XVIII ежегодная международная конференции АШМБ стран СНГ
по теме «Образование будущего-путь к успеху и благополучию»

«Применение виртуальных лабораторий для обучения и оценивания работ студентов по критериям B и C по программе MYP естественно-математического направления»

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12 апреля, 12:15-13:00, сессия 8,
Секция 37 (ауд. №4)

Вступление – 5 мин
Теоретическая часть – 15 мин
Практическая часть – 15 мин
Вопросы и рефлексия – 10 мин

Вступление

Теоретическая часть

Практическая часть

Вопросы и рефлексия

Наука →

Наука → измерения, эксперименты.

Наука → измерения, эксперименты.

Оборудование

Наука → измерения, эксперименты.

Оборудование

Недоступность

Наука → измерения, эксперименты.

Оборудование

Недоступность

Опасность

Дизайн исследования

Investigating the relationship between pressure and volume of an ideal gas

Introduction

Ideal gas is a model of a gas that does include several factors about the gas, i.e., makes few assumptions about it (Zhabinskaya):

- The gas particles are negligibly small compared to the volume the gas occupies.
- There are no intermolecular forces between the particles.
- There is no energy loss due to particle collisions.

Although the given model does not precisely represent the behaviour of a real gas, it helps us to understand fundamental notions about the gas.

In this experiment, particularly, the relationship between pressure and volume of an ideal gas will be investigated. This relationship is crucial in several areas such as weather forecasting, medicine, and air conditioning systems (“Applications of Ideal Gas Law”).

Background

Although Richard Towneley and Henry Power first noticed the relationship between pressure and volume in the XVII century, Robert Boyle was the first person to confirm their discovery via experiment. Boyle used a closed tube, and after pouring mercury from one side, he forced the air on the other side to contract under the pressure of mercury; thus, he concluded that the pressure of a gas is inversely proportional to the volume (Wikipedia Contributors, "Boyle's Law"). Subsequently, the relationship between pressure and volume was called "Boyle's Law". Nowadays, this claim could be confirmed via experiment much easier as there are syringes that have very precise scale division and digital manometers that show the exact pressure value. Therefore, the research question is: **"How can the relationship between pressure and volume be found using a syringe and manometer?"**

According to Boyle's Law, this is a relationship between pressure and volume:

$$P \propto \frac{1}{V}$$

Дизайн исследования

Hypothesis

I predict that using a syringe and manometer, I will find the relationship between pressure and volume, which would be inversely proportional according to Boyle's Law, and according to the gradient of the graph, I will find the approximate value of nRT.

Variables

The **independent variable** is volume, measured in milliliters.
The **dependent variable** is pressure, measured in Pascals.
The **controlled variables**, their significance, and methods to control them are listed below:

Дизайн исследования

Materials

1. Syringe
2. Digital manometer

Methodology

1. Take the syringe and connect the digital manometer to it.
2. Squeeze the plunger of the syringe and put it to values of 20, 17.5, 15, 12.5, and 10 milliliters.
3. Measure the pressure at given volume values.
4. Repeat this process two more times.

add ethical and environmental issues

No safety measurements are required since there will not be any hot, sharp, or dangerous objects.

