1 Vector Field Sketch (Curvilinear Coordinates)

Sketch each of the vector fields below by hand. You can check your answers using technology. Make sure that you show enough arrows to show the key features of the graph.

(a) $\vec{\boldsymbol{K}} = s\,\hat{\boldsymbol{s}}$

(b) $\vec{\boldsymbol{M}} = \sin\phi\,\hat{\boldsymbol{s}}$

(c) $\vec{\boldsymbol{N}} = \sin(2\pi s)\,\hat{\boldsymbol{\phi}}$

2 Circulation I

The *circulation* of a vector field $\vec{\boldsymbol{F}}$ around a closed curve C is given by

$$\oint_C \vec{\boldsymbol{F}} \cdot d\vec{\boldsymbol{r}}$$

For each of the vector fields below, explain whether you expect the given vector field to have positive, negative, or zero circulation *counterclockwise* around the closed curve C shown in the figure. Two of the segments of C are circular arcs centered at the origin; the other two are radial line segments.

I. $\vec{\boldsymbol{G}} = x\,\hat{\boldsymbol{x}} + y\,\hat{\boldsymbol{y}}$

II. $\vec{\boldsymbol{H}} = y\,\hat{\boldsymbol{x}} - x\,\hat{\boldsymbol{y}}$

3 Memorize the Vector Differential

Nothing to turn in.

Write $\vec{dr}$ in rectangular, cylindrical, and spherical coordinates.

(a) Rectangular:

$$\vec{dr} = \tag{1}$$

(b) Cylindrical:

$$\vec{dr} = \tag{2}$$

(c) Spherical:

$$\vec{dr} = \tag{3}$$

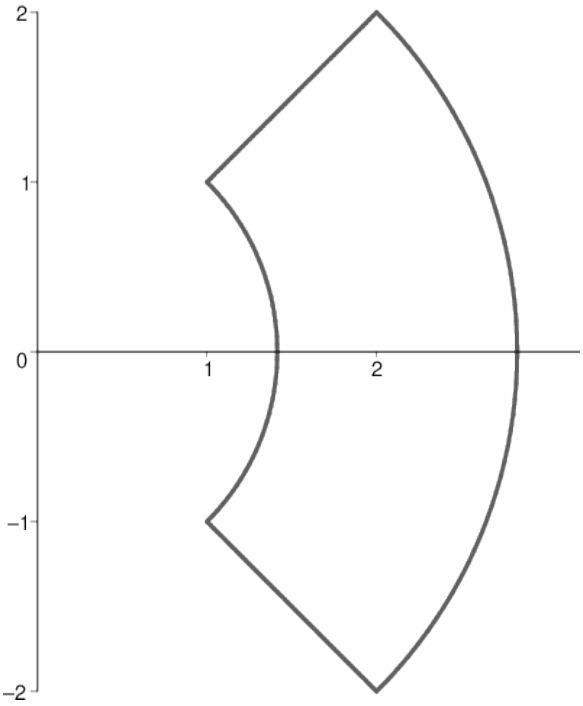


Figure 1: Path for Problem Circulation I