

$$1 \text{ cm}^3 = 1 \text{ mL}$$

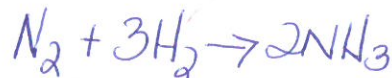
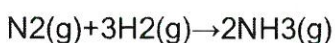
$$1 \text{ dm}^3 = 1 \text{ L}$$

### Worksheet: Law of Combining Volumes

Q1

1:3 ratio

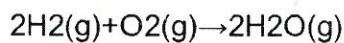
How many liters of ammonia gas is generated with 1 L of nitrogen gas reacts with 3 L of hydrogen gas via the following reaction (assuming no changing pressure and temperature):



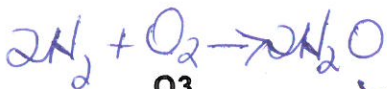
$$1 \text{ L N}_2 \times \frac{2 \text{ L NH}_3}{1 \text{ L N}_2} = 2 \text{ L NH}_3 \text{ no excess Re}$$

Q2

How many liters of water vapor is generated after 2 L of hydrogen gas react with 1 L of oxygen gas (assuming no changing pressure and temperature)?

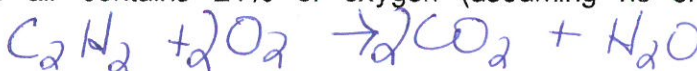


$$2 \text{ L H}_2 \times \frac{2 \text{ L H}_2\text{O}}{2 \text{ L H}_2} = 2 \text{ L H}_2\text{O}$$



Q3

What is the theoretical volume of air required to completely burning 50 cubic meters of acetylene gas (C<sub>2</sub>H<sub>2</sub>) if the air contains 21% of oxygen (assuming no changing pressure and temperature)?



$$50 \text{ m}^3 \times \frac{10 \text{ dm}^3}{1 \text{ m}} \times \frac{10 \text{ dm}^3}{1 \text{ m}} \times \frac{10 \text{ dm}^3}{1 \text{ m}} = 50000 \text{ dm}^3 = 50000 \text{ L}$$

Q4

$$50 \text{ m}^3 \text{ C}_2\text{H}_2 \times \frac{2 \text{ m}^3 \text{ O}_2}{1 \text{ m}^3 \text{ C}_2\text{H}_2} \times \frac{100 \text{ m}^3 \text{ air}}{21 \text{ m}^3 \text{ O}_2} = 476 \text{ m}^3 \text{ air}$$

In a combustion chamber containing 5 L of carbon monoxide and 2.5 L of oxygen is ignited at 298 K and 1 atmosphere pressure. Assuming complete combustion and no loss of gas, what will be the volume of carbon dioxide formed at 298 K and 1 atmosphere pressure?

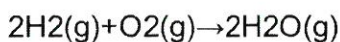


$$2.5 \text{ L O}_2 \times \frac{2 \text{ L CO}_2}{1 \text{ L O}_2} = 5 \text{ L CO}_2$$

Q5

$$5 \text{ L CO} \times \frac{2 \text{ L CO}_2}{2 \text{ L CO}} = 5 \text{ L CO}_2$$

Consider the combustion reaction of hydrogen (assuming no changing pressure and temperature):



1. What volume of steam is formed from 50 cm<sup>3</sup> of hydrogen and 50 cm<sup>3</sup> of oxygen mixed together?
2. What gas(s) is in excess and by how much?

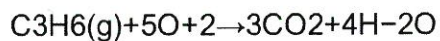
$$50 \text{ cm}^3 \text{ H}_2 \times \frac{2 \text{ cm}^3 \text{ H}_2\text{O}}{2 \text{ cm}^3 \text{ H}_2} = 50 \text{ cm}^3 \text{ H}_2\text{O}$$

$$50 \text{ cm}^3 \text{ O}_2 \times \frac{2 \text{ cm}^3 \text{ H}_2\text{O}}{1 \text{ cm}^3 \text{ O}_2} = 100 \text{ cm}^3 \text{ H}_2\text{O}$$



Q6

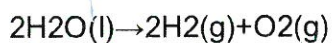
What volume of propane  $\text{C}_3\text{H}_6(\text{g})$  reacts with  $100\text{cm}^3$  of oxygen used in the complete combustion reaction, assuming no changing pressure and temperature: (hint: construct the balanced combustion reaction).



$$100\text{cm}^3\text{O}_2 \times \frac{1\text{cm}^3\text{C}_3\text{H}_6}{5\text{cm}^3\text{O}_2} = 20\text{cm}^3\text{C}_3\text{H}_6$$

Q7

Liquid water can be decomposed into hydrogen and oxygen under suitable conditions (e.g., electrolysis) via the balanced reaction:



If an experiment generates  $2500\text{cm}^3$  of  $\text{H}_2$  gas, what volume of  $\text{O}_2$  is generated under the same conditions of temperature and pressure?

$$2500\text{cm}^3\text{H}_2 \times \frac{1\text{cm}^3\text{O}_2}{2\text{cm}^3\text{H}_2} = 1250\text{cm}^3\text{O}_2$$