ideal gas law?
***PV* = *n*RT**

3. What is the first step in solving a combined gas law problem?
Analyze the problem, and list the known variables and the unknown variable.

4. What numerical value of the gas constant, R, is used to solve this problem? Explain your answer.
The R value used in this problem is 8.314 L·kPa/(mol·K) because the pressure of the gas in this problem is expressed in kPa, not atm or mm Hg.

5. What unit remains at the end? Is this the desired unit? Of what quantity is it a unit?
The remaining unit is mol, which is the desired unit, describing the number of moles, a quantity.

6. In step 3, how would you evaluate the answer to see whether or not it is reasonable?
The unit in the answer is in moles.

7. If you were asked to find the molar mass of a gas in an ideal gas law problem, what form of the ideal gas law equation would you use? Show how this equation is derived from the original form of the ideal gas law equation.
***PV* = *n*RT; Because the number of moles of a gas (*n*) is equal to the mass (*m*) divided by the molar mass (M), then the ideal gas law equation can be rewritten as *PV* = *m*RT/M or M = *m*RT/*PV*.**

8. What is Avogadro's principle and how does it relate to the ideal gas law?
Avogadro's principle states that equal volumes of gases at the same temperature and pressure contain equal numbers of particles. This principle translates into the conversion factor of 22.4 L/1 mol gas that may be used in the ideal gas law.

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 22

Calculating Percent by Mass, Mole Fraction, and Molality from Mass Measurements

Use with Chapter 15, Section 15.2

1. Calculate the percent by mass, mole fraction, and molality of a solution that contains 25.0 g of sodium chloride (NaCl) dissolved in 100.0 g of water.

Percent by Mass:

Percent by mass = mass of solute/mass of solution × 100

= mass of solute/(mass of solute + mass of solvent) × 100

= 25.0 g/(25.0 g + 100.0 g) = (25.0 ~~g~~/125.0 ~~g~~) × 100 = 20.0%

Mole Fraction:

$X_{NaCl} = n_{NaCl}/n_{NaCl} + n_{H_2O}$ = (mass of solute/molar mass of solute)/[(mass of solute/molar mass of solute) + (mass of solvent/molar mass of solvent)]

= (25.0 ~~g NaCl~~/58.44 ~~g NaCl~~/mol NaCl)/[(25.0 ~~g NaCl~~/58.44 ~~g NaCl~~/mol NaCl) + (100.00 ~~g H_2O~~/18.02 ~~g H_2O~~/mol H_2O)]

= 0.428 ~~mol~~/0.428 ~~mol~~ + 5.55 ~~mol~~ = 7.16×10^{-2}

$X_{NaCl} + X_{H_2O} = 1$

$X_{H_2O} = 1 - X_{NaCl}$

$X_{H_2O} = 1 - 0.0716$

$X_{H_2O} = 0.9284$

Molality:

Molality = moles of solute/kilogram of solvent = 0.428 mol NaCl/(100.0 ~~g~~ H_2O × 1 kg/1000 ~~g~~)

= 4.28 mol NaCl/kg H_2O

= 4.28*m*

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET **23**

Calculating Boiling Points and Freezing Points of Solutions

Use with Chapter 15, Section 15.3

1. What is the boiling point of a 1.5*m* aqueous solution of fructose ($C_6H_{12}O_6$)? The boiling point elevation constant of water is 0.515°C/*m*. Assume solute is a nonelectrolyte.

$T_{b_{solution}} = T_{b_{solvent}} + m_{solute}K_{b_{solvent}}$

$= 100°C + (1.5\cancel{m})(0.515°C/\cancel{m}) = 100°C + 0.77°C$

$= 100.77°C$

2. What is the freezing point of a solution of 1.5*m* aqueous solution of potassium bromide (KBr)? The freezing point depression constant of water is 1.86°C/*m*. Assume 100% dissociation.

$T_{f_{solution}} = T_{f_{solvent}} - m_{solute}K_{f_{solvent}}$

$= 0°C - (2)(1.5\cancel{m})(1.86°C/\cancel{m}) = 0°C - 5.6°C$

$= -5.6°C$

3. Calculate the freezing point of a solution of a 0.975*m* aqueous solution of calcium nitrate ($Ca(NO_3)_2$). Assume 100% dissociation.

$T_{f_{solution}} = T_{f_{solvent}} - m_{solute}K_{f_{solvent}}$

$= 0°C - (3)(0.975\cancel{m})(1.86°C/\cancel{m}) = 0°C - 5.44°C$

$= -5.44°C$

4. What is the boiling point of a solution of 20.0 g carbon tetrachloride (CCl_4) dissolved in 250.0 g of benzene (C_6H_6)? The boiling point of benzene is 80.10°C, and its boiling point elevation constant is 2.53°C/*m*. Assume solute is a nonelectrolyte.

$20.0\ \cancel{g\ CCl_4} \times 1\ mol\ CCl_4/153.81\ \cancel{g\ CCl_4} = 0.130\ mol\ CCl_4$

Molality = moles of solute/kilograms of solvent

$= 0.130\ mol\ CCl_4/0.250\ kg\ C_6H_6 = 0.520m$

$T_{b_{solution}} = T_{b_{solvent}} + m_{solute}K_{b_{solvent}}$

$= 80.10°C + (0.520\cancel{m})(2.53°C/\cancel{m}) = 80.10°C + 1.32°C$

$= 81.42°C$

5. Calculate the boiling point for a solution of 25.0 g calcium nitrate ($Ca(NO_3)_2$) dissolved in 100.0 g of water. Assume 100% dissociation.

$25.0\ \cancel{g\ Ca(NO_3)_2} \times (1\ mol\ Ca(NO_3)_2/164.10\ \cancel{g\ Ca(NO_3)_2}) = 0.152\ mol\ Ca(NO_3)_2$

Molality = moles of solute/kilograms of solvent

$= 0.152\ mol\ Ca(NO_3)_2/0.100\ kg\ H_2O = 0.152m$

$T_{b_{solution}} = T_{b_{solvent}} + m_{solute}K_{b_{solvent}}$

$= 100°C + (3)(0.152\cancel{m})(0.515°C/\cancel{m}) = 100°C + 0.235°C$

$= 100.235°C$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET **24**

Determining the Heat Capacity of a Calorimeter

Use with Chapter 16, Section 16.2

1. Why is it unnecessary to know the mass of the calorimeter apparatus to determine its heat capacity?

The heat capacity of the calorimeter is the total amount of heat absorbed or released by the apparatus and does not depend on how much mass is involved.

2. You are using a calorimetry experiment to determine the amount of heat absorbed when a solid melts. How would the results be affected if the heat capacity of the calorimeter was not included in your calculations? Why?

The amount of heat absorbed would be determined to be less than it should be. The heat released by the calorimeter was not accounted for in the determination.

3. What is the mathematical relationship for heat from the hot water?

Heat = mass of hot water × specific heat of water × temperature change

4. What is the mathematical relationship for heat from the cold water?

Heat = mass of cold water × specific heat of water × temperature change

5. Why does the calorimeter apparatus use a heat capacity rather than a specific heat?

Specific heat is used to describe a pure substance. A calorimeter apparatus is composed of many substances. Rather than using many specific heats to describe the apparatus, these are combined into a single relationship known as the heat capacity.

