Molar Ratio

C11 - 4.1 - Stoichiometry Moles <-> Moles <-> Mass <-> Volume Notes

Stoichiometry: *the relationship between amount of reactants used in a chemical reaction and amounts of products produced by the chemical reaction.*

Reactants → Products

$2H_2 \quad + 1O_2 \quad \rightarrow \quad 2H_2O$

Assume Coefficient = # of Moles or # of Molecules

2 : 1 : 2	*Molar Ratio*

$2\ mol\ H_2 : 1\ mol\ O_2 : 2\ mol\ H_2O$

$\frac{2\ mol\ H_2}{1\ mol\ O_2} \qquad \frac{2\ mol\ H_2}{2\ mol\ H_2O} \qquad \frac{1\ mol\ O_2}{2\ mol\ H_2O}$

How many moles of 0_2 *are required to react with* 20 *moles of* H_2?

$\frac{reactant}{reactant}$

$2\ mol\ H_2 : 1\ Mole\ O_2$

$20\ mol\ H_2 : 10\ Moles\ O_2$

OR

$\#\ moles\ O_2 = 20\ moles\ H_2 \times \frac{1\ moles\ O_2}{2\ mol\ H_2} = 10\ moles\ O_2$

Choose the fraction to cross off the units you don't want and get the units you do.

2 : 1 : 2
20 : 10 : 20

$Given\ units \times \frac{desired\ units}{given\ units}$

How many moles of H_2 *are required to produce* 14 *moles of* H_2O?

$\frac{reactant}{product}$

$\#\ mol\ H_2 = 14\ mol\ H_2O \times \frac{2\ mol\ H_2}{2\ mol\ H_2O} = 14\ mol\ H_2$

2 : 1 : 2
14 : 7 : 14

$\times \frac{3}{2}$ *or* 1.5

2 : 3

$\times \frac{2}{3}$ *or* 0.666 ...

What mass of H_2O *is produce by reacting* 10 *moles of* O_2?

$mass\ H_2O = 10\ mol\ O_2 \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{18\ g\ H_2O}{mol\ H_2O} = 360\ g\ H_2O$

OR

20 : 10 : 20

$20\ mol\ H_2O \times \frac{18\ g\ H_2O}{mol\ H_2O} = 360\ g\ H_2O$

What mass of H_2O *is produced by reacting* 10 *grams of* O_2?

$mass\ H_2O = 10\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{18\ g\ H_2O}{mol\ H_2O} = 2.81\ g\ H_2O$

What mass of H_2O *is produced by reacting* 2 *L of* O_2 *at STP*?

$mass\ H_2O = 2\ L\ O_2 \times \frac{1\ mol\ O_2}{22.4\ L\ O_2} \times \frac{2\ mol\ H_2O}{1\ mol\ O_2} \times \frac{18\ g\ H_2O}{mol\ H_2O} = 3.21\ g\ H_2O$

C11 - 4.2 - Excess Mass Notes

10 g Hydrogen gas reacts with 8 g Oxygen gas to produce Water.

$$2\,H_2 \quad + \quad 1\,O_2 \quad \rightarrow \quad 2\,H_2O$$ ①

Mole Ratio

$2\ mol\ H_2$ $\quad$ $1\ Mol\ O_2$ $\quad$ $2\ Mol\ H_2O$ ②

③ $10\ g\ H_2 \times \frac{1\ mol}{2\ g\ H_2} = 5\ mol\ H_2$

Convert to Moles

④ $8\ g\ O_2 \times \frac{1\ mol}{32\ g\ O_2} = 0.25\ mol\ O_2$

Find g H_2O produced

Excess

Moles based on H_2 $\quad$ $5\ mol\ H_2$ $\quad$ $2.5\ mol\ O_2$

Have $\quad$ Need

We have 0.25 mol O_2 which needs 0.5 mol H_2 but we have 5 mol H_2. H_2 is in Excess.

Need $\quad$ Have

Moles based on O_2 $\quad$ $0.5\ mol\ H_2$ $\quad$ $0.25\ mol\ O_2$ $\quad$ $0.5\ mol\ H_2O$

Limiting

⑤ *Use Limiting Reagent*

We have 5 mol H_2 which needs 2.5 mol O_2 but we only have 0.25 mol O_2. O_2 is Limiting.

Find Limiting Reagent

⑥ $0.5\ mol\ H_2O \times \frac{18\ g\ H_2O}{mol} = 9\ g\ H_2O$

Or find out how much each reactant produces and the one that produces less is limiting.

Find amount in Excess

⑦ *Excess :*

$5\ mol\ H_2 - 0.5\ mol\ H_2 = 4.5\ mol\ H_2$

$$Have - Used = Excess\ Left\ Over$$

C11 - 4.3 - Percent Yield/Percent Purity p.136

$$Percent\ Yield = \frac{mass\ of\ product\ obtained}{mass\ of\ product\ expected} \times 100\%$$

$$Percent\ Purity = \frac{mass\ of\ pure\ reactant}{mass\ of\ impure\ reactant} \times 100\%$$

$$2H_2 + O_2 = 2H_2O$$

If $20\ g\ of\ O_2$ *is reacted with an excess of* H_2 *,* $7.4\ g\ of\ H_2O$ *is formed.*
What is the percentage yield?

$$mass\ H_2O = 20\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{1 mol H_2O}{1 mol O_2} \times \frac{18\ g\ H_2O}{1\ mol\ H_2O} = 11.25\ g\ H_2O$$

$$Percent\ Yield = \frac{mass\ of\ product\ obtained}{mass\ of\ product\ expected} \times 100\%$$

$$Percent\ Yield = \frac{7.4\ g\ H_2O}{11.25\ g\ H_2O} \times 100\%$$

$$Percent\ Yield = 65.8\%$$