KENDRIYA VIDYALAYA EOI

KATHMANDU



Academic year: 22-23

**PROJECT REPORT ON:**

Menu Based Program for Periodic Table in Python

**SUMBITTED BY:**

Krish K. Singh

Roll no: 11117

Class: 11 ‘A’

**Under The Guidance of:**

Mr. A. P. S. Khushwaha

PGT(CS)

KENDRIYA VIDYALAYA EOI

KATHMANDU



This is to certify that Cadet Krish Kumar Singh Roll No: 11117 has successfully completed the project Work entitled " Menu Based Program for Periodic Table in Python" in the subject Computer Science (083) laid down in the regulations of CBSE for the purpose of Practical [ Examination in Class XI to be held in Kendriya Vidyalaya EOI on 15th January 2023.

(Mr. A. P. S. Khushwaha)

PGT Comp Science

**Date:**

**15th Jan, 2023**

**Acknowledgement**

I am grateful for the support and guidance of many individuals who have been instrumental in the successful completion of this project.

I express my deep appreciation to God for giving me the strength to complete it. My parents' constant encouragement was greatly appreciated. I also extend my thanks to the individuals who contributed to the project, despite my flaws. I am particularly grateful to the Mr. A. P. Vinod Kumar Principal for their motivation and support.

Additionally, I want to thank the school for providing the necessary infrastructure and support during the project's implementation. I am also grateful to my teacher Mr. Arun Pratap Singh Kushwaha, who served as a guide, mentor, and friend, and provided critical review and assistance throughout the project.

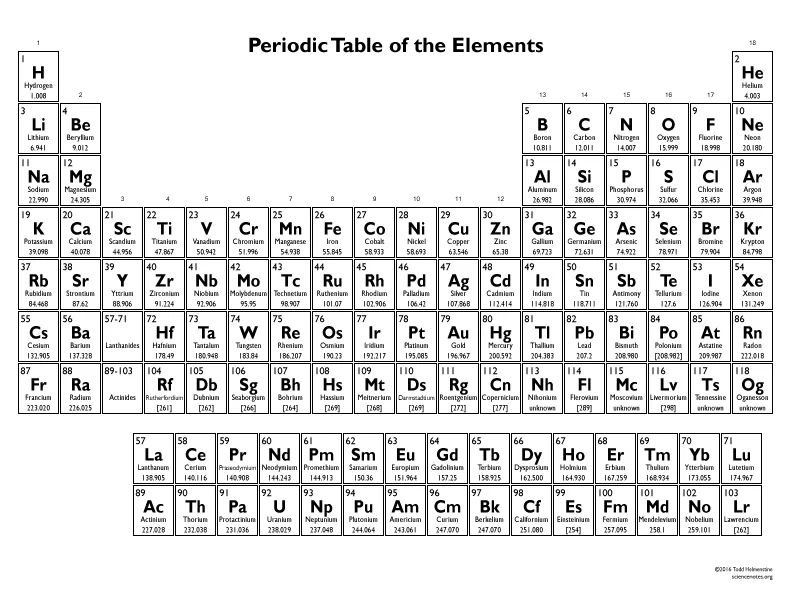
Lastly, I want to acknowledge the support and contribution of all members who have helped with this project, their support was vital to its success.

**Table of Contents**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Description** | **Pg.No** |
| **1.** | **Introduction of Project** | **1** |
| **2.** | **Objective of Project** | **2** |
| **3.** | **Scope of Project** | **2** |
| **4.** | **Input/Output Requirement** | **3** |
| **5.** | **The Existing System** | **3** |
| **6.** | **Proposed System** | **4** |
| **7.** | **Hardware and Software Requirement** | **4** |
| **8.** | **System Design** | **6** |
| **9.** | **Security Control** | **9** |
| **10.** | **Source Code** | **9** |
| **11.** | **Output** | **23** |
| **12.** | **Conclusion** | **24** |
| **13.** | **Reference or bibliography** | **24** |

**INTRODUCTION OF PROJECT**

The project upon the topic of ‘Menu Based program for Periodic

Table’ is a simple menu based python program developed to assists its users to achieve information regarding any element present in the periodic table. 

This program helps the user to learn various aspects of

the periodic table and extrapolate the meaning and value behind the various symbols present in the periodic table.

**OBJECTIVE OF THE PROJECT**

The program can have an array of objectives it intends to fulfill. Some of the major objectives of the program are presented below:

* To provide easy access to users regarding information related to the periodic table.
* To provide students and individuals wishing to learn an interactive way to learn about the periodic table.
* To encourage everyone to learn more about the periodic table and its importance.

**Scope of The Project**

The following project of mine has great scope in the future.

It has potential to reach great heights with the proper time and investment.

Several new additions can be made to the program. One major upgrade can be made to add on a GUI (Graphical User Interface) to increase the effectiveness of the program alongside an improvement to its interface.

Another major addition that could be added in the future is a larger database to provide more in-depth information regarding periodic table and the elements.

The program could also be made more accessible to the general public to increases its reach and get more reviews on improving the program.

**Input/Output Requirement**

**Input requirements:**

1. An input device to enter input.

**Output requirements:**

1. A monitor to display information
2. Have terminal open

**The Existing System**

The following project performs its manual work by pulling values stored systematically in dictionaries. These dictionaries are stored locally to improve data pulling speeds and thus increase efficiency.

The project aims to minimize efforts and reduce time taken for users to obtain information regarding Periodic Table and all the different elements currently known. This projects helps user get detailed information on all known elements free of costs, in a time efficient manner.

**The Proposed System**

This following projects helps minimize efforts for the user

in the process of achieving information regarding the periodic table.

The following project helps provide its user a platform with concentrated information regarding various aspects of periodic table. This helps the user save time and minimize effort as they can achieve all the information regarding the periodic table on a single platform, helping them avoid going through several different platforms to achieve their desired information.

**Hardware and Software Requirement**

1. **Hardware Requirements:**

* Operating System: Windows 7 or above
* Processor: Pentium(any) or AMD ATHALON (3800+- 4200+ DUAL CORE)
* Motherboard: 1.845 or 915995 for Pentium or MSI

K9MM-V VIA K8M800+8237R plus chipset for AMD

* RAM: 512MB+ out of 2 GB
* Hard Disk: SATA 40GB or above
* CD/DVD r/w multi drive combo: (if backup required)
* Floppy Drive: (if backup required)
* Monitor
* Keyboard and Mass
* Printer (if hard copy required)

1. **Software Requirements:**

* Windows/Linux/Mac OS
* Python
* And idle to run the program on

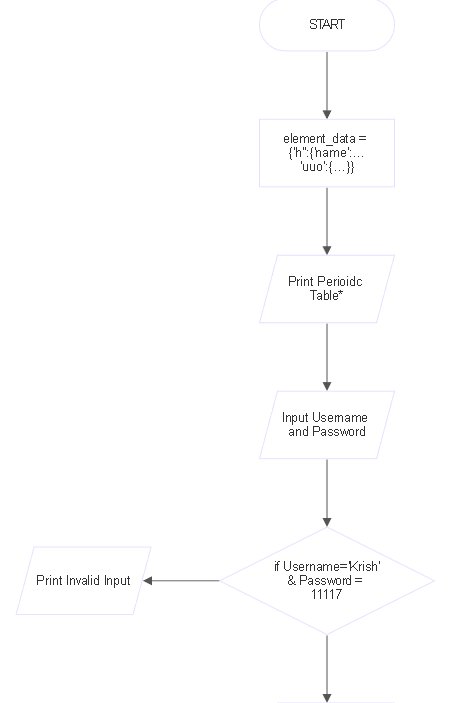
IDLE (Integrated Development and Learning Environment) is an integrated development environment (IDE) for Python, included with the standard distribution of the language. DLE is an IDE for Python that comes with the standard distribution of the language. It includes a text editor, shell, and debugging tools for writing and testing Python code, suitable for both beginners and experienced programmers.

