Topic to disscuss

$$\rightarrow \triangle \cdot \nabla = \triangle - \nabla$$

$$\rightarrow (| + \Delta) (| - \nabla) = |$$

$$\rightarrow \mu^2 = 1 + \frac{1}{4} S^2$$

$$\rightarrow S = \nabla \cdot \vec{E}^{\frac{1}{2}}$$

$$\rightarrow E = e^{hD}$$
, $D = \frac{d}{dx}$

Q:1 Prove that $\Delta \cdot \nabla = \Delta - \nabla$

Solution: $\Delta f(x) = f(x+h) - f(x)$ $\nabla f(x) = f(x) - f(x-h)$

We can white,

$$\Delta f(x) - \nabla f(x) = f(x+h) - f(x) - f(x) + f(x-h)$$

$$(\Delta - \nabla) f(x) = f(x+h) - 2f(x) + f(x-h) - 0$$

$$(\Delta - \nabla) f(x) = f(x+h) - 2f(x) + f(x-h) - 0$$

Also, $\triangle \cdot \nabla f(x) = \Delta \left(f(x) - f(x-h) \right)$ $= \Delta f(x) - \Delta f(x-h)$ = f(x+h) - f(x) - f(x-h+h) + f(x-h) = f(x+h) - 2f(x) + f(x-h) - 2 So, from egn. — (1) 2 (11), We get. $(\Delta - \nabla) f(x) = \Delta \cdot \nabla f(x)$ YouTube @StartPracticing $\therefore \quad \nabla \cdot \nabla \quad = \quad \nabla \cdot \nabla$

Solution:
$$\triangle f(x) = f(x+h) - f(x)$$

$$\triangle f(x) = Ef(x) - f(x)$$

$$\triangle f(x) = (E-1) f(x)$$

$$\triangle = E-1$$

$$E = \triangle + 1$$
Now, $(1+\Delta)(1-\nabla) f(x) = (1+\Delta)[f(x)-\nabla f(x)]$

$$= E(f(x)-f(x)+f(x-h)]$$

$$= f(x-h+h)$$

$$(1+\Delta)(1-\nabla)\cdot f(x)=f(x)$$

$$(1+\Delta)(1-\nabla)=1$$
Proved)

Q:3: Prove that, $\mu^2 = 1 + \frac{1}{4} S^2$

Solution: We know,

$$Sf(x) = f(x + \frac{h}{2}) - f(x - \frac{h}{2})$$

$$= E^{\frac{1}{2}}f(x) - E^{-\frac{1}{2}}f(x)$$

$$Sf(x) = (E^{\frac{1}{2}} - E^{-\frac{1}{2}}) f(x)$$

Squaring both side,
$$E^{\frac{1}{2}} - E^{\frac{1}{2}}$$

$$S^{2} = (E^{\frac{1}{2}} - E^{\frac{1}{2}})^{2}$$

$$S^2 = E + E^{-1} - 2$$

$$E + E^{-1} = S^2 + 2 - 0$$

Again, we know,
$$\mu = \frac{1}{2} \left[f(x + \frac{h}{2}) + f(x - \frac{h}{2}) \right]$$

$$\mu = \frac{1}{2} \left[E^{\frac{1}{2}} + E^{-\frac{1}{2}} \right]$$
Soprasing both side,
$$\mu^{2} = \frac{1}{4} \left[E + E^{-1} + 2 \right]$$

$$= \frac{1}{4} \left[S^{2} + 2 + 2 \right]$$

$$= \frac{1}{4} \left[S^{2} + 4 \right]$$

$$\mu^{2} = 1 + \frac{S^{2}}{4}$$

$$\mu^{3} = \frac{1}{4} \left[S^{2} + 4 \right]$$

Q:4 Prove the relation, $S = \nabla \cdot E^{\frac{1}{2}}$

Solution:

$$Sf(\alpha) = f(\alpha + \frac{h}{2}) - f(\alpha - \frac{h}{2})$$

$$= E^{\frac{1}{2}}f(\alpha) - E^{-\frac{1}{2}}f(\alpha)$$

$$S = E^{\frac{1}{2}} - E^{-\frac{1}{2}}$$

$$= E^{\frac{1}{2}}(1 - E^{-\frac{1}{2}})$$

$$= E^{\frac{1}{2}} \times \nabla$$

$$S = \nabla \cdot E^{\frac{1}{2}}$$

$$E = e^{hD}$$
, $D = \frac{d}{dx}$

Solution: We know,

$$Ef(x) = f(x+h)$$

$$= f(x) + hf'(x) + \frac{h^2}{2!}f''(x) + \frac{h^3}{3!}f'''(x) + \cdots$$

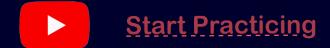
$$= f(x) + hf'(x) + \frac{h^2}{2!}f''(x) + \frac{h^3}{3!}f'''(x) + \cdots$$
(By tailors theorem)

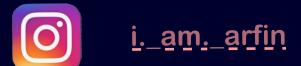
$$= f(x) + hDf(x) + \frac{h^2}{2!} \times D^2 f(x) + \frac{h^2}{3!} D^3 f(x) + \cdots$$

$$E f(x) = \left(1 + hD + \frac{h^2D^2}{2!} + \frac{h^3D^3}{3!} + \dots \right) f(x)$$

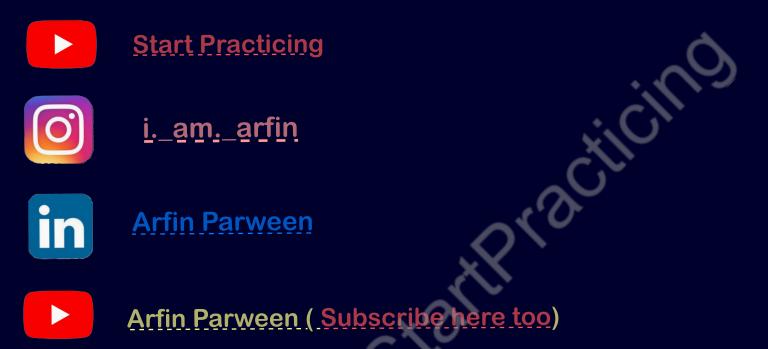
$$E = 1 + hD + \frac{h^2D^2}{2!} + \frac{h^3D^3}{3!} + \dots$$

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