PH203:
Vacuum Science and Techniques
End-Semester Assignment

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PROBLEM STATEMENT

- Write a computer program (Software Development) to calculate the conductance of different connection designs.

IMPLEMENTATION/APPROACH OF THE PROGRAM

- The computer program is written in the C++ Programming language. The program is capable of calculating the equivalent conductance of any circuit which is formed out of series and parallel conductance connections. The precision of the calculation will be up to the 6th decimal place. The precision may be increased by specifying explicitly in the program file (Conductance Calculation.cpp)

USING THE PROGRAM:

First open the File named 'Conductance Calculation.exe'. This is the calculation software.

How to give the Input in the program?

The input is taken in the form of a string which is a combination of two functions S(x1, x2, x3, ...) and P(x1, x2, x3, ...) where:

- S(x1, x2, x3, ...) represents conductance x1, x2, x3, ... all connected in series
- P(x1, x2, x3, ...) represents conductance x1, x2, x3, ... all connected in parallel
- Some examples of inputs are shown below.
- Simple Series: S(1, 2, 3)
- Simple parallel: P(1, 2, 3, 4)
- 2 Parallel circuits in series: S(P(1, 2, 3), P(1.9, 3.2, 4.5))
- More complicated circuits can be easily written and solved

CONDUCTANCE

- Conductance is the characteristic of a vacuum component or system to readily allow the flow of gas and can be thought of as the inverse of resistance to flow.
- The conductance between two points is defined as the gas flow rate flowing through a device divided by the pressure drop that is driving it.
- The unit of conductance is Siemens (S), and its symbol is ‘G’.

EQUIVALENT CONDUCTANCE OF A COMBINATIONAL CIRCUIT

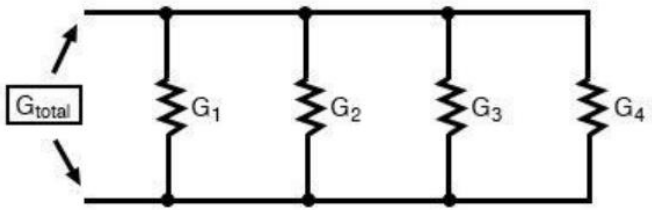
1.Parallel combination of circuit

The multiple paths (parallel combination) for the gas particles reduces total resistance for the whole circuit, as the gas is able to flow more easily through the whole network of multiple branches than through any one of those branch resistances alone.

In terms of conductance, the additional branches result in a greater total conductance.

The total conductance in a parallel circuit is equal to the sum of the individual conductance:

$$G_{total} = G_1 + G_2 + G_3 + G_4$$



G_{total} is greater than G_1, G_2, G_3, G_4 individually

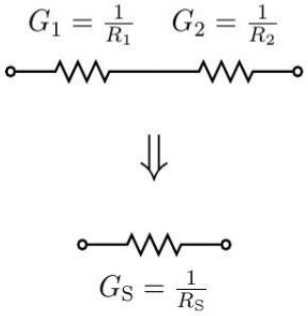
Conductance is nothing more than the mathematical reciprocal (1/x) of resistance, we can translate each term of the previously mentioned formula into resistance by substituting the reciprocal of each respective conductance as:

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$

2. Series Combination

The equivalent conductance of series resistors is obtained in the same manner as the resistance of resistors in parallel

$$\frac{1}{G_{eq}} = \frac{1}{G_1} + \frac{1}{G_2} + \frac{1}{G_3} + \cdots + \frac{1}{G_N}$$



Prior checked test cases

Test case-1

```
133     cout << "Enter any letter and press ENTER to exit." << endl;
134     cin >> hold;
135 }
```

S(3,P(P(1,2) , 3))

Copy

Run

Run+URL (Generates URL as well)

Time(sec) : 0

Memory(MB) : 3.5617447546387

Output:

Copy

```
Enter the input of circuit arrangement: The Net Conductance of the System is = 2
Enter any letter and press ENTER to exit.
```

Test case-2

```
133     cout << "Enter any letter and press ENTER to exit." << endl;
134     cin >> hold;
135 }
```

P(P(1,2) ,P(P(2.3,3) ,P(5.5,1)))

Copy

Run

Run+URL (Generates URL as well)

Time(sec) : 0

Memory(MB) : 3.4914347546387

Output:

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```
Enter the input of circuit arrangement: The Net Conductance of the System is = 14.8
Enter any letter and press ENTER to exit.
```

Test case-3

```
133     cout << "Enter any letter and press ENTER to exit." << endl;
134     cin >> hold;
135 }
```

S(P(1,2) ,S(P(2.3,3) ,S(5.5,1)))

Copy

Run

Run+URL (Generates URL as well)

Time(sec) : 0

Memory(MB) : 3.4562847546387

Output:

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```
Enter the input of circuit arrangement: The Net Conductance of the System is = 0.586913
Enter any letter and press ENTER to exit.
```

Test case-4

```
133     cout << "Enter any letter and press ENTER to exit." << endl;
134     cin >> hold;
135 }
```

S(P(1,2) ,3)

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Run

Run+URL (Generates URL as well)

Time(sec) : 0

Memory(MB) : 3.4562847546387

Output:

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```
Enter the input of circuit arrangement: The Net Conductance of the System is = 1.5
Enter any letter and press ENTER to exit.
```

THANK YOU!