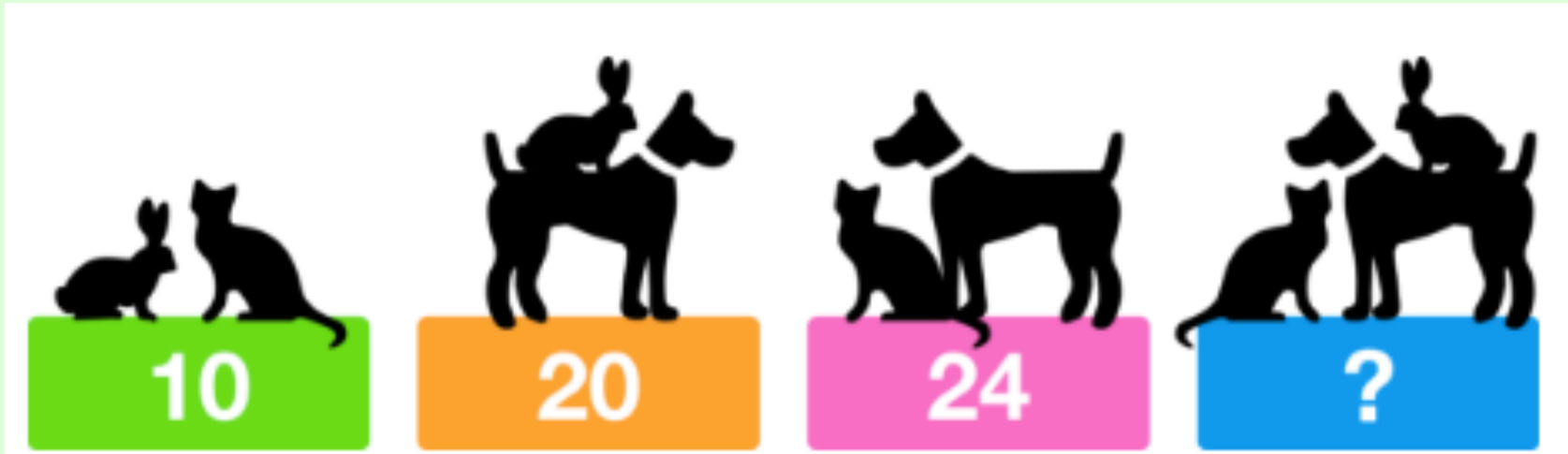
Stoichiometry
Limiting Reactants
Percent Yield

Chapter 4
Sections 4.3 & 4.4

I am always looking for good wrong answers for future use. So if the answer you really wanted wasn't among the choices, please tell me (or at the very least, write down the slide # and submit your suggestion.)

What weight will the 4th scale display?