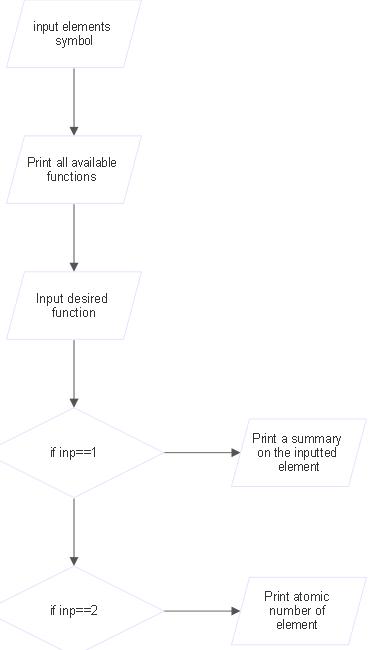
**System Design**

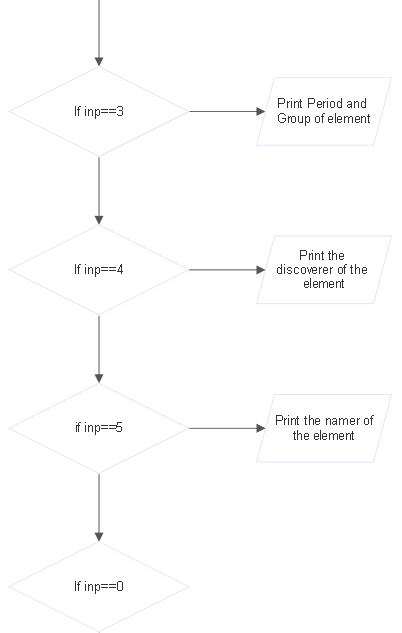
ALGORITHM:

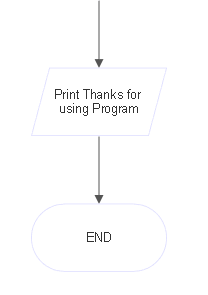
1. Ask for username and password
2. Check if username and password are correct
3. If the username and password are correct continue
4. If they aren’t correct end program and print, ‘Wrong username or password entered. Run Program Again’.
5. Print a visual form of periodic table
6. Print all available functions that can be performed
7. Take input of element from user
8. Take the particular action the user wants to perform on the inputted element.
9. If input is ‘1’. Then print a general summary on element inputted by user
10. If input is ‘2’. Then print atomic number of element inputted by user
11. If input is ‘3’. Then print period and group of element inputted by user
12. If input is ‘4’. Then print the person who discovered the element inputted by user
13. If input is ‘5’. Then print the person who names the element inputted by the user
14. If input is ‘0’. Then exit program
15. Until ‘0’ is inputted the program will keep running
16. If there is an invalid input print,’ wrong input identified. TRY AGAIN -\_-‘.

**FLOWCHART:**

****

****

****

****

**Security Control**

For security purposes user name to protect the database. The username and password are as:

* Username: krish
* Password: 11117

**Source Code**

**Code can be downloaded from the hyperlink given below:**

[Menu Based Periodic Table](https://github.com/Krish-rollno-11117/Menu-Based-Periodic-Table.git)

element\_data = {

'h': {

"name": "Hydrogen","atomic-mass": 1.0079,"boil": 20.271,"category": 'NONMETAL',

"density": 0.08988,"discovered-by": "Henry Cavendish","melt": 13.99,"molar-heat": 28.836,

"named-by": "Antoine Lavoisier","atomic\_number": 1,"period": 1,"phase": 'GAS',"symbol": "H",'group': 1,'period': 1},

'he': {

"name": "Helium","atomic-mass": 4.0026022,"boil": 4.222,"category": 'NOBLEGAS',

"density": 0.1786,"discovered-by": "Pierre Janssen","melt": 0.95,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 2,"period": 1,"phase": 'GAS',"symbol": "He",'group': 18,'period': 1},

'li':{

"name": "Lithium","atomic-mass": 6.94,"boil": 1603,"category": 'ALKALIMETAL',

"density": 0.534,"discovered-by": "Johan August Arfwedson","melt": 453.65,"molar-heat": 24.86,

"named-by": "Unknown","atomic\_number": 3,"period": 2,"phase": 'SOLID',"symbol": "Li",'group': 1,'period':2},

'be': {

"name": "Beryllium","atomic-mass": 9.01218315,"boil": 2742,"category": 'ALKALINEEARTHMETAL',

"density": 1.85,"discovered-by": "Louis Nicolas Vauquelin","melt": 1560,"molar-heat": 16.443,

"named-by": "Unknown","atomic\_number": 4,"period": 2,"phase": 'SOLID',"symbol": "Be",'group': 2,'period': 2},

'b': {

"name": "Boron","atomic-mass": 10.81,"boil": 4200,"category": 'METALLOID',

"density": 2.08,"discovered-by": "Joseph Louis Gay-Lussac","melt": 2349,"molar-heat": 11.087,

"named-by": "Unknown","atomic\_number": 5,"period": 2,"phase": 'SOLID',"symbol": "B",'group': 13,'period': 2},

'c': {

"name": "Carbon","atomic-mass": 12.011,"boil": 'None',"category": 'NONMETAL',

"density": 1.821,"discovered-by": "Ancient Egypt","melt": 'None',"molar-heat": 8.517,

"named-by": "Unknown","atomic\_number": 6,"period": 2,"phase": 'SOLID',"symbol": "C",'group': 14,'period': 2},

'n': {

"name": "Nitrogen","atomic-mass": 14.007,"boil": 77.355,"category": 'NONMETAL',

"density": 1.251,"discovered-by": "Daniel Rutherford","melt": 63.15,"molar-heat": 'None',

"named-by": "Jean-Antoine Chaptal","atomic\_number": 7,"period": 2,"phase": 'GAS',"symbol": "N",'group': 15,'period': 2},

'o': {

"name": "Oxygen","atomic-mass": 15.999,"boil": 90.188,"category": 'NONMETAL',

"density": 1.429,"discovered-by": "Carl Wilhelm Scheele","melt": 54.36,"molar-heat": 'None',

"named-by": "Antoine Lavoisier","atomic\_number": 8,"period": 2,"phase": 'GAS',"symbol": "O",'group': 16,'period': 2},

'f': {

"name": "Fluorine","atomic-mass": 18.9984031636,"boil": 85.03,"category": 'DIATOMIC NONMETAL',

"density": 1.696,"discovered-by": "Andr\u00e9-Marie Amp\u00e8re","melt": 53.48,"molar-heat": 'None',

"named-by": "Humphry Davy","atomic\_number": 9,"period": 2,"phase": 'GAS',"symbol": "F",'group': 17,'period': 2},

'ne': {

"appearance": "colorless gas exhibiting an orange-red glow when placed in a high voltage electric field",

"name": "Neon","atomic-mass": 20.17976,"boil": 27.104,"category": 'NOBLEGAS',

"density": 0.9002,"discovered-by": "Morris Travers","melt": 24.56,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 10,"period": 2,"phase": 'GAS',"symbol": "Ne",'group': 18,'period': 2},

'na': {

"appearance": "silvery white metallic",

"name": "Sodium","atomic-mass": 22.989769282,"boil": 1156.09,"category": 'ALKALIMETAL',

"density": 0.968,"discovered-by": "Humphry Davy","melt": 370.944,"molar-heat": 28.23,

"named-by": "Unknown","atomic\_number": 11,"period": 3,"phase": 'SOLID',"symbol": "Na",'group': 1,'period': 3},

'mg': {

"appearance": "shiny grey solid",

"name": "Magnesium","atomic-mass": 24.305,"boil": 1363,"category": 'ALKALINEEARTHMETAL',

"density": 1.738,"discovered-by": "Joseph Black","melt": 923,"molar-heat": 24.869,

"named-by": "Unknown","atomic\_number": 12,"period": 3,"phase": 'SOLID',"symbol": "Mg",'group': 2,'period': 3},

'al': {

"appearance": "silvery gray metallic",

"name": "Aluminium","atomic-mass": 26.98153857,"boil": 2743,"category": 'POSTTRANSITIONMETAL',

"density": 2.7,"discovered-by": 'None',"melt": 933.47,"molar-heat": 24.2,

"named-by": "Humphry Davy","atomic\_number": 13,"period": 3,"phase": 'SOLID',"symbol": "Al",'group': 13,'period': 3},

