Q. → Equation of continuity in fluid flow.

The divergence of a vector field $\vec{A}$ that is, $\vec{\nabla}\cdot\vec{A}$ represents the net outflow of $\vec{A}$ per unit volume. Let now a quantity of fluid of density ρ flow with velocity $\vec{v}$ and consider the flow in a small volume $d\tau$. Due to the outflow of ~~the~~ fluid, its density ρ inside $d\tau$ will decrease. ~~But Out By prin~~

The principle of conservation of mass is the total outflow of mass must equal the total decrease in mass in $d\tau$ due to change in density.

$$\therefore \vec{\nabla}\cdot(\rho\vec{v})\,d\tau = -\frac{d\rho}{dt}\,d\tau$$

or, $$\vec{\nabla}\cdot(\rho\vec{v}) + \frac{d\rho}{dt} = 0 \quad \text{——— (1)}$$

which is the equation of continuity for compressible fluid, however

ρ = constant

or, $\frac{d\rho}{dt} = 0$ and the equation of continuity is $\vec{\nabla}\cdot(\rho\vec{v}) = 0$ or $\vec{\nabla}\cdot\vec{v} = 0$ ——— (2)