# NEW FORMULATION OF THE RECIPROCAL OF VELOCITY FOR PARTICLE MOTION

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## Abstract

In this paper, the reciprocal of dimensional velocity of kinematical motion was converted into new formula defined time velocity. It is a gradient of time. The second derivative of time with respect to 3- dimension coordinates is called the time acceleration which is Laplacian operator of time. The time acceleration is non-vector and can also be evaluated from kinematical time equations .The addition formulas was produced from the principal time velocity equation. The results indicate that the reciprocal of velocity has the same numerical value of the time velocity which has negative sign. The initial and final time velocities, time acceleration, displacement and time are deduced from the equations of particle motion due to time. Similarly the kinematical dimension rotation can be transformed into time rotation motion by the same manner. The rectilinear, curvilinear, rotation and other types of motion have completely applied the concept of non- relativistic motion for particle due to time. The new formula gives depth complementarily of particle movement and complement of moving equation.

**Keywords**: reciprocal, particle, velocity, linear, kinetic, time, motion, kinematics.

## 1-Introduction

Kinematics is an introduction to dynamics, which treats the geometry of the motion for the particle, without taking into account their inertias [1].

The rest and motion are relative concepts that serve as frame of reference [2]. An event of motion has not only position; it also has a time of occurrence [3].The time is an independent variable, non-vector and continues in infinity; it varies steady in space [1] The three components of the position vectors are functions of time. The first and second differentiation yield the velocity and acceleration respectively which are kinematical quantities [4,5]. They refer to the dimension of velocity and the dimension of acceleration [3,6] .In pure geometry the theories of similar (reciprocal theorem of Betti and Raleigh) reciprocal and inverse figures (reciprocal diagram) have led to many extensions of science (e.g. the refractive index being proportional to the velocity or the reciprocal of velocity) [7] .

If the capsular theory was taken, it will use the reciprocal of velocity as a multiplier instead of the velocity itself [8]. For simplicity, the variability of the time t(x) is elapsing between timing events, but the time of velocity and reciprocal of velocity are the same [8]. The concepts generalize to time - varying and to vector – valued Morse functions[9]. It sometimes uses the reciprocal lattice for crystal structure. (Lima Siow) formulated equivalent principle that the kinetic acceleration is equal to the potential acceleration ($d^2r/dt^2 = - d\Phi/dr$)[10] .

This strict study does shed more light into understanding the basic conceptual and theoretical framework on which the concepts are more complicated to other fields of physics. From the practical point of view, it is important because it provides techniques, which can be used in almost any areas of pure and applied researches due to motions.

## 2- The Principle Representation

The principle, the displacement can be correlated with the time by means of a known functional relation [1]:

$\mathbf{r} = f(t)$ (1)

Where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$

The instantaneous velocity and acceleration of a particle are [11,12, 15, 17]: .

$\mathbf{v} = \nu_x\mathbf{i} + \nu_y\mathbf{j} + \nu_z\mathbf{k}$ , $\mathbf{a} = a_x\mathbf{i} + a_y\mathbf{j} + a_z\mathbf{k}$ (2)

These six components describing the kinematics of the particle are called the dimension of velocity and dimension of acceleration[1,6] The displacement–time curve of uniform and uniformly variable motion are straight and curve line respectively. The velocity–time curve of such motion is straight line parallel to the axis of abscissas ($\nu_x$= const.), also the tangential acceleration–time curve is a straight line coincident with the axis of abscissas ($a_x$= 0) [2]. The tangential acceleration curve is a straight line parallel to the axis of abscissa ($a_x$ = const.) [2]. The linear and rotational equations for kinematical dimension motions of a particle are known [1,6]. .The other equation of motion due to spherical and cylindrical co-ordinates can also be mathematically evaluated using the same manner.