'si': {

"appearance": "crystalline, reflective with bluish-tinged faces",

"name": "Silicon","atomic-mass": 28.085,"boil": 3538,"category": 'METALLOID',

"density": 2.329,"discovered-by": "J\u00f6ns Jacob Berzelius","melt": 1687,"molar-heat": 19.789,

"named-by": "Thomas Thomson chemist","atomic\_number": 14,"period": 3,"phase": 'SOLID',"symbol": "Si",'group': 14,'period': 3},

'p': {

"appearance": "colourless, waxy white, yellow, scarlet, red, violet, black",

"name": "Phosphorus","atomic-mass": 30.9737619985,"boil": 'None',"category": 'NONMETAL',

"density": 'None',"discovered-by": "Hennig Brand","melt": 'None',"molar-heat": 23.824,

"named-by": "Unknown","atomic\_number": 15,"period": 3,"phase": 'SOLID',"symbol": "P",'group': 15,'period': 3},

's': {

"appearance": "lemon yellow sintered microcrystals",

"name": "Sulfur","atomic-mass": 32.06,"boil": 717.8,"category": 'NONMETAL',

"density": 2.07,"discovered-by": "Ancient china","melt": 388.36,"molar-heat": 22.75,

"named-by": "Unknown","atomic\_number": 16,"period": 3,"phase": 'SOLID',"symbol": "S",'group': 16,'period': 3},

'cl': {

"appearance": "pale yellow-green gas",

"name": "Chlorine","atomic-mass": 35.45,"boil": 239.11,"category": 'DIATOMIC NONMETAL',

"density": 3.2,"discovered-by": "Carl Wilhelm Scheele","melt": 171.6,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 17,"period": 3,"phase": 'GAS',"symbol": "Cl",'group': 17,'period': 3},

'ar': {

"appearance": "colorless gas exhibiting a lilac/violet glow when placed in a high voltage electric field",

"name": "Argon","atomic-mass": 39.9481,"boil": 87.302,"category": 'NOBLEGAS',

"density": 1.784,"discovered-by": "Lord Rayleigh","melt": 83.81,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 18,"period": 3,"phase": 'GAS',"symbol": "Ar",'group': 18,'period': 3},

'k': {

"appearance": "silvery gray",

"name": "Potassium","atomic-mass": 39.09831,"boil": 1032,"category": 'ALKALIMETAL',

"density": 0.862,"discovered-by": "Humphry Davy","melt": 336.7,"molar-heat": 29.6,

"named-by": "Unknown","atomic\_number": 19,"period": 4,"phase": 'SOLID',"symbol": "K",'group': 1,'period': 4},

'ca': {

"name": "Calcium","atomic-mass": 40.0784,"boil": 1757,"category": 'ALKALINEEARTHMETAL',

"density": 1.55,"discovered-by": "Humphry Davy","melt": 1115,"molar-heat": 25.929,

"named-by": "Unknown","atomic\_number": 20,"period": 4,"phase": 'SOLID',"symbol": "Ca",'group': 2,'period': 4},

'sc': {

"appearance": "silvery white",

"name": "Scandium","atomic-mass": 44.9559085,"boil": 3109,"category": 'TRANSITIONMETAL',

"density": 2.985,"discovered-by": "Lars Fredrik Nilson","melt": 1814,"molar-heat": 25.52,

"named-by": "Unknown","atomic\_number": 21,"period": 4,"phase": 'SOLID',"symbol": "Sc",'group': 3,'period': 4},

'ti': {

"appearance": "silvery grey-white metallic",

"name": "Titanium","atomic-mass": 47.8671,"boil": 3560,"category": 'TRANSITIONMETAL',

"density": 4.506,"discovered-by": "William Gregor","melt": 1941,"molar-heat": 25.06,

"named-by": "Martin Heinrich Klaproth","atomic\_number": 22,"period": 4,"phase": 'SOLID',"symbol": "Ti",'group': 4,'period': 4},

'v': {

"appearance": "blue-silver-grey metal",

"name": "Vanadium","atomic-mass": 50.94151,"boil": 3680,"category": 'TRANSITIONMETAL',

"density": 6.0,"discovered-by": "Andr\u00e9s Manuel del R\u00edo","melt": 2183,"molar-heat": 24.89,

"named-by": "Isotopes of vanadium","atomic\_number": 23,"period": 4,"phase": 'SOLID',"symbol": "V",'group': 5,'period': 4},

'cr': {

"appearance": "silvery metallic",

"name": "Chromium","atomic-mass": 51.99616,"boil": 2944,"category": 'TRANSITIONMETAL',

"density": 7.19,"discovered-by": "Louis Nicolas Vauquelin","melt": 2180,"molar-heat": 23.35,

"named-by": "Unknown","atomic\_number": 24,"period": 4,"phase": 'SOLID',"symbol": "Cr",'group': 6,'period': 4},

'mn': {

"appearance": "silvery metallic",

"name": "Manganese","atomic-mass": 54.9380443,"boil": 2334,"category": 'TRANSITIONMETAL',

"density": 7.21,"discovered-by": "Torbern Olof Bergman","melt": 1519,"molar-heat": 26.32,

"named-by": "Unknown","atomic\_number": 25,"period": 4,"phase": 'SOLID',"symbol": "Mn",'group': 7,'period': 4},

'fe': {

"appearance": "lustrous metallic with a grayish tinge",

"name": "Iron","atomic-mass": 55.8452,"boil": 3134,"category": 'TRANSITIONMETAL',

"density": 7.874,"discovered-by": "5000 BC","melt": 1811,"molar-heat": 25.1,

"named-by": "Unknown","atomic\_number": 26,"period": 4,"phase": 'SOLID',"symbol": "Fe",'group': 8,'period': 4},

'co': {

"appearance": "hard lustrous gray metal",

"name": "Cobalt","atomic-mass": 58.9331944,"boil": 3200,"category": 'TRANSITIONMETAL',

"density": 8.9,"discovered-by": "Georg Brandt","melt": 1768,"molar-heat": 24.81,

"named-by": "Unknown","atomic\_number": 27,"period": 4,"phase": 'SOLID',"symbol": "Co",'group': 9,'period': 4},

'ni': {

"appearance": "lustrous, metallic, and silver with a gold tinge",

"name": "Nickel","atomic-mass": 58.69344,"boil": 3003,"category": 'TRANSITIONMETAL',

"density": 8.908,"discovered-by": "Axel Fredrik Cronstedt","melt": 1728,"molar-heat": 26.07,

"named-by": "Unknown","atomic\_number": 28,"period": 4,"phase": 'SOLID',"symbol": "Ni",'group': 10,'period': 4},

'cu': {

"appearance": "red-orange metallic luster",

"name": "Copper","atomic-mass": 63.5463,"boil": 2835,"category": 'TRANSITIONMETAL',

"density": 8.96,"discovered-by": "Middle East","melt": 1357.77,"molar-heat": 24.44,

"named-by": "Unknown","atomic\_number": 29,"period": 4,"phase": 'SOLID',"symbol": "Cu",'group': 11,'period': 4},

'zn': {

"appearance": "silver-gray",

"name": "Zinc","atomic-mass": 65.382,"boil": 1180,"category": 'TRANSITIONMETAL',

"density": 7.14,"discovered-by": "India","melt": 692.68,"molar-heat": 25.47,

"named-by": "Unknown","atomic\_number": 30,"period": 4,"phase": 'SOLID',"symbol": "Zn",'group': 12,'period': 4},

'ga': {

"appearance": "silver-white",

"name": "Gallium","atomic-mass": 69.7231,"boil": 2673,"category": 'POSTTRANSITIONMETAL',

"density": 5.91,"discovered-by": "Lecoq de Boisbaudran","melt": 302.9146,"molar-heat": 25.86,

"named-by": "Unknown","atomic\_number": 31,"period": 4,"phase": 'SOLID',"symbol": "Ga",'group': 13,'period': 4},

'ge': {

"appearance": "grayish-white",

"name": "Germanium","atomic-mass": 72.6308,"boil": 3106,"category": 'METALLOID',

"density": 5.323,"discovered-by": "Clemens Winkler","melt": 1211.4,"molar-heat": 23.222,

"named-by": "Unknown","atomic\_number": 32,"period": 4,"phase": 'SOLID',"symbol": "Ge",'group': 14,'period': 4},

