

# Mathematics

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# 1 Calculus

## 1.1 Differentiation

**2 Series**

**3 Multivariable Calculus**

## 4 Vector Calculus

## 5 Fluid Mechanics

### 5.1 Kinematics

#### 5.1.1 Coordinates

**Lagrangian**  $\underline{x}(\underline{a}, t)$ : The motion of individual particles is studied; the position  $\underline{x}$  of a particle at time  $t$  is related to its position at a reference point in time  $\underline{a}$  (typically at  $t = 0$ ).

**Eulerian**  $(\underline{x}, t)$ : The state of a fluid is described in terms of the values at a fixed location  $\underline{x}$  and at fixed time  $t$

#### 5.1.2 Velocity

In Cartesian coordinates the velocity of a fluid particle at position  $\underline{x}(x, y, z)$  is given by:

$$\underline{u}(x, y, z) = u(x, y, z)\hat{i} + v(x, y, z)\hat{j} + w(x, y, z)\hat{k}$$