ENGR 102
Relative Humidity and Dew Point Calculation in C++

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Introduction

This program calculates the relative humidity and dew point temperature based on the dry bulb temperature, wet bulb temperature, and barometric pressure. Relative humidity is a measure of the moisture content in the air relative to the maximum moisture capacity at a given temperature. Dew point temperature is the temperature at which air becomes saturated with moisture, leading to condensation.

Problem Statement

Given the dry bulb temperature (T), wet bulb temperature (Tw), and barometric pressure (p_{sta}), the task is to compute the relative humidity (RH) and dew point temperature (Td) using the provided formulas.

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Solution Steps

- Define the variables for dry bulb temperature (T), wet bulb temperature (Tw), and barometric pressure (p_{sta}).
- Compute the saturation vapor pressure (es) and vapor pressure (ew) using the Clausius-Clapeyron equation.
- Calculate the actual vapor pressure (ee) using the provided formula.
- Determine the relative humidity (RH) as the ratio of actual vapor pressure to saturation vapor pressure.
- Compute the dew point temperature (Td) using the Magnus-Tetens formula.
- Output the calculated relative humidity and dew point temperature.

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Pseudo Code

1. Begin main function.

   1.1 Define the dry bulb temperature (T), wet bulb temperature (Tw), and barometric pressure (psta).

   1.2 Calculate the saturation vapor pressure (e_s) using the formula:

   e_s = 6.112 * exp((17.67 * T) / (T + 243.5))

   1.3 Calculate the vapor pressure at the wet bulb temperature (e_w) using the formula:

   e_w = 6.112 * exp((17.67 * Tw) / (Tw + 243.5))

   1.4 Calculate the actual vapor pressure (e) using the formula:

   e = e_w - (psta * (T - Tw) * 0.00066 * (1 + 0.00115 * Tw))

   1.5 Calculate the relative humidity (RH) using the formula:

   RH = 100 * (e / e_s)

   1.6 Calculate the dew point temperature (Td) using the formula:

   Td = (243.5 * log(e / 6.112)) / (17.67 - log(e / 6.112))

   1.7 Output the calculated relative humidity (RH) with the text "Relative Humidity: " followed by "%" symbol.

   1.8 Output the calculated dew point temperature (Td) with the text "Dew Point: " followed by " degrees Celsius".

   1.9 End main function.

C++ Code

```
#include <iostream>
#include <cmath>
using namespace std;
int main() {
    double T = 25; // Dry bulb temperature
    double Tw = 19; // Wet bulb temperature
    double psta = 985; // Barometric pressure in millibars
    double e_s = 6.112 * exp((17.67 * T) / (T + 243.5));
    double e_w = 6.112 * exp((17.67 * Tw) / (Tw + 243.5));
    double e = e_w - (psta * (T - Tw) * 0.00066 * (1 + 0.00115 * Tw));
    double RH = 100 * (e / e_s);
    double Td = (243.5 * log(e / 6.112)) / (17.67 - log(e / 6.112));
    cout << "Relative Humidity: " << RH << "%" << endl;
    cout << "Dew Point: " << Td << " degrees Celsius" << endl;
    return 0;
}
```

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Code Explanation

- **#include <iostream>#include <cmath>using namespace std;**

These lines include necessary header files.

- **int main() {**

This line marks the beginning of the ‘main’ function, which is the entry point of the program.

- **double T = 25; // Dry bulb temperature double Tw = 19; // Wet bulb temperature double psta = 985; // Barometric pressure in millibars**

These lines define and initialize variables representing the dry bulb temperature (T), wet bulb temperature (Tw), and barometric pressure (psta).

- **double e_s = 6.112 * exp((17.67 * T) / (T + 243.5)); double e_w = 6.112 * exp((17.67 * Tw) / (Tw + 243.5)); double e = e_w - (psta * (T - Tw) * 0.00066 * (1 + 0.00115 * Tw));**

These lines calculate the saturation vapor pressure (e_s), vapor pressure at the wet bulb temperature (e_w), and actual vapor pressure (e) using the provided formulas.

Code Explanation

- **double RH = 100 * (e / e_s); double Td = (243.5 * log(e / 6.112)) / (17.67 - log(e / 6.112));**

These lines calculate the relative humidity (RH) and dew point temperature (Td) using the formulas provided.

- **cout << "Relative Humidity: " << RH << "%" << endl; cout << "Dew Point: " << Td << " degrees Celsius" << endl;**

These lines output the calculated relative humidity and dew point temperature to the standard output stream (typically the console), preceded by appropriate text.

- **return 0;}**

This line indicates the end of the ‘main’ function and returns an integer value of ‘0’ to the operating system, typically indicating successful execution.

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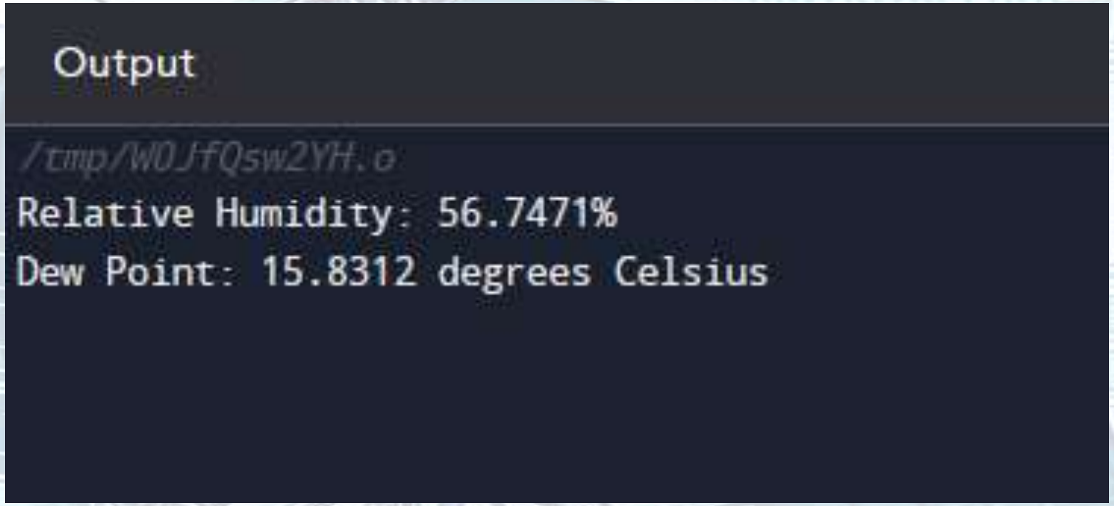
Final Answer

The calculated values for RH and Td represent the relative humidity and dew point temperature, respectively.

Relative Humidity (RH): 56.7471%

Dew Point (TD): 15.8312 degrees Celsius



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Additional Comments/Tips

- Ensure the input values for temperature and pressure are accurate and within appropriate ranges.
- Validate the correctness of the formulas and the computed results.
- Consider units consistency when interpreting the results.

Conclusion

This program provides a valuable tool for meteorological analysis by computing relative humidity and dew point temperature, which are crucial parameters for understanding atmospheric moisture conditions.