Discussion

- Is the compound ionic or covalent? Then name it..
  a) CI_4 (Carbon and Iodine)
  b) SO_3
  c) As_2S_2
  d) NCl_3 (Nitrogen and Chlorine)

- Give the symbol for the following compounds:
  a) selenium dioxide
  b) diarsenic pentoxide
  c) oxygen difluoride

The Mole

What is a mole?

- The mole is a counting unit—like a dozen.
- Atoms, molecules and ions are very small & numerous in a sample, this makes it difficult to count.
- Therefore scientists came up with the MOLE! (based on amount of particles in 12g of C-12)

The Mole

- Mole = 6.022×10^{23} representative particles

Avogadro's Number

1 mol = 6.02×10^{23} atoms

1 mol = 6.02×10^{23} ions

1 mol = 6.02×10^{23} molecules

1 mol = 6.02×10^{23} formula units

This number is a "count", 1 mol is 6.02×10^{23} particles regardless of the particles size or type.

https://www.youtube.com/watch?v=TEl4jeETVmg

Just How Big Is a Mole?

- One mole of salt would form a cube 44 kilometers (27 miles) high that would cover Miami.
- You could spread the mole of salt evenly 17 cm thick over the entire Earth’s surface!

Here is a mole of popcorn seeds compared to the salt cube:

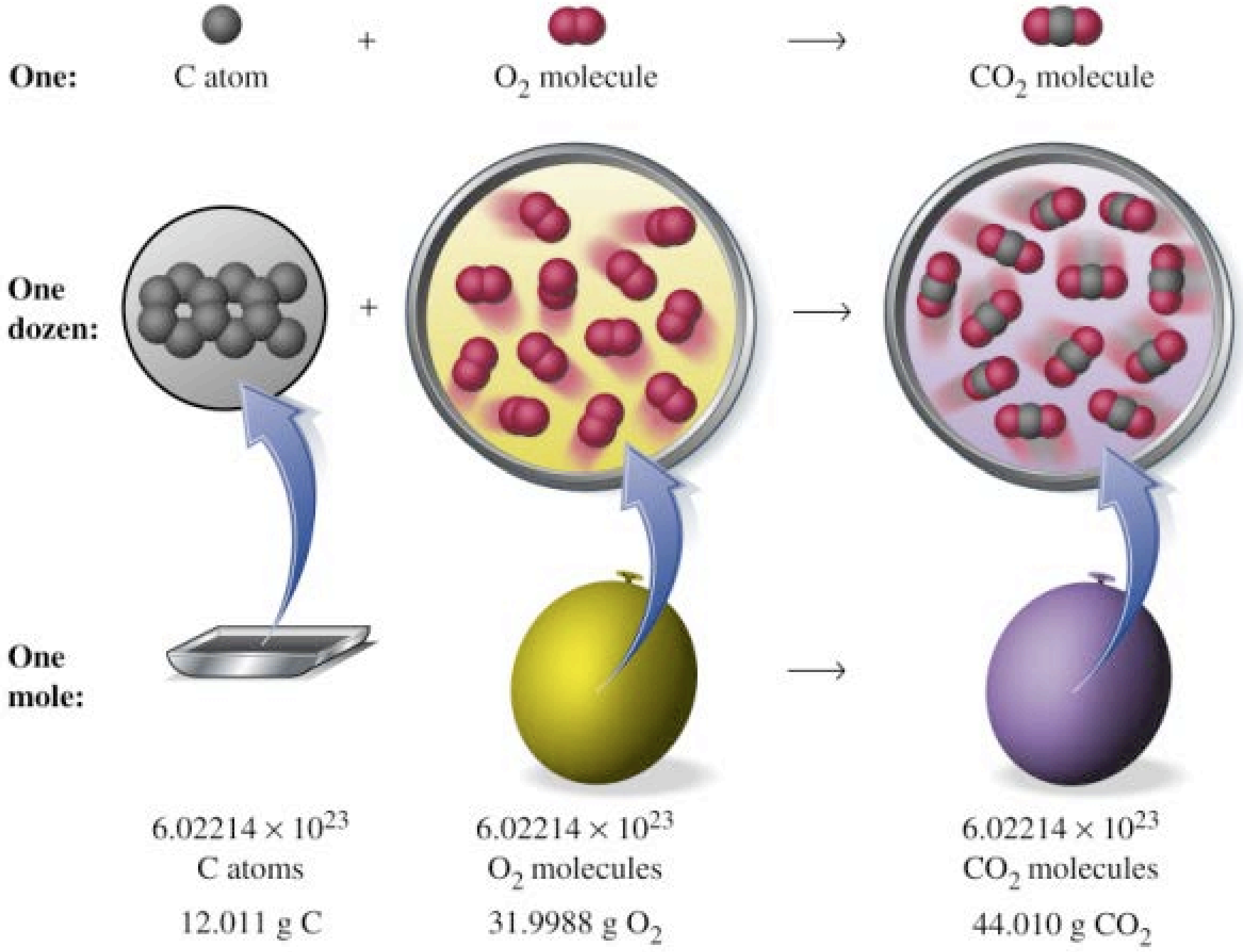
Think….

