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Abstract. The research aims to prove the effect of electric currents on taracalor by performing observations, analyze the results using the taracalor formulation which is the literature and by the application of mathematics is the total differential. Steps performed in the research start from the study of theory, subsequent experiments, analysis and comparison of matches against the literature. The result of this research shows that the average values of taracalor for 1 Ampere, 2 Ampere, and 3 Ampere are 0,7725, 0,8894, and 0.9786, respectively. While the average functions for 1 Ampere, 2 Ampere, and 3 Ampere are $(2,235 \times 10^{-3})(dt - 90 d\Delta T)$, $(2,57 \times 10^{-3})(dt - 25,71 d\Delta T)$, and $(2,833 \times 10^{-3})(dt - 12,86 d\Delta T)$, respectively.

1. Introduction

Physics is a science that studies the motion and behavior of the phenomenon in the sphere of time and space, along with related concepts such as energy and style. The ultimate goal of physics is to understand how the universe works. Mathematical physics is one application of physics, this science is closely related to theoretical physics that seeks to discuss mathematical laws of physics through logical reviewers and the calculation and application of quantitative various laws of physics empirical.

A natural occurrence which is an example of physics is, if there is an electric current flow in a circuit it will arise heat on the electrical circuit that is the place or center of electrical current activity. Therefore, there will be electrical energy that is converted to heat energy. The comparison between the electrical energy given to the heat generated is the taracalor.

In this research empirical approach, concept and mathematical approach. The empirical approach is done by observing the effect of electric current on the heat generated by variant the current by 1 Ampere, 2 Ampere, and 3 Ampere. Determining taracalor has been done by employing total differential.

Electric current is a flow of electric charge. When electric charge moves, we have a current of electricity [1]. In electric circuits this charge is often carried by moving electrons in a wire. It can also be carried by ions in an electrolyte, or by both ions and electrons such as in an ionized gas (plasma) [2].

The SI unit for measuring an electric current is the ampere, which is the flow of electric charge across a surface at the rate of one coulomb per second. Electric current is measured using a device called an ammeter [3]. If there is a current of I ampere in a circuit, and this is such that in t seconds, Q coulombs flow, the rate of flow is Q(t) coulombs per second. This gives us a useful formula:

$$I = \frac{Q}{t} \tag{1}$$

Tara calor is defined as the comparison between the electrical energy used and the heat generated. We had seen that when electric current passes through a resistor, the electric energy spented or electric work done in moving the charges is converted into heat energy. In fact work is done in any form mechanical and chemical can be converted into heat energy. Joule conducted a series of experiments and founded that the same work done in different forma produces the same quantity of heat in all cases. This is called Joule's La [6]. Joule showed that there is a definite relation between works done and hear produced by it. Let W is the mechanical work done and Q is the heat produced in calories.

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If a piece of resistance wire immersed in a liquid or clad in solids and inserted as part of the system, the incidence of potential difference V and electric current I in the resistance cord always awaken the flow of energy called workmanship. If this business continues for a time t, then the number of attempts made by W is

$$W = VIt \tag{5}$$

It is the amount of energy added to the system, if the resistivity is no longer part of the system, the energy transfer is called the drainage and during the time t, the amount of energy that is transported is called the quantity Q, where:

$$Q = (m_a c_a + m_k c_k)\Delta T \tag{6}$$

Total Differential

If $y = f(x)$, then dy/dx can be thought of either as the slope of the curve $y = f(x)$ or as the rate of change of y with respect to x. Rates occur frequently in physics; time rates such as velocity, acceleration, and rate of cooling of a hot body are obvious examples. There are also other rates: rate of change of volume of a gas with applied pressure, rate of decrease of the fuel in your automobile tank with distance traveled, and so on. Equations involving rates (differential equations) often need to be solved in applied problems. Derivatives are also used in finding maximum and minimum points of a curve and in finding the power series of a function. All these applications, and more, occur also when we consider a function of several variables.

