Classical Mechanics

Basic Papers

(A brief review)

- Kinematics -

Paper 6

First principle: Any reference frame should be fixed to a body.

Second principle: It is possible to agree that any reference frame fixed to a body should be non-rotating.

If any reference frame is a non-rotating reference frame, then each coordinate axis of a reference frame S will remain at a fixed angle to the corresponding coordinate axis of another reference frame S'. Therefore, to simplify calculations it will be assumed that each axis of S is parallel to the corresponding axis of S', as shown in Figure 1.

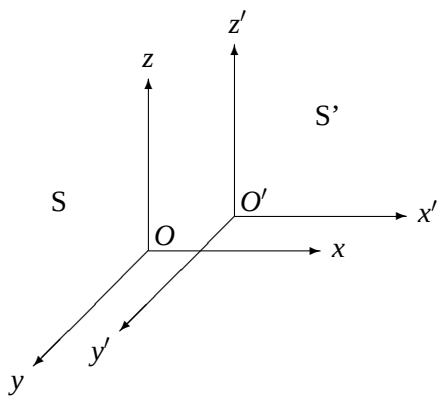

Figure 1

A change of coordinates x, y, z, t from reference frame S to coordinates x', y', z', t' from reference frame S' whose origin O' has coordinates $x_{o'}$, $y_{o'}$, $z_{o'}$ measured from S, can be carried out by means of the following equations:

$$x' = x - x_{o'}$$
$$y' = y - y_{o'}$$
$$z' = z - z_{o'}$$
$$t' = t$$

From these equations, the transformation of velocity and acceleration from reference frame S to reference frame S' may be carried out, and expressed in vector form as follows:

$$\mathbf{v}' = \mathbf{v} - \mathbf{v}_{o'}$$
$$\mathbf{a}' = \mathbf{a} - \mathbf{a}_{o'}$$

where $\mathbf{v}_{o'}$ and $\mathbf{a}_{o'}$ are the velocity and acceleration respectively, of reference frame S' relative to S.

- Laws of Motion -

Paper 8

First new law of motion: The forces acting on a particle A and the forces acting on a reference frame S can change the state of motion of particle A relative to the reference frame S.

Second new law of motion: The acceleration $\mathbf{a}_{A|S}$ of a particle A relative to a reference frame S (non-rotating) fixed to a particle S is given by the following equation:

$$\mathbf{a}_{A|S} = \frac{\sum \mathbf{F}_A}{m_A} - \frac{\sum \mathbf{F}_S}{m_S}$$

where $\sum \mathbf{F}_A$ is the sum of the forces acting on particle A, m_A is the mass of particle A, $\sum \mathbf{F}_S$ is the sum of the forces acting on particle S, and m_S is the mass of particle S.

- Dynamics -

Paper 5

First definition: The force $\mathbf{F}$ acting on a particle is a vector quantity representing the interaction between particles.

The transformation of forces (real) from one reference frame to another is given by

$$\mathbf{F}' = \mathbf{F}$$

Second definition: The mass m of a particle is a scalar quantity representing a constant characteristic of the particle.

The transformation of masses from one reference frame to another is given by

$$m' = m$$

Third definition: The universal acceleration $\mathbf{a}_A^\circ$ of a particle A is the real acceleration $\mathbf{a}_A$ of particle A relative to the universal reference frame S$^\circ$ (the universal reference frame S$^\circ$ is a reference frame which is fixed to a particle on which no force is acting, and which is used as a universal reference frame)

The transformation of universal accelerations from one reference frame to another is given by

$$\mathbf{a}^{\circ\prime} = \mathbf{a}^\circ$$

First principle: Any particle in a state of universal rest or of universal uniform linear motion tends to remain in such a state unless acted upon by an unbalanced external force.

Second principle: The sum of all forces $\sum \mathbf{F}_A$ acting on a particle A of mass m_A produces a universal acceleration $\mathbf{a}_A^\circ$ according to the following equation:

$$\sum \mathbf{F}_A = m_A \mathbf{a}_A^\circ$$

Finally, the new laws of motion of paper [8] can be deduced from the statements of papers [5] and [6].