

Boyle's law lab

- Purpose: to investigate mathematical relationship between pressure and volume
- Sample calculations:

Diameter of piston $\cong 2.40$ cm (2.30-2.50)

Radius $\cong 1.20$ cm

Area $\cong \pi r^2 \cong 4.52$ cm² (4.15 - 4.91)

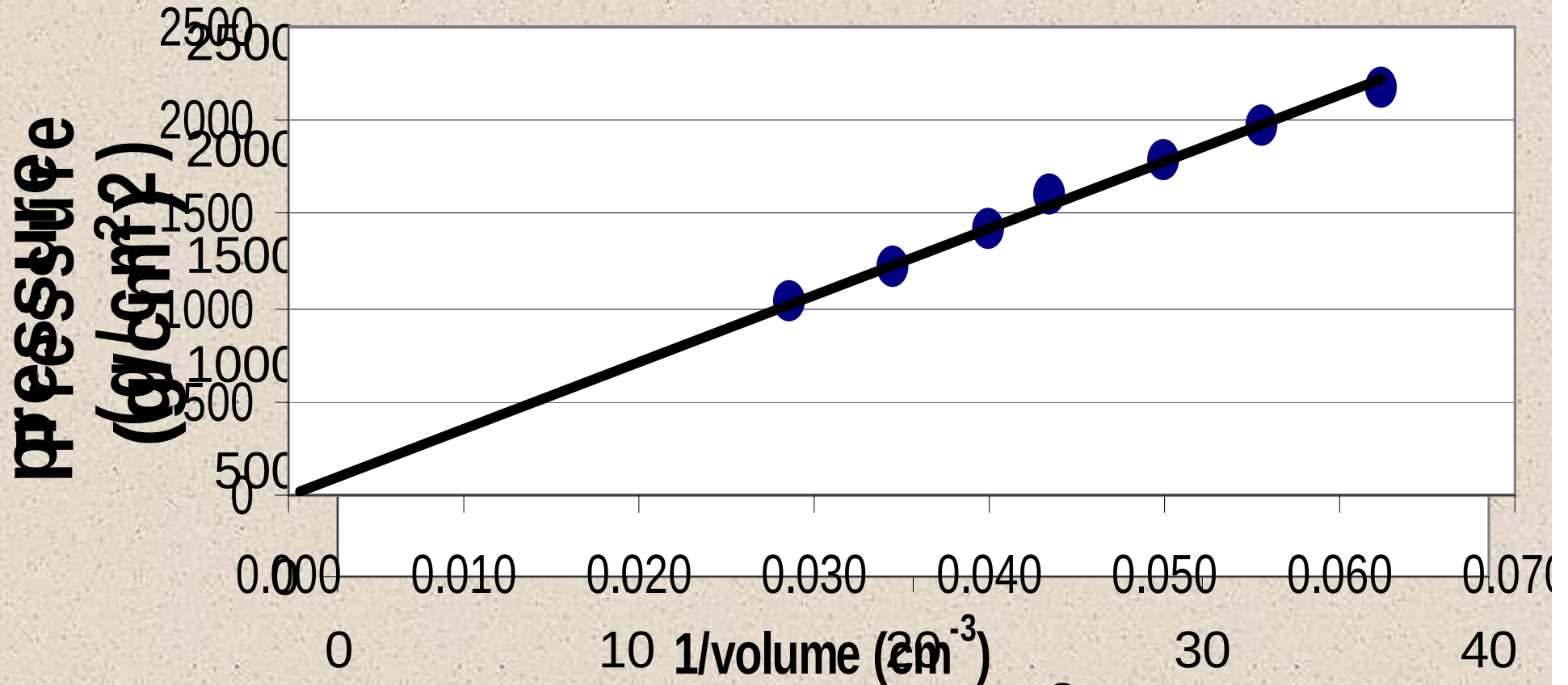
Book pressure $\cong \frac{\text{average book weight}}{\text{area of contact}}$

$\cong 850$ g / 4.52 cm²

$\cong 188$ g / cm² (173 - 205)

PV column should be 36,000 all the way down

Pressure vs. 1/Volume



$$y = mx + b$$

$$P = (\text{constant})(1/V) + 0$$

$$PV = \text{constant} \quad (\text{answer to both 1 and 2})$$

Conclusions and Questions

3. If P doubles, V is cut in half. If P is tripled, V becomes 1/3 of its original value.
4. “As the pressure on a gas increases, the volume of the gas decreases proportionally, provided that the temperature and amount of gas remain constant”. I.e. $P_1V_1 = P_2V_2$.
5. As volume decreases, there are more collisions with the side of the container per unit of time, thus the pressure increases.
6. $P_1=103 \text{ kPa}$, $V_1=5.2 \text{ L}$, $P_2=400 \text{ kPa}$, $V_2=?$
Using Boyle's law: $P_1V_1 = P_2V_2$,
 $103 \text{ kPa} \times 5.2 \text{ L} = 400 \text{ kPa} \times V_2$
 $V_2 = (103 \text{ kPa} \times 5.2 \text{ L}) / 400 \text{ kPa} = \underline{\underline{1.34 \text{ L}}}$

7. $P_1 = 700 \text{ mm Hg} \times 1 \text{ atm} / 760 \text{ mm Hg} =$
0.921 atm, $V_1 = 200 \text{ ml}$, $P_2 = ?$, $V_2 = 950 \text{ ml}$

Using Boyle's law: $P_1 V_1 = P_2 V_2$

$0.921 \text{ atm} \times 200 \text{ ml} = P_2 \times 950 \text{ ml}$

$P_2 = (0.921 \text{ atm} \times 200 \text{ ml}) / 950 \text{ ml} = \mathbf{0.194 \text{ atm}}$

Conclusion

- By comparing values in the PV column and via the graph we see that $PV = \text{constant}$
- This is called Boyle's law (after the scientist that first discovered the relationship)
- We will be looking more closely at Boyle's law
- For example, using the form $P_1V_1 = P_2V_2$
- Read "Results of Boyle's Law Experiment" on handout. Do questions 1 – 6.