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$$dz = \frac{\partial z}{\partial x} dx + \frac{\partial z}{\partial y} dy \tag{7}$$

The differential dz is called the *total differential* of z[7].The total differential of x is the dx whose value is equal to the change of x because y is changed plus the change of x because z is changed.
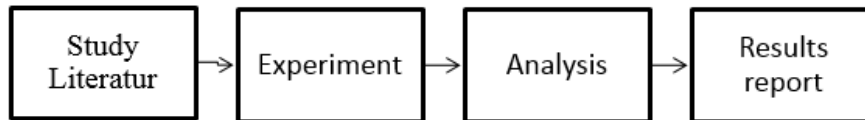
Everything we have said about functions of two variables works just as well for functions of any number of variables. If $u = f(x, y, z, \cdots)$, then by definition

$$du = \frac{\partial f}{\partial x} dx + \frac{\partial f}{\partial y} dy + \frac{\partial f}{\partial z} dz + ... \tag{8}$$

And *du* is a good approximation to Δu if the partial derivatives of *f* are continuous and *dx, dy, dz*, etc., are small.
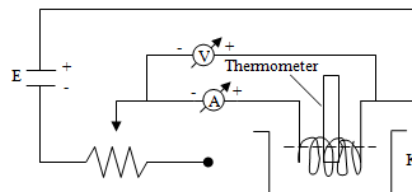
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This research activity begins by studying the theory. Then, after proceeding with experiments or experimental activities as an empirical approach and obtain data to be processed mathematically. The increased of temperature which is the designation of heat which is the main object of the observation of the effect of the current given, so in this study the current is made varies to know the effect of heat generated which later influence on the determination of electric heat calorie. Tools and materials used are amperemeter, calorimeter, resistance, thermometer, power supply, voltmeter, stopwatch, connecting cable. As for a series of experimental steps of preparing tools and materials, filling the calorimeter with water and weighing the mass of water and the mass of calorimeters, assembling tools and connecting with currents, stirring the calorimeter and observing the temperature changes and repeating the steps with different currents. Here's a series of tools used for experiments:

Figure 2. Tool Series.

After obtaining the data, then analyze the calculation by used the existing formula (exact) and by using the total differential. Based on the results of this study then made a report of research results.

3. Results and Discussion
The calculated data based on the exact way can be presented in table 1 and based on how the total differential has obtained the result of the function presented in table 2. If shown in graphical form the effect of the time relation force on the taracalor in each current is presented as figure 1 for the exact calculation and figure 2 in the total differential calculation.

Table 1. Tara Calor Value With Exact Calculations

Current (I)	t(minutes)	ΔT (°C)	Q (Joule)	W (Joule)	J
	3	2	1584,458	1224	0,7725
	6	4	3168,916	2448	0,7725
1	9	6	4753,374	3672	0,7725
	12	8	6337,832	4896	0,7725
Average					0,7725
2	3	7	5545,603	4932	0,8894