6. Determine the heat capacity of a calorimeter using the following data.

	Mass	Initial Temperature	Final Temperature
Hot water	150.0 g	45.0°C	36.8°C
Cold water	100.0 g	25.0°C	36.8°C

17.7 J/°C = Heat Capacity

Solution

$-(150.0\ g \times 4.184\ J/g{\cdot}°C \times (36.8°C - 45.0°C)) =$

$(100.0\ g \times 4.184\ J/g{\cdot}°C \times (36.8°C - 25.0°C)) + (Heat\ Capacity \times (36.8°C - 25.0°C))$

$5146.32\ J = 4937.12\ J + (Heat\ Capacity \times (11.8°C))$

$209.2\ J/11.8°C = Heat\ Capacity$

$17.7\ J/°C = Heat\ Capacity$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 25

Hess's Law

Use with Chapter 16, Section 16.4

1. In the example, what type of reactions are described in the starting equations?

They are examples of formation reactions.

2. What must be done to the formation reaction for hydrogen chloride to obtain the target equation?

This equation must be reversed, the equation and enthalpy multiplied by 2, and the sign of the enthalpy changed.

3. What must be done to the formation reaction for water to obtain the target equation?

This equation does not change.

4. How can the enthalpy for the target reaction be obtained?

The resulting values for the enthalpy for each reaction are added after all mathematical rearrangements have been completed.

5. Calculate $\Delta H°$ for the target reaction: $2Al(s) + Fe_2O_3(s) \rightarrow 2Fe(s) + Al_2O_3(s)$. Show your work. Use the following reactions and enthalpies.

$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$ $\quad \Delta H° = -3351.4$ kJ

$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ $\quad \Delta H° = -1648.4$ kJ

$\Delta H° = -851.5$ kJ

Solution:

$2Fe_2O_3(s) \rightarrow 4Fe(s) + 3O_2(g)$ $\quad \Delta H° = +1648.4$ kJ

$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$ $\quad \Delta H° = -3351.4$ kJ

$4Al(s) + 3O_2(g) + 2Fe_2O_3(s) \rightarrow 2Al_2O_3(s) + 4Fe(s) + 3O_2(g)$

$\Delta H° = (-3351.4 \text{ kJ}) + (+1648.4 \text{ kJ})$

Cancelling terms gives:

$4Al(s) + 2Fe_2O_3(s) \rightarrow 2Al_2O_3(s) + 4Fe(s)$ $\quad \Delta H° = -1703.0$ kJ

This is twice the target reaction. Dividing by 2 gives:

$2Al(s) + Fe_2O_3(s) \rightarrow Al_2O_3(s) + 2Fe(s)$ $\quad \Delta H° = -851.5$ kJ

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 26

Determining Spontaneity

Use with Chapter 16, Section 16.5

1. The term $T\Delta S$ always has the same sign as ΔS. Explain why this is so.

Temperature, T, is in kelvins and kelvin temperatures have only positive values.

A positive value multiplied by another value assumes the sign of that other value.

2. A gas has a very large ΔH and a very small ΔS. Both values have negative signs. What can you say about the temperature below which condensation will be spontaneous?

The temperature below which condensation is spontaneous will be rather high.

A very large number divided by a very small one will give a relatively large result.

The result in this case is the temperature.

3. A chemical reaction has a ΔH of $+135.5$ kJ/mol and a ΔS of $+148.9$ J/ mol·K. Will this reaction be spontaneous at a temperature of 750°C? Show your work.

The reaction will be spontaneous.

Solution:

$T = 750°C + 273 = 1023$ K

$\Delta G = \Delta H - T\Delta S = (135.5 \text{ kJ/mol}) - (1023 \text{ K} \times (148.9 \text{ J/mol·K})(1 \text{ kJ}/1000 \text{ J}))$

$\Delta G = (135.5 \text{ kJ/mol}) - (152.3 \text{ kJ/mol}) = -16.8$ kJ

The sign of ΔG indicates heat is released, so the reaction is spontaneous at this temperature.

4. Use the data given in question 3 to determine the temperature at which the reaction will be in equilibrium. Give your answer in kelvins. Show your work.

The equilibrium temperature is 910.0 K.

Solution:

$\Delta G = 0$ at equilibrium, so $\Delta H = T\Delta S$

$T = \Delta H \div \Delta S = (135.5 \text{ kJ/mol}) \div (148.9 \text{ J/mol·K})(1 \text{ kJ}/1000 \text{ J})$

$T = 910.0$ K

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 27

Determining Reaction Orders

Use with Chapter 17, Section 17.3

Use the following data to determine the order of the reaction for each reactant.

Experimental Initial Rates for $aA + bB \rightarrow$ products			
Trial	**Initial [A] (*M*)**	**Initial [B] (*M*)**	**Initial Rate (mol/L·s)**
1	0.10	0.30	7.20×10^{-3}
2	0.10	0.60	1.44×10^{-2}
3	0.20	0.90	8.64×10^{-2}

Assume that the general rate law for this type of reaction is Rate $= k[A]^m[B]^n$

1. Determine n by comparing trials 1 and 2. Follow Steps 1–5 shown on the transparency.

Step 1. **Rate 1 = $k[A_1]^m[B_1]^n$; Rate 2 = $k[A_2]^m[B_2]^n$**

Step 2. **Rate 2 = 2 Rate 1**

Step 3. **$k[A_2]^m[B_2]^n = 2k[A_1]^m[B_1]^n$**

Step 4. **$[A_2] = [A_1]$ $[B_2] = 2[B_1]$**

Step 5. **$k[A_1]^m(2[B_1])^n = 2k[A_1]^m[B_1]^n$**

$\cancel{k}\cancel{[A_1]^m}(2)^n\cancel{[B_1]^n} = 2\cancel{k}\cancel{[A_1]^m}\cancel{[B_1]^n}$

$(2)^n = 2$; $n = 1$

2. Determine m by comparing trials 2 and 3. Follow Steps 1–5 shown on the transparency.

Step 1. **Rate 2 = $k[A_2]^m[B_2]^n$; Rate 3 = $k[A_3]^m[B_3]^n$**

Step 2. **Rate 3 = 6 Rate 2**

Step 3. **$k[A_3]^m[B_3]^n = 6k[A_2]^m[B_2]^n$**

Step 4. **$[A_3] = 2[A_2]$ $[B_3] = 1.5[B_2]$**

Step 5. **$k(2[A_2])^m(1.5[B_2])^n = 6k[A_2]^m[B_2]^n$**

$\cancel{k}(2)^m\cancel{[A_2]^m}(1.5)^n\cancel{[B_2]^n} = 6\cancel{k}\cancel{[A_2]^m}\cancel{[B_2]^n}$; From Question 1, you know $n = 1$.

$(2)^m(1.5)^1 = 6$; $(2)^m = 6/1.5 = 4$; $m = 2$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 28

Determining Equilibrium

Use with Chapter 18, Section 18.1

The equilibrium constants for the reactions in the table are correct at a certain temperature. The concentrations given in the table, however, may or may not be correct when the system is at equilibrium at that temperature. Use the information in the table to answer the following questions.

1. On the basis of the K_{eq} values given in the table, which reaction mixture contains the largest amount of product(s) when at equilibrium? Explain.

The reaction mixture $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ contains the largest amount of products when at equilibrium because it has the highest equilibrium constant.

2. Which reaction mixture contains the largest amount of reactants when at equilibrium? Explain.

The reaction mixture $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ contains the largest amount of reactants when at equilibrium because it has the lowest equilibrium constant.