'as': {

"appearance": "metallic grey",

"name": "Arsenic","atomic-mass": 74.9215956,"boil": 'None',"category": 'METALLOID',

"density": 5.727,"discovered-by": "Bronze Age","melt": 'None',"molar-heat": 24.64,

"named-by": "Unknown","atomic\_number": 33,"period": 4,"phase": 'SOLID',"symbol": "As",'group': 15,'period': 4},

'se': {

"appearance": "black, red, and gray not pictured allotropes",

"name": "Selenium","atomic-mass": 78.9718,"boil": 958,"category": 'NONMETAL',

"density": 4.81,"discovered-by": "J\u00f6ns Jakob Berzelius","melt": 494,"molar-heat": 25.363,

"named-by": "Unknown","atomic\_number": 34,"period": 4,"phase": 'SOLID',"symbol": "Se",'group': 16,'period': 4},

'br': {

"name": "Bromine","atomic-mass": 79.904,"boil": 332.0,"category": 'DIATOMIC NONMETAL',

"density": 23.1028,"discovered-by": "Antoine J\u00e9r\u00f4me Balard","melt": 265.8,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 35,"period": 4,"phase": 'LIQUID', "symbol": "Br",'group': 17,'period': 4},

'kr': {

"appearance": "colorless 'gas', exhibiting a whitish glow in a high electric field",

"name": "Krypton","atomic-mass": 83.7982,"boil": 119.93,"category": 'NOBLEGAS',

"density": 3.749,"discovered-by": "William Ramsay","melt": 115.78,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 36,"period": 4,"phase": 'GAS',"symbol": "Kr",'group': 18,'period': 4},

'rb': {

"appearance": "grey white",

"name": "Rubidium","atomic-mass": 85.46783,"boil": 961,"category": 'ALKALIMETAL',

"density": 1.532,"discovered-by": "Robert Bunsen","melt": 312.45,"molar-heat": 31.06,

"named-by": "Unknown","atomic\_number": 37,"period": 5,"phase": 'SOLID',"symbol": "Rb",'group': 1,'period': 5},

'sr': {

"name": "Strontium","atomic-mass": 87.621,"boil": 1650,"category": 'ALKALINEEARTHMETAL',

"density": 2.64,"discovered-by": "William Cruickshank chemist","melt": 1050,"molar-heat": 26.4,

"named-by": "Unknown","atomic\_number": 38,"period": 5,"phase": 'SOLID',"symbol": "Sr",'group': 2,'period': 5},

'y': {

"appearance": "silvery white",

"name": "Yttrium","atomic-mass": 88.905842,"boil": 3203,"category": 'TRANSITIONMETAL',

"density": 4.472,"discovered-by": "Johan Gadolin","melt": 1799,"molar-heat": 26.53,

"named-by": "Unknown","atomic\_number": 39,"period": 5,"phase": 'SOLID',"symbol": "Y",'group': 3,'period': 5},

'zr': {

"appearance": "silvery white",

"name": "Zirconium","atomic-mass": 91.2242,"boil": 4650,"category": 'TRANSITIONMETAL',

"density": 6.52,"discovered-by": "Martin Heinrich Klaproth","melt": 2128,"molar-heat": 25.36,

"named-by": "Unknown","atomic\_number": 40,"period": 5,"phase": 'SOLID',"symbol": "Zr",'group': 4,'period': 5},

'nb': {

"appearance": "gray metallic, bluish when oxidized",

"name": "Niobium","atomic-mass": 92.906372,"boil": 5017,"category": 'TRANSITIONMETAL',

"density": 8.57,"discovered-by": "Charles Hatchett","melt": 2750,"molar-heat": 24.6,

"named-by": "Unknown","atomic\_number": 41,"period": 5,"phase": 'SOLID',"symbol": "Nb",'group': 5,'period': 5},

'mo': {

"appearance": "gray metallic",

"name": "Molybdenum","atomic-mass": 95.951,"boil": 4912,"category": 'TRANSITIONMETAL',

"density": 10.28,"discovered-by": "Carl Wilhelm Scheele","melt": 2896,"molar-heat": 24.06,

"named-by": "Unknown","atomic\_number": 42,"period": 5,"phase": 'SOLID',"symbol": "Mo",'group': 6,'period': 5},

'tc': {

"appearance": "shiny gray metal",

"name": "Technetium","atomic-mass": 98,"boil": 4538,"category": 'TRANSITIONMETAL',

"density": 11,"discovered-by": "Emilio Segr\u00e8","melt": 2430,"molar-heat": 24.27,

"named-by": "Unknown","atomic\_number": 43,"period": 5,"phase": 'SOLID',"symbol": "Tc",'group': 7,'period': 5},

'ru': {

"appearance": "silvery white metallic",

"name": "Ruthenium","atomic-mass": 101.072,"boil": 4423,"category": 'TRANSITIONMETAL',

"density": 12.45,"discovered-by": "Karl Ernst Claus","melt": 2607,"molar-heat": 24.06,

"named-by": "Unknown","atomic\_number": 44,"period": 5,"phase": 'None',"symbol": "Ru",'group': 8,'period': 5},

'rh': {

"appearance": "silvery white metallic",

"name": "Rhodium","atomic-mass": 102.905502,"boil": 3968,"category": 'TRANSITIONMETAL',

"density": 12.41,"discovered-by": "William Hyde Wollaston","melt": 2237,"molar-heat": 24.98,

"named-by": "Unknown","atomic\_number": 45,"period": 5,"phase": 'SOLID',"symbol": "Rh",'group': 9,'period': 5},

'pd': {

"appearance": "silvery white",

"name": "Palladium","atomic-mass": 106.421,"boil": 3236,"category": 'TRANSITIONMETAL',

"density": 12.023,"discovered-by": "William Hyde Wollaston","melt": 1828.05,"molar-heat": 25.98,

"named-by": "Unknown","atomic\_number": 46,"period": 5,"phase": 'SOLID',"symbol": "Pd",'group': 10,'period': 5},

'ag': {

"appearance": "lustrous white metal",

"name": "Silver","atomic-mass": 107.86822,"boil": 2435,"category": 'TRANSITIONMETAL',

"density": 10.49,"discovered-by": "'unknowN', before 5000 BC","melt": 1234.93,"molar-heat": 25.35,

"named-by": "Unknown","atomic\_number": 47,"period": 5,"phase": 'SOLID',"symbol": "Ag",'group': 11,'period': 5},

'cd': {

"appearance": "silvery bluish-gray metallic",

"name": "Cadmium","atomic-mass": 112.4144,"boil": 1040,"category": 'TRANSITIONMETAL',

"density": 8.65,"discovered-by": "Karl Samuel Leberecht Hermann","melt": 594.22,"molar-heat": 26.02,

"named-by": "Isotopes of cadmium","atomic\_number": 48,"period": 5,"phase": 'SOLID',"symbol": "Cd",'group': 12,'period': 5},

'in': {

"appearance": "silvery lustrous gray",

"name": "Indium","atomic-mass": 114.8181,"boil": 2345,"category": 'POSTTRANSITIONMETAL',

"density": 7.31,"discovered-by": "Ferdinand Reich","melt": 429.7485,"molar-heat": 26.74,

"named-by": "Unknown","atomic\_number": 49,"period": 5,"phase": 'SOLID',"symbol": "In",'group': 13,'period': 5},

'sn': {

"appearance": "silvery-white beta, \u03b2 or gray alpha, \u03b1",

"name": "Tin","atomic-mass": 118.7107,"boil": 2875,"category": 'POSTTRANSITIONMETAL',

"density": 7.365,"discovered-by": "'unknowN', before 3500 BC","melt": 505.08,"molar-heat": 27.112,

"named-by": "Unknown","atomic\_number": 50,"period": 5,"phase": 'SOLID',"symbol": "Sn",'group': 14,'period': 5},

'sb': {

"appearance": "silvery lustrous gray",

"name": "Antimony","atomic-mass": 121.7601,"boil": 1908,"category": 'METALLOID',

"density": 6.697,"discovered-by": "'unknowN', before 3000 BC","melt": 903.78,"molar-heat": 25.23,

"named-by": "Unknown","atomic\_number": 51,"period": 5,"phase": 'SOLID',"symbol": "Sb",'group': 15,'period': 5},

