

VERIFICATION OF BOYLE'S LAW USING SIMPLE LAB APPARTUS

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ABSTRACT

The verification of Boyle's law is investigated by using a simple lab apparatus developed consisting of doctor's syringe, in which oxygen gas is enclosed. Keeping different weights, volume compressed is noted and PV is calculated, it is found that PV= constant. When graphs P Vs V plotted which shows curve, having decreasing tendency and P Vs 1/V yield straight line passing through origin. This agrees with the definition of Boyle's law. Hence Boyle's law is verified.

Key words: Boyle's law, Ideal gas law, Equation of states, Real gases.

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INTRODUCTION

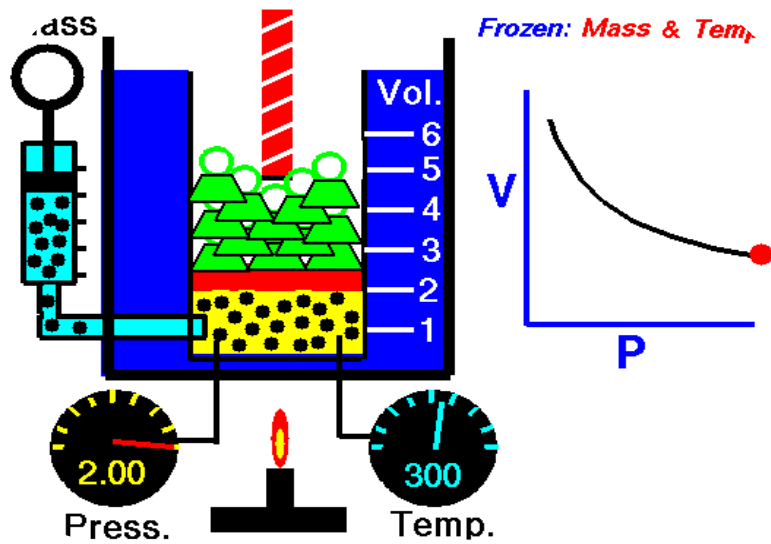
Boyle's law is an experimental gas law that describes how the pressure of a gas tends to increase as the volume of gas decreases. A modern statement of Boyle's law is

The absolute pressure exerted by a given mass of an ideal gas is inversely proportional to the volume it occupies if the temperature and amount of gas remain unchanged within a closed system^[2,3,5].

Mathematically, Boyle's law can be stated as

$P \propto 1/V$ and $PV = K = \text{Constant}$.

Verification of Boyle's Law Using Simple Lab Appartus



Boyle's law verification (Source: www.wikipedia.com ^[1])

From tabulation values $P_1V_1=P_2V_2=P_3V_3=.....$

Material and Methods: Graduated syringe (60ml), Tripod stand, weights (Butts)-
1kg,2kg,5kg

Experimental set up:

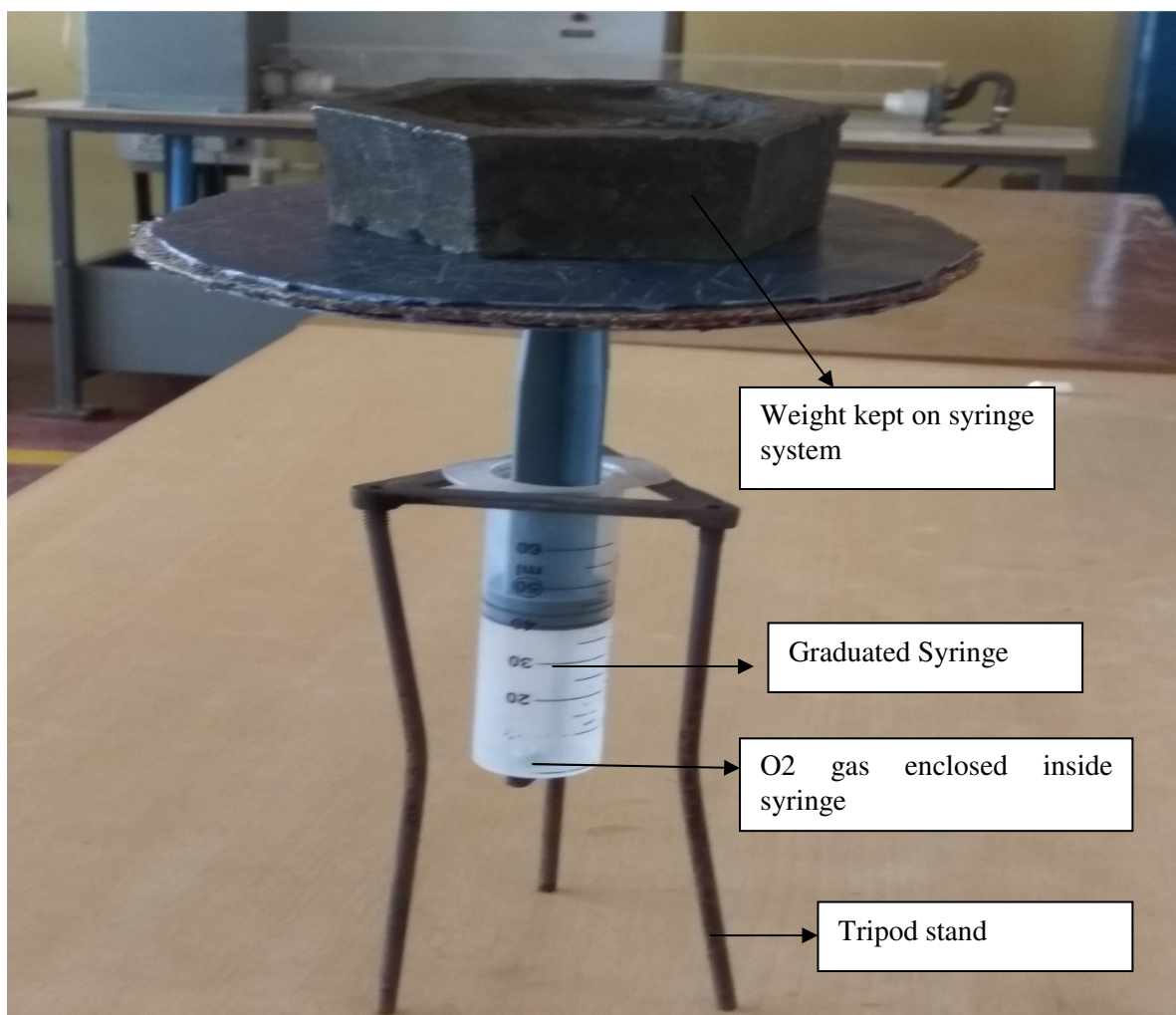


Figure 1 Experimental Set up for verifying Boyle’s Law

Note down the room temperature, determine the Area of Syringe (diameter is known= 3 cm),Put 1 kg weight on the piston of the syringe wait for 10 min note down the volume in ml, remove, 1kg weight and keep 2 kg weight and wait for 10 min, Note down the volume, repeat the procedure for 3kg,4kg,5kg,kg,7,kg,8kg weights and note down respective volumes, calculate and tabulate the results.

Observation column:

S.No.	Mass kept on system (kg)	Volume Compressed (ml)
1.	0	50
2.	1	45
3.	2	39
4.	3	34
5.	4	30
6.	5	28
7.	6	24
8.	7	23
9	8	20

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Calculations:

1. Area of Syringe, $A = \frac{\pi}{4} \times d^2 = 3.142 \times (3 \times 10^{-2})^2 = 7.0695 \text{ m}^2$

2. Force acting on System (Syringe enclosed with gas),

$$F = m \times g = 1 \times 9.81 = 9.81 \text{ N}$$

3. Total Pressure, $P_T = P_{\text{gauge}} + P_{\text{atm}} = 13885 + 101325 = 115210 \text{ N/m}^2$

4. $PV = 115210 \times 0.000050 = 5.184 \text{ J}$

Tabulations:

S.No.	Force, $F = m \times g$ in N	Gauge Pressure $P_{\text{gauge}} = \frac{F}{A}$ in N/m^2	Total Pressure, $(P_T = P_{\text{gauge}} + P_{\text{atm}})$ N/m^2	Volume Compressed, V m^3	$1/V$, m^{-3}	PV
1.	0	0	101325	0.000050	20000	5.066
2.	9.81	13885	115210	0.000045	22000	5.184
3.	19.62	27770	129095	0.000039	25600	5.034
4.	29.43	41656	142981	0.000034	29400	4.861
5.	39.24	55540	156870	0.000030	33300	4.706
6.	49.05	69426	170751	0.000028	35700	4.781
7.	58.86	83312	184637	0.000024	41600	4.431
8.	68.67	97190	198515	0.000023	43400	4.565
9.	78.67	11108	21240	0.000020	50000	4.948

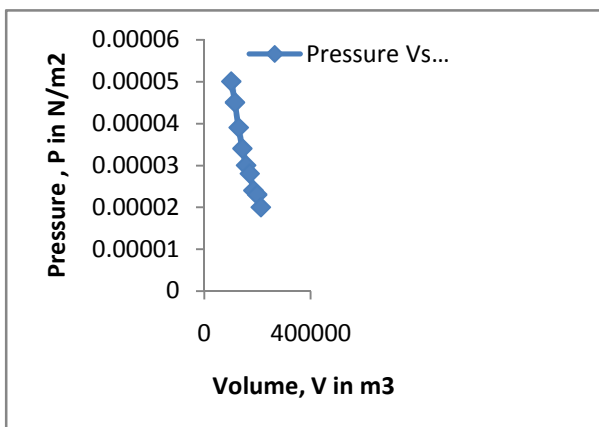


Figure:2 Pressure Vs Volume Graph

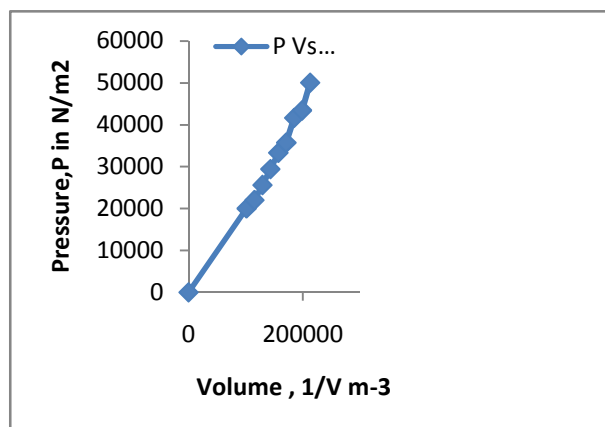


Figure 3 Pressure Vs 1/Volume graph

RESULTS AND DISCUSSION:

It is clear from the graph that as pressure increases volume decreases, that is gas undergoes compression. hence $P \propto 1/V$ and $PV = K = \text{Constant}$. From tabulation values $P_1V_1 = P_2V_2 = P_3V_3 =$

CONCLUSION

At Isothermal conditions (assuming room temperature is remains constant =27⁰C), pressure varies as inversely to volume, which is by definition of Boyles's law. Hence Boyle's law is verified.^{[4],[6-11]}.

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