## 3-The Equivalence Principle

It states that the reciprocal of kinetic velocity is equal to the gradient of time, which conventionally is expressed as [13]:

$$\frac{\hat{u}}{\nu_r} = -\text{grad } t \qquad (3)$$

where the L.H.S. of the equation is equivalent to:

$$\nu_t = -\frac{\hat{u}}{\nu_r} \qquad (4)$$

such that $\hat{\mathbf{u}}$ is a unit vector of $\nu_r$ or $\nu_t$ and the absolute value of equation (4) leads to the formula $\nu_r = 1/\nu_t$ .

The negative sign of eq. (3) is placed to compare between more two numerical values of particle velocity . In other wards the negative numerical value decreases as number increase. The variable $\nu_t$ is defined as the reciprocal of dimension velocity or velocity of time (in units: s/cm, s/m, or μs/m,…). The reciprocal diagram between $\nu_r$ and $\nu_t$ is shown in Fig. (1). To evaluate the time acceleration, multiply eq. (3) by the grad symbol this yields [11]:

$$\nabla.\mathbf{\nu_t} = \nabla.\cdot(\nabla t) \qquad (5)$$

or

$$d\nu_t/ dr = \nabla^2 t \qquad (6)$$

such that the left-hand side of equation (6) is a scalar quantity called the acceleration of time ($a_t$) (in units s/cm$^2$, s/m$^2$ or µs/m$^2$,…), $\nabla^2$ is the Laplacian operator, however equation (6) becomes:

$$a_t = \partial^2 t/\partial x^2 + \partial^2 t/\partial y^2 + \partial^2 t/\partial z^2 \qquad (7)$$

To derive the equation of motion due to kinematical time in one - dimension, we use equation (7), which then becomes:

$$a_{tx} = d^2t/ dx^2 \qquad (8)$$

or

$$a_{tx}=d\nu_t/dx$$

$$a_{tx} \int_{x_0}^{x_1} dx = \int_{\nu_{t0}}^{\nu_{t1}} d\nu_t \qquad (9)$$

Let $a_{tx} = a_t$

So $a_t(x_1-x_o) = \nu_{t1}-\nu_{to}$

Since

$$a_x(t_1-t_o)= \nu_{x1}-\nu_{xo} \qquad (10)$$

Divide eq. (10) on eq. (9) to obtains:

$$\frac{a_{tx}(t_1 - t_0)}{a_t(x_1 - x_0)} = \frac{\nu_{x_1} - \nu_{x_0}}{\nu_{t_1} - \nu_{t_0}}$$

substitute eqs. $\nu_t = - 1/\nu_{x1}$ and $\nu_{to} = - 1/\nu_{xo}$ ,the equation becomes :

$$a_x= \nu_{xo}\nu_{x1}\nu_x a_t \qquad (11)$$

Where $\nu_x = \dfrac{x_1 - x_0}{t_1 - t_0}$

By using the same manner:

$$a_t = - \nu_{to}\nu_{t1}\nu_t a_x \qquad (12)$$

Where $\nu_x = -\dfrac{t_1 - t_0}{x_1 - x_0}$

Since the average dimension velocity is give by the eqn. :

$$\bar{\nu}_x = \frac{\nu_{x_0} - \nu_{x_1}}{2}$$

When substitute $v_x = -\frac{1}{v_t}$ in equation, the average time velocity become:

$$\bar{v}_t = \frac{2v_{t_0}v_{t_1}}{v_{t_0}+v_{t_1}} \tag{13}$$

Also at $x_o=0$ , from eqs. (13) and (9) substitute in following equation :

$$t = -\bar{v}_t x \tag{14}$$

becomes :

$$t = \frac{2v_{t_0}v_{t_1}(v_{t_1}+v_{t0})}{a_t(v_{t_0}+v_{t_1})}$$

or

$$a_t = \frac{2v_{t_0}v_{t_1}(v_{t_1}+v_{t0})}{t(v_{t_0}+v_{t_1})} \tag{15}$$

From equation (14) , and at $x_o=0$ ,$t_o=0$ by using eqns. (13) and (9) the time equation will have the formula :

$$t = \frac{2v_{t_0}x(v_{t0}+a_1x)}{2v_{t_0}+a_1x} \tag{16}$$

So the equations (9),(12),(13),(15) and(16) are the linear kinetic equations due to time . Similarly for kinematical rotation motion, it can also be derived using an analogous expression of reciprocal angular velocity that is equal to the gradient of rotation time. The new groups of equations with respect to time motion for linear and rotation motion are shown in table(1).