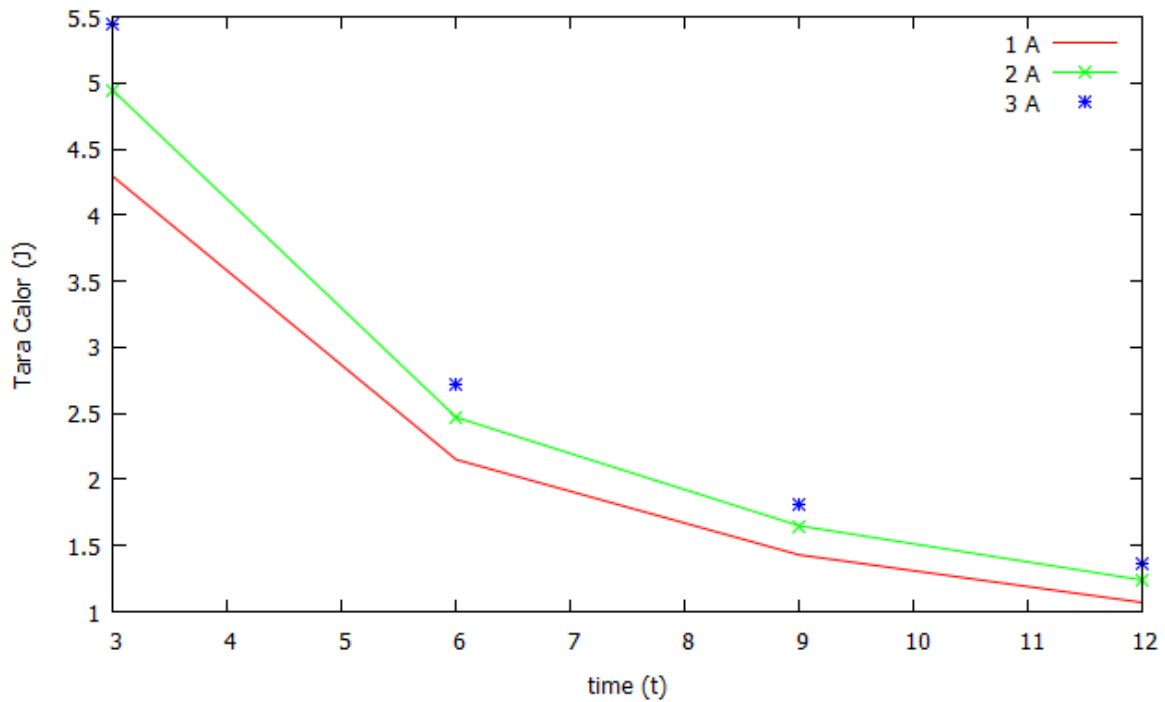|	6	14	11091,206	9864	0,8894
	9	21	16636,809	14796	0,8894
	12	28	22182,412	19728	0,8894
Average					0,8894
3	3	14	11091,206	10854	0,9786
	6	28	22182,412	21708	0,9786
	9	42	33273,618	32562	0,9786
	12	56	44364,824	43416	0,9786
Average					0,9786
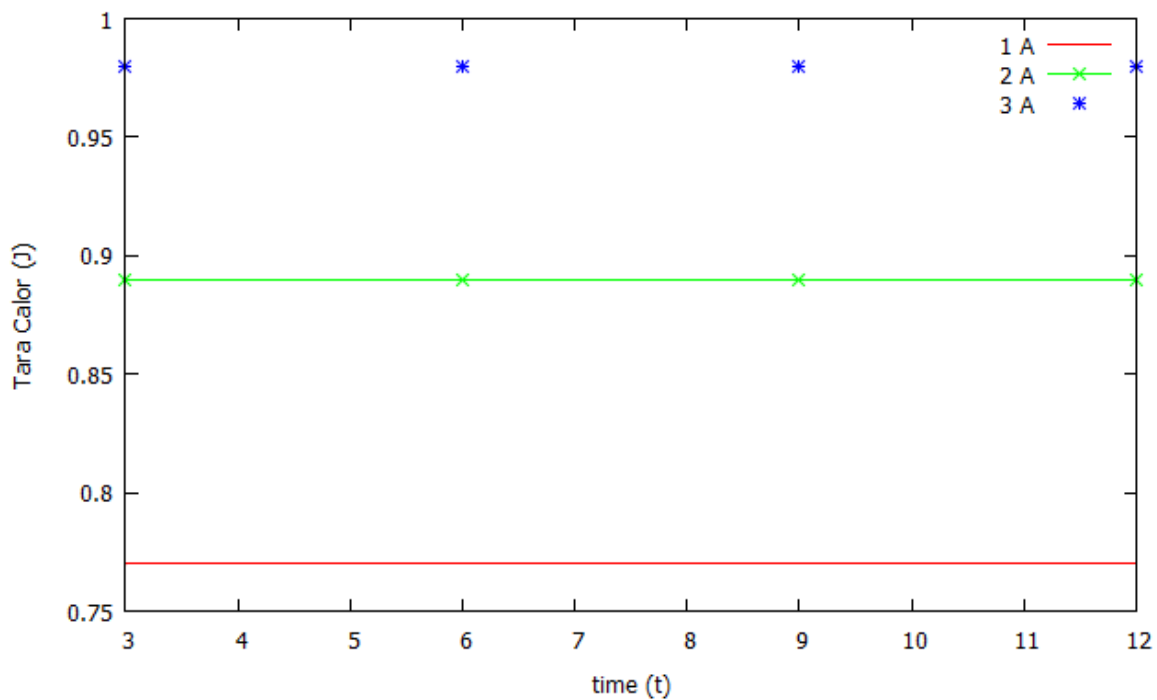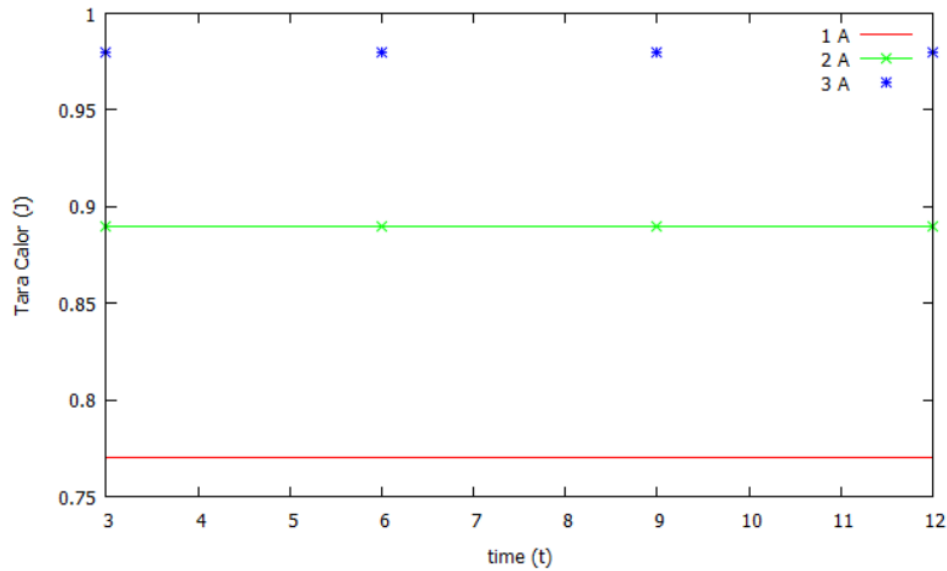
 Figure 3. Graph the relationship between time (t) to the taracalor in each current with with exact calculations.

