Recorder: _____

Task Master: _____ **Cynic:** _____ **Other:** _____

DIVERGENCE & CURL

Working in small groups (3 or 4 people), solve as many of the problems below as possible. Try to resolve questions within the group before asking for help. The Recorder is responsible for writing up the group's results and turning it in. Show your work! Full credit will only be given if your answer is supported by calculations and/or explanations as appropriate.

1. Choose a vector field $\vec{\boldsymbol{F}}$ from the first column below. Choose a small loop C (that is, a simple, closed, positively-oriented curve) which does **not** go around the origin.

(a) Is $\oint_C \vec{\boldsymbol{F}} \cdot d\vec{\boldsymbol{r}}$ positive, negative, or zero?

(b) Will a paddlewheel spin if placed inside your loop, and, if so, which way?

(c) Do you think $\vec{\nabla} \times \vec{\boldsymbol{F}}$ is zero or nonzero inside your loop? *Explain.*

(d) Compute $\vec{\nabla} \times \vec{\boldsymbol{F}}$. Did you guess right? *Explain.*

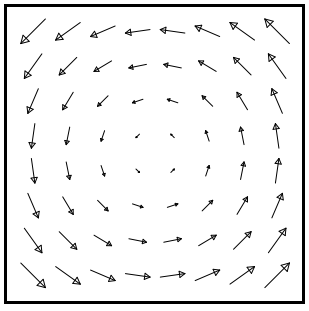
(e) Is $\oint_C \vec{\boldsymbol{F}} \cdot \hat{\boldsymbol{n}}\, ds$ positive, negative, or zero? ($\hat{\boldsymbol{n}}$ is the *outward* pointing normal vector to C.)

(f) Is the net flow outwards across your loop positive, negative, or zero?

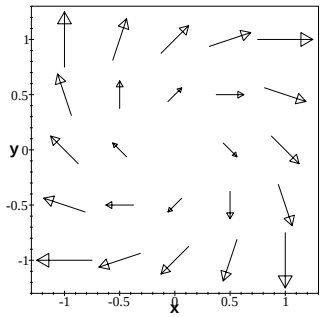
(g) Do you think $\vec{\nabla} \cdot \vec{\boldsymbol{F}}$ is zero or nonzero inside your loop? *Explain.*

(h) Compute $\vec{\nabla} \cdot \vec{\boldsymbol{F}}$. Did you guess right? *Explain.*

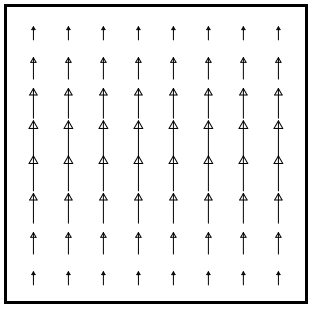
2. Repeat the above steps for vector fields $\vec{\boldsymbol{G}}$ and $\vec{\boldsymbol{H}}$ chosen from the second and third columns.



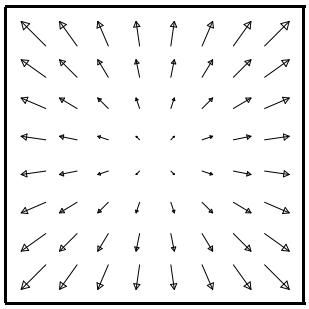
$-y\hat{\boldsymbol{\imath}} + x\hat{\boldsymbol{\jmath}} = r\,\hat{\boldsymbol{\phi}}$



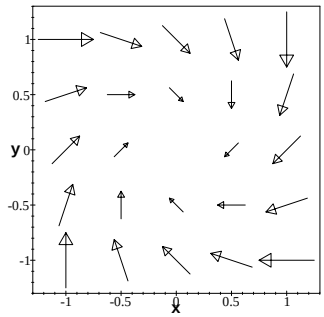
$(x+y)\,\hat{\boldsymbol{\imath}} + (y-x)\,\hat{\boldsymbol{\jmath}}$



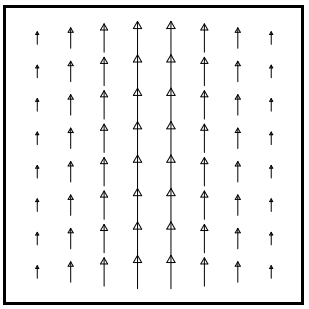
$e^{-y^2}\,\hat{\boldsymbol{\jmath}}$



$x\hat{\boldsymbol{\imath}} + y\hat{\boldsymbol{\jmath}} = r\,\hat{\boldsymbol{r}}$



$(y-x)\,\hat{\boldsymbol{\imath}} - (x+y)\,\hat{\boldsymbol{\jmath}}$



$e^{-x^2}\,\hat{\boldsymbol{\jmath}}$