

## Appraisal of the Actual Time of Cooling of a 1.5HP Window Unit Air - Conditioner Using Thermometric Apparatus

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### Abstracts

The study, appraisal of the actual time of cooling of a 1.5HP Window air conditioner using thermometric apparatus has been done. The investigation took fifteen days during which data were collated utilizing locally improvised materials like thermometer and stopwatch. The experimental data collation was done in the Morning Hours: 7:00AM - 9:00AM; Afternoon Hours: 12:00PM - 2:00PM and Evening Hours: 4:00PM - 6:00PM respectively and it started from the least 16°C and ended with the highest which is 30°C. The investigation revealed that for every 1°C rise, it will take 1.207% time taken to cool the Office Room during the period of 7:00AM - 9:00AM, 1.119% time taken to cool the Office Room during the period 12:00PM - 2:00PM and 1.186% time taken to cool the Office Room during the period 4:00PM - 6:00PM respectively. Also, it was found that the relative humidity affects the time of cooling adversely thereby causing fluctuation in the certainty of time. It is recommended that cleaning of the filter twice weekly will debar blockage thereby ameliorating the air conditioner performance.

**Keyword:** Temperature, Thermometric Apparatus, Relative Humidity, Stopwatch

### 1. INTRODUCTION

The word cooling means mostly to any natural procedure by which heat is degenerated. The procedure of generating utmost cold temperature is termed cryogenics [1]. However, the air - conditioning system is to cool the air in the confined space thereby making the temperature of the confined space comfy and for suitable performance of some industrial processes. It is also a machine that is made to stabilize the humid air and temperature of the confined space [2] [3]. Usually, the air - conditioning systems is categorized into unitary and centralized air - conditioning systems and both the two are refers to as conventional air - conditioning system which depends on vapour compression cycle [4]. This machine called air conditioning system, has two important modes of operation which includes the liquid absorbed heat when it transforms from liquid into gas and gas emit heat when it transforms from gas into liquid. Also, the water absorbs heat from the flame as it boils and changes into gas. When the gas condenses into liquid there is a radiation of heat [5]. The air - conditioner is made up of four equipment which include the compressor, evaporator, condenser and expander. The position of the compressor and condenser are usually outside the part of the machine while the evaporator and expander are situated inside the house. The refrigerant gets into the compressor which in turn affects the pressure of the fluid thereby increasing it [6]. The air - conditioning device is made to render a comfy working atmosphere within a specified domain thereby controlling the environs at an appropriate level of temperature, relative humidity, circulation of air, and purification of air. Also, the usage of air - conditioning device everyday is to make the occupiers to be comfy considering the atmospheric tropical weather environmental condition of Nigeria [7] [8].

Previously, the author performed an observational finding of the actual time of cooling with respect to comparable temperature of 1.5HP Air Conditioner unit [9]. It was observed in the experimental data based analysis that an average of twelve minutes (12mins.) is required to cool the office - Room with a comparable temperature of 16°C and it was also found that for every increment of 1°C of temperature, a comparable 10% of the average time taken to cool the Office Room was utilized. Thus, the present work will analyze the appraisal of the actual time of cooling of a 1.5HP Air - Conditioner utilizing thermometric apparatus and peculiarity will be based on the time it takes to cool the Office - Room in the Morning, Afternoon and Evening since each season has different atmospheric conditions that affect time of cooling.

## 2. METHODOLOGY

The investigation was done on a 1.5HP Air - Conditioner attached to Office - Room of size 6.83m x 2.48m which is situated at Room 21, Third Floor, Engineering Wing, Proposed Senate Building, Yaba College of Technology, Yaba, Lagos State, Nigeria. The data collations followed a sequential procedural methodical process of tentatively and meticulously takes time at every degree on interval as it appears on the dash board of the air conditioner utilizing thermometer and stopwatch for recording of the time. The data experimentation was performed for fifteen days and it was done in the Morning Hours: 7:00AM - 9:00AM; Afternoon Hours: 12:00PM - 2:00PM and Evening Hours: 4:00PM - 6:00PM respectively and it started from the least 16°C and ended with the highest which is 30°C. The average of the respective time taken for each degree and each section was calculated and compared to [9]. Also, useful thermodynamic equations and psychometric chart (See Appendix A) was used to determine the coefficient of performance and the refrigerating effects of the air conditioner and from Figure 2.1, the Equations for the Coefficient of Performance (COP) and Refrigerating Effects ( $Q_{41}$ ) are deduced [5][10] [11][12].

