Numerical methods
Homework #2

Subin Lee

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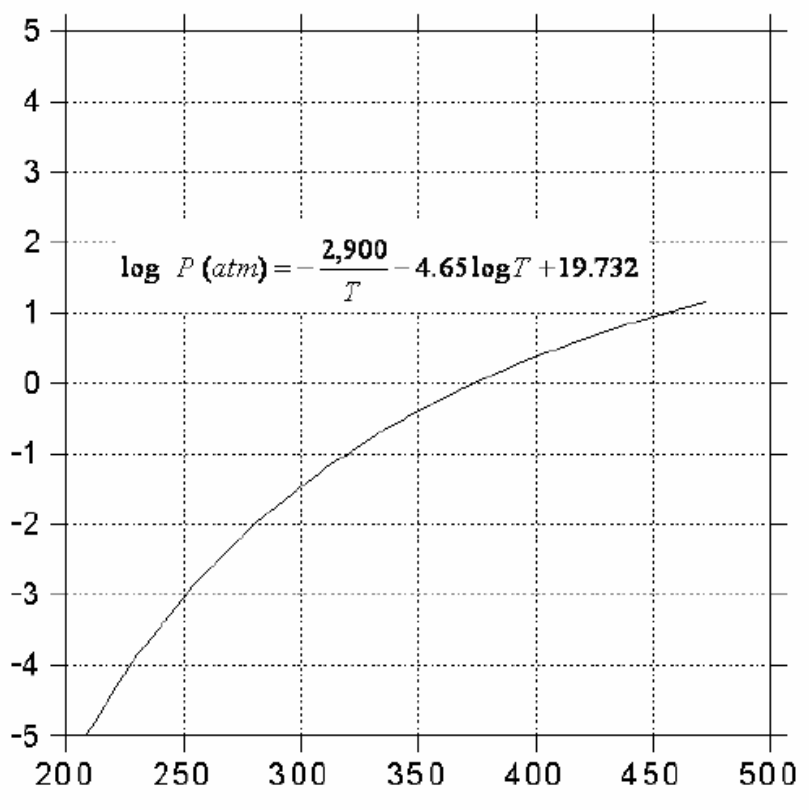
Department of Materials Science & Engineering
Pohang University of Science & Technology

Problem

$$\log P\,(atm) = -\frac{2{,}900}{T} - 4.65\log T + 19.732$$

- 물의 수증기압이 0.5 atm 이 되는 온도를 구하라.

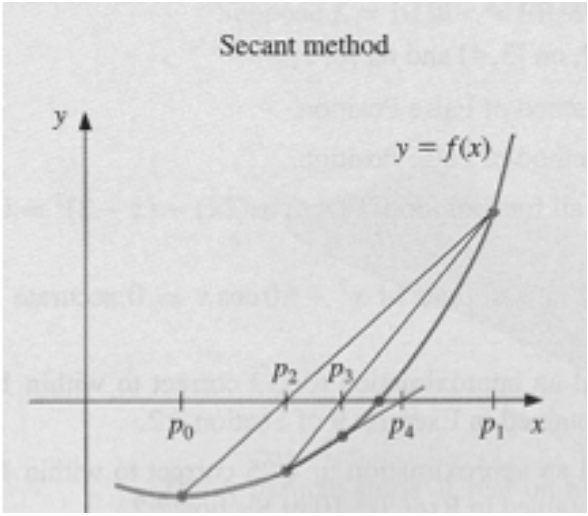


By

1. Secant method
2. Newton-Raphson method

Secant method

```c
#include <stdio.h>
#include <math.h>

int main(int argc, const char * argv[])
{
    float T_1, T_2, P_1, P_2, T_new ;

    // Defining ower and upper boundary
    printf("Insert the boundary temperatures :");
    scanf("%f %f",& T_1, &T_2);

    // Loop for narrowing the range
    for(int i=1; i<5000; i++){
        P_1 = -2900.0/T_1 -4.65*log10(T_1) +19.732-log10(0.5);
        P_2 = -2900.0/T_2 -4.65*log10(T_2) +19.732-log10(0.5);

        if (fabs(P_1 - P_2)<0.1){
            printf("The temperature is %.2f K (%d loops).₩n",T_1,i);
            break;
        }

        T_new = T_2 - (P_2 * (T_2 - T_1)/(P_2 - P_1)); //Find new temperature point

        T_1 = T_2;      //Replacing old values with new values
        T_2 = T_new;

    }
```