3. Which reactions in the table have concentrations that represent the systems at equilibrium? Explain.

Reactions 1, 2, and 4 have concentrations that represent systems at equilibrium.

Reaction 1: $[C_2H_2][H_2]^3/[CH_4]^2 = [0.194][0.582]^3/[0.500]^2 = 0.153$.

Reaction 2: $[NH_3][CO]/[HCONH_2] = [0.30][0.30]/[1.9 \times 10^{-2}] = 4.7$.

Reaction 3: $[PCl_3][Cl_2]/[PCl_5] = [0.45][0.22]/[0.30] = 0.33$, which is too small.

Reaction 4: $[NO_2]^2/[N_2O_4] = [5.60 \times 10^{-2}]^2/[0.754] = 4.16 \times 10^{-3}$.

Reaction 5: $[HI]^2/[H_2][I_2] = [0.780]^2/[0.110][0.500] = 11.1$, which is too small.

4. For each reaction that is not at equilibrium, change the concentration of *only one* of the reactants or products so that the ratio represents the system at equilibrium.

For reaction 3, the concentrations give a ratio that is too small to represent the system at equilibrium. Lower the concentration of PCl_5 to 0.055*M*, raise the concentration of PCl_3 to 2.5*M*, or raise the concentration of Cl_2 to 1.2*M*.

For reaction 5, the concentrations give a value for the equilibrium constant that is too small. Either lower the concentration of one of the reactants, H_2 or I_2, or raise the concentration of the product. For example, you could lower the concentration of H_2 from 0.110*M* to 2.42×10^{-2}*M*.

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MATH SKILLS TRANSPARENCY WORKSHEET 29

Using Solubility Product Constants

Use with Chapter 18, Section 18.3

Use the list of solubility product constants (K_{sp}) to answer the following questions. Avoid doing detailed calculations. Try to estimate the answers as much as possible and provide a short justification for your reasoning.

1. Write the solubility product constant expression for each of the following salts.

a. PbI_2 $K_{sp} = [Pb^{2+}][I^-]^2$

b. Ag_3PO_4 $K_{sp} = [Ag^+]^3[PO_4^{3-}]$

2. What is the solubility of $PbSO_4$ in water at 298 K?

The solubility of $PbSO_4$ would be on the order of 10^{-4} (actually 1.6×10^{-4}). Each mole of $PbSO_4$ yields 1 mole of Pb^{2+} and 1 mole of SO_4^{2-}, therefore, the concentrations of these ions at equilibrium are equal. The solubility of the mixture is the square root of the solubility product constant.

3. What is the approximate concentration of fluorine in a CaF_2 solution?

The approximate concentration of fluorine is between 2×10^{-4} and $2 \times 10^{-3}M$. Because the K_{sp} expression for this compound is $[Ca^{2+}][F^-]^2$, the solubility of calcium ions is approximately the cube root of the K_{sp}. Because the concentration of fluorine ions is twice this (every CaF_2 molecule produces two fluorine ions for every one calcium ion), multiply the concentration of Ca^{2+} ions by two.

4. A chemist finds that 4.6×10^{-5} moles of Ag_2SO_4 dissolves in a liter of a certain solvent. Is the solvent water or $AgNO_3$ solution? Explain.

From the K_{sp} expression for Ag_2SO_4, the solubility of Ag_2SO_4 is determined to be approximately the cube root of 1.2×10^{-5}, or $2.3 \times 10^{-2}M$. Because this value is much larger than 4.6×10^{-5}, the solvent must be $AgNO_3$. The lower solubility is an indication that a common ion, Ag^+, is present.

5. Will a precipitate form if a $0.075M$ $MgCl_2$ solution is added to an equal amount of a $0.25M$ NaOH solution? Explain.

The precipitate $Mg(OH)_2$ will form. The solubility product constant expression for this compound is $[Mg^{2+}][OH^-]^2 = K_{sp}$. The concentrations of Mg^{2+} and OH^- in the mixed solution can be calculated from the concentrations of the initial solution. This gives a value of 5.8×10^{-4}. Because this value is much higher than the K_{sp} for $Mg(OH)_2$, which is on the order of 10^{-12}, a precipitate will form.

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MATH SKILLS TRANSPARENCY WORKSHEET 30

Powers of Ten Related to Acid and Base Equilibria

Use with Chapter 19, Section 19.2

1. What is the main advantage of writing large or small numbers in scientific notation?

Answers will vary but may include being more concise or convenient.

2. Write each of the following values for K_a and K_b in scientific notation.

a. acetic acid: $K_a = 0.000018$ 1.8×10^{-5}

b. phenol: $K_a = 0.00000000010$ 1.0×10^{-10}

c. carbonic acid: $K_a = 0.00000045$ 4.5×10^{-7}

d. diethylamine: $K_b = 0.00086$ 8.6×10^{-4}

e. ethanolamine: $K_b = 0.000032$ 3.2×10^{-5}

f. oxalic acid: $K_a = 0.056$ 5.6×10^{-2}

g. phosphoric acid: $K_a = 0.0072$ 7.2×10^{-3}

h. pyridine: $K_b = 0.0000000017$ 1.7×10^{-9}

3. A $0.020M$ hypobromous acid (HBrO) solution has a hydrogen ion concentration of $6.8 \times 10^{-6}M$. Find K_a for this acid.

$K_a = [H^+][BrO^-]/[HBrO] = (6.8 \times 10^{-6})(6.8 \times 10^{-6})/2.0 \times 10^{-2}$
$= (6.8 \times 6.8)(6.8 \times 10^{-6-6})/2.0 \times 10^{-2}$

$= 46 \times 10^{-12}/2.0 \times 10^{-2} = 23 \times 10^{-12-(-2)} = 23 \times 10^{-10} = 2.3 \times 10^{-9}$

4. A $0.15M$ solution of boric acid (H_3BO_3) has a $H_2BO_3^-$ ion concentration of $9.3 \times 10^{-6}M$. Calculate K_a for this acid.

$K_a = [H^+][H_2BO_3^-]/[H_3BO_3] = (9.3 \times 10^{-6})(9.3 \times 10^{-6})/1.5 \times 10^{-1}$
$= (9.3 \times 9.3)(10^{-6-6})/1.5 \times 10^{-1}$

$= 86 \times 10^{-12}/1.5 \times 10^{-1} = 57 \times 10^{-12-(-1)} = 57 \times 10^{-11} = 5.7 \times 10^{-10}$

5. Ammonia (NH_3) gas dissolves in water to form a base. The concentration of ammonium ions (NH_4^+) in a $0.36M$ ammonia solution equals the concentration of hydroxide ions and is $2.5 \times 10^{-3}M$. Find K_b for ammonia.

$K_b = [NH_4^+][OH^-]/[NH_3] = (2.5 \times 10^{-3})(2.5 \times 10^{-3})/3.6 \times 10^{-1}$
$= (2.5 \times 2.5)(10^{-3-3})/3.6 \times 10^{-1}$

$= 6.3 \times 10^{-6}/3.6 \times 10^{-1} = 1.8 \times 10^{-6-(-1)} = 1.8 \times 10^{-5}$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 31

Logs and Antilogs Related to pH and pOH

Use with Chapter 19, Section 19.3

1. In your own words, define a logarithm.
A logarithm is the exponent to which 10 must be raised to equal a specified number.