| **Linear Time Motion** | **Rotation Time Motion** |
|---|---|
| $a_t x = v_{t1} - v_{to}$ | $\alpha_t\theta = \omega_{t1} - \omega_{to}$ |
| $\bar{v}_t = \frac{2v_{t_0}v_{t_1}}{v_{t_0}+v_{t_1}}$ | $\bar{\omega}_t = \frac{2\omega_{t_0}\omega_{t_1}}{\omega_{t_0}+\omega_{t_1}}$ |
| $a_t = -v_{to}v_{t1}v_t a_x$ | $\alpha_t = -\omega_{to}\omega_{t1}\omega_t\alpha_\theta$ |
| $t = \frac{-2v_{t_0}x(v_{t_0}-a_t x)}{2v_{t_0}+a_t x}$ | $t = \frac{-2\omega_{t_0}\theta(\omega_{t_0}+\alpha_t\theta)}{2\omega_{t_0}+\alpha_t\theta}$ |
| $a_t = \frac{2v_{t_0}v_{t1}(v_{t_0}-v_{t_1})}{t(v_{t_0}-v_{t_1})}$ | $a_t = \frac{2\omega_{t_0}\omega_{t1}(\omega_{t_0}-\omega_{t_1})}{t(\omega_{t_0}-\omega_{t_1})}$ |

## 4- Continuity of Equations

As result of linear or rotational equation due to time, we can deduce many equations related to Newtonian (classical) mechanics. The parameters such as force, torque, work, momentum, …etc. may also converted into another factors due to dynamical time that are called time force, time torque, time work, time momentum, …etc .The particle has a dynamical time motion.

## 5- Results and Discussion

The principal problem of kinematics is that of determining all characteristics of a particle as a whole or any of particles or bodies [1]. The first and second differential equations due to time with respect to dimension represents the time of velocity and time of acceleration respectively. They have been formulated with another a new style and perfect representation of various classical kinematics for particle motion. The reciprocal of dimension velocity is equivalent to the gradient of elapsed time that is also defined velocity of time . The negative sign of equation (4) means that the effective numerical value of both $\nu_x$ and $\nu_t$ have the same concept for the moving particle. Equation (4) is similar to electrical field equation ($\mathbf{E} = - \nabla\varphi$). The acceleration of time is analogous to Poisson's equation ($\nabla^2\varphi= \rho/\varepsilon$) [14]. Fig. (1) indicates to the negative inverse proportional relation between $\nu_r$ and $\nu_t$, which have the same kinetic meaning as a numerical value for a particle motion. They are symmetrical about origin. If we have taken any numerical value of $\nu_x$ ,$\nu_t$ will have the same numerical velocity meaning. Fig. (2) shows any steady motion of a particle of t as a function of x. Figs. (3) and (4) describe the constant values of $\nu_x$ and $\nu_t$ respectively. $a_x$ and $a_{tx}$ are equal to zero when t and x are uniformly varying (both $\nu_x$ and $\nu_t$ are constants) as shown in Figs (5) and (6). For steady increasing or decreasing velocity of dimension or time , Figs.(7) and (8) explain the relations between t against x and $\nu_t$ against x .Also Figs. (9) and (10) refer to constant dimension acceleration and variable time acceleration against time and distance respectively . Finally Figs (11) and (12) show a constant and variable time acceleration against increasing distance. The movement of any particle in a straight line as shown in the previous simple graphs give additional concept for new parameters. There are no difference between the new factors related to time and the ordinary factors due to dimension to know the moving particle .They will give the same results if they are used the numerical with values of parameters together. The overlapping between new and ordinary factors as shown in equation (12) can be evaluated one from each other. The perfect association of conformal-conjugate transformation for a moving particle using a new manner can be applied for another movements such as curvilinear, circular, and rotational motion. They have given the same meaning for the movement of the particle. The ability to generalize these new equations is realized by using the same previous steps.