'te': {

"name": "Tellurium","atomic-mass": 127.603,"boil": 1261,"category": 'METALLOID',

"density": 6.24,"discovered-by": "Franz-Joseph M\u00fcller von Reichenstein","melt": 722.66,"molar-heat": 25.73,

"named-by": "Unknown","atomic\_number": 52,"period": 5,"phase": 'SOLID',"symbol": "Te",'group': 16,'period': 5},

'i': {

"appearance": "lustrous metallic gray, violet as a gas",

"name": "Iodine","atomic-mass": 126.904473,"boil": 457.4,"category": 'DIATOMIC NONMETAL',

"density": 4.933,"discovered-by": "Bernard Courtois","melt": 386.85,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 53,"period": 5,"phase": 'SOLID',"symbol": "I",'group': 17,'period': 5},

'xe': {

"appearance": "colorless 'gas', exhibiting a blue glow when placed in a high voltage electric field",

"name": "Xenon","atomic-mass": 131.2936,"boil": 165.051,"category": 'NOBLEGAS',

"density": 5.894,"discovered-by": "William Ramsay","melt": 161.4,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 54,"period": 5,"phase": 'GAS',"symbol": "Xe",'group': 18,'period': 5},

'cs': {

"appearance": "silvery gold",

"name": "Cesium","atomic-mass": 132.905451966,"boil": 944,"category": 'ALKALIMETAL',

"density": 1.93,"discovered-by": "Robert Bunsen","melt": 301.7,"molar-heat": 32.21,

"named-by": "Unknown","atomic\_number": 55,"period": 6,"phase": 'SOLID',"symbol": "Cs",'group': 1,'period': 6},

'ba': {

"name": "Barium","atomic-mass": 137.3277,"boil": 2118,"category": 'ALKALINEEARTHMETAL',

"density": 3.51,"discovered-by": "Carl Wilhelm Scheele","melt": 1000,"molar-heat": 28.07,

"named-by": "Unknown","atomic\_number": 56,"period": 6,"phase": 'SOLID',"symbol": "Ba",'group': 2,'period': 6},

'la': {

"appearance": "silvery white",

"name": "Lanthanum","atomic-mass": 138.905477,"boil": 3737,"category": 'LANTHANIDE',

"density": 6.162,"discovered-by": "Carl Gustaf Mosander","melt": 1193,"molar-heat": 27.11,

"named-by": "Unknown","atomic\_number": 57,"period": 6,"phase": 'SOLID',"symbol": "La",'group': 3,'period': 9},

'ce': {

"appearance": "silvery white",

"name": "Cerium","atomic-mass": 140.1161,"boil": 3716,"category": 'LANTHANIDE',

"density": 6.77,"discovered-by": "Martin Heinrich Klaproth","melt": 1068,"molar-heat": 26.94,

"named-by": "Unknown","atomic\_number": 58,"period": 6,"phase": 'SOLID',"symbol": "Ce",'group': 4,'period': 9},

'pr': {

"appearance": "grayish white",

"name": "Praseodymium","atomic-mass": 140.907662,"boil": 3403,"category": 'LANTHANIDE',

"density": 6.77,"discovered-by": "Carl Auer von Welsbach","melt": 1208,"molar-heat": 27.2,

"named-by": "Unknown","atomic\_number": 59,"period": 6,"phase": 'SOLID',"symbol": "Pr",'group': 5,'period': 9},

'nd': {

"appearance": "silvery white",

"name": "Neodymium","atomic-mass": 144.2423,"boil": 3347,"category": 'LANTHANIDE',

"density": 7.01,"discovered-by": "Carl Auer von Welsbach","melt": 1297,"molar-heat": 27.45,

"named-by": "Unknown","atomic\_number": 60,"period": 6,"phase": 'SOLID',"symbol": "Nd",'group': 6,'period': 9},

'pm': {

"appearance": "metallic",

"name": "Promethium","atomic-mass": 145,"boil": 3273,"category": 'LANTHANIDE',

"density": 7.26,"discovered-by": "Chien Shiung Wu","melt": 1315,"molar-heat": 'None',

"named-by": "Isotopes of promethium","atomic\_number": 61,"period": 6,"phase": 'SOLID',"symbol": "Pm",'group': 7,'period': 9},

'sm': {

"appearance": "silvery white",

"name": "Samarium","atomic-mass": 150.362,"boil": 2173,"category": 'LANTHANIDE',

"density": 7.52,"discovered-by": "Lecoq de Boisbaudran","melt": 1345,"molar-heat": 29.54,

"named-by": "Unknown","atomic\_number": 62,"period": 6,"phase": 'SOLID',"symbol": "Sm",'group': 8,'period': 9},

'eu': {

"name": "Europium","atomic-mass": 151.9641,"boil": 1802,"category": 'LANTHANIDE',

"density": 5.264,"discovered-by": "Eug\u00e8ne-Anatole Demar\u00e7ay","melt": 1099,"molar-heat": 27.66,

"named-by": "Unknown","atomic\_number": 63,"period": 6,"phase": 'SOLID',"symbol": "Eu",'group': 9,'period': 9},

'gd': {

"appearance": "silvery white",

"name": "Gadolinium","atomic-mass": 157.253,"boil": 3273,"category": 'LANTHANIDE',

"density": 7.9,"discovered-by": "Jean Charles Galissard de Marignac","melt": 1585,"molar-heat": 37.03,

"named-by": "Unknown","atomic\_number": 64,"period": 6,"phase": 'SOLID',

"summary": "Gadolinium is a chemical element with symbol Gd and atomic number 64. It is a silvery-white, malleable and ductile rare-earth metal. It is found in nature only in combined salt form.","symbol": "Gd",'group': 10,'period': 9},

'tb': {

"appearance": "silvery white",

"name": "Terbium","atomic-mass": 158.925352,"boil": 3396,"category": 'LANTHANIDE',

"density": 8.23,"discovered-by": "Carl Gustaf Mosander","melt": 1629,"molar-heat": 28.91,

"named-by": "Unknown","atomic\_number": 65,"period": 6,"phase": 'SOLID',"symbol": "Tb",'group': 11,'period': 9},

'dy': {

"appearance": "silvery white",

"name": "Dysprosium","atomic-mass": 162.5001,"boil": 2840,"category": 'LANTHANIDE',

"density": 8.54,"discovered-by": "Lecoq de Boisbaudran","melt": 1680,"molar-heat": 27.7,

"named-by": "Unknown","atomic\_number": 66,"period": 6,"phase": 'SOLID',"symbol": "Dy",'group': 12,'period': 9},

'ho': {

"appearance": "silvery white",

"name": "Holmium","atomic-mass": 164.930332,"boil": 2873,"category": 'LANTHANIDE',

"density": 8.79,"discovered-by": "Marc Delafontaine","melt": 1734,"molar-heat": 27.15,

"named-by": "Unknown","atomic\_number": 67,"period": 6,"phase": 'SOLID',"symbol": "Ho",'group': 13,'period': 9},

'er': {

"appearance": "silvery white",

"name": "Erbium","atomic-mass": 167.2593,"boil": 3141,"category": 'LANTHANIDE',

"density": 9.066,"discovered-by": "Carl Gustaf Mosander","melt": 1802,"molar-heat": 28.12,

"named-by": "Unknown","atomic\_number": 68,"period": 6,"phase": 'SOLID',"symbol": "Er",'group': 14,'period': 9},

'tm': {

"appearance": "silvery gray",

"name": "Thulium","atomic-mass": 168.934222,"boil": 2223,"category": 'LANTHANIDE',

"density": 9.32,"discovered-by": "Per Teodor Cleve","melt": 1818,"molar-heat": 27.03,

"named-by": "Unknown","atomic\_number": 69,"period": 6,"phase": 'SOLID',"symbol": "Tm",'group': 15,'period': 9},

'yb': {

"name": "Ytterbium","atomic-mass": 173.0451,"boil": 1469,"category": 'LANTHANIDE',

"density": 6.9,"discovered-by": "Jean Charles Galissard de Marignac","melt": 1097,"molar-heat": 26.74,

"named-by": "Unknown","atomic\_number": 70,"period": 6,"phase": 'SOLID',"symbol": "Yb",'group': 16,'period': 9},