Анализ данных

Raw Data

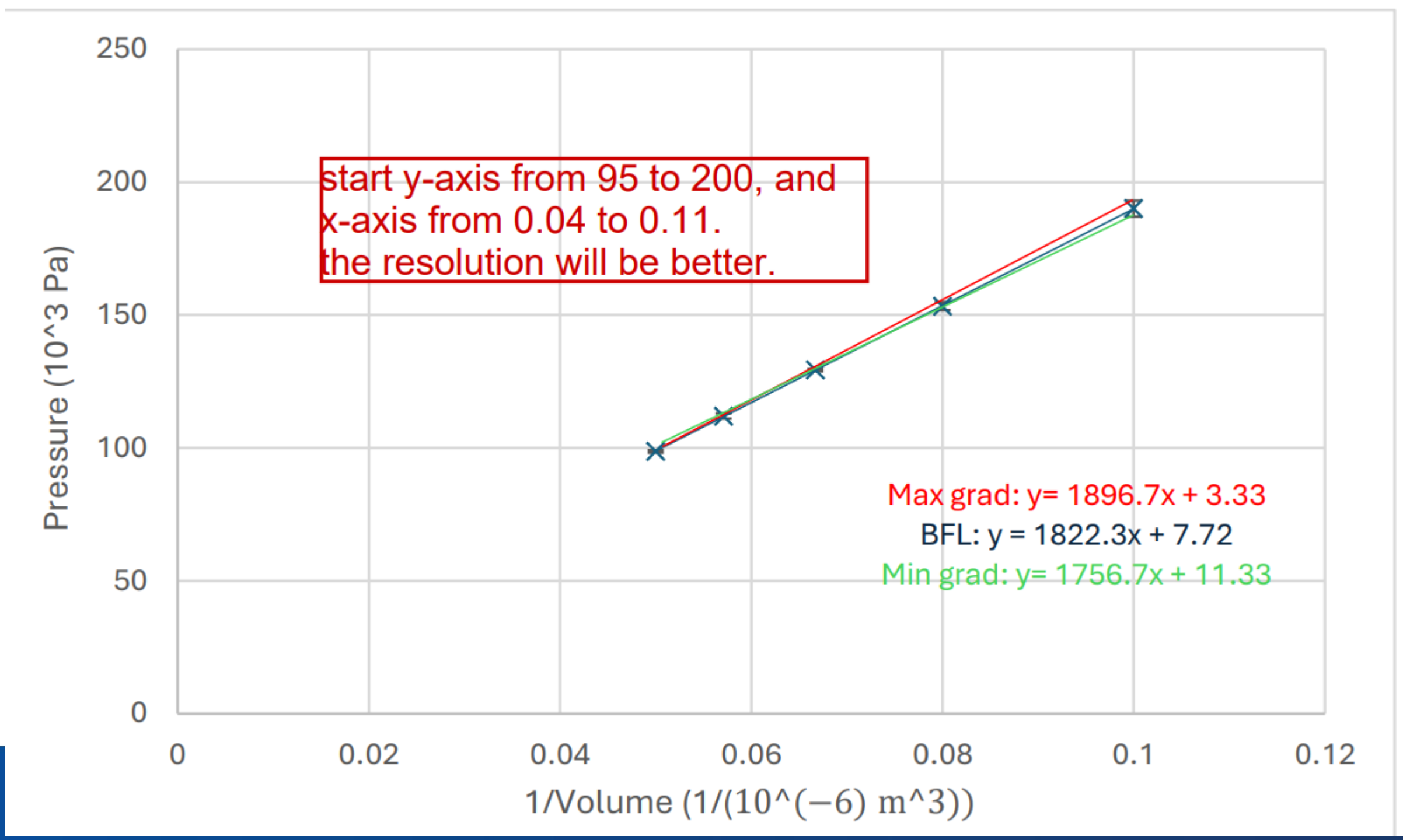
Volume $(10^{-6}m^3)$	Pressure $(10^3 Pa)$		
	Trial 1	Trial 2	Trial 3
20	99	98	99
17.5	112	113	111
15	129	129	130

use consistent s.f.

Анализ данных

Processed Data

$\frac{1}{Volume}\ (\frac{1}{10^{-6}m^3})$	Mean pressure $(10^3 Pa)$	Uncertainty $(\pm 10^3 Pa)$
0.050	98.67	0.5 use consistent s.f.
0.057	112.00	1
0.067	129.33	0.5
0.080	153.33	1.5
1.000	190.00	3


start y-axis from 95 to 200, and
x-axis from 0.04 to 0.11.
the resolution will be better.
Max grad: y= 1896.7x + 3.33
BFL: y = 1822.3x + 7.72
Min grad: y= 1756.7x + 11.33
Pressure (10^3 Pa)
250
200
150
100
50
0
0
0.02
0.04
0.06
0.08
0.1
0.12
1/Volume (1/(10^(−6) m^3))

Заключение

Conclusion

The obtained results support the hypothesis as I acquired an inversional proportion of pressure to the volume, confirming Boyle's Law, and also got an nRT value of $1.82\ N \cdot m$ with very small uncertainty of $\pm 0.0700 N \cdot m$, which, in percentage, is only 3.85%.

Thus, according to the results, with easily accessible tools (a syringe and manometer), it is possible to find both the relationship between pressure and volume and nRT value with high precision.

with literature

Вывод

Evaluation & Improvements

Error	Signficance of an error	Improvements
Potential error in volume measurements due to a little “hill” at the bottom of the syringe’s barrel.	Slightly significant, this “hill” may take approximately 0.3-0.4 ml which is very little.	Use a syringe whose sides are completely flat.
Minor fluctuations of volume when measuring the pressure.	Slightly significant. Due to the difficulty of squeezing the plunger of the syringe on low volume values, there were little fluctuations ($\approx \pm 0.5ml$) of the volume in the syringe, which may cause slight changes in pressure	Use a clamp to ensure that the plunger does not fluctuate.

12 апреля, АШМБ, Закон радиоактивного распада

https://www.walter-fendt.de/html5/phru/lawdecay_ru.htm

1. Отсканируйте QR код.

2. Заполните таблицу используя виртуальную лабораторию:

12 апреля, АШМБ, Фотоэффект

https://simphy.com/view_simulation?photoelectric-effect&

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Вступление
Теоретическая часть
Практическая часть
Вопросы и рефлексия

Вопросы?

Рефлексия

1. Оцените презентацию из 5 баллов.

_____

2. Что вам понравилось?

_____

_____

_____

_____

_____

Вступление

Теоретическая часть

Практическая часть

Вопросы и рефлексия

- 3. Что можно улучшить и как?
- _____
- _____
- _____
- _____
- _____
- _____

СПАСИБО !!!

Источники:

1. MYP Sciences guide, IBO, 2014.
2. https://simphy.com/view_simulation?photoelectric-effect&
3. https://www.walter-fendt.de/html5/phru/lawdecay_ru.htm