It is observed that the corresponding rotational time equations are analogous to the linear time equations which are shown in the table (1). Most mechanical instruments and equipment are design to measure the factors of particle or body using dimension equations. In spite of involving timer or any device due to time, it is possible to design equipment due to time equations. The new factors involve more accurate units such as micro and nanometer with large units (e.g. ns/m, µs/cm). However the unknown value can be evaluated from one of two types of equations. It must take into account the sign of numerical values for time velocity or time acceleration.

## 6- Conclusion

The reciprocal of dimension velocity has a new formula called time velocity with the same direction. It is a gradient of time for a moving particle. The time acceleration is the Laplacian operator of time, which is a non-vector quantity .The linear and rotational time equations have another new style to evaluate the parameters of moving particle, moreover involving a new concept of a moving particle and design instrument related to time.

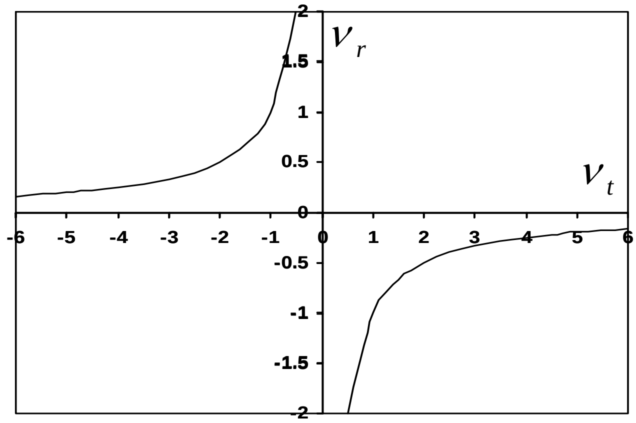


Fig. (1) The relationship between the dimention velocity and its reciprocal.

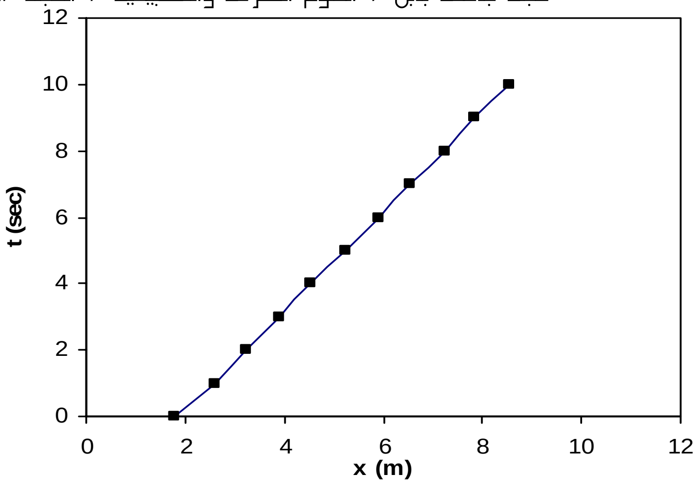


Fig. (2) Steady motion for any moving particle for t against x.