A. 25
B. 26
C. 27
D. 28
E. 29
F. 30



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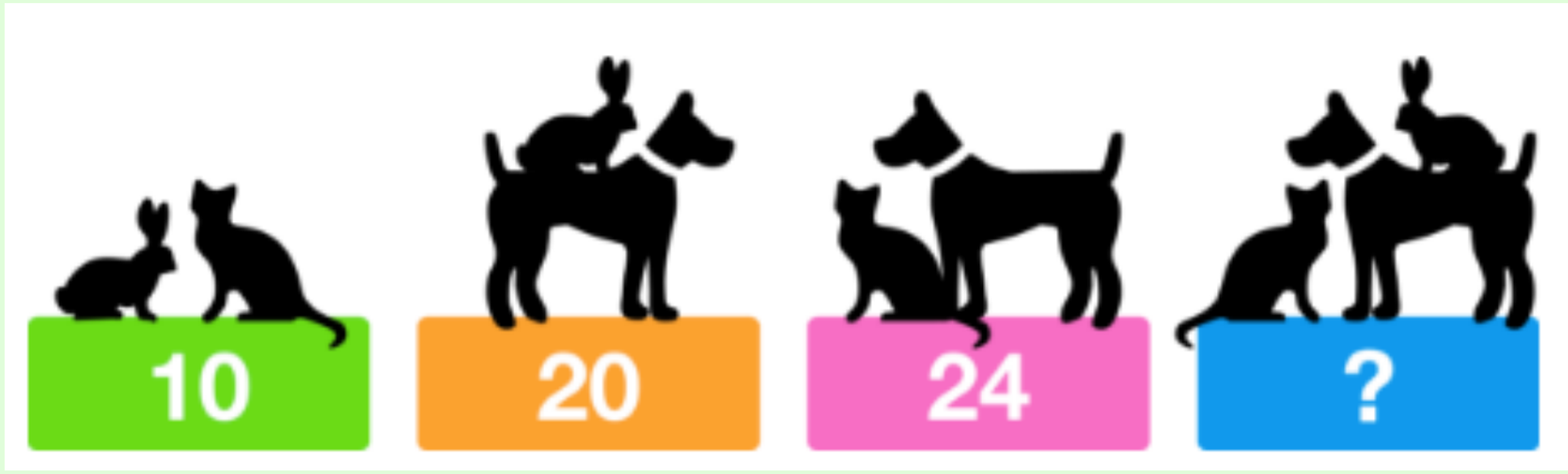
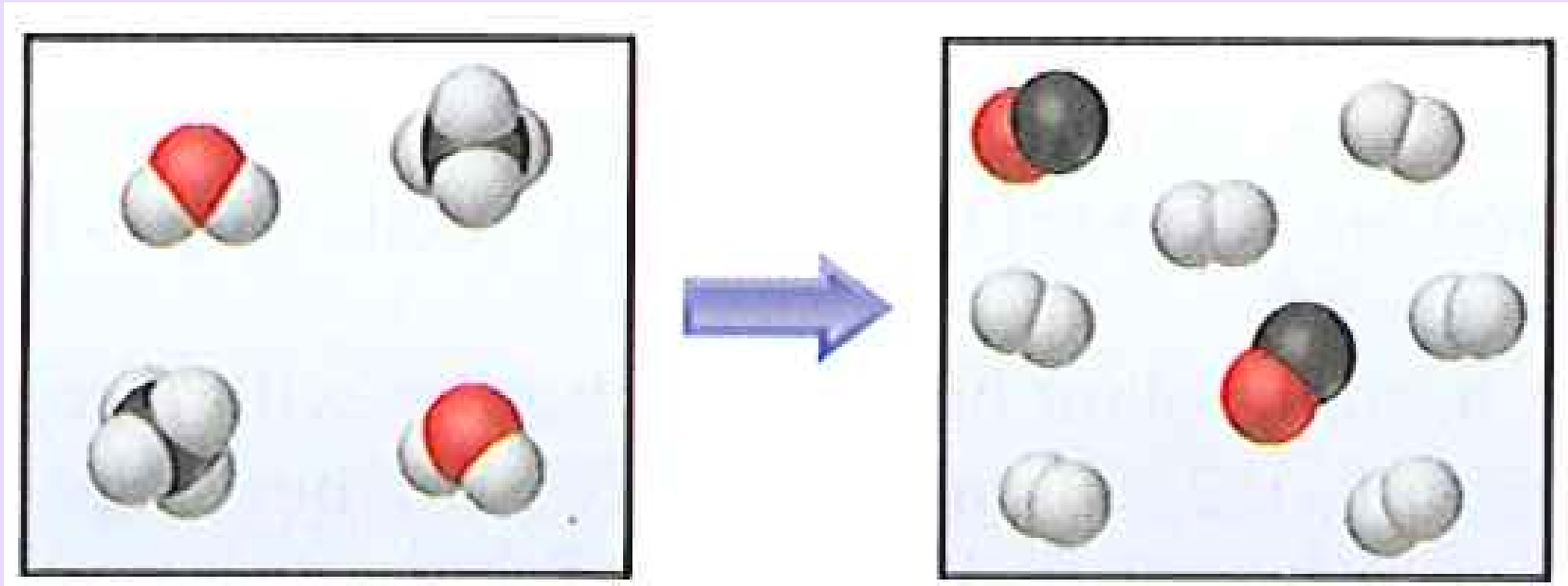
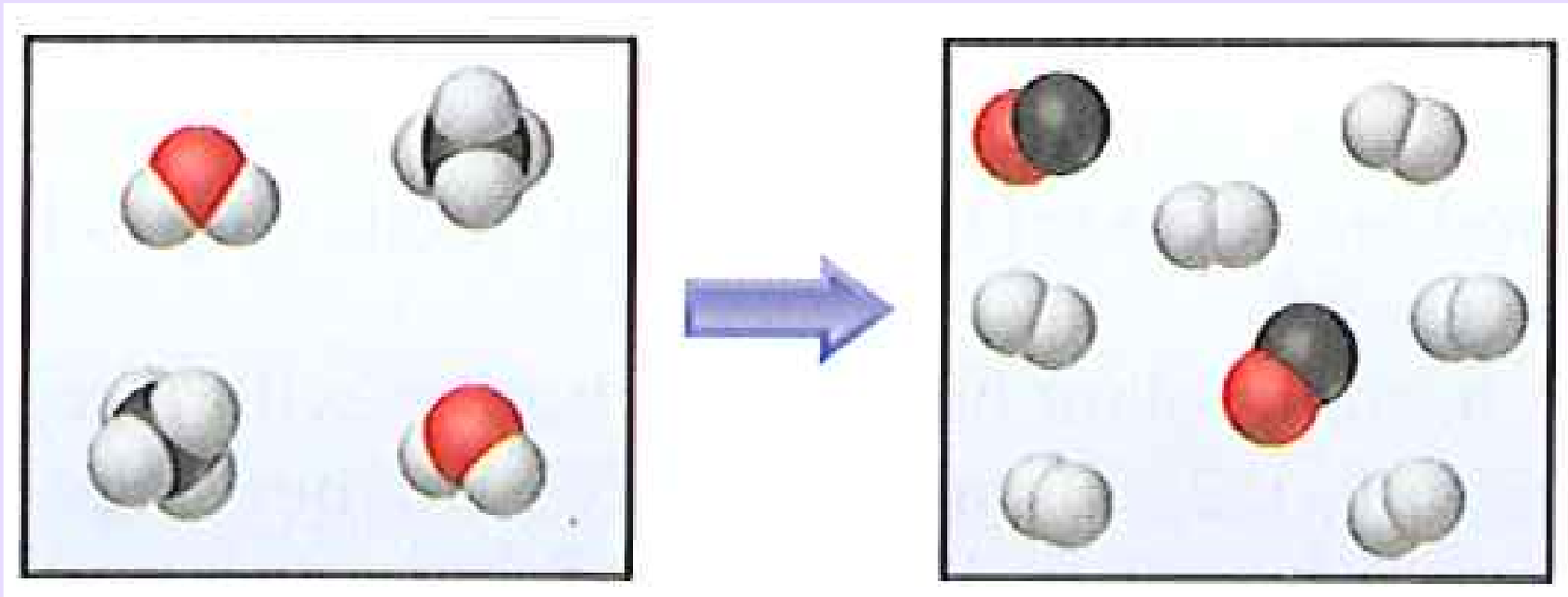


