Title:	Balancing Chemical Equations
Standard:	*5.a I can balance chemical reactions and explain them conceptually using the concept of conservation of mass.*

1) What is the law of conservation of mass and how does it connect to chemical reactions?

The conservation of mass states that no mass is created or destroyed in chemical reactions. It relates to chemical reactions because no atoms are created or destroyed, only rearranged.

2) Which option obeys the law of conservation of mass?
   a) $2Li + O_2 \rightarrow 1Li_2O$
   b) $4Li + O_2 \rightarrow 2Li_2O$
   c) $5Li + O_2 \rightarrow Li_2O$
   d) $Li + O_2 \rightarrow Li_2O$

3) Which option shows that no mass is created or destroyed in a chemical reaction?
   a) $Mn + O_2 \rightarrow MnO_7$
   b) $7Mn + 2O_2 \rightarrow 2MnO_7$
   c) $1Mn + 7O_2 \rightarrow 2MnO_7$
   d) $2Mn + 7O_2 \rightarrow 2MnO_7$

4) Balance the equations below.

$$\mathbf{1}Pb(s) + \mathbf{2}NaNO_3(aq) \rightarrow \mathbf{1}Pb(NO_3)_2(aq) + \mathbf{2}Na(s)$$

$$\mathbf{2}C_2H_6(g) + \mathbf{7}O_2(g) \rightarrow \mathbf{4}CO_2(g) + \mathbf{6}H_2O(l)$$

$$\mathbf{1}Te_8(s) + \mathbf{24}F_2(g) \rightarrow \mathbf{8}TeF_6(l)$$

Title:	Relating reactants and products
Standard:	*5.b I can relate reactants to products using a chemical reaction and can convert from molecules A to molecules B or moles A to moles B.*

Use the reaction below for questions 1-3

$$2Mn(s) + 7O_2(g) \rightarrow 2MnO_7(s)$$

1) What will occur to the amount of reactants and products as the reaction proceeds?

The amount of reactants will decrease because they are used up. The amount of products will increase because they are being made in the reaction.

2) How many moles of oxygen gas are needed to react completely with 4 moles of manganese?

$$\frac{4\ mol\ Mn}{} x \frac{7\ mol\ O_2}{2\ mol\ Mn} = 14\ mol\ O_2$$

3) If you react one mole of manganese with one mole of oxygen, will they both be used up completely? Explain.

No. The reaction requires more oxygen than manganese. The oxygen will be used up, and then the manganese will be left over.

$$\frac{1\ mol\ Mn}{} x \frac{7\ mol\ O_2}{2\ mol\ Mn} = 3.5\ mol\ O_2$$

As shown in the equation above, 1 mol of Mn requires 3.5 mol of O_2. Since there isn't that much O_2, the Mn won't be used up all the way.

Use the reaction below for questions 4-6

$$4Li(s) + O_2(g) \rightarrow 2Li_2O(s)$$

4) How many molecules of oxygen are required to completely react with 16 x 10^8 atoms of lithium?

$$\frac{16\ x\ 10^8\ atoms\ Li}{} x \frac{1\ molecule\ O_2}{4\ atoms\ Li} = 4\ x\ 10^8\ molecules\ O_2$$

5) Imagine there are originally 100 molecules of oxygen. If 40 atoms of lithium react, how many molecules of oxygen are left?

$$\frac{40\ atoms\ Li}{} x \frac{1\ molecule\ O_2}{4\ atoms\ Li} = 10\ molecules\ O_2\ used$$

100 molecules O_2 – 10 molecules O_2 used = 90 molecules O_2 left over

6) If 5 moles of lithium oxide reacted backwards to produce reactants, how many total moles of reactants would be produced?

The lithium oxide would be producing both lithium and oxygen, so we need to find the moles of lithium and the moles of oxygen.

$$\frac{5\ mol\ Li_2O}{} x \frac{4\ mol\ Li}{2\ mol\ Li_2O} = 10\ mol\ Li$$

$$\frac{5\ mol\ Li_2O}{} x \frac{1\ mol\ O_2}{2\ mol\ Li_2O} = 2.5\ mol\ O_2$$

Total reactants = 10mol Li + 2.5 mol O_2 = 12.5 mol reactants

Title:	The mole
Standard:	*5.c I can define a mole and Avogadro's number and can use it to convert from molecules to moles.*

1) Are 1 dozen and 1 mole equal to each other or is one bigger than the other? Explain.

1 dozen is only 12 of something whereas 1 mole is 6.02×10^{23} of something. 1 mole is much larger.

2) How was the mole defined?

The mole is defined as the number of atoms in 12g of carbon-12.

3) Rank the following amounts from the least numerous to the most numerous.
   a. 3 moles
   b. 3 dozen
   c. 150,000,000,000
   d. 1
   e. 1×10^{30}
   f. ½ a mole
   g. 6.02×10^{23}

Least numerous → d → b → c → f → g → a → e → Most numerous

4) How many ~~molecules~~ atoms are contained in a sample of gas that has 3.5 moles of krypton gas?

$$\frac{3.5\ mol\ Kr}{} x \frac{6.02\ x\ 10^{23}\ atoms\ Kr}{1\ mol\ Kr} = 21.07\ x\ 10^{23}\ atoms\ Kr$$

5) Magnesium burns extremely brightly in air and is often used in fireworks. If there are 1.2×10^{23} atoms of magnesium in a firework, and for proper functioning the device needs at least 2 moles of magnesium, will the firework work? Justify your answer with a complete sentence and show all work.

$$\frac{1.2\ x\ 10^{23}\ atoms\ Mg}{} x \frac{1\ mol\ Mg}{6.02\ x\ 10^{23}\ atoms\ Mg} = 0.2\ mol\ Mg$$

The firework will not work. There are only 0.2mol of Mg, and there needs to be 2mol Mg.