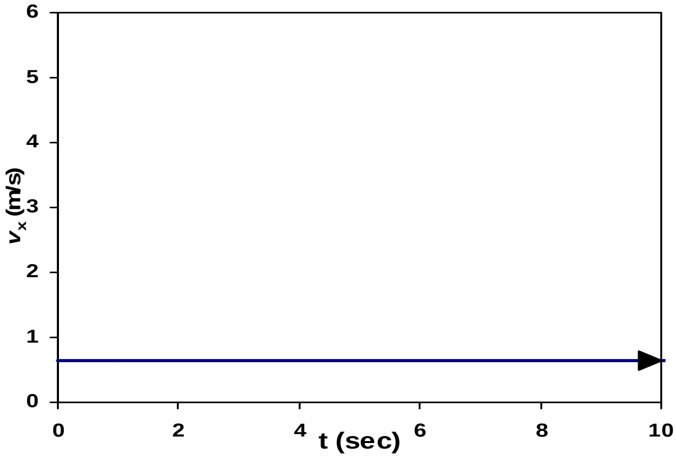


Fig. (3) Indicates to constant value of displacement velocity for a particle .

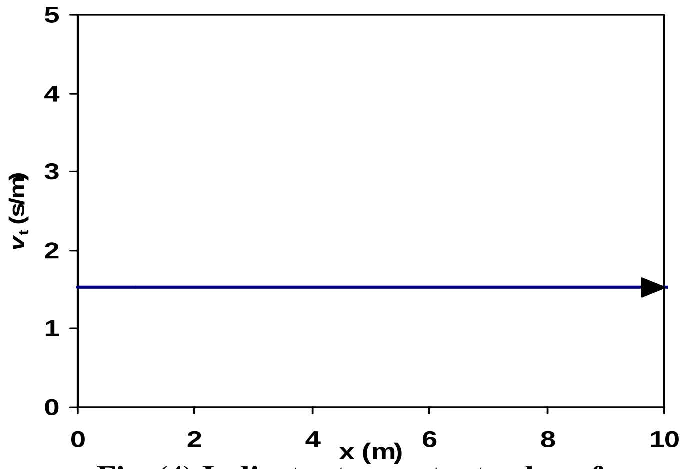


Fig. (4) Indicates to constant value of time velocity for a particle.

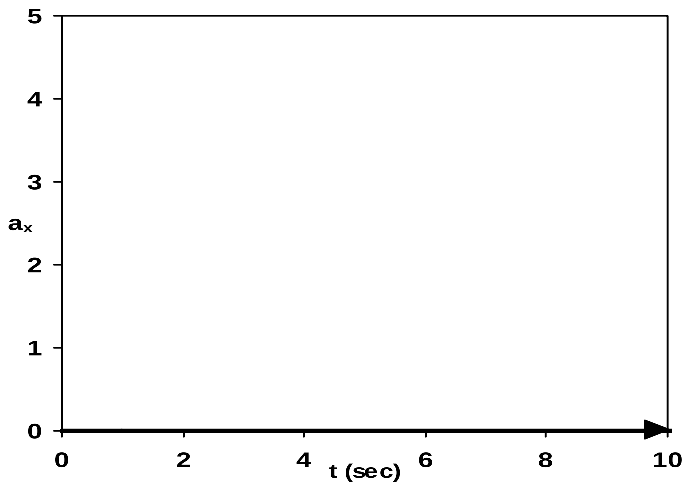


Fig. (5) Indicates the zero value of $a_x$ against increasing t .

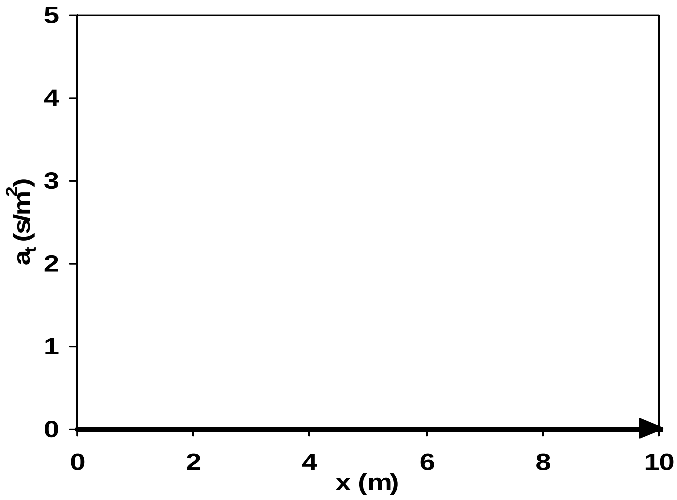


Fig. (6) Indicates the zero value of $a_t$ against increasing x.