2. In your own words, define an antilogarithm.
An antilogarithm equals the number for which the logarithm is the power of ten.

3. How many times more acidic is a solution with a pH of 3 compared to one with a pH of 6?
10^3, or 1000

4. Calculate the pH and pOH of each of the following solutions.

a. $[H^+] = 1.0 \times 10^{-4} M$ **pH = $-\log(1.0 \times 10^{-4})$ = 4.00; pOH = 14.00 − 4.00 = 10.00**

b. $[H^+] = 7.9 \times 10^{-6} M$ **pH = $-\log(7.9 \times 10^{-6})$ = 5.10; pOH = 14.00 − 5.10 = 8.90**

c. $[OH^-] = 1.0 \times 10^{-2} M$ **pOH = $-\log(1.0 \times 10^{-2})$ = 2.00; pH = 14.00 − 2.00 = 12.00**

d. $[OH^-] = 2.3 \times 10^{-8} M$ **pOH = $-\log(2.3 \times 10^{-8})$ = 7.64; pH = 14.00 − 7.64 = 6.36**

5. For each of the following solutions, if pH is given, find pOH. If pOH is given, find pH.

a. pOH = 1.2 **14.0 − 1.2 = 12.8**

b. pOH = 7.0 **14.0 − 7.0 = 7.0**

c. pH = 9.3 **14.0 − 9.3 = 4.7**

d. pH = 13.5 **14.0 − 13.5 = 0.5**

6. Determine $[H^+]$ and $[OH^-]$ for each of these solutions.

a. pH = 3.0
$[H^+] = 10^{-3.0} = 1.00 \times 10^{-3} M$; $[OH^-] = 1.00 \times 10^{-14}/(1.00 \times 10^{-3}) = 1.00 \times 10^{-11} M$

b. pH = 5.7
$[H^+] = 10^{-5.7} = 2.00 \times 10^{-6} M$; $[OH^-] = 1.00 \times 10^{-14}/(2.00 \times 10^{-6}) = 5.00 \times 10^{-9}$

c. pOH = 9.7
$[OH^-] = 10^{-9.7} = 2.00 \times 10^{-10} M$; $[H^+] = 1.00 \times 10^{-14}/(2.00 \times 10^{-10}) = 5.00 \times 10^{-5} M$

d. pOH = 12.3
$[OH^-] = 10^{-12.3} = 5.01 \times 10^{-13} M$; $[H^+] = 1.00 \times 10^{-14}/(5.01 \times 10^{-13}) = 2.00 \times 10^{-2} M$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 32

Calculating Standard Cell Potentials

Use with Chapter 21, Section 21.1

1. How do you decide which half-reaction will proceed as a reduction and which will proceed as an oxidation?
The half-reaction with the higher reduction potential will proceed as a reduction. The half-reaction with the lower reduction potential will proceed as an oxidation.

2. How do you decide in which direction to write the half-reactions?
The reduction half-reaction is written in the forward direction. The oxidation half-reaction is written in the reverse direction.

3. Will the overall cell reaction shown on the transparency proceed spontaneously? Explain why or why not.
Yes, it will proceed spontaneously because the standard cell potential is positive.

The following questions pertain to a voltaic cell in which the following half-reactions occur:

$S(s) + 2e^- \rightarrow S^{2-}(aq)$ $\quad E^0_{S|S^{2-}} = -0.476\ V$

$Ca^{2+}(aq) + 2e^- \rightarrow Ca(s)$ $\quad E^0_{Ca^{2+}|Ca} = -2.868\ V$

4. Which half-reaction will proceed as a reduction?
The sulfur half-reaction will proceed as a reduction.

5. Which half-reaction will proceed as an oxidation?
The calcium half-reaction will proceed as an oxidation.

6. Rewrite the half-reactions in the correct directions.
$S(s) + 2e^- \rightarrow S^{2-}(aq)$ $\quad Ca(s) \rightarrow Ca^{2+}(aq) + 2e^-$

7. Write a balanced equation for the overall cell reaction.
$S(s) + Ca(s) \rightarrow S^{2-}(aq) + Ca^{2+}(aq)$

8. Calculate the standard cell potential.
$E^0_{cell} = E^0_{reduction} - E^0_{oxidation}$; −0.476 V − (−2.868 V) = +2.392 V

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MATH SKILLS TRANSPARENCY WORKSHEET 33

Comparing the Performance of Batteries

Use with Chapter 21, Section 21.2

The transparency shows how the voltage of two batteries changes when they are used to power the same kind of electrical device.

1. What is the starting voltage of each battery?
   9 V for both batteries

2. What is the remaining voltage of each battery after 100 minutes?
   alkaline battery, about 6.8 V; nickel–cadmium battery, about 6.5 V

3. If the device requires a voltage of at least 6 V to work properly, how long will it work with each battery?
   about 300 min (5 h) with the alkaline battery; about 120 min (2 h) with the nickel–cadmium battery

4. How many of each battery would you need to keep the device working for 5 days if you replaced each battery when its voltage dropped to 6 V?
   5 days × (24 h/day) = 120 h
   alkaline battery: 120 h ÷ (5 h/battery) = 24 batteries
   nickel–cadmium battery: 120 h ÷ (2 h/battery) = 60 batteries

5. Alkaline batteries are not rechargeable. Suppose each alkaline battery costs $1.25. How much would it cost to run the device for 5 days with alkaline batteries if you replaced each worn-out battery with a new one?
   24 batteries × ($1.25/battery) = $30.00

6. Nickel–cadmium batteries are rechargeable. Suppose each nickel–cadmium battery costs $10.00, and a battery charger costs $20.00. How much would it cost to run the device for 5 days with nickel–cadmium batteries if you recharged them? (Assume you use two nickel–cadmium batteries, and that one battery can be fully recharged while the other keeps the device running. Include the cost of the charger, but ignore the cost of electricity to recharge the batteries.)
   $20.00 + $10.00 + $10.00 = $40.00

7. How long would you have to run the device before the cost of replacing alkaline batteries exceeded the cost of two nickel–cadmium batteries and a charger?
   $40.00 ÷ ($1.25/battery) = 32 batteries
   32 batteries × (5 h/battery) = 160 h, or 6 days 16 h

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MATH SKILLS TRANSPARENCY WORKSHEET 34

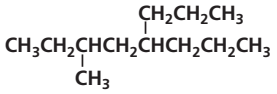
Naming and Drawing Alkanes

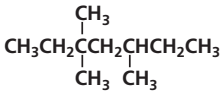
Use with Chapter 22, Section 22.1

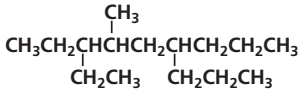
Name the structures labeled 1 through 14 on the transparency.

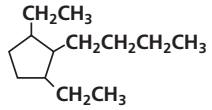
1. **butane**
2. **hexane**
3. **decane**
4. **3-methylhexane**
5. **2-methylhexane**
6. **3-methylheptane**
7. **3,5-dimethylheptane**
8. **4-ethyl-4-propylheptane**
9. **3,5-diethyloctane**
10. **3,4,6,7-tetraethylnonane**
11. **3,6-diethyl-4-methyl-7-propyldecane**
12. **cyclopentane**
13. **1,2-dimethylcyclobutane**
14. **1-ethyl-3-methylcyclohexane**

Draw the structures of alkanes 15 through 18 on the transparency.

15. 

16. 

17. 

18. 