'lu': {

"appearance": "silvery white",

"name": "Lutetium","atomic-mass": 174.96681,"boil": 3675,"category": 'LANTHANIDE',

"density": 9.841,"discovered-by": "Georges Urbain","melt": 1925,"molar-heat": 26.86,

"named-by": "Unknown","atomic\_number": 71,"period": 6,"phase": 'SOLID',"symbol": "Lu",'group': 17,'period': 9},

'hf': {

"appearance": "steel gray",

"name": "Hafnium","atomic-mass": 178.492,"boil": 4876,"category": 'TRANSITIONMETAL',

"density": 13.31,"discovered-by": "Dirk Coster","melt": 2506,"molar-heat": 25.73,

"named-by": "Unknown","atomic\_number": 72,"period": 6,"phase": 'SOLID',"symbol": "Hf",'group': 4,'period': 6},

'ta': {

"appearance": "gray blue",

"name": "Tantalum","atomic-mass": 180.947882,"boil": 5731,"category": 'TRANSITIONMETAL',

"density": 16.69,"discovered-by": "Anders Gustaf Ekeberg","melt": 3290,"molar-heat": 25.36,

"named-by": "Unknown","atomic\_number": 73,"period": 6,"phase": 'SOLID',"symbol": "Ta",'group': 5,'period': 6},

'w': {

"appearance": "grayish white, lustrous",

"name": "Tungsten","atomic-mass": 183.841,"boil": 6203,"category": 'TRANSITIONMETAL',

"density": 19.25,"discovered-by": "Carl Wilhelm Scheele","melt": 3695,"molar-heat": 24.27,

"named-by": "Unknown","atomic\_number": 74,"period": 6,"phase": 'SOLID',"symbol": "W",'group': 6,'period': 6},

're': {

"appearance": "silvery-grayish",

"name": "Rhenium","atomic-mass": 186.2071,"boil": 5869,"category": 'TRANSITIONMETAL',

"density": 21.02,"discovered-by": "Masataka Ogawa","melt": 3459,"molar-heat": 25.48,

"named-by": "Walter Noddack","atomic\_number": 75,"period": 6,"phase": 'SOLID',"symbol": "Re",'group': 7,'period': 6},

'os': {

"appearance": "silvery, blue cast",

"name": "Osmium","atomic-mass": 190.233,"boil": 5285,"category": 'TRANSITIONMETAL',

"density": 22.59,"discovered-by": "Smithson Tennant","melt": 3306,"molar-heat": 24.7,

"named-by": "Unknown","atomic\_number": 76,"period": 6,"phase": 'SOLID',"symbol": "Os",'group': 8,'period': 6},

'ir': {

"appearance": "silvery white",

"name": "Iridium","atomic-mass": 192.2173,"boil": 4403,"category": 'TRANSITIONMETAL',

"density": 22.56,"discovered-by": "Smithson Tennant","melt": 2719,"molar-heat": 25.1,

"named-by": "Unknown","atomic\_number": 77,"period": 6,"phase": 'SOLID',"symbol": "Ir",'group': 9,'period': 6},

'pt': {

"appearance": "silvery white",

"name": "Platinum","atomic-mass": 195.0849,"boil": 4098,"category": 'TRANSITIONMETAL',

"density": 21.45,"discovered-by": "Antonio de Ulloa","melt": 2041.4,"molar-heat": 25.86,

"named-by": "Unknown","atomic\_number": 78,"period": 6,"phase": 'SOLID',"symbol": "Pt",'group': 10,'period': 6},

'au': {

"appearance": "metallic yellow",

"name": "Gold","atomic-mass": 196.9665695,"boil": 3243,"category": 'TRANSITIONMETAL',

"density": 19.3,"discovered-by": "Middle East","melt": 1337.33,"molar-heat": 25.418,

"named-by": "Unknown","atomic\_number": 79,"period": 6,"phase": 'SOLID',"symbol": "Au",'group': 11,'period': 6},

'hg': {

"appearance": "silvery",

"name": "Mercury","atomic-mass": 200.5923,"boil": 629.88,"category": 'TRANSITIONMETAL',

"density": 13.534,"discovered-by": "'unknowN', before 2000 BCE","melt": 234.321,"molar-heat": 27.983,

"named-by": "Unknown","atomic\_number": 80,"period": 6,"phase": 'LIQUID',"symbol": "Hg",'group': 12,'period': 6},

'tl': {

"appearance": "silvery white",

"name": "Thallium","atomic-mass": 204.38,"boil": 1746,"category": 'POSTTRANSITIONMETAL',

"density": 11.85,"discovered-by": "William Crookes","melt": 577,"molar-heat": 26.32,

"named-by": "Unknown","atomic\_number": 81,"period": 6,"phase": 'SOLID',"symbol": "Tl",'group': 13,'period': 6},

'pb': {

"appearance": "metallic gray",

"name": "Lead","atomic-mass": 207.21,"boil": 2022,"category": 'POSTTRANSITIONMETAL',

"density": 11.34,"discovered-by": "Middle East","melt": 600.61,"molar-heat": 26.65,

"named-by": "Unknown","atomic\_number": 82,"period": 6,"phase": 'SOLID',"symbol": "Pb",'group': 14,'period': 6},

'bi': {

"appearance": "lustrous silver",

"name": "Bismuth","atomic-mass": 208.980401,"boil": 1837,"category": 'POSTTRANSITIONMETAL',

"density": 9.78,"discovered-by": "Claude Fran\u00e7ois Geoffroy","melt": 544.7,"molar-heat": 25.52,

"named-by": "Unknown","atomic\_number": 83,"period": 6,"phase": 'SOLID',"symbol": "Bi",'group': 15,'period': 6},

'po': {

"appearance": "silvery",

"name": "Polonium","atomic-mass": 209,"boil": 1235,"category": 'METALLOID',

"density": 9.196,"discovered-by": "Pierre Curie","melt": 527,"molar-heat": 26.4,

"named-by": "Unknown","atomic\_number": 84,"period": 6,"phase": 'SOLID',"symbol": "Po",'group': 16,'period': 6},

'at': {

"appearance": "'unknowN', probably metallic",

"name": "Astatine","atomic-mass": 210,"boil": 610,"category": 'DIATOMIC NONMETAL',

"density": 26.35,"discovered-by": "Dale R. Corson","melt": 575,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 85,"period": 6,"phase": 'SOLID',"symbol": "At",'group': 17,'period': 6},

'rn': {

"appearance": "colorless 'gas', occasionally glows green or red in discharge tubes",

"name": "Radon","atomic-mass": 222,"boil": 211.5,"category": 'NOBLEGAS',

"density": 9.73,"discovered-by": "Friedrich Ernst Dorn","melt": 202,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 86,"period": 6,"phase": 'GAS',"symbol": "Rn",'group': 18,'period': 6},

'fr': {

"name": "Francium","atomic-mass": 223,"boil": 950,"category": 'ALKALIMETAL',

"density": 1.87,"discovered-by": "Marguerite Perey","melt": 300,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 87,"period": 7,"phase": 'SOLID',"symbol": "Fr",'group': 1,'period': 7},

'ra': {

"appearance": "silvery white metallic",

"name": "Radium","atomic-mass": 226,"boil": 2010,"category": 'ALKALINEEARTHMETAL',

"density": 5.5,"discovered-by": "Pierre Curie","melt": 1233,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 88,"period": 7,"phase": 'SOLID',"symbol": "Ra",'group': 2,'period': 7},

'ac': {

"name": "Actinium","atomic-mass": 227,"boil": 3500300,"category": 'ACTINIDE',

"density": 10,"discovered-by": "Friedrich Oskar Giesel","melt": 1500,"molar-heat": 27.2,

"named-by": "Unknown","atomic\_number": 89,"period": 7,"phase": 'SOLID',"symbol": "Ac",'group': 3,'period': 10},

'th': {

"appearance": "silvery, often with black tarnish",

"name": "Thorium","atomic-mass": 232.03774,"boil": 5061,"category": 'ACTINIDE',

"density": 11.724,"discovered-by": "J\u00f6ns Jakob Berzelius","melt": 2023,"molar-heat": 26.23,

"named-by": "Unknown","atomic\_number": 90,"period": 7,"phase": 'SOLID','group': 4,'period': 10},