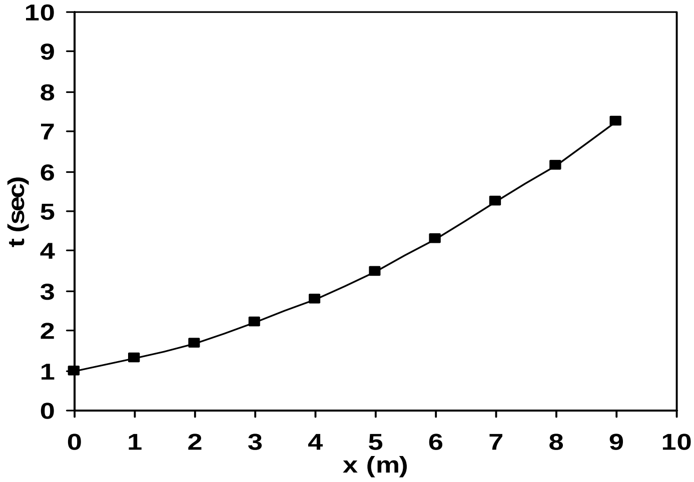


**Fig. (7) Describes the relationship between t and x for steady increasing of time velocity for a particle .**

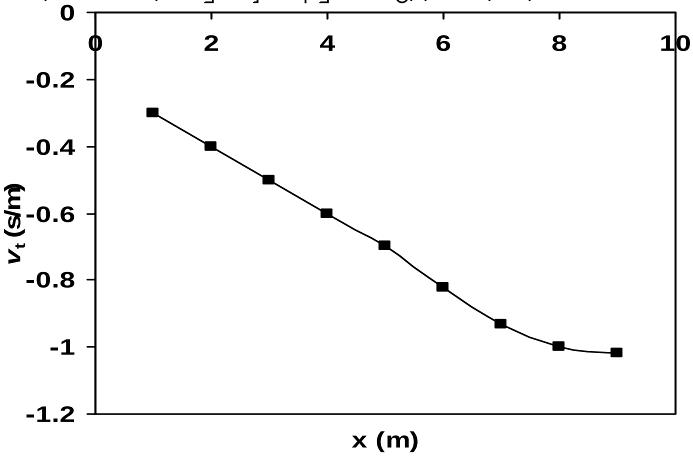


**Fig. (8) Describes the increasing in $v_t$ as x increases.**

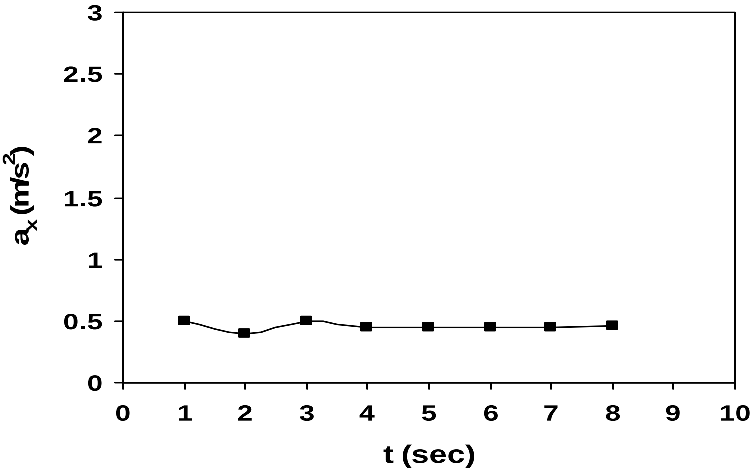


**Fig. (9) The known relation between $a_x$ and t.**

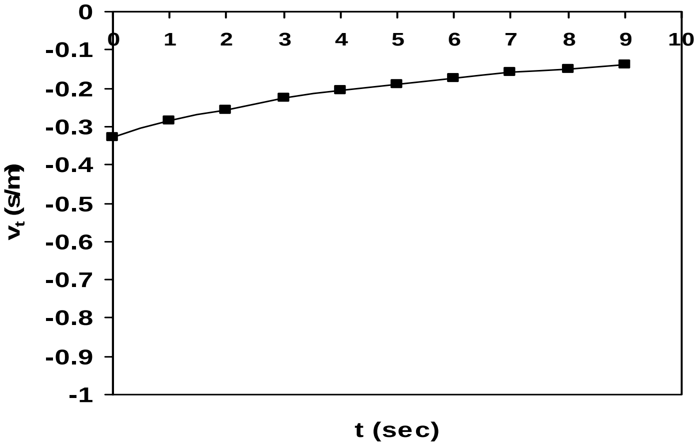


