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Quantitative Concepts

CH 110
25 September 2008

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Counting by particles

- Chemical formulas
 - Show the number of each kind of atom in the molecule – CO_2 : one C atom and 2 O atoms
 - Show the number of moles of each kind of atom molecule – CO_2 : one mole of C atoms and 2 moles of O atoms
- Equations are balanced
 - In terms of molecules $\text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$
 - In terms of moles

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Counting by Mass

- In the chemistry lab quantities are usually measured as
 - Mass – in grams (g)
 - Volume – in milliliters (mL)
 - Temperature – in degrees ($^{\circ}\text{C}$)
- The particles of interest – atoms and molecules – are too small to see and count
- So, we combine counting numbers and mass to count by mass.

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What is the mass of a mole of carbon dioxide?

- 1 mole of C has a mass of 12.011 g
- 1 mole of O has a mass of 15.994 g
- 1 mole of CO₂ will have a mass of
 - 1 mol C x 12.001 g C/mol = 12.011 g
 - 2 mol O x 15.994 g O/mol = 31.988 g
 - 43.999 g CO₂/mol
 - or 44 g CO₂/mol
- What is the mass of 1 mole of ammonia?

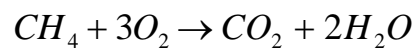
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If 3.3 Gt of C as CO₂ is added to the atmosphere annually, what is the mass of CO₂ added?

- The relationship between C and CO₂ is represented by C + O₂ → CO₂
- Each mole of C added to the atmosphere then represents 1 mole of CO₂ added
- Mass comparisons
 - The ratio of mass of C to mass of CO₂ is 0.2727272 or the mass of C is 0.273 (about ¼) that of CO₂
 - The inverse is also true!
 - The ratio of the mass of CO₂ to mass of C is 44:12 or the mass of CO₂ is 3.666666667 time that of carbon.
- So the mass of CO₂ added to the atmosphere will be 3.67 x the mass reported as C or
- 3.67 x 3.3 Gt = 12.111 Gt CO₂

G → giga is 10⁹
t is metric ton is 1000 kg

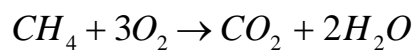
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The above equation represents the reaction of one mole of methane with 3 moles of oxygen to produce 1 mole of carbon dioxide and 2 moles of water.

- A. True
- B. False

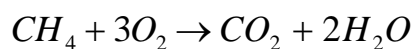
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Based on the above equation, if 3 moles of methane are burned, how many moles of water would be produced?

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Another problem



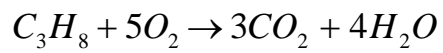
- How many moles of water will be produced if we burn 128 g of methane?
 - Calculate the molar mass of methane
 - Calculate the moles of methane that burned
 - Use the balanced equation to find moles of water produced.
- What will be the mass of that amount of water?
 - Calculate the molar mass of water
 - Calculate the mass of the moles of water

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What follows is a problem to be worked in three sequential steps

Give answers in whole numbers.

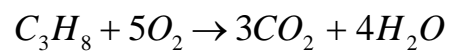
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How many moles of propane are used
if 132 g of propane are burned?

molar mass of propane
44 g C₃H₈/mol

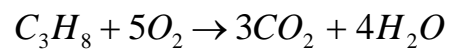
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When 132 g of propane are burned, how
many moles of oxygen are required?

molar mass of propane
44 g/mol

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When 132 g of propane are
burned, what mass of oxygen gas is
consumed?