'pa': {

"appearance": "bright, silvery metallic luster",

"name": "Protactinium","atomic-mass": 231.035882,"boil": 4300,"category": 'ACTINIDE',

"density": 15.37,"discovered-by": "William Crookes","melt": 1841,"molar-heat": 'None',

"named-by": "Otto Hahn","atomic\_number": 91,"period": 7,"phase": 'SOLID',"symbol": "Pa",'group': 5,'period': 10},

'u': {

"name": "Uranium","atomic-mass": 238.028913,"boil": 4404,"category": 'ACTINIDE',

"density": 19.1,"discovered-by": "Martin Heinrich Klaproth","melt": 1405.3,"molar-heat": 27.665,

"named-by": "Unknown","atomic\_number": 92,"period": 7,"phase": 'SOLID',"symbol": "U",'group': 6,'period': 10},

'np': {

"appearance": "silvery metallic",

"name": "Neptunium","atomic-mass": 237,"boil": 4447,"category": 'ACTINIDE',

"density": 20.45,"discovered-by": "Edwin McMillan","melt": 9123,"molar-heat": 29.46,

"named-by": "Unknown","atomic\_number": 93,"period": 7,"phase": 'SOLID',"symbol": "Np",'group': 7,'period': 10},

'pu': {

"appearance": "silvery white, tarnishing to dark gray in air",

"name": "Plutonium","atomic-mass": 244,"boil": 3505,"category": 'ACTINIDE',

"density": 19.816,"discovered-by": "Glenn T. Seaborg","melt": 912.5,"molar-heat": 35.5,

"named-by": "Unknown","atomic\_number": 94,"period": 7,"phase": 'SOLID',"symbol": "Pu",'group': 8,'period': 10},

'am': {

"appearance": "silvery white",

"name": "Americium","atomic-mass": 243,"boil": 2880,"category": 'ACTINIDE',

"density": 12,"discovered-by": "Glenn T. Seaborg","melt": 1449,"molar-heat": 62.7,

"named-by": "Unknown","atomic\_number": 95,"period": 7,"phase": 'SOLID',"symbol": "Am",'group': 9,'period': 10},

'cm': {

"appearance": "silvery metallic, glows purple in the dark",

"name": "Curium","atomic-mass": 247,"boil": 3383,"category": 'ACTINIDE',

"density": 13.51,"discovered-by": "Glenn T. Seaborg","melt": 1613,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 96,"period": 7,"phase": 'SOLID',"symbol": "Cm",'group': 10,'period': 10},

'bk': {

"appearance": "silvery",

"name": "Berkelium","atomic-mass": 247,"boil": 2900,"category": 'ACTINIDE',

"density": 14.78,"discovered-by": "Lawrence Berkeley National Laboratory","melt": 1259,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 97,"period": 7,"phase": 'SOLID',"symbol": "Bk",'group': 11,'period': 10},

'cf': {

"appearance": "silvery",

"name": "Californium","atomic-mass": 251,"boil": 1743,"category": 'ACTINIDE',

"density": 15.1,"discovered-by": "Lawrence Berkeley National Laboratory","melt": 1173,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 98,"period": 7,"phase": 'SOLID',"symbol": "Cf",'group': 12,'period': 10},

'es': {

"appearance": "silver-colored",

"name": "Einsteinium","atomic-mass": 252,"boil": 1269,"category": 'ACTINIDE',

"density": 8.84,"discovered-by": "Lawrence Berkeley National Laboratory","melt": 1133,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 99,"period": 7,"phase": 'SOLID',"symbol": "Es",'group': 13,'period': 10},

'fm': {

"name": "Fermium","atomic-mass": 257,"boil": 'None',"category": 'ACTINIDE',

"density": 'None',"discovered-by": "Lawrence Berkeley National Laboratory","melt": 1800,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 100,"period": 7,"phase": 'SOLID',"symbol": "Fm",'group': 14,'period': 10},

'md': {

"name": "Mendelevium","atomic-mass": 258,"boil": 'None',"category": 'ACTINIDE',

"density": 'None',"discovered-by": "Lawrence Berkeley National Laboratory","melt": 1100,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 101,"period": 7,"phase": 'SOLID',"symbol": "Md",'group': 15,'period': 10},

'no': {

"name": "Nobelium","atomic-mass": 259,"boil": 'None',"category": 'ACTINIDE',

"density": 'None',"discovered-by": "Joint Institute for Nuclear Research","melt": 1100,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 102,"period": 7,"phase": 'SOLID',"symbol": "No",'group': 16,'period': 10},

'lr': {

"name": "Lawrencium","atomic-mass": 266,"boil": 'None',"category": 'ACTINIDE',

"density": 'None',"discovered-by": "Lawrence Berkeley National Laboratory","melt": 1900,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 103,"period": 7,"phase": 'SOLID',"symbol": "Lr",'group': 17,'period': 10},

'rf': {

"name": "Rutherfordium","atomic-mass": 267,"boil": 5800,"category": 'TRANSITIONMETAL',

"density": 23.2,"discovered-by": "Joint Institute for Nuclear Research","melt": 2400,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 104,"period": 7,"phase": 'SOLID',"symbol": "Rf",'group': 4,'period': 7},

'db': {

"name": "Dubnium","atomic-mass": 268,"boil": 'None',"category": 'TRANSITIONMETAL',

"density": 29.3,"discovered-by": "Joint Institute for Nuclear Research","melt": 'None',"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 105,"period": 7,"phase": 'SOLID',"symbol": "Db",'group': 5,'period': 7},

'sg': {

"name": "Seaborgium","atomic-mass": 269,"boil": 'None',"category": 'TRANSITIONMETAL',

"density": 35.0,"discovered-by": "Lawrence Berkeley National Laboratory","melt": 'None',"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 106,"period": 7,"phase": 'SOLID',"symbol": "Sg",'group': 6,'period': 7},

'bh': {

"name": "Bohrium","atomic-mass": 270,"boil": 'None',"category": 'TRANSITIONMETAL',

"density": 37.1,"discovered-by": "Gesellschaft f\u00fcr Schwerionenforschung","melt": 'None',"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 107,"period": 7,"phase": 'SOLID',"symbol": "Bh",'group': 7,'period': 7},

'hs': {

"name": "Hassium","atomic-mass": 269,"boil": 'None',"category": 'TRANSITIONMETAL',

"density": 40.7,"discovered-by": "Gesellschaft f\u00fcr Schwerionenforschung","melt": 126,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 108,"period": 7,"phase": 'SOLID',"symbol": "Hs",'group': 8,'period': 7},

'mt': {

"name": "Meitnerium","atomic-mass": 278,"boil": 'None',"category": 'TRANSITIONMETAL',

"density": 37.4,"discovered-by": "Gesellschaft f\u00fcr Schwerionenforschung","melt": 'None',"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 109,"period": 7,"phase": 'SOLID',"symbol": "Mt",'group': 9,'period': 7},

'ds': {

"name": "Darmstadtium","atomic-mass": 281,"boil": 'None',"category": 'TRANSITIONMETAL',

"density": 34.8,"discovered-by": "Gesellschaft f\u00fcr Schwerionenforschung","melt": 'None',"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 110,"period": 7,"phase": 'SOLID',"symbol": "Ds",'group': 10,'period': 7},

'rg': {

"name": "Roentgenium","atomic-mass": 282,"boil": 'None',"category": 'TRANSITIONMETAL',

"density": 28.7,"discovered-by": "Gesellschaft f\u00fcr Schwerionenforschung","melt": 'None',"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 111,"period": 7,"phase": 'SOLID',"symbol": "Rg",'group': 11,'period': 7},

'cn': {

"name": "Copernicium","atomic-mass": 285,"boil": 3570,"category": 'TRANSITIONMETAL',

"density": 23.7,"discovered-by": "Gesellschaft f\u00fcr Schwerionenforschung","melt": 'None',"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 112,"period": 7,"phase": "Boiling point","symbol": "Cn",'group': 12,'period': 7},

'uut': {

"name": "Nihonium","atomic-mass": 286,"boil": 1430,"category": 'SYNTHETIC',

"density": 16,"discovered-by": "RIKEN","melt": 700,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 113,"period": 7,"phase": 'SOLID',"symbol": "Nh",'group': 13,'period': 7},