**Fig. (10) The relationship between time velocity against t.**

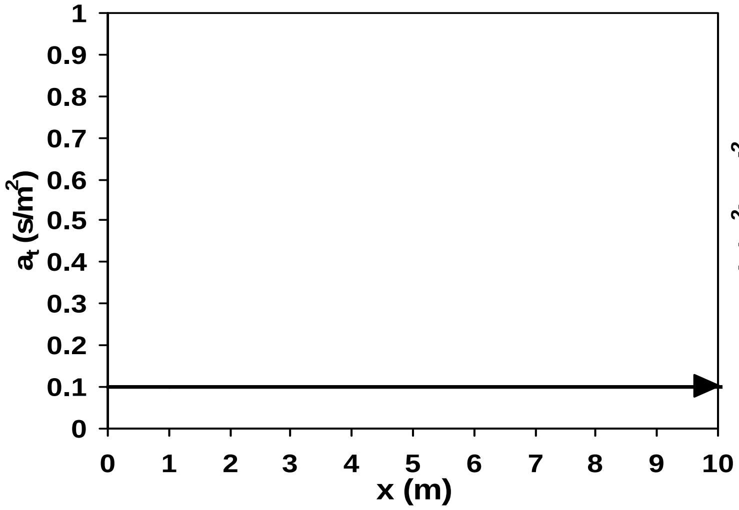


**Fig. (11) Describes constant time acceleration against x.**

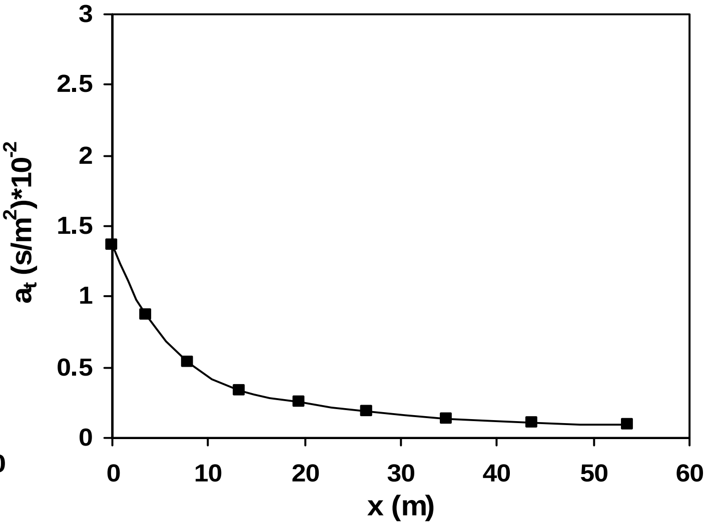


**Fig. (12) Describes a variable time accecleration against x.**

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