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MATH SKILLS TRANSPARENCY WORKSHEET **35**

Comparing Alkanes, Alkenes, and Alkynes

Use with Chapter 22, Section 22.2

1. How many carbon and hydrogen atoms are in each of the following alkanes?

a. ethane, CH_3CH_3 — 2 carbons — 6 hydrogens

b. propane, $CH_3CH_2CH_3$ — 3 carbons — 8 hydrogens

c. butane, $CH_3(CH_2)_2CH_3$ — 4 carbons — 10 hydrogens

2. If an alkane has *n* carbon atoms, how many hydrogen atoms will it have?

2*n* + 2

3. How many carbon and hydrogen atoms are in each of the following alkenes?

a. ethene, $CH_2{=}CH_2$ — 2 carbons — 4 hydrogens

b. propene, $CH_2{=}CHCH_3$ — 3 carbons — 6 hydrogens

c. 1-butene, $CH_2{=}CHCH_2CH_3$ — 4 carbons — 8 hydrogens

4. If an alkene has *n* carbon atoms and one double bond, how many hydrogen atoms will it have?

2*n*

5. How many carbon and hydrogen atoms are in each of the following alkynes?

a. ethyne, $CH{\equiv}CH$ — 2 carbons — 2 hydrogens

b. propyne, $CH{\equiv}CCH_3$ — 3 carbons — 4 hydrogens

c. 1-butyne, $CH{\equiv}CCH_2CH_3$ — 4 carbons — 6 hydrogens

6. If an alkyne has *n* carbon atoms and one triple bond, how many hydrogen atoms will it have?

2*n* − 2

7. Look carefully at the ball-and-stick models and space-filling models of ethane, ethene, and ethyne. Describe the spatial arrangement of the atoms in each molecule.

The atoms in ethane do not lie in a single plane.

The atoms in ethene lie in a single plane.

The atoms in ethyne lie along a single line.

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MATH SKILLS TRANSPARENCY WORKSHEET **36**

Hydrocarbon Density

Use with Chapter 22, Section 22.2

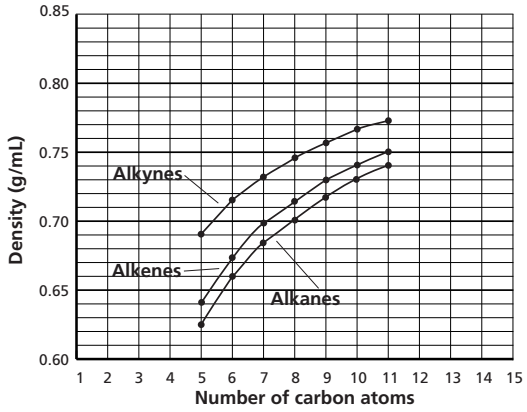
1. Describe the relationship between the number of carbon atoms and the density of hydrocarbons.

As the number of carbon atoms increases, the density increases.

2. How does density vary among alkanes, alkenes, and alkynes with the same number of carbon atoms?

Akynes are denser than alkenes, and alkenes are denser than alkanes.

3. On the grid below, plot the density of each series of hydrocarbons versus the number of carbon atoms. Connect the data points for each series with a smooth curve. Label all three curves and both axes.



4. Use the curves that you drew to predict the density of the following 12-carbon hydrocarbons.

$CH_3(CH_2)_{10}CH_3$ **measured value is 0.749 g/mL; accept values that are close**

$CH_2{=}CH(CH_2)_9CH_3$ **measured value is 0.758 g/mL; accept values that are close**

$CH{\equiv}C(CH_2)_9CH_3$ **measured value is 0.779 g/mL; accept values that are close**

5. Suppose you were asked to predict the density of a straight-chain hydrocarbon with 15 carbon atoms. Would you have as much confidence in your prediction as you do for your prediction about 12-carbon hydrocarbons? Explain why or why not.

No; slight errors in extrapolating are magnified as you get farther from the plotted data points.

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MATH SKILLS TRANSPARENCY WORKSHEET 37

Naming Organic Compounds

Use with Chapter 23, Section 23.1

The table shows the prefixes used in naming functional groups such as those found in alkyl halides. Each prefix corresponds to the number of atoms or functional groups.

1. How many chlorine atoms are there in a molecule of 1,1-dibromo-2,3,3-trichloro-2,4,5,6-tetraiodohexane? **three**

a. How many bromine atoms are there in that molecule? **two**

b. How many iodine atoms are there in the molecule? **four**

c. Find the total number of halogen atoms in the molecule. **3 + 2 + 4 = 9**

d. How many carbon atoms are there in the molecule? **six**

e. Given what you know about bonding in alkanes and substituted alkanes, find the number of hydrogen atoms in the molecule. Explain your reasoning.
There must be a total of 14 single bonds to the 6 bonded carbon atoms. Nine are already accounted for by the halogen atoms, so the number of hydrogen atoms must be 14 − 9 = 5.

2. How many fluorine atoms are there in a molecule of 1,2-difluoro-3,5,6-triiodobenzene? **two**

a. How many iodine atoms are there in that molecule? **three**

b. Find the total number of halogen atoms in the molecule. **2 + 3 = 5**

c. How many carbon atoms are there in the molecule? Explain.
Six; a benzene ring always has six carbon atoms.

d. Given what you know about bonding in substituted aryl compounds, find the number of hydrogen atoms in the molecule. Explain your reasoning.
There must be a total of six single bonds to the six bonded carbon atoms in the ring. Five are already accounted for by the halogen atoms, so the number of hydrogen atoms must be 6 − 5 = 1.

3. Use the table of prefixes to figure out the names of the compounds labeled *A*, *B*, *C*, and *D*. Remember to use numerals to indicate the positions of the halogen atoms in the molecules. Keep in mind that the halogens must be listed alphabetically and that the numbers are assigned so as to be as low as possible for the first halogen listed.

a. compound A **1,2,2-tribromo-4,4-dichloro-3-fluoroheptane**

b. compound B **1,4-dibromo-3-chloro-4,5,5-triiodocyclooctane**

c. compound C **1,3-dichloro-2,4,5-trifluoro-6-iodobenzene**

d. compound D **1-bromo-2-chloro-4,5-difluorobenzene**

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 38

Using *n* to Calculate Molecular Masses of Polymers

Use with Chapter 23, Section 23.5

1. In general, what is the structural unit of a polymer?
the repeating group of atoms in the polymer formed by the bonding of monomers

2. What does the letter *n* symbolize when used in reference to a polymer chain?
the number of structural units that make up the chain

3. How can the value of *n* be used to calculate the approximate molecular mass of a polymer, given a table of atomic masses and knowledge of the structural unit of the polymer?
Find the mass of the structural unit by summing the masses of the atoms that make up the structural unit, then multiply the sum by *n*.