Does a dozen eggs have the same mass as a dozen cars?

No…

So will a 1 mole of Carbon have the same mass as 1 mole of Nitrogen?

No….


One:
C atom
+
O_2 molecule
⟶
CO_2 molecule
One dozen:
+
⟶
One mole:
⟶
6.02214×10^{23} C atoms
12.011 g C
6.02214×10^{23} O_2 molecules
31.9988 g O_2
6.02214×10^{23} CO_2 molecules
44.010 g CO_2

Molar Mass/Formula Mass

- a general expression used to refer to the mass of a mole of any substance (g/mol)

How do you find the molar mass of an element?

Easy just find its atomic mass on the periodic table. (the number written under the element symbol)

Example: carbon has an atomic mass of 12.01; So the molar mass of is 12 grams per mole.
(round to the nearest whole number)

Practice

- Find the molar mass of the following:

HF _____

HI _____

HBr _____

NaCl _____

KBr _____

MgI_2 _____

Molar Mass Calculations

Example A: What is the mass of 0.208 moles of magnesium?

Solution:

1) Find the Atomic Mass of one mole of Mg?

24 g/mole

2) Set up the problem:

$$\frac{0.208 \text{ mol Mg}}{1} \left| \frac{24 \text{ g Mg}}{1 \text{ mol Mg}} \right. = 5.0 \text{ g Mg}$$

You try...

- B) What is the mass of 1.49 mol Hydrogen gas?

$$\frac{1.49 \text{ mol } H_2}{} \left| \frac{2.01 \text{ g } H_2}{1 \text{ mol } H_2} \right. = 2.99 \text{ g } H_2$$

- C) What is the mass of 2 mol of titanium?

$$\frac{2 \text{ mol Ti}}{} \left| \frac{47.88 \text{ g Ti}}{1 \text{ mol Ti}} \right. = 95.76 \text{ g Ti}$$

Practice & Lab

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Now for molecules

Example: How many molecules are there in .25 moles of nitrogen gas? (remember nitrogen gas is N_2)

Solution:

1) 1 mole of N_2 = 6.02 x 10^{23} molecules of N_2

2) Set up the problem:

$$\frac{.25 \text{ mol } N_2 \quad | \quad 6.02 \times 10^{23} \text{ molecules } N_2}{| \quad 1 \text{ mol } N_2} = 1.5 \text{ molecules } N_2$$