The following diagram represents a high-temperature reaction between CH_4 and H_2O. Based on this diagram, write a balanced chemical equation to represent this reaction.



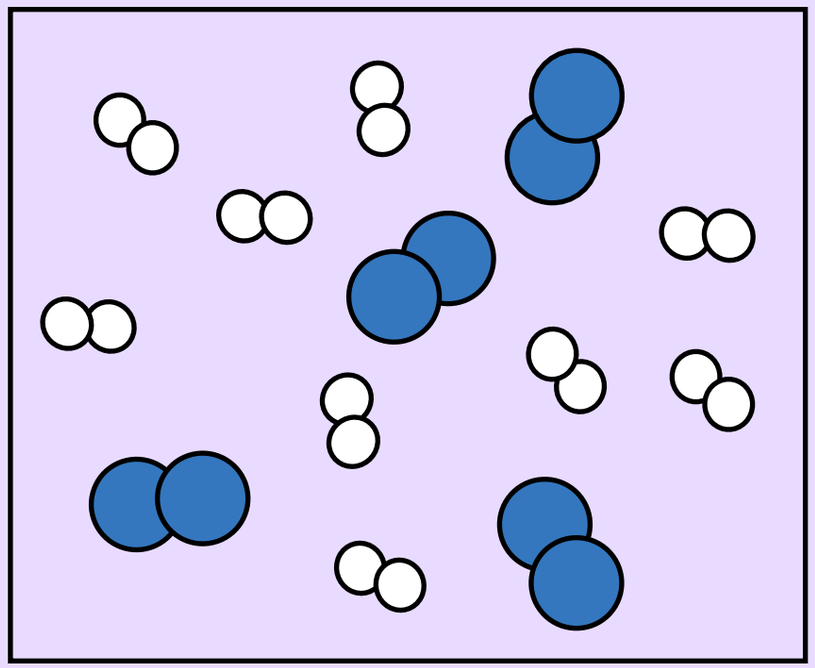
The following diagram represents a high-temperature reaction between CH_4 and H_2O. Based on this diagram, write a balanced chemical equation to represent this reaction.