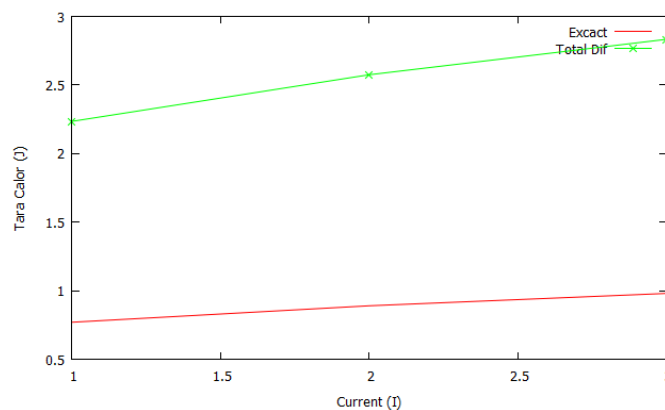**Table 2.** Function Of Tara Calor With Total Differential.

Current(I)	T(minutes)	ΔT (°C)	dJ
1	3	2	$(4{,}29\times10^{-3})(dt-90d\Delta T)$
	6	4	$(2{,}15\times10^{-3})(dt-90d\Delta T)$
	9	6	$(1{,}43\times10^{-3})(dt-90d\Delta T)$
	12	8	$(1{,}07\times10^{-3})(dt-90d\Delta T)$
Average			$(2{,}235\times10^{-3})(dt-90d\Delta T)$
2	3	7	$(4{,}94\times10^{-3})(dt-25{,}71d\Delta T)$
	6	14	$(2{,}47\times10^{-3})(dt-25{,}71d\Delta T)$
	9	21	$(1{,}65\times10^{-3})(dt-25{,}71d\Delta T)$
	12	28	$(1{,}24\times10^{-3})(dt-25{,}71d\Delta T)$
Average			$(2{,}575\times10^{-3})(dt-25{,}71d\Delta T)$

	3	14	$(5{,}44 \times 10^{-3})(dt - 12{,}86 d\Delta T)$
3	6	28	$(2{,}72 \times 10^{-3})(dt - 12{,}86 d\Delta T)$
	9	42	$(1{,}81 \times 10^{-3})(dt - 12{,}86 d\Delta T)$
	12	56	$(1{,}36 \times 10^{-3})(dt - 12{,}86 d\Delta T)$
	Average		$(2{,}833 \times 10^{-3})(dt - 12{,}86 d\Delta T)$

Figure 4. Graph the relationship between time (t) to the taracalor in each current with total differential calculation.

