ball upon the
f the ball. [**Hint**:
› the downward
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opopause is near
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he Earth lies in
trop On the

level up to the 850-hPa pressure surface. Estimate the equatorward mass flux into the equatorial zone. [**Hint**: The equatorward mass flux across the 15 °N, in units of kg s^{-1}, is given by

$$-\oint_{15\,^\circ\mathrm{N}} \int_0^{z850} \rho v \, dz \, dx$$

where ρ is the density of the air, v is the meridional (northward) velocity component, the line integral denotes an integration around the 15 °N latitude circle, and the vertical integral is from sea level up to the height of the 850-hPa surface. Evaluate the integral, making use of the relations

$$\oint_{15\,^\circ\mathrm{N}} dx = 2\pi R_E \cos 15^\circ$$

what is a flux? units contain the meaning.

units: $\left(\frac{kg}{m^3}\right)\frac{m}{s} = \frac{kg}{m^2 s}$ ← stuff = mass

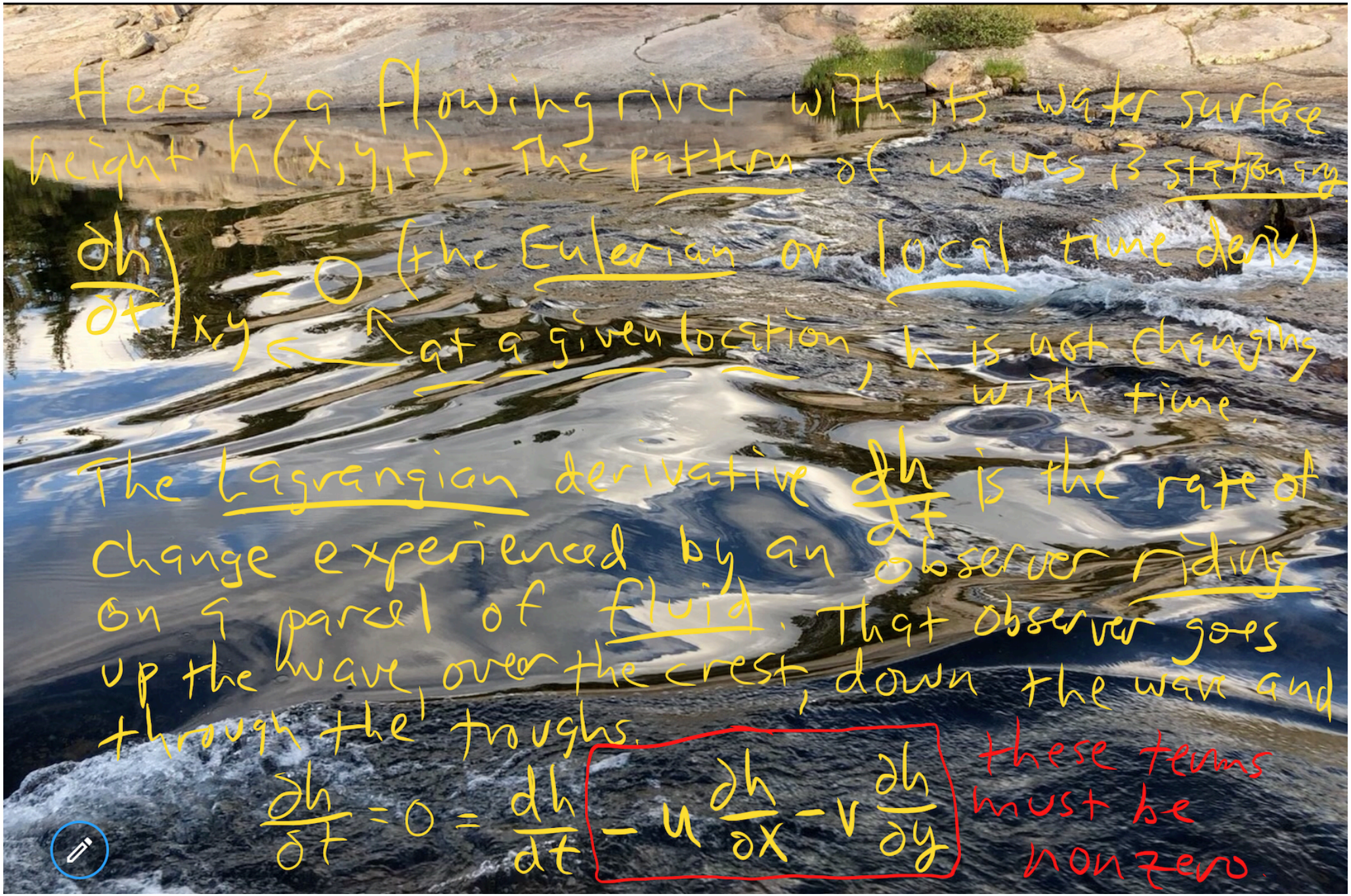
mass flux

what units are a momentum flux?

$\left(\frac{kg}{m^2}\frac{m/s}{s}\right)$

units of force $F = ma$ $\left(\frac{kg\,m}{s^2}\right)$

Pencil Only | Pen | Highlighter | Line | Arrow | Rectangle | Oval | Text | Color | Eraser | Undo | Redo | Clear


Here is a flowing river with its water surface height $h(x,y,t)$. The pattern of waves is stationary.
$\left(\frac{\partial h}{\partial t}\right)_{x,y} = 0$ (the Eulerian or local time deriv.)
at a given location, h is not changing with time.
The Lagrangian derivative $\frac{dh}{dt}$ is the rate of change experienced by an observer riding on a parcel of fluid. That observer goes up the wave, over the crest, down the wave and through the troughs.
$\frac{\partial h}{\partial t} = 0 = \frac{dh}{dt} - u\frac{\partial h}{\partial x} - v\frac{\partial h}{\partial y}$
these terms must be nonzero.