4. Look at the polyvinyl chloride chain on the transparency. Its structural unit is shown in brackets. What is the mass of the structural unit? (Assume the following approximate atomic masses: H = 1.0 amu, C = 12.0 amu, Cl = 35.5 amu.)
(1.0 amu/H × 3 H) + (12.0 amu/C × 2 C) + (35.5 amu Cl × 1 Cl) = 62.5 amu

5. What is the approximate molecular mass of a polyvinyl chloride chain with 700 structural units?
700 × 62.5 amu = 43 750 amu = (rounded) 43 800 amu

6. What is the mass of the structural unit of polystyrene?
(1.0 amu/H × 8 H) + (12.0 amu/C × 8 C) = 104.0 amu

7. What is the approximate molecular mass of a polystyrene chain with 1250 structural units?
1250 × 104.0 amu = 130 000 amu

8. What is the mass of the structural unit of polyethylene?
(1.0 amu/H × 4 H) + (12.0 amu/C × 2 C) = 28.0 amu

9. What is the approximate molecular mass of a polyethylene chain with 900 structural units?
900 × 28.0 amu = 25 200 amu

10. What is the mass of the structural unit of nylon 6,6? (Assume the following atomic masses: O = 16.0 amu, N = 14.0 amu.)
(1.0 amu/H × 22 H) + (12.0 amu/C × 12 C) + (16.0 amu/O × 2 O) + (14.0 amu/N × 2 N) = 226.0 amu

11. What is the approximate molecular mass of a nylon 6,6 chain with 1750 structural units?
1750 × 226.0 amu = 395 500 amu

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 39

Enzyme Activity and pH

Use with Chapter 24, Section 24.1

Enzyme activity is a measure of how much an enzyme can speed up a chemical reaction. The four graphs on the transparency show how the activity of four enzymes varies with pH.

1. At what pH is each enzyme most active?

pepsin, pH 2; trypsin, pH 8; cholinesterase, pH 7 and above; papain, pH 4 and above

2. Which enzymes would be active to some degree at the following pH values?

pH 3 **pepsin**

pH 7 **trypsin, cholinesterase, papain**

pH 11 **cholinesterase, papain**

3. Which enzyme has an activity that is not affected by pH?

papain

4. Suppose you have a solution of trypsin and a solution of cholinesterase, both at pH 7. You add enough NaOH to change the pH of each solution by one pH unit. How would that pH change affect the activity of each enzyme if the enzyme's substrate was present? Explain your reasoning.

Because NaOH is a base, the pH would increase from 7 to 8. Trypsin is most active at pH 8, so its activity would increase. Cholinesterase has the same activity above pH 7, so its activity would not change.

5. Both pepsin and trypsin catalyze the breakdown of proteins as you digest your food. During digestion, your stomach secretes digestive fluid that has a pH of 2, whereas the fluid in your small intestine has a neutral or slightly alkaline pH. In which organ would you expect to find each enzyme? Explain your reasoning.

You would expect to find pepsin in the stomach because it is most active at pH 2. You would expect to find trypsin in the small intestine because it is most active at pH 8, which is slightly alkaline.

6. Suppose you have an aqueous solution with an H_3O^+ concentration of $3.2 \times 10^{-5} M$. Which enzymes would be active to some degree in that solution? (Hint: Recall that pH $= -\log [H_3O^+]$.)

pH = −log (3.2 × 10^{-5}) = 4.49. Cholinesterase and papain are active at that pH.

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 40

From DNA to Protein

Use with Chapter 24, Section 24.4

The transparency shows how a bacterial cell uses the genetic information in its DNA to make a protein with a specific amino acid sequence.

1. The DNA in a bacterial cell contains about 4.2×10^6 nucleotide base pairs. RNA is made from DNA at a rate of about 60 nucleotides per second. How long would it take a bacterial cell to produce an RNA molecule containing all of the genetic information in its DNA?

The transparency indicates that RNA is made from one of the nucleotides in each base pair, so all of the genetic information is contained in 4.2×10^6 nucleotides.

4.2×10^6 nucleotides × (1 s/60 nucleotides) = 7×10^4 s, or 19 h

2. Each amino acid is specified by a group of RNA nucleotides called a codon. The maximum number of different amino acids that can be specified is 4^x, where x is the number of nucleotides in a codon. How many different amino acids could be specified if $x = 1$? If $x = 2$? If $x = 3$? If $x = 4$?

$x = 1$ **4** $x = 2$ **16** $x = 3$ **64** $x = 4$ **256**

3. What is the minimum codon size needed to specify all 20 of the amino acids commonly found in proteins?

3 nucleotides

4. Suppose a strand of RNA contains 36 nucleotides. If all of the codons in the RNA are translated into amino acids, how many amino acids will be in the polypeptide that is formed?

36 nucleotides × (1 codon/3 nucleotides) × (1 amino acid/codon) = 12 amino acids

5. How many different amino acid sequences are possible for a polypeptide that is translated from a 36-nucleotide strand of RNA?

$20^{12} = 4.096 \times 10^{15}$ sequences

6. An average-sized protein contains about 400 amino acids. How many RNA nucleotides would be needed to code for such a protein?

400 amino acids × (1 codon/amino acid) × (3 nucleotides/codon) = 1200 nucleotides

7. How many average-sized proteins could the DNA in a bacterial cell code for? (See question 1.)

4.2×10^6 nucleotides × (1 protein/1200 nucleotides) = 3500 proteins

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 41

Balancing Nuclear Equations

Use with Chapter 25, Section 25.2

1. In equation 1, what do the numbers 238 and 92, written to the left of the symbol U, represent?
238 is the mass number of the isotope, and 92 is the atomic number of the isotope.

2. Explain how both mass number and atomic number have been conserved in equation 1.
On the left side of the equation, the mass number of uranium is 238. On the right side of the equation, the sum of the mass number of thorium, 234, and the mass number of helium, 4, is also equal to 238. On the left side of the equation, the atomic number of uranium is 92. On the right side of the equation, the sum of the atomic number of thorium, 90, and the atomic number of helium, 2, is also equal to 92.

3. Write the nuclear symbol for the missing term in equation 2.
$^{69}_{31}Ga$

4. Write the nuclear symbol for the missing term in equation 3.
$^{204}_{82}Pb$

5. In equation 4, name the particle represented by the nuclear symbol $^{1}_{0}n$.
neutron

6. Write the nuclear symbol for the missing term in equation 4.
γ

7. What is represented by the expression $3^{1}_{0}n$ in equation 5?
3 neutrons

8. Write the nuclear symbol for the missing term in equation 5.
$^{138}_{48}Cd$

9. Write the nuclear symbol for the missing term in equation 6.
$^{1}_{1}H$

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET 42

Solving Half-Life Problems

Use with Chapter 25, Section 25.3

1. Write the nuclear symbol for the missing term in equation 1.
$^{238}_{96}Cm$

2. How much time has passed when 3.0 g $^{242}_{98}Cf$ remain?
3.0 g/48.0 g = 1/16 original amount; 1/16 = $(1/2)^4$, or 4 half-lives = 4 × 3.5 min = 14 min

3. How much $^{242}_{98}Cf$ remains after 21 minutes?
Amount remaining = 48.0 g × $(1/2)^{21.0\ \text{min}/3.5\ \text{min}}$ = 48.0 g × $(1/2)^6$ = 0.750 g

4. Write the nuclear symbol for the missing term in equation 2.
$^{131}_{54}Xe$

5. How long will it take for 60.0 g of the original $^{131}_{53}I$ sample to decay?
When 60.0 g has decayed, 4.0 g remain; 4.0 g/64.0 g = 1/16 original amount; 1/16 = $(1/2)^4$, or 4 half-lives = 4 × 8.0 d = 32 d

6. How much $^{131}_{53}I$ remains after 56 days?
Amount remaining = 64.0 g × $(1/2)^{56\ \text{d}/8.0\ \text{d}}$ = 64.0 g $(1/2)^7$ = 0.50 g

7. Write the nuclear symbol for the missing term in equation 3.
$^{146}_{63}Eu$

8. How much of the isotope $^{146}_{64}Gd$ remains after 290 days?
Amount remaining = 72.0 g × $(1/2)^{290\ \text{d}/48.3\ \text{d}}$ = 72.0 g $(1/2)^6$ = 1.12 g

9. How much time has passed when 9.00 g $^{146}_{64}Gd$ remain?
9.00 g = 9.00 g/72.0 g = 1/8 = $(1/2)^3$; 3 half-lives = 3 × 48.3 d = 145 d

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET **43**

Calculating the Volume of Earth's Water

Use with Chapter 26, Section 26.2

1. The total volume of water in the hydrosphere is estimated at about 1.392×10^6 km^3. Earth's water is distributed as shown in the table on the transparency. From the data in that table, complete the chart below by calculating the volume of water for each source listed.