Here is a graph of current to taracalor both exact and total differential calculations.

Figure 5. Graph of the current relationship to the average heat rate on each calculation by exact and total differential.

Based on the results of research, it is obtained that the current influences the taracalor, that the greater the current the greater the value of taracalor. In research of taracalor 3 Ampere that is 0.9786

bigger than tarakalor with 2 Ampere that is 0.8894, and 1 Ampere that is 0.7725. Similarly, the calculation used the total differential function obtained at current of 3 Ampere is $(dt - 12,86d\Delta T)$ greater than 2 Ampere of. and 1 Ampere of $(dt - 90d\Delta T)$ this is because the results of (-) on a 3 Ampere is smaller than the (-) of 1 Ampere at a function of temperature $(d\Delta T)$ means the more temperatures rise more rapidly when current of 3 Ampere. The symptom is also felt during the conduct of research (data collection). This is because of the greater flow of electrons when the electrons impinge on the coils. The greater the electron pounding, the heat generated faster so that the required time is less. Beside the similarity between the shape of the resulting graph exact and total differential calculation, resulting in common interpretations proved their influence on the flow of electricity and heat tare can be determined also by the total differential.

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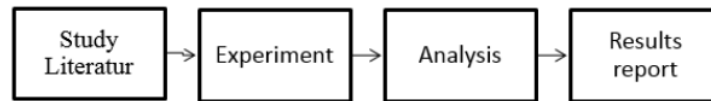
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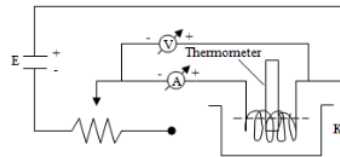
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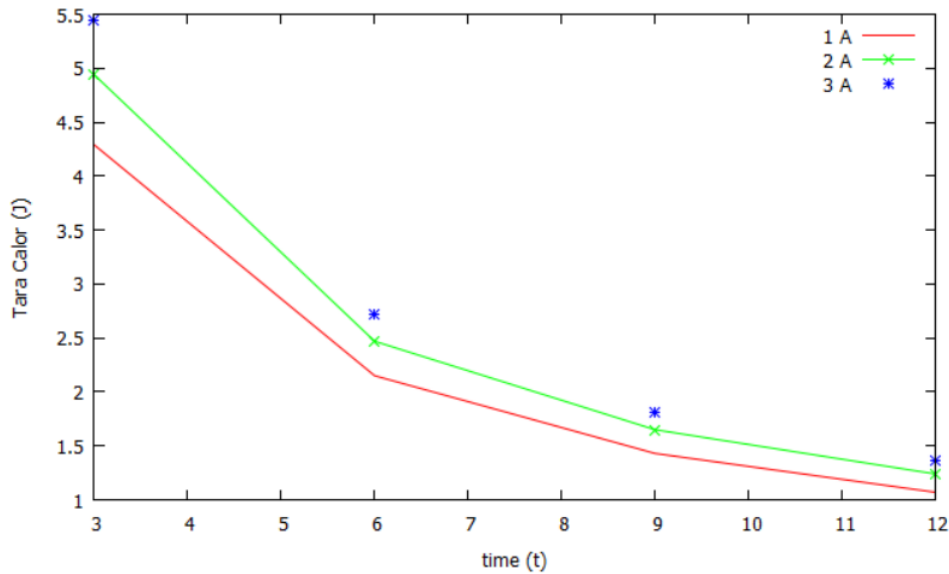| | 3 | 14 | $(5{,}44 \times 10^{-3})(dt - 12{,}86 d\Delta T)$ |
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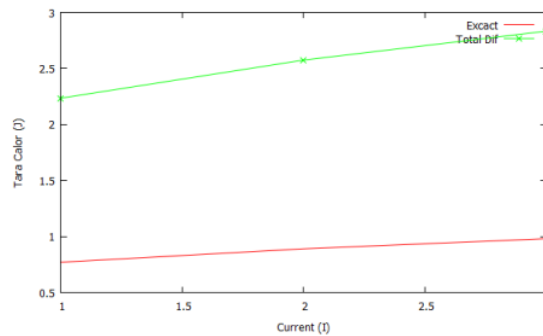Here is a graph of current to taracalor both exact and total differential calculations.

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