5) Given the reaction below, how many molecules of oxygen would be required to produce 4 moles of MnO_7?

$$2Mn(s) + 7O_2(g) \rightarrow 2MnO_7(s)$$

$$\frac{4\ mol\ MnO_7}{} x \frac{7\ mol\ O_2}{2\ mol\ MnO_7} = 14\ mol\ O_2$$

$$\frac{14\ mol\ O_2}{} x \frac{6.02\ x\ 10^{23}\ molecules\ O_2}{1\ mol\ O_2} = 84.28\ x\ 10^{23}\ molecules\ O_2$$

Title:	Molar mass
Standard:	*5.d I can calculate the number of grams in one mole of any compound based on the formula.*

1) Calculate the molar masses for the follow chemicals. Include units.
   a. Caffeine: $C_8H_{10}N_4O_2$ **194g/mol**
   b. Water: H_2O **18g/mol**
   c. Table sugar (sucrose): $C_{12}H_{22}O_{11}$ **342g/mol**
   d. Iron (III) oxide (rust): Fe_2O_3 **160g/mol**
   e. Oxygen: O_2 **32g/mol**
   f. Carbon Dioxide: CO_2 **44g/mol**

2) How many atoms are in 31g of phosphorous?

You really don't need to do the math. Just think: the molar mass is 31g/mol, which means that in 31 grams there is one mole, which is 6.02×10^{23} atoms. The math is shown below for further proof.

$$\frac{31g\ P}{} x \frac{1\ mol\ P}{31g\ P} = 1\ mol\ P$$

$$\frac{1\ mol\ P}{} x \frac{6.02\ x\ 10^{23}\ atoms\ P}{1\ mol\ P} = 6.02\ x\ 10^{23}\ atoms\ P$$

3) Rank the following from high to low gram molecular mass (molar mass).
   a. Hf
   b. HF
   c. $Sr(OH)_2$
   d. AgOH
   e. PH_3

(High) a → d → c → e → b (low)

4) How many grams of chromium are present in a can that contains 2.5 moles of chromium?

$$\frac{2.5\ mol\ Cr}{} x \frac{52g\ Cr}{1\ mol\ Cr} = 130g\ Cr$$

5) Ms. Chen is thirsty and asks Mr. Itow to go get her 5 moles of H_2O. Mr. Itow uses his scale to measure out 100g of H_2O. Has he given her too much, too little, or just the right amount of water? Justify your answer with a complete sentence and show all work.

$$\frac{5\ mol\ H_2O}{} x \frac{18g\ H_2O}{1\ mol\ H_2O} = 90g\ H_2O$$

5 moles of water is equal to 90g. If Mr. Itow got 100g of water, than he has gotten too much water for Ms. Chen

Poor Ms. Chen.

Title:	Converting from grams of one chemical to grams of another chemical
Standard:	*5.e I can convert from grams A to grams B, or any other two step conversion in a reaction.*

Use the following reaction for problems 1-4

$$ZnS(s) + 2O_2(g) \rightarrow 2ZnO(s) + SO_2(g)$$

1) How many moles of sulfur dioxide are produced when 194g of zinc sulfide react completely with oxygen?

$$\frac{194g\ ZnS}{} x \frac{1\ mol\ ZnS}{97g\ ZnS} = 2\ mol\ ZnS$$

$$\frac{2\ mol\ ZnS}{} x \frac{1\ mol\ SO_2}{1\ mol\ ZnS} = 2\ mol\ SO_2$$

2) If 32g of O_2 react fully, how many grams of zinc sulfide must have also been used up?

$$\frac{32g\ O_2}{} x \frac{1\ mol\ O_2}{32g\ O_2} = 1\ mol\ O_2$$

$$\frac{1\ mol\ O_2}{} x \frac{1\ mol\ ZnS}{2\ mol\ O_2} = 0.5\ mol\ ZnS$$

$$\frac{0.5\ mol\ ZnS}{} x \frac{97g\ ZnS}{1\ mol\ ZnS} = 48.5g\ ZnS$$

3) How many molecules of sulfur dioxide can be produced from 16g of oxygen gas?

$$\frac{16g\ O_2}{} x \frac{1\ mol\ O_2}{32g\ O_2} = 0.5\ mol\ O_2$$

$$\frac{0.5\ mol\ O_2}{} x \frac{1\ mol\ SO_2}{2\ mol\ O_2} = 0.25\ mol\ SO_2$$

$$\frac{0.25\ mol\ SO_2}{} x \frac{6.02\ x\ 10^{23}\ molecules\ SO_3}{1\ mol\ SO_2} = 1.5\ x\ 10^{23}\ molecules\ SO_3$$

4) If more than 40g of sulfur dioxide are produced in an unvented area, a monkey in the room will die of acid burns to the lungs. When Dante reacts 48.5g of zinc sulfide completely, does the monkey die?

$$\frac{48.5g\ ZnS}{} x \frac{1\ mol\ ZnS}{97g\ ZnS} = 0.5\ mol\ ZnS$$

$$\frac{0.5\ mol\ ZnS}{} x \frac{1\ mol\ SO_2}{1\ mol\ ZnS} = 0.5\ mol\ SO_2$$

$$\frac{0.5\ mol\ SO_2}{} x \frac{64g\ SO_2}{1\ mol\ SO_2} = 32g\ SO_2$$

Less than 40g of SO_2 are produced, and so the monkey will live! Yay!