'fl': {

"name": "Flerovium","atomic-mass": 289,"boil": 420,"category": 'UNKNOWN',

"density": 14,"discovered-by": "Joint Institute for Nuclear Research","melt": 340,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 114,"period": 7,"phase": 'SOLID',"symbol": "Fl",'group': 14,'period': 7},

'uup': {

"name": "Moscovium","atomic-mass": 289,"boil": 1400,"category": 'SYNTHETIC',

"density": 13.5,"discovered-by": "Joint Institute for Nuclear Research","melt": 670,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 115,"period": 7,"phase": 'SOLID',"symbol": "Mc",'group': 15,'period': 7},

'lv': {

"name": "Livermorium","atomic-mass": 293,"boil": 10351135,"category": 'UNKNOWN',

"density": 12.9,"discovered-by": "Joint Institute for Nuclear Research","melt": 637780,"molar-heat": 'None',

"named-by": "Unknown","atomic\_number": 116,"period": 7,"phase": 'SOLID',"symbol": "Lv",'group': 16,'period': 7},

'uus': {

"name": "Tennessine","atomic-mass": 294,"boil": 883,"category": 'SYNTHETIC',

"density": 7.17,"discovered-by": "Joint Institute for Nuclear Research","melt": 623823,"molar-heat": 'None',

"named-by": "Joseph Hamilton","atomic\_number": 117,"period": 7,"phase": 'SOLID',"symbol": "Ts",'group': 17,'period': 7},

'uuo': {

"name": "Oganesson","atomic-mass": 294,"boil": 35030,"category": 'SYNTHETIC',

"density": 4.95,"discovered-by": "Joint Institute for Nuclear Research","melt": 'None',"molar-heat": 'None',

"named-by": "Yuri Oganessian","atomic\_number": 118,"period": 7,"phase": 'SOLID',"symbol": "Og",'group': 18,'period': 7

}

}

print('''

┌────┐ ┌────┐

│ H │ │ He │

├────┼────┐ ┌────┬────┬────┬────┬────┼────┤

│ Li │ Be │ │ B │ C │ N │ O │ F │ Ne │

├────┼────┤ ├────┼────┤────┼────┤────┼────┤

│ Na │ Mg │ │ Al │ Si │ P │ S │ Cl │ Ar │

├────┼────┼────┬────┬────┬────┬────┬────┬────┬────┬────┬────┼────┼────┼────┼────┼────┼────┤

│ K │ Ca │ Sc │ Ti │ V │ Cr │ Mn │ Fe │ Co │ Ni │ Cu │ Zn │ Ga │ Ge │ As │ Se │ Br │ Kr │

├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤

│ Rb │ Sr │ Y │ Zr │ Nb │ Mo │ Tc │ Ru │ Rh │ Pd │ Ag │ Cd │ In │ Sn │ Sb │ Te │ I │ Xe │

├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤

│ Cs │ Ba │LaLu│ Hf │ Ta │ W │ Re │ Os │ Ir │ Pt │ Au │ Hg │ Tl │ Pb │ Bi │ Po │ At │ Rn │

├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤

│ Fr │ Ra │AcLr│ Rf │ Db │ Sg │ Bh │ Hs │ Mt │ Ds │ Rg │ Cn │ Uut│ Uuq│ Uup│ Uuh│ Uus│ Uuo│

└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘

┌────┬────┬────┬────┬────┬────┬────┬────┬────┬────┬────┬────┬────┬────┬────┐

│ La │ Ce │ Pr │ Nd │ Pm │ Sm │ Eu │ Gd │ Tb │ Dy │ Ho │ Er │ Tm │ Yb │ Lu │

├────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┼────┤

│ Ac │ Th │ Pa │ U │ Np │ Pu │ Am │ Cm │ Bk │ Cf │ Es │ Fm │ Md │ No │ Lr │

└────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┴────┘

''')

print('--------------------------------------------------------------------------------------------')

print('\n First enter username and correct password to access the program')

print(‘\n Username: Krish \n Password: 11117 ‘)

user = input('Enter the username: ')

password = input('Enter the password: ')

if user == 'krish' and password == '11117':

while True:

inp = input('Enter the symbol of wished element: ')

if str.lower(inp) in element\_data:

print('''

Enter 1 to get full description of element

Enter 2 to get atomic number of element

Enter 3 to get period and group of element

Enter 4 to find the discoverer of element

Enter 5 to find the namer of the element

Enter 0 to exit program

''')

p = int(input('Enter the number to perform wished action: '))

elif inp == '0':

print('Thanks for using the program')

break

else:

print('Invalid input. Choose an element present in the given table')

if p == 1:

print('Name: ',element\_data[inp]['name'])

print('Symbol: ',element\_data[inp]['symbol'])

print('Atomic number: ',element\_data[inp]['atomic\_number'])

print('Atomic mass: ',element\_data[inp]['atomic-mass'])

print('Boiling point: ',element\_data[inp]['boil'])

print('Melting point: ',element\_data[inp]['melt'])

print('Category: ',element\_data[inp]['category'])

print('Density: ',element\_data[inp]['density'])

print('Discovered by: ',element\_data[inp]['discovered-by'])

print('Named by: ',element\_data[inp]['named-by'])

print('Group: ',element\_data[inp]['group'])

print('Period: ', element\_data[inp]['period'])

print('Phase: ' ,element\_data[inp]['phase'])

elif p == 2:

print('Atomic numer of', inp.upper(), ': ', element\_data[inp]["atomic\_number"])

elif p == 3:

print('Period and Group of ', inp.upper(),'are ',element\_data[inp]["period"], 'and ',element\_data[inp]["group"],' respectively' )

elif p == 4:

print('The discoverer of ', inp.upper() , 'is ', element\_data[inp]["discovered-by"])

elif p == 5:

print(element\_data[inp]["named-by"],' discovered ', inp)

elif p == 0 :

print('Thank you for using this program')

break

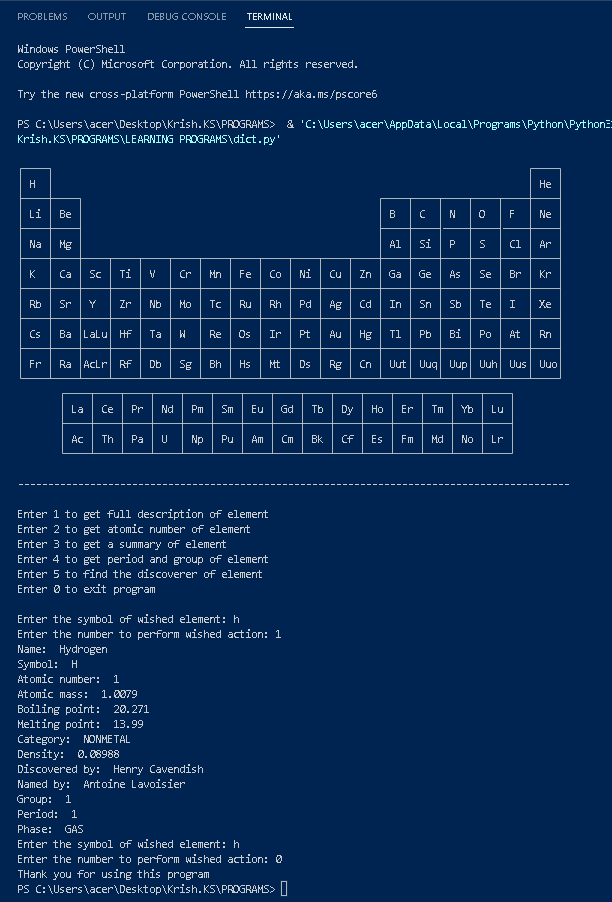
else:

print('wrong input identified. TRY AGAIN -\_-')

else:

print('Wrong username or password entered. Run Program Again')

**Output**

****

**Conclusion**

The development of this program was a long yet beautiful journey for me. I learnt many new things during the development of this project such as classes in python, saving database in MYSQL database or in binary file and many more.

I would like to thank my teacher to provide me such an opportunity to expand my horizons and reach new bounds.

**Bibliography**

1. <https://stackoverflow.com/questions/55894706/making-a-program-that-has-a-periodic-table>