Ideal Gases Quantitative Question (printable worksheet) ← *Fold Here*

Student Workspace	**Feedback and Solutions**
<u>Question</u> Gases 2.E.26 A balloon inflated with three breaths of air has a volume of 1.7 L. At the same temperature and pressure, what is the volume of the balloon if five more same-sized breaths are added to the balloon? **Attribution:** 8.2: Relating Pressure, Volume, Amount, and Temperature- The Ideal Gas Law (Q 8.30 OpenStax) hhttps://openstax.org/books/chemistry-atoms-first-2e/pages/8-exercises	Attempt the question on your own first. Unfold the page to see if you are on the right track! ☺
Show all of your work	Showing all of your work includes: ☐ defining each variable ☐ stating the formula ☐ calculation set up (dimensional analysis) ☐ individual mathematical steps ☐ appropriate units and significant figures **Answer: 4.5 L** Sig figs: 2 Units: litres More help? P2 – strategy map P3 – guided solution

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Question A balloon inflated with three breaths of air has a volume of 1.7 L. At the same temperature and pressure, what is the volume of the balloon if five more same-sized breaths are added to the balloon?	**Strategy map** Lets make a plan to solve this question ☺
Strategy: This is a changing conditions ideal gas calculation 1. List all the variables a. What variables are constant? b. What variables are changing? P_1 = ______________ n_1 = ______________ P_2 = ______________ n_2 = ______________ V_1 = ______________ T_1 = ______________ V_2 = ______________ T_2 = ______________ 2. What formula relates changing variables? *HINT* look at units of R = atmL/molK 3. Cancel out the constant variables, rearrange for desired value 4. Input variables and solve	1. a. constant variables $P_1 = P_2$ $T_1 = T_2$ b. changing variables V_1 = 1.7 L V_2 = ? n_1 = 3 'breaths' = 3x n_2 = (3+5) 'breaths' = (3+5)x = 8 'breaths' = 8x x is an unknown number of moles of gas in a "same-sized breath" 2. Combined gas law $R = \frac{PV}{nT} = \frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$ 3. $\frac{V_1}{n_1} = \frac{V_2}{n_2}$ $V_2 = V_1\frac{n_2}{n_1}$ 4. $V_2 = (1.7\text{ L})\left(\frac{8x}{3x}\right)$ $V_2 = (1.7\text{ L})\left(\frac{8}{3}\right)$ $= (1.7\text{ L})(2.666)$ $= 4.5\text{ L}$ More help? P3 – guided solution

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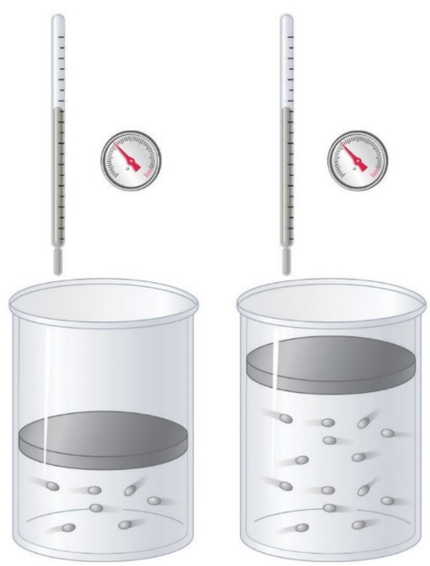
<u>Question</u> A balloon inflated with three breaths of air has a volume of 1.7 L. At the same temperature and pressure, what is the volume of the balloon if five more same-sized breaths are added to the balloon?	**Guided Solution** Lets think out loud about this problem ☺

Make the connections between theory and calculation steps

1. What does the question ask?
   a. When we add gas to the balloon how does pressure change?
   b. What is the volume of a breath of air?
   c. How many moles of gas is in a breath?
   d. What will the volume of a balloon be when more gas is added?

2. Think about the behaviour of ideal gases; if pressure and temperature remain constant, predict what happens to volume when the amount is increased.



The thermometer and pressure gauge indicate the temperature and the pressure qualitatively, the level in the flask indicates the volume, and the number of particles in each flask indicates relative amounts.

(Thermometers and Pressure Gauges. By anonymous via LibreText, BY NC-SA 4.0)

Feedback and Solutions

1. d. What will the **volume** of a balloon be when more gas is added?

Pressure and temperature are constant. The number of moles and volume are changing. We will calculate the **final volume**

We do not need to know that actual number of moles in each breath, because the mole ratio is the same as the volume ratio!

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

Rearrange:

$$\frac{V_1}{V_2} = \frac{n_1}{n_2}$$

Rearrange:

$$V_2 = V_1\frac{n_2}{n_1}$$

2. **Avogadro's Law**
At constant pressure and temperature**, volume increases as amount of gas increases**.