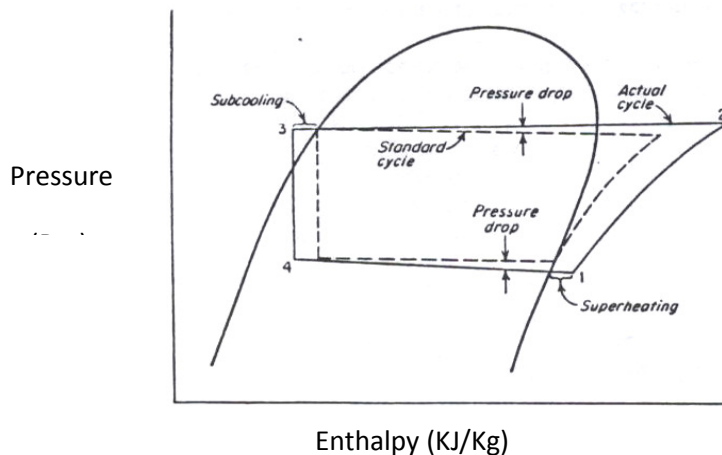


Figure 2.1: P - h Diagram of the Cooling Process [5] [9][10]

$$COP_{ref} = \frac{Q_{41}}{W} = \frac{h_2 - h_4}{h_2 - h_1} \quad 2.1$$

$$Q_{41} = h_1 - h_4 \quad 2.2$$

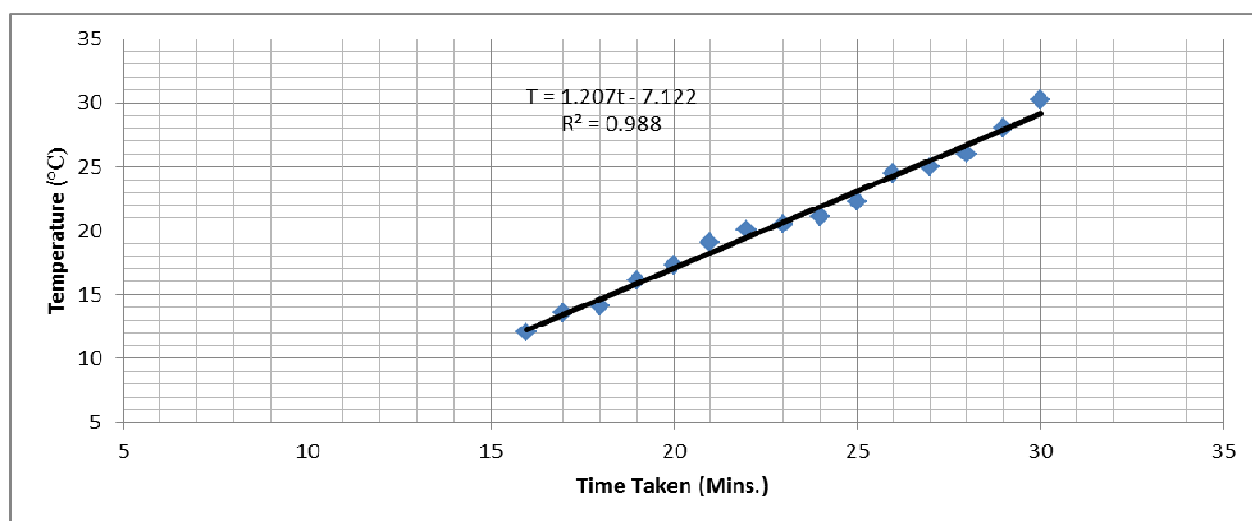
### 3. RESULTS AND DISCUSSIONS

#### 3.1 Results:

Table 3.1 contains the average of the readings utilizing the stopwatch to record the appropriate time after tentatively and conscientiously monitor the thermometer readings. The reading begins with 16°C and ends with 30°C and the average was calculated and tabulated. Excel Software was used to plot the graph of temperature against the time taken in the various sections while the initial temperature or relative humidity is plotted against the time of cooling at various sections. The Figures 3.2 - 3.5 gives a better illustration.