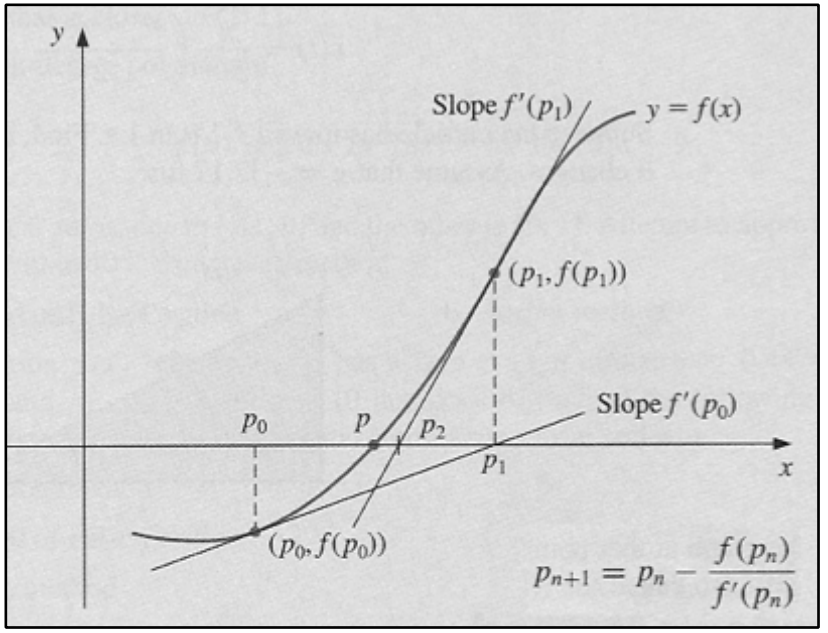



```
Subin — bash — 80×24
Leeui-MacBook-Air:HW2_1 Subin$ ./HW_2_1_0.1
Insert the boundary temperatures :200 500
The temperature is 355.73 K (6 loops).
Leeui-MacBook-Air:HW2_1 Subin$ ./HW_2_1_0.0001
Insert the boundary temperatures :200 500
The temperature is 354.69 K (8 loops).
Leeui-MacBook-Air:HW2_1 Subin$ ./HW_2_1_1atm
Insert the boundary temperatures :200 500
The temperature is 373.08 K (8 loops).
Leeui-MacBook-Air:HW2_1 Subin$
```

Temperature at 0.5 atm: 354.69 K (0.01 % accuracy)
355.73 K (1 % accuracy)
Temperature at 1 atm: 373.08 K (Ref. 373.15)

Newton-Raphson method

```c
#include <stdio.h>
#include <math.h>

int main(int argc, const char * argv[])
{
    float T_1, P_1, T_new,slope ;

    // Defining ower and upper boundary
    printf("Insert the initial temperatures :");
    scanf("%f", & T_1);

    // Loop for narrowing the range
    for(int i=1; i<5000; i++){
        P_1 = -2900.0/T_1 -4.65*log10(T_1) +19.732-log10(1.0);
        slope=2900/(pow(T_1,2))-4.65/T_1;
        T_new = T_1 -P_1/slope; //Find new temperature point

        if (fabs(T_1 - T_new)<0.001){
            printf("The temperature is %.2f K (%d loops).₩n",T_1,i);
            break;
        }

        T_1 = T_new;   //Replacing old values with new values

    }
    return 0;
}
```




```
Subin — bash — 80×
Leeui-MacBook-Air:HW_2_2 Subin$ ./HW_2_2_0.0001
Insert the initial temperatures :200
The temperature is 354.69 K (46 loops).
Leeui-MacBook-Air:HW_2_2 Subin$ ./HW_2_2_0.1
Insert the initial temperatures :200
The temperature is 354.73 K (23 loops).
Leeui-MacBook-Air:HW_2_2 Subin$ ./HW_2_2_1atm
Insert the initial temperatures :200
The temperature is 373.08 K (76 loops).
Leeui-MacBook-Air:HW_2_2 Subin$
```

Temperature at 0.5 atm: 354.69 K (0.01 % accuracy)
355.73 K (1 % accuracy)
-> Same results compared to previous results

Conclusion

- The results from two different methods were same
  Temp. at 0.5 atm: 354.69 K
  Temp. at 1 atm: 373.08 K

- Iteration numbers
  Secant method: 6~8
  Newton-Raphson method: 23~76

- Initial input parameters
  Secant method: Upper & lower boundaries
  Newton-Raphson method: Single initial point