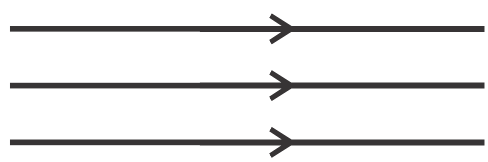
$\underline{\bar{\nabla} \bullet \bar{A} = 0}$ implies that a vector field is **solenoidal** or **divergenceless.** In addition, a vector field that meets this condition can be expressed in terms of the curl of another vector field (a vector potential), e.g.,

$$\bar{A} = \bar{\nabla} \times \bar{F} \quad \text{since} \quad \bar{\nabla} \bullet (\bar{\nabla} \times \bar{F}) = 0$$

$\underline{\bar{\nabla} \times \bar{A} = 0}$ implies that a vector field is **irrotational** or **potential.** In addition, a vector field that meets this condition is **conservative**. This means that the line integral of this field between two points is the same, regardless of path.

Why **potential?** $\bar{A} = \pm \bar{\nabla} V$ since $\bar{\nabla} \times \bar{A} = \bar{\nabla} \times (\pm \bar{\nabla} V) = 0$

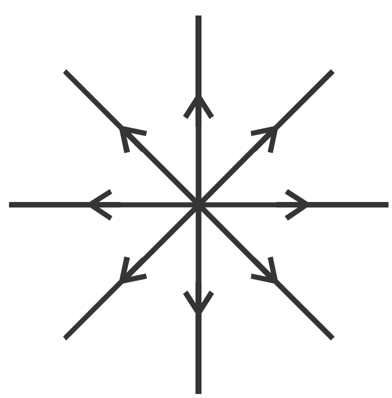
Examples



$\bar{\nabla} \bullet \bar{A} = 0$

$\bar{\nabla} \times \bar{A} = 0$

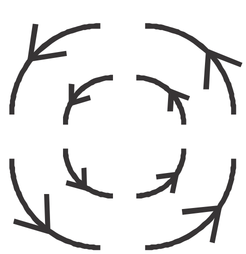
Solenoidal & **Irrotational** & **Conservative**



$\bar{\nabla} \bullet \bar{A} \neq 0$

$\bar{\nabla} \times \bar{A} = 0$

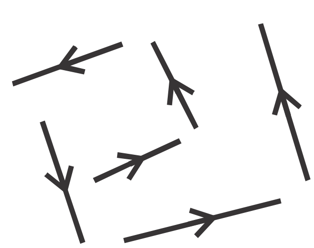
Irrotational & **Conservative**



$\bar{\nabla} \bullet \bar{A} = 0$

$\bar{\nabla} \times \bar{A} \neq 0$

Solenoidal



$\bar{\nabla} \bullet \bar{A} \neq 0$

$\bar{\nabla} \times \bar{A} \neq 0$

Neither