Source	Volume (in km^3)
Oceans	1.354×10^6
Glaciers and ice caps	2.923×10^4
Liquid freshwater	8.352×10^3
Groundwater	8.213×10^3
Lakes and rivers	1.253×10^2
Atmosphere	1.392×10^1

2. How much greater is the amount of freshwater found in groundwater compared to freshwater found in lakes and rivers?

0.59% : 0.009% or $8.213 \times 10^3 : 1.253 \times 10^2$, or 65 times greater

3. How much greater is the amount of water found in glaciers and ice caps compared to all liquid freshwater?

2.1% : 0.60% or $2.923 \times 10^4 : 8.352 \times 10^3$, or 3.5 times greater

4. How much greater is the amount of seawater on Earth compared to the amount of all liquid freshwater?

97.3% : 0.60% or $1.354 \times 10^6 : 8.352 \times 10^3$, or 162 times greater

Name _____ Date _____ Class _____

MATH SKILLS TRANSPARENCY WORKSHEET **44**

Calculating Percentages of Water Use

Use with Chapter 26, Section 26.2

1. Complete the third column in the table on the transparency by calculating the percentage of water use for each activity listed. Assume that dishwashing is being done by machine.

Water Use	Amount per Day	Percentage
Drinking	1.5 L	0.47%
Cooking	5.5 L	1.7%
Brushing teeth	4.0 L	1.3%
Washing dishes (dishwasher)	41 L	13%
Washing dishes (by hand)	75 L	—
Flushing toilets	82 L	26%
Bathing (shower)	103 L	32%
Watering yard	81 L	25%

2. How many times greater is the amount of water used for dishwashing by hand compared to by machine?

75 L : 41 L, or 1.8 times greater

3. What is the total amount of water used for each activity in the table in one month (30 days)?

The numbers in column 1 would read, from top to bottom: 45 L; 165 L; 120 L; 1230 L; 2250 L; 2460 L; 3090 L; 2430 L

4. Suppose that the charge for water use in a community is 36 cents per hundred liters. What would be the charge for each activity listed in the table for one month (30 days)?

$0.16; $0.59; $0.43; $4.43; $8.10; $8.86; $11.12; $8.75

5. What would be the monthly water bill if all dishwashing is done by machine?

$34.34

Name _____ Date _____ Class _____

MATH HANDBOOK TRANSPARENCY WORKSHEET 1

Scientific Notation

Use with Appendix B, Scientific Notation

1. Express each of the following numbers in scientific notation.

a. 230

230 = 2.3×10^2

b. 5601

5601 = 5.601×10^3

c. 14 100 000

14 100 000 = 1.41×10^7

d. 56 million

56 million = 56 000 000 = 5.6×10^7

e. 2/10

2/10 = $2 \times 0.1 = 2 \times 10^{-1}$

f. 0.450 13

0.450 13 = 4.5013×10^{-1}

g. 0.089

0.089 = 8.9×10^{-2}

h. 0.000 26

0.000 26 = 2.6×10^{-4}

i. 0.000 000 698

0.000 000 698 = 6.98×10^{-7}

j. 12 thousandth

12 thousandth = 12/1000 = $12 \times 0.001 = 12 \times 10^{-3} = 1.2 \times 10^{-2}$

2. Express each of the following measurements in scientific notation.

a. speed of light in a vacuum, 299 792 458 m/s

299 792 458 m/s = $2.997\ 924\ 58 \times 10^8$ m/s

b. number of seconds in a day, 86 400 s

86 400 s = 8.64×10^4 s

c. mean radius of Earth, 6378 km

6378 km = 6.378×10^3 km

d. density of oxygen gas at 0°C and pressure of 101 kPa, 0.001 42 g/mL

0.001 42 g/mL = 1.42×10^{-3} g/mL

e. radius of an argon atom, 0.000 000 000 098 m

0.000 000 000 098 m = 9.8×10^{-11} m

Name _____ Date _____ Class _____

MATH HANDBOOK TRANSPARENCY WORKSHEET 2

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

1. Perform the following operations and express the answers in scientific notation.

a. $(1.2 \times 10^5) + (5.35 \times 10^6)$

$(1.2 \times 10^5) + (5.35 \times 10^6) = (0.12 \times 10^6) + (5.35 \times 10^6) = (0.12 + 5.35) \times 10^6 = 5.47 \times 10^6$

b. $(6.91 \times 10^{-2}) + (2.4 \times 10^{-3})$

$(6.91 \times 10^{-2}) + (2.4 \times 10^{-3}) = (6.91 \times 10^{-2}) + (0.24 \times 10^{-2}) = (6.91 + 0.24) \times 10^{-2} = 7.15 \times 10^{-2}$

c. $(9.70 \times 10^6) + (8.3 \times 10^5)$

$(9.70 \times 10^6) + (8.3 \times 10^5) = (9.70 \times 10^6) + (0.83 \times 10^6) = (9.70 + 0.83) \times 10^6 = 10.53 \times 10^6 = 1.053 \times 10^7$

d. $(3.67 \times 10^2) - (1.6 \times 10^1)$

$(3.67 \times 10^2) - (1.6 \times 10^1) = (3.67 \times 10^2) - (0.16 \times 10^2) = (3.67 - 0.16) \times 10^2 = 3.51 \times 10^2$

e. $(8.41 \times 10^{-5}) - (7.9 \times 10^{-6})$

$(8.41 \times 10^{-5}) - (7.9 \times 10^{-6}) = (8.41 \times 10^{-5}) - (0.79 \times 10^{-5}) = (8.41 - 0.79) \times 10^{-5} = 7.62 \times 10^{-5}$

f. $(1.33 \times 10^5) - (4.9 \times 10^4)$

$(1.33 \times 10^5) - (4.9 \times 10^4) = (1.33 \times 10^5) - (0.49 \times 10^5) = (1.33 - 0.49) \times 10^5 = 0.84 \times 10^5 = 8.4 \times 10^4$