***Same set up for formula units/atoms

The Mole: Conversions

Some problems will be 3 steps…

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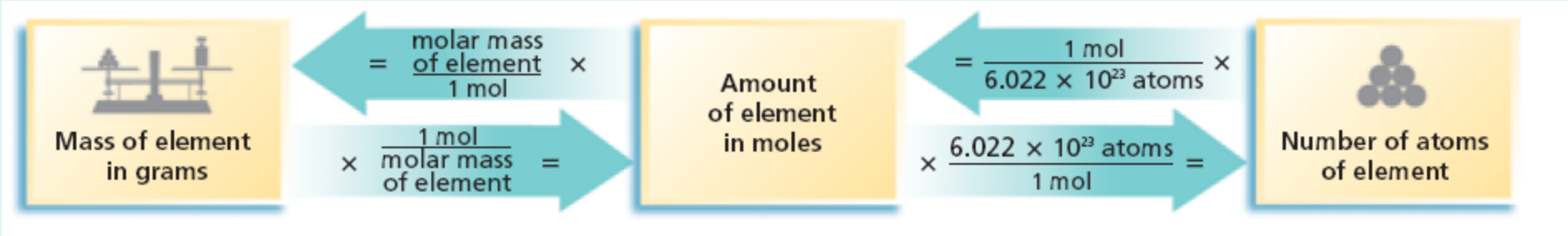
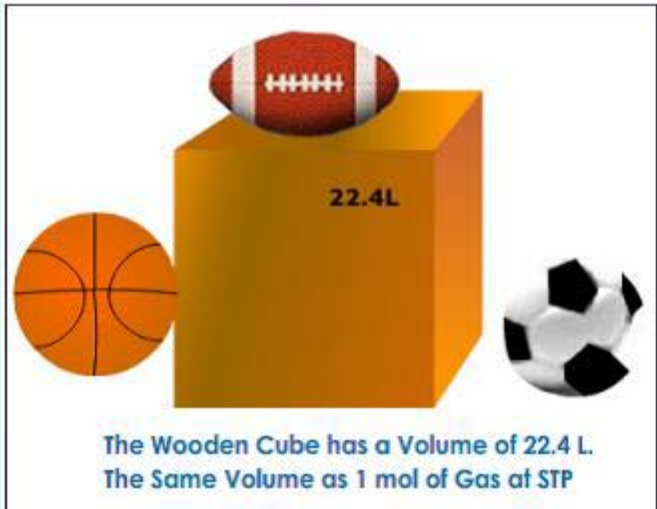
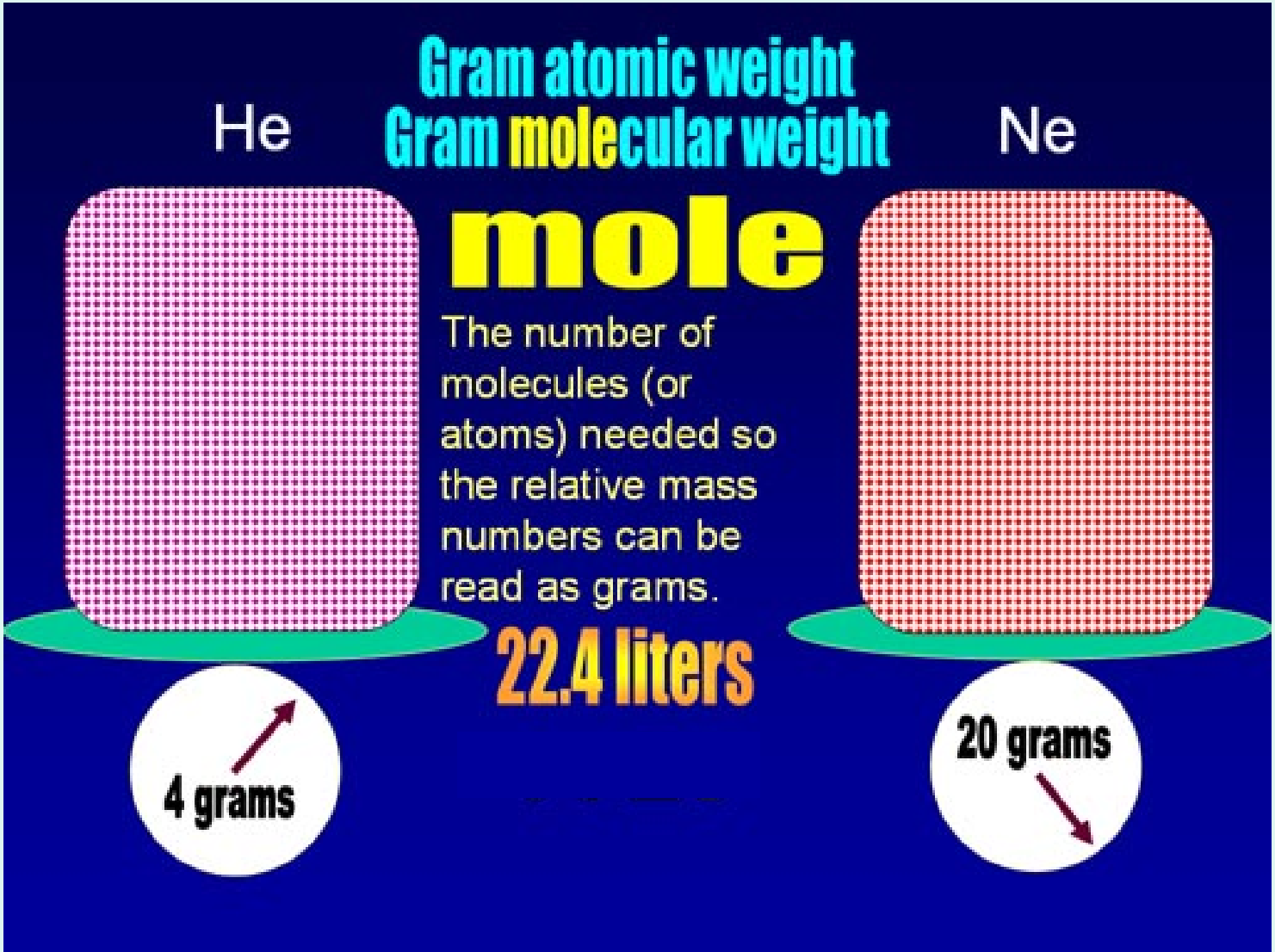


Gases
Standard Temp. & Pressure-STP

- **<u>Molar Volume</u>**- the volume occupied by one mole of a gas at standard temperature & pressure is 22.4 L.
- Any gas at STP will be 1 mole of the gas, because gases are compressible
- **1 mole of a gas = 22.4 L**



Does 1 mole of He have the same mass as 1 mole of Ne?



Example 1: Determine the **volume**, in liters, of 0.60 mol SO_2 gas at STP.

$$0.60 \text{ mol } SO_2 \times \frac{22.4 \text{ L } SO_2}{1 \text{ mol } SO_2} = 13.44 = \mathbf{13\ L\ SO_2}$$

Example 2: How many **moles** are there in 20 L of Hydrogen gas at STP?

$$20 \text{ L } H_2 \times \frac{1 \text{ mole } H_2}{22.4 \text{ L } H_2} = .8928 = \mathbf{.89\ moles\ H_2}$$

Example 3: How many **grams** are there in 20 L of Hydrogen gas at STP?

Solution: same set up but add molar mass of hydrogen to get last conversion.

H_2=2g/mol

$$20\ L\ H_2 \times \frac{1\ mole\ H_2}{22.4\ L\ H_2} \times \frac{2\ g\ H_2}{1\ mole\ H_2} = 1.8\ g\ H_2$$