

# 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  $\cong \pi r^2 \cong 4.52$  cm<sup>2</sup> (4.15 - 4.91)

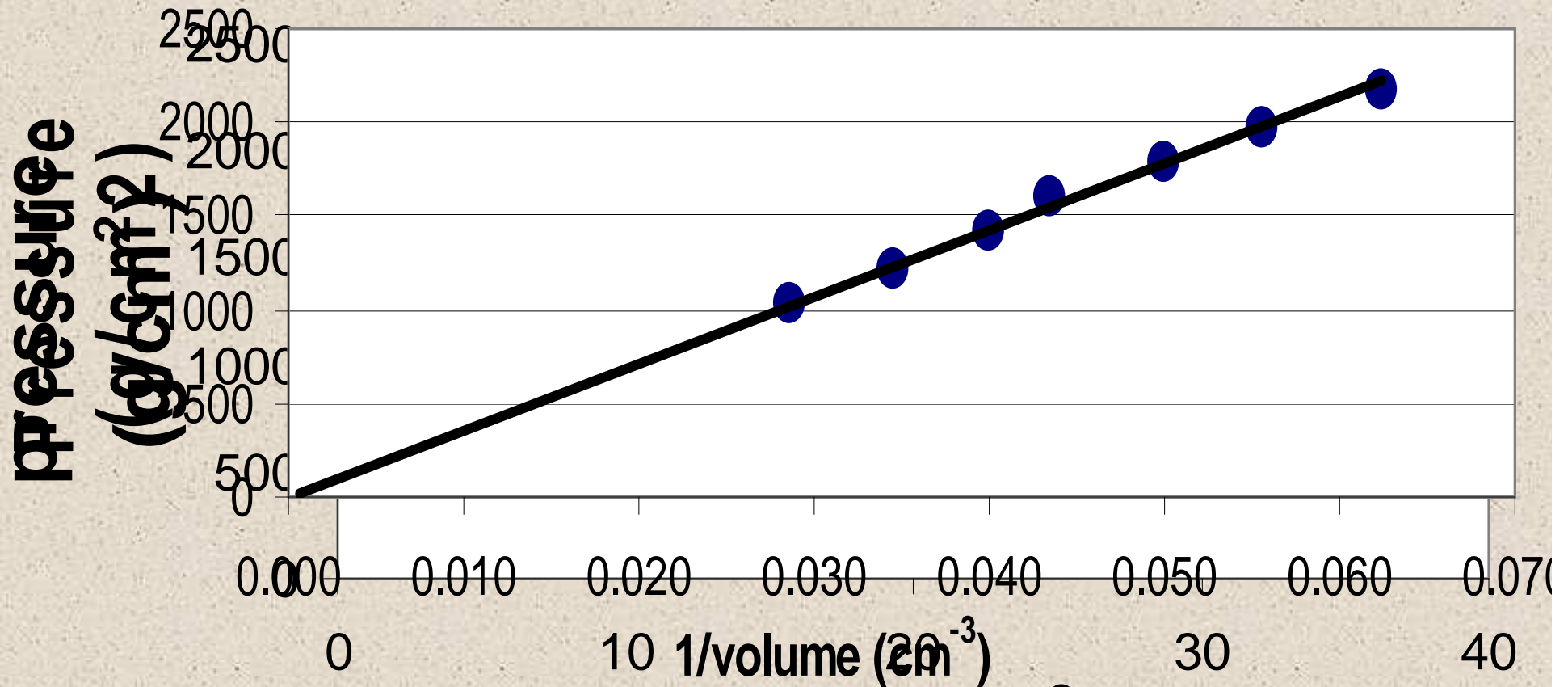
Book pressure  $\cong \frac{\text{average book weight}}{\text{area of contact}}$

$\cong 850$  g / 4.52 cm<sup>2</sup>

$\cong 188$  g / cm<sup>2</sup> (173 - 205)

PV column should be 36,000 all the way down

# Pressure vs. Volume



$$y = mx + b$$

volume (cm<sup>3</sup>)

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

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

# 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.  $P_1=103$  kPa,  $V_1=5.2$  L,  $P_2=400$  kPa,  $V_2=?$   
Using Boyle's law:  $P_1V_1 = P_2V_2$ ,  
 $103$  kPa  $\times$   $5.2$  L =  $400$  kPa  $\times$   $V_2$   
 $V_2 = (103$  kPa  $\times$   $5.2$  L) /  $400$  kPa = **1.34 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.