**Table 3.1: Reading of Time Taken at Various Degrees Intervals**

S/N	Temperature (°C)	Initial (°C)	7-9 (AM) (Mins.)	12-2(PM) (Mins.)	4 - 6(PM) (Mins.)
1	16.00	32.00	12.05	13.04	11.00
2	17.00	33.00	13.58	14.02	12.55
3	18.00	32.00	14.05	15.07	14.48
4	19.00	34.20	16.07	15.23	15.00
5	20.00	30.00	17.30	17.00	16.48
6	21.00	40.00	19.05	19.03	18.05
7	22.00	36.00	20.10	20.50	19.30
8	23.00	33.30	20.50	20.58	20.01
9	24.00	35.50	21.10	21.00	20.00
10	25.00	37.40	22.30	22.00	21.02
11	26.00	38.00	24.50	23.50	23.00
12	27.00	39.20	25.00	24.00	24.00
13	28.00	36.00	26.00	26.00	25.50
14	29.00	38.00	28.00	28.00	27.35
15	30.00	40.00	30.20	29.30	29.00



**Figure 3.2: Temperature against the Time it Takes to Cool the Office - Room (7:00AM - 9:00AM)**

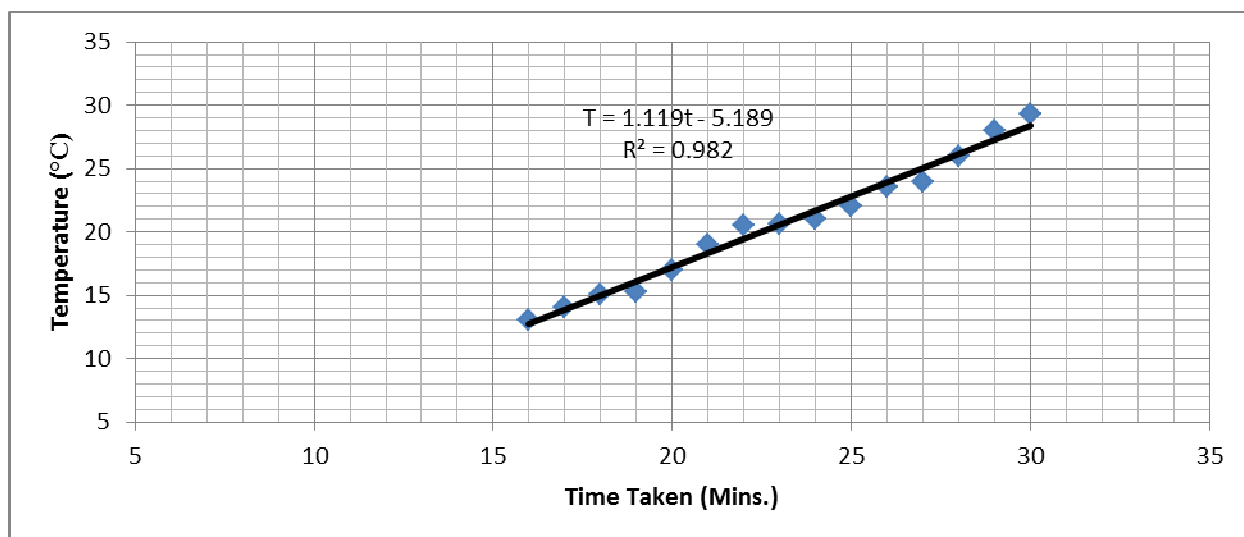


Figure 3.3: Temperature against the Time it Takes to Cool the Office - Room (12:00PM - 2:00PM)