- $2CH_4 + 2H_2O \rightarrow 2CO + 6H_2$
- It is more appropriate to write chemical equations in the lowest whole number ratio.
- $CH_4 + H_2O \rightarrow CO + 3H_2$



Nitrogen and hydrogen react to form ammonia (NH_3). Consider the model of the mixture shown below. Draw a representation of the product mixture, assuming the reaction goes to completion.

reactants

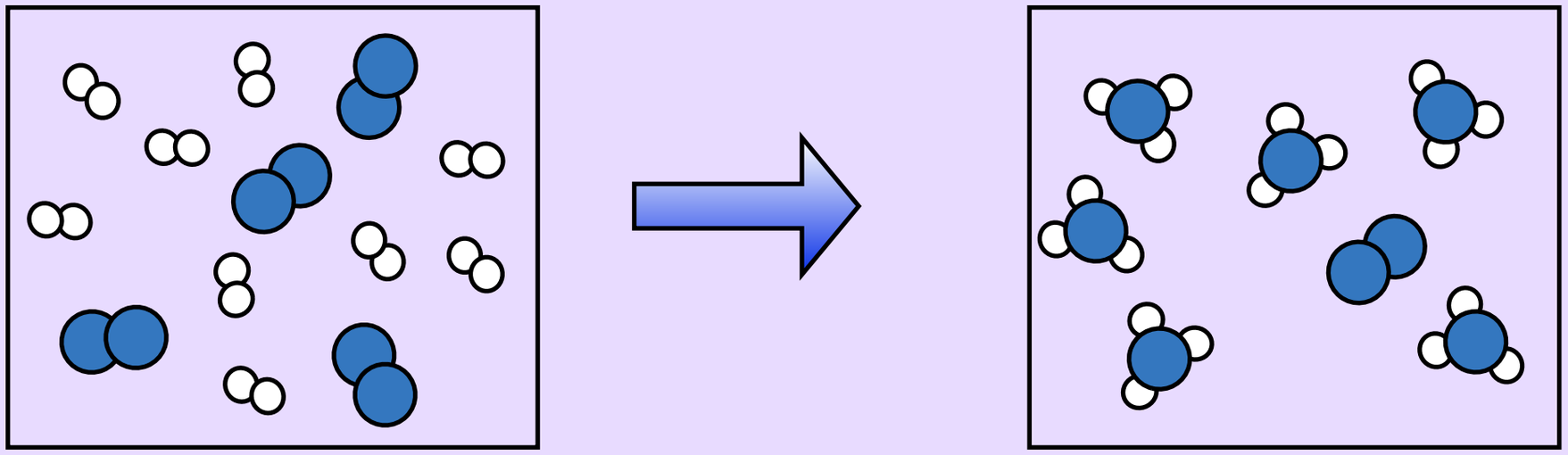


Which color sphere best represents nitrogen and which color for hydrogen?