2. Perform the following operations and express the answers in scientific notation.

a. $(4.3 \times 10^8) \times (2.0 \times 10^6)$

$(4.3 \times 10^8) \times (2.0 \times 10^6) = (4.3)(2.0) \times 10^{8+6} = 8.6 \times 10^{14}$

b. $(6.0 \times 10^3) \times (1.5 \times 10^{-2})$

$(6.0 \times 10^3) \times (1.5 \times 10^{-2}) = (6.0)(1.5) \times 10^{3+(-2)} = 9.0 \times 10^1$

c. $(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1})$

$(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1}) = (1.5)(8.0) \times 10^{-2+(-1)} = 12.00 \times 10^{-3} = 1.2 \times 10^{-2}$

d. $\dfrac{7.8 \times 10^3}{1.2 \times 10^4}$

$7.8 \times 10^3/1.2 \times 10^4 = 7.8/1.2 \times 10^{3-4} = 6.5 \times 10^{-1}$

e. $\dfrac{8.1 \times 10^{-2}}{9.0 \times 10^2}$

$8.1 \times 10^{-2}/9.0 \times 10^2 = 8.1/9.0 \times 10^{-2-2} = 0.90 \times 10^{-4} = 9.0 \times 10^{-5}$

f. $\dfrac{6.48 \times 10^5}{(2.4 \times 10^4)(1.8 \times 10^{-2})}$

$6.48 \times 10^5/(2.4 \times 10^4)(1.8 \times 10^{-2}) = 6.48/(2.4)(1.8) \times 10^{5-4-(-2)} = 1.5 \times 10^3$

Name _____ Date _____ Class _____

MATH HANDBOOK TRANSPARENCY WORKSHEET 3

Significant Figures

Use with Appendix B, Significant Figures

1. For each of the measurements in the table below, determine if the underlined number is significant or not significant. Place a check mark in the appropriate box and in the box under the rule that you used to make your determination.

Measurement	Significant	Not Significant	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
a. 30<u>3</u>8 m	✓			✓			
b. 1.5<u>6</u>1 L	✓		✓				
c. 0.<u>0</u>74 mm		✓				✓	
d. 505<u>0</u> s		✓				✓	
e. 3.<u>0</u>07 km	✓				✓		
f. 6.1<u>0</u>°C	✓				✓		
g. 82<u>1</u>.0 g	✓		✓				
h. <u>0</u>.560 g		✓				✓	

2. Determine the number of significant figures in each of the following measurements.

a. 56 m **2**

b. 1104 mL **4**

c. 15 pairs **infinite number**

d. 0.20 mol **2**

e. 105 000 mm **3**

f. 6.02 L **3**

g. 0.176 kPa **3**

h. 819 000.0 g **7**

i. 4.030 m^3 **4**

j. 0.005 42 s **3**

k. 49 000 km **2**

l. 7.81 kg **3**

m. 7.01 m/s **3**

n. 0.0021 m **2**

o. 30 015 g **5**

p. 90 km **1**

q. 12.0 cm **3**

r. 0.0305 kPa **3**

s. 50 gross **infinite number**

t. 83.90 m/s^2 **4**

u. 0.100 50 cg **5**

v. 0.0510 kg **3**

w. 6.12×10^5 mm **3**

x. 4.01×10^2 s **3**

y. $60\,000 \times 10^3$ g **1**

z. 1.000×10^2 kPa **4**

Name _____ Date _____ Class _____

MATH HANDBOOK TRANSPARENCY WORKSHEET 4

Unit Conversion

Use with Appendix B, Unit Conversion

Convert the following measurements as indicated. Express each answer in scientific notation.

1. 6 km = _____ m

6 ~~km~~ × 10^3 m/1 ~~km~~ = 6 × 10^3 m

2. 4.9 mg = _____ g

4.9 ~~mg~~ × 1 g/10^3 ~~mg~~ = 4.9 × 10^{-3} g

3. 7.6 dm = _____ mm

7.6 ~~dm~~ × 1 ~~m~~/10^1 ~~dm~~ × 10^3 mm/1 ~~m~~ = 7.6 × 10^{-1+3} mm = 7.6 × 10^2 mm

4. 32.1 g = _____ cg

32.1 ~~g~~ × 10^2 cg/1 ~~g~~ = 32.1 × 10^2 cg = 3.21 × 10^3 cg

5. 5.6×10^3 cm = _____ m

5.6 × 10^3 ~~cm~~ × 1 m/10^2 ~~cm~~ = 5.6 × 10^{3-2} m = 5.6 × 10^1 m

6. 760 g = _____ kg

760 ~~g~~ × 1 kg/10^3 ~~g~~ = 760 × 10^{-3} kg = 7.6 × 10^{-1} kg

7. 4.50 km^2 = _____ m^2

4.50 ~~km^2~~ × $(10^3 m)^2$/1 ~~km^2~~ = 4.50 × 10^6 m^2

8. 1.23 g/mL = _____ kg/L

1.23 ~~g~~/~~mL~~ × 1 kg/10^3 ~~g~~ × 10^3 ~~mL~~/1 L = 1.23 × 10^{-3+3} kg/L = 1.23 kg/L

9. 12 km = _____ nm

12 ~~km~~ × 10^3 ~~m~~/1 ~~km~~ × 10^9 nm/1 ~~m~~ = 12 × 10^{3+9} nm = 12 × 10^{12} nm = 1.2 × 10^{13} nm

10. 6.4 mg = _____ pg

6.4 ~~mg~~ × 1 ~~g~~/10^3 ~~mg~~ × 10^{12} pg/~~g~~ = 6.4 × 10^{-3+12} pg = 6.4 × 10^9 pg

Name _____ Date _____ Class _____

MATH HANDBOOK TRANSPARENCY WORKSHEET 5

Logarithms and Antilogarithms

Use with Appendix B, Logarithms and Antilogarithms

1. Find the logarithm of each of the following numbers.

a. 15.0

$\log 15.0 = \log (1.50 \times 10^1) = \log 1.50 + \log 10^1 = 0.176 + 1 = 1.176$

b. 5.00

$\log 5.00 = \log (5.00 \times 10^0) = \log 5.00 + \log 10^0 = 0.699 + 0 = 0.699$

c. 21550

$\log 21550 = \log (2.155 \times 10^4) = \log 2.155 + \log 10^4 = 0.3334 + 4 = 4.3334$

d. 0.375

$\log 0.375 = \log (3.75 \times 10^{-1}) = \log 3.75 + \log 10^{-1} = 0.574 + (-1) = -0.426$

e. 7.19×10^1

$\log (7.19 \times 10^1) = \log 7.19 + \log 10^1 = 0.857 + 1 = 1.857$

f. 6.32×10^8

$\log (6.32 \times 10^8) = \log 6.32 + \log 10^8 = 0.801 + 8 = 8.801$

g. 4.86×10^{-2}

$\log (4.86 \times 10^{-2}) = \log 4.86 + \log 10^{-2} = 0.687 + (-2) = -1.313$

2. Find the antilogarithm of each of the following logarithms.

a. 3.15

$\text{antilog } (3.15) = 10^{3.15} = 10^{0.15 + 3} = 10^{0.15} \times 10^3 = 1.4 \times 10^3$

b. 6.738

$\text{antilog } (6.738) = 10^{6.738} = 10^{0.738 + 6} = 10^{0.738} \times 10^6 = 5.47 \times 10^6$

c. 0.542

$\text{antilog } (0.542) = 10^{0.542} = 3.48$

d. −1.491

$\text{antilog } (-1.491) = 10^{-1.491} = 10^{0.509 + (-2)} = 10^{0.509} \times 10^{-2} = 3.23 \times 10^{-2}$

e. −2

$\text{antilog } (-2) = 10^{-2} = 1 \times 10^{-2}$

f. −4.676

$\text{antilog } (-4.676) = 10^{-4.676} = 10^{0.324 + (-5)} = 10^{0.324} \times 10^{-5} = 2.11 \times 10^{-5}$