Momentum-Velocity Equivalence

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Abstract: In Newtonian mechanics, the momentum of a moving object is measured as the product of its mass and velocity. In this article, a new concept and equations are proposed regarding the momentum-velocity equivalence.

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Momentum and Velocity

The momentum (*P*) of a moving object is directly proportional to its velocity with respect (*v*) to its mass (*m*) over time (*t*).

$$P \ \alpha \ v \ \Rightarrow P = mv, \text{where } m \text{ is constant.}$$

$$Let\ m > m_i.\ P = m_i v_i = mv, where\ v < v_i.$$

Suppose the non-zero m is a variable, the following equations are true.

$$P = m_1 v_1;\ P = m_2 v_2;\ P = m_3 v_3;\ \cdots;\ P = m_k v_k\ at\ t = k, \text{for } t = 1, 2, 3, \cdots, k.$$

Since the momentum is directly proportional to the velocity, $P = m_k v_k = mv$.

Let m be constant. Then, $m_i = m\ and\ v_i = v$, for $i = 1, 2, 3, \cdots, k$.

$i.e.,\qquad P = m_1 v_1 = m_2 v_2 = m_3 v_3 = \cdots = m_k v_k = mv.$

Let us differentiate the momentum as follows:

$$\frac{dP}{dt} = m_k \frac{dv_k}{dt} + v_k \frac{dm_k}{dt} = \frac{d(m_k v_k)}{dt}, \text{where } m_k \text{ and } v_k \text{ are a variable.} \qquad (1)$$

$$\frac{dP}{dt} = m \frac{dv}{dt} = \frac{d(mv)}{dt}, \text{where } m \text{ is constant.} \qquad (2)$$

From the equations (1) and (2), we conclude that

$$m_k \frac{dv_k}{dt} + v_k \frac{dm_k}{dt} = \frac{d(m_k v_k)}{dt} = \frac{d(mv)}{dt}, \qquad (3)$$

where m_k and m are variable and constant respectively.