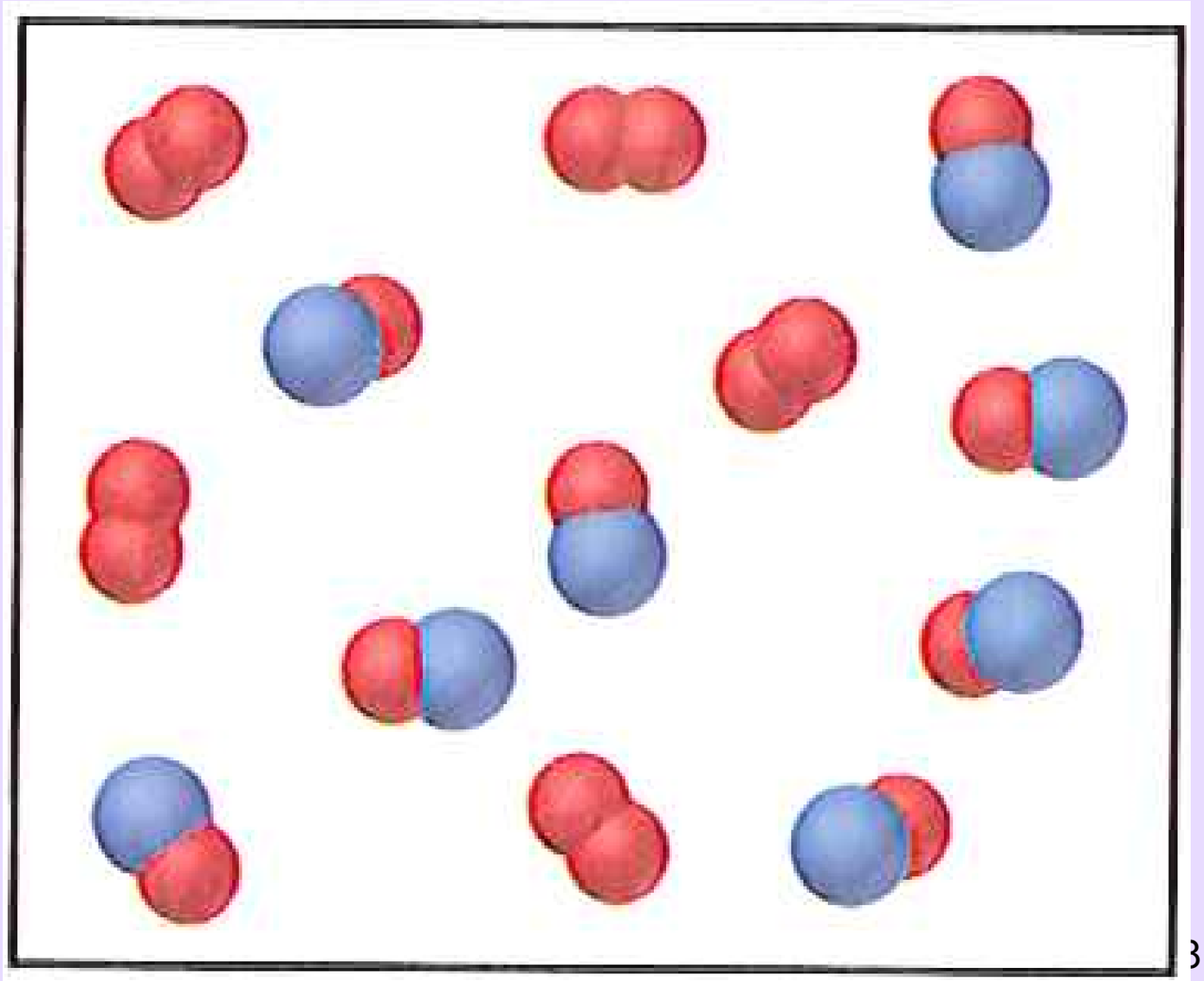
Break out the scrap paper to sketch a response or write right on the desk

Nitrogen (N_2) and hydrogen (H_2) react to form ammonia (NH_3). Consider the model of the mixture shown below.
Blue spheres = N and white spheres = H. Draw a representation of the product mixture, assuming the reaction goes to completion.

- $N_2 + 3H_2 \rightarrow 2NH_3$
- 8N's, $4N_2$ require 24 H's, $12H_2$ for a complete reaction.
- Only $9H_2$ are present, thus H_2 limits.
- $9H_2$ require $3N_2$, one N_2 in excess, and $6NH_3$ are produced.



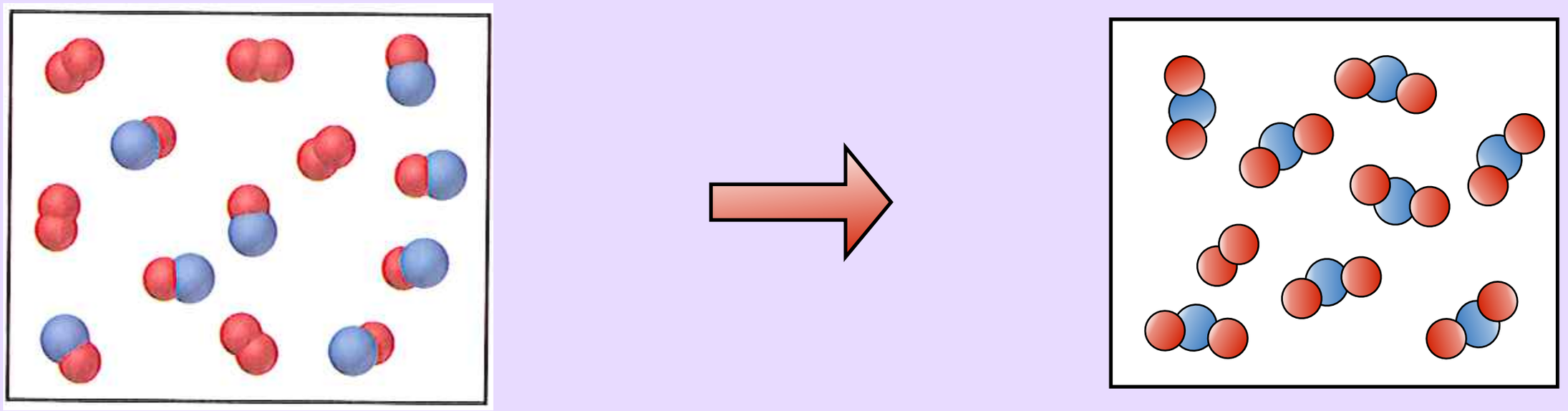
Nitrogen monoxide and oxygen gas react to form nitrogen dioxide. Consider the model of the mixture shown below. Blue spheres = N and red spheres = O. Draw a representation of the product mixture, assuming the reaction goes to completion.



