Chemistry 20

Unit D: Quantities in chemical change

Limiting reagents and percent yield

One reactant runs out first

- A reaction stops producing the intended substance when one reactant is used up, even if another reactant is still in the flask.
- The reactant that remains is leftover, and the reactant that disappeared sets the product amount.

Limiting reagent and percent yield

- Counted atoms on both sides of a balanced equation represent equal mass.
- The calculated maximum and the measured mass are compared by a percent.

Key terms

limiting reagent

The reactant that is consumed first and therefore sets the amount of product. (H_2 in the ammonia case)

excess reagent

The reactant that remains after the limiting reagent has been consumed. (0.333 mol N_2)

percent yield

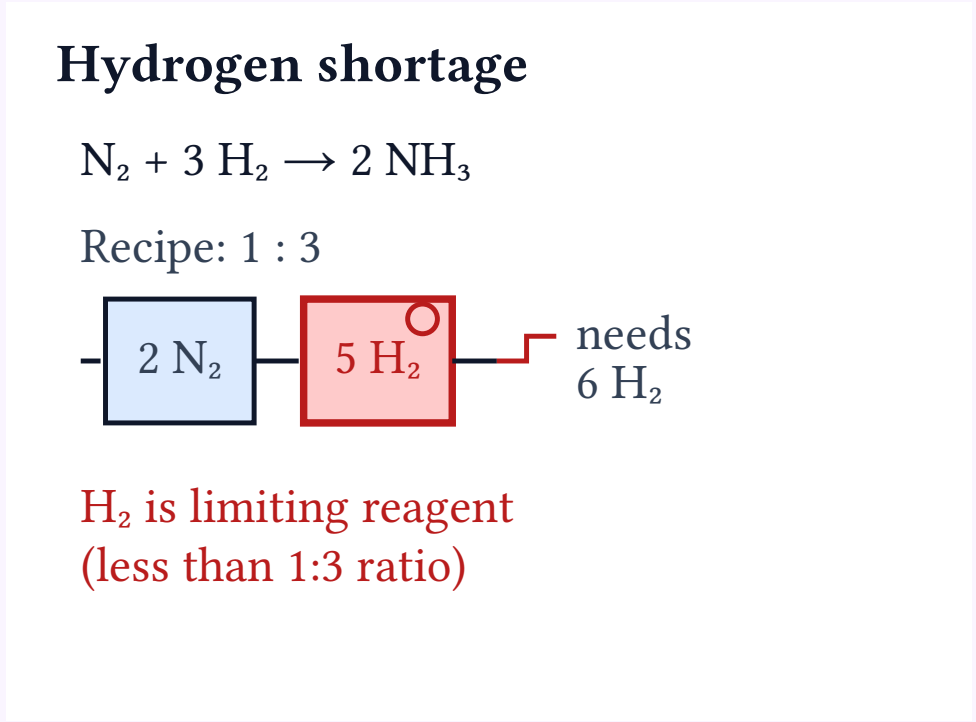
The actual mass divided by the theoretical mass, multiplied by 100. (80.0%)

actual yield

The mass of product measured after the reaction and the transfer are finished. (6.80 g)

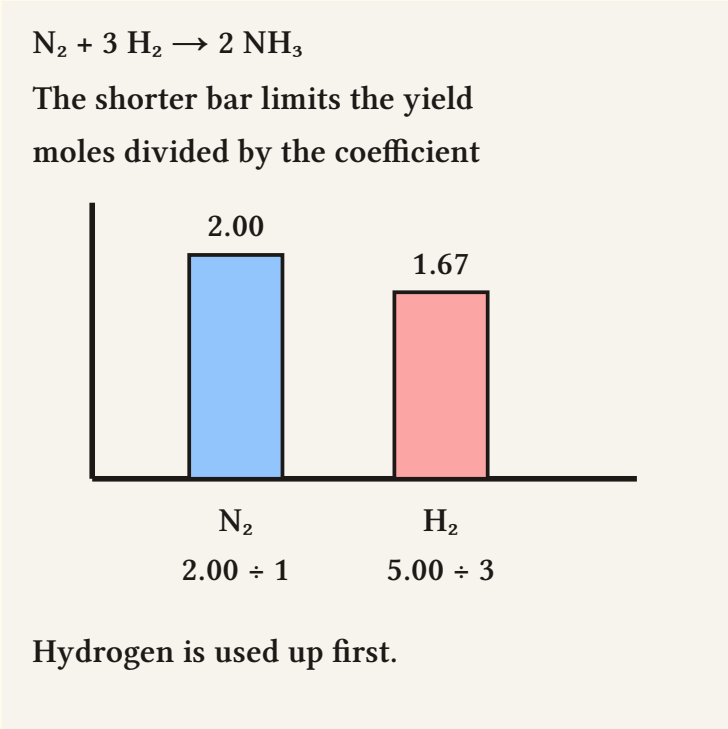
Equal mass, then a hydrogen shortage

- The equation $N_2 + 3\ H_2 \longrightarrow 2\ NH_3$ is the mass check and the recipe for the poured mixture.
- A mixture of 2.00 mol of nitrogen and 5.00 mol of hydrogen supplies less hydrogen than the 1 to 3 recipe demands.



Hydrogen sets the ammonia amount

- Divide each available amount by its coefficient and compare the quotients.
- The smaller quotient belongs to the reactant that is consumed first.



From 8.50 g calculated to 6.80 g measured

- The theoretical yield is the mass calculated from the limiting reagent.
- The actual yield is the mass measured after collection.

Yield

- The reactant with the smaller moles-per-coefficient value is consumed first.
- A percent below 100 names a gap between the balance and the calculation.