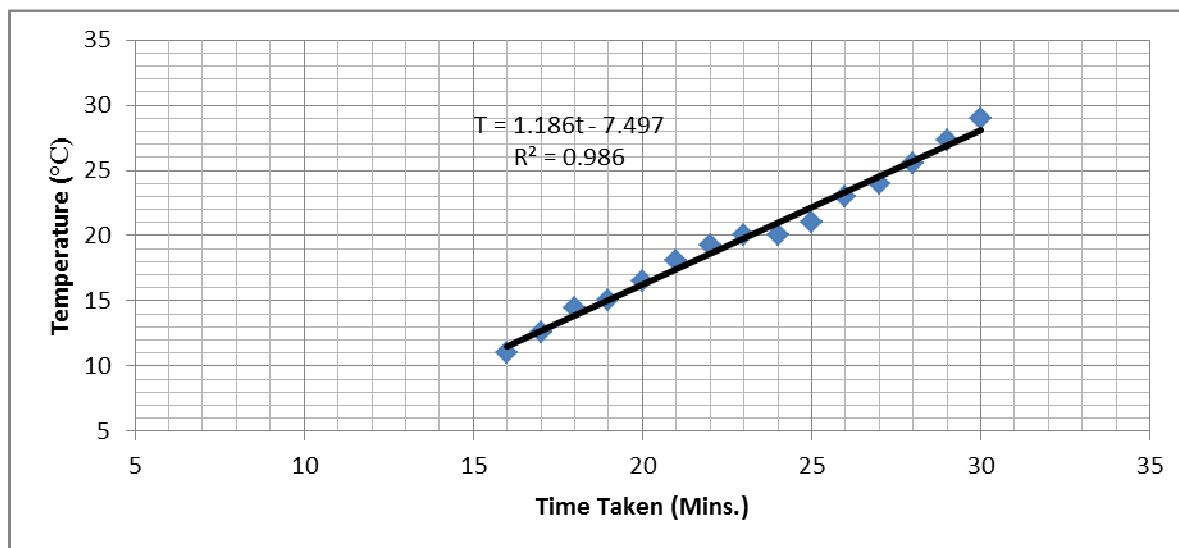
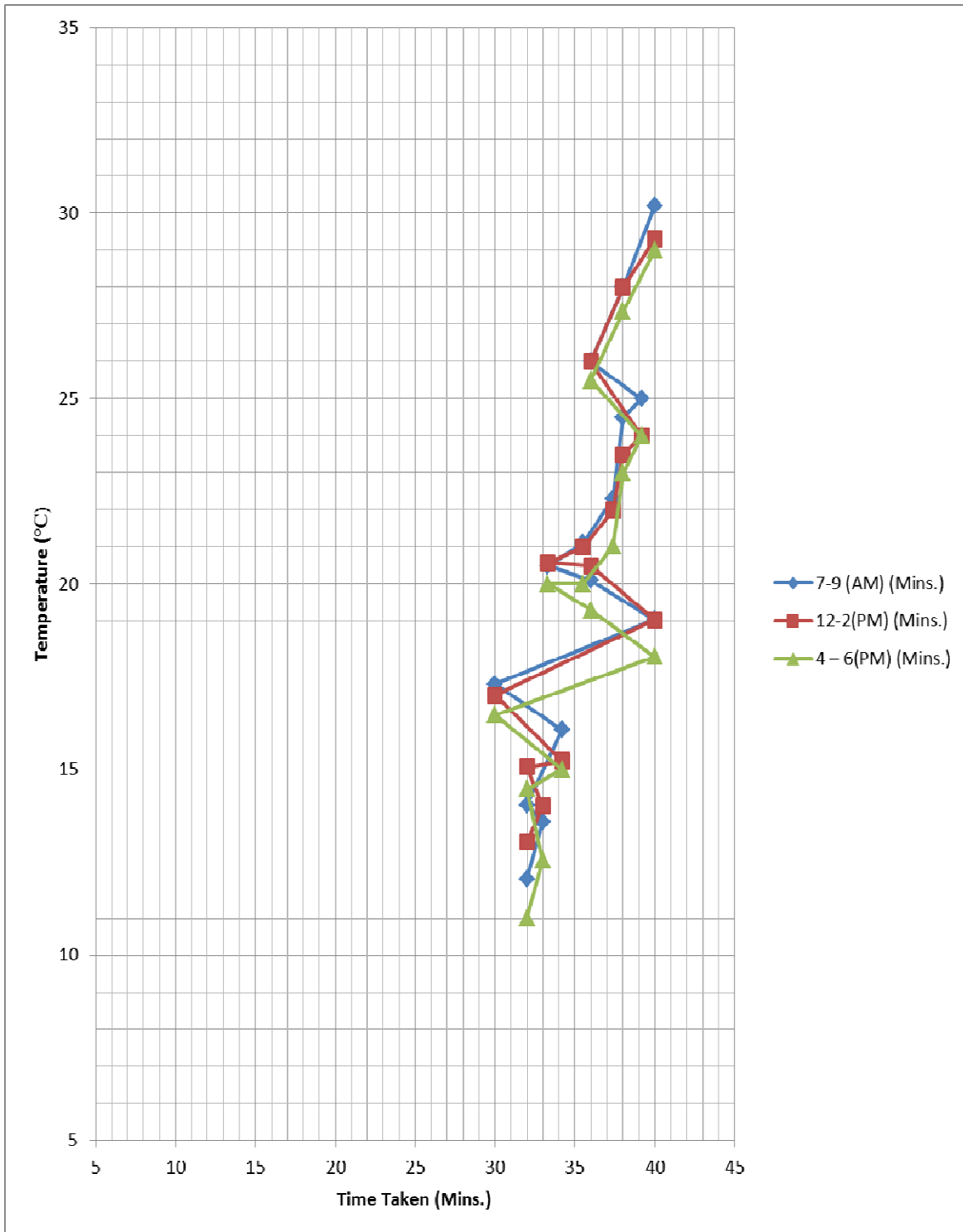