On scrap paper or the whiteboards, or on the desk with chalk to sketch a response.

Nitrogen monoxide and oxygen react to form nitrogen dioxide. Consider the model of the mixture shown below. Blue spheres = N and white spheres = O. Draw a representation of the product mixture, assuming the reaction goes to completion.

- $2NO + O_2 \rightarrow 2NO_2$
- $8NO$ require $4O_2$ for a complete reaction.
- $5O_2$ are present, thus O_2 is in excess and NO limits.
- $8NO$ require $4O_2$, one O_2 in excess, and $8NO_2$ are produced.



Working Problems that Involve Carbonates

Metal carbonates will nearly always react into *something* AND carbon dioxide.

In the AP curriculum, we will see carbonates decomposing upon heating or reacting with acid.

Write an equation to represent the decomposition of copper(II) carbonate into copper(II) oxide and carbon dioxide

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$$CuCO_3 \xrightarrow{\Delta} CuO + CO_2$$

In the AP curriculum, we will usually see metal carbonates decomposing upon heating into the metal oxide and carbon dioxide.

(Alkali carbonates do NOT decompose upon heating.)

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In the AP curriculum, we will see carbonates decomposing upon heating OR reacting with acid.

Write an equation to represent the reaction of potassium carbonate with hydrochloric acid to produce potassium chloride, water, and carbon dioxide.

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$K_2CO_3 + 2HCl \rightarrow 2KCl + H_2O + CO_2$

Let's take a closer look at what's really happening when metal carbonates react with acid.

On first inspection, this reaction should look like a double replacement reaction:

$$K_2CO_3 + 2HCl \rightarrow 2KCl + H_2CO_3$$

however, carbonic acid is a “phantom” a substance that decomposes:

$$H_2CO_3 \rightarrow H_2O + CO_2$$

The Phantoms

Molecules that decompose into gases when they form as a product.

- As we just saw, H_2CO_3 decomposes into H_2O and CO_2
- NH_4OH decomposes into H_2O and NH_3
- H_2SO_3 decomposes into H_2O and SO_2
- H^+ with S^{2-} produces a gas, H_2S

Write an equation to represent the reaction between nitric acid and calcium carbonate.

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$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$

A 2.00 gram mixture of calcium carbonate and calcium chloride are treated with an excess of hydrochloric acid and 0.66 grams of carbon dioxide (44 g/mol) are produced. What is the percent of $CaCO_3$ (100 g/mol) by mass in the original mixture?

1. 25%
2. 30%
3. 50%
4. 75%
5. 90%

First, we should think about what happens when hydrochloric acid is poured on calcium chloride?

A 2.00 gram mixture of calcium carbonate and calcium chloride are treated with an excess of hydrochloric acid and 0.66 grams of carbon dioxide (44 g/mol) are produced. What is the percent of $CaCO_3$ (100 g/mol) by mass in the original mixture?

- Resist the temptation of just writing everything you see into an equation.
- ~~$CaCO_3 + CaCl_2 + 2HCl \rightarrow$~~
- think about what's happening between the $CaCl_2$ and the HCl …
  nothing ….so what about the acid and carbonate?

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- What is happening to the carbonate?
- $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
- Look at the stoichiometry between CO_2 and $CaCO_3$ 1:1
- back to the question…

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$$CaCO_3 + 2HCl \rightarrow H_2O + CO_2 + CaCl_2$$

$$0.66g \times \frac{1mol}{44g} = 0.015molCO_2 \quad thus\ 0.015molCaCO_3$$

$$0.015molCaCO_3 \times \frac{100g}{1mol} = 1.5gCaCO_3$$

$$\frac{1.5gCaCO_3}{2gMixture} \times 100 = 75\%$$

Could you do this without a calculator?