Figure 3.4: Temperature against the Time it Takes to Cool the Office - Room (4:00PM - 6:00PM)



**Figure 3.5:** Effect of Relative Humidity on the Time of Cooling

### 3.2 Discussion

Figure 3.2 shows that as the temperature increases by 1°C, the time it takes to cool the Office Room increases by 1.207% during the period: 7:00AM - 9:00AM. The Figure 3.3 depicts that as the temperature rises by 1°C, the time it takes to cool the office rises by 1.119% during the period: 12:00PM - 2:00PM. Also, in Figure 3.4, it was discovered that for every 1°C rise in temperature, the time taken to cool the office is 1.186% during the period: 4:00PM - 6:00PM. Figure 3.5 indicates that the relative humidity has serious effect on the time the air conditioner will be used to cool the Office Room looking at the haphazard nature of the characteristic behavior of the graph. Finally, utilizing the Psychrometric Chart (Appendix A) and considering the temperatures of the air conditioner: lowest - 16°C and highest - 30°C, the enthalpies at point 1, 2, 3 and 4 can be deduced respectively:  $h_1 = 410 \text{KJ/Kg}$ ,  $h_2 = 450 \text{KJ/Kg}$ ,  $h_3 = h_4 = 225 \text{KJ/Kg}$ . Therefore, substituting appropriately in Equation 2.1 and Equation 2.2; the Coefficient of Performance will be 4.63 and the refrigerating effect will be 185KJ/Kg [9] [12].

### 4. CONCLUSION

The study appraisal of the actual time of cooling of a 1.5hp window unit air - conditioner using thermometric apparatus has been done. The investigation revealed that for every 1°C rise it will take 1.207% time taken to cool the Office Room during the period of 7:00AM - 9:00AM, 1.119% time taken to cool the Office Room during the period 12:00PM - 2:00PM and 1.186% to time taken cool the Office Room during the period 4:00PM - 6:00PM respectively. Also, it was discovered that the relative humidity affects the time of cooling adversely thereby causing fluctuation in the certainty of time. It is recommended that cleaning of the air filter twice weekly will debar blockage of air thereby ameliorating the air conditioner performance.

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**Appendix A**  
**Psychrometric Chart [5][9][10][11]**

