Practice problems are posted for those who want a little more practice with the basics. Feel free to ignore them if they look too easy. There is nothing to turn in.

# 1 Vector Field Sketch (Rectangular Coordinates)

*More practice for seeing the shape of vector fields, based on their algebraic form. These examples are in rectangular coordinates. You have some examples in cylindrical and spherical coordinates to turn in.*

Sketch each of the vector fields below.

(a) $\vec{\boldsymbol{F}} = -y\,\hat{\boldsymbol{x}} + x\,\hat{\boldsymbol{y}}$

(b) $\vec{\boldsymbol{G}} = x\,\hat{\boldsymbol{x}} + y\,\hat{\boldsymbol{y}}$

(c) $\vec{\boldsymbol{H}} = y\,\hat{\boldsymbol{x}} + x\,\hat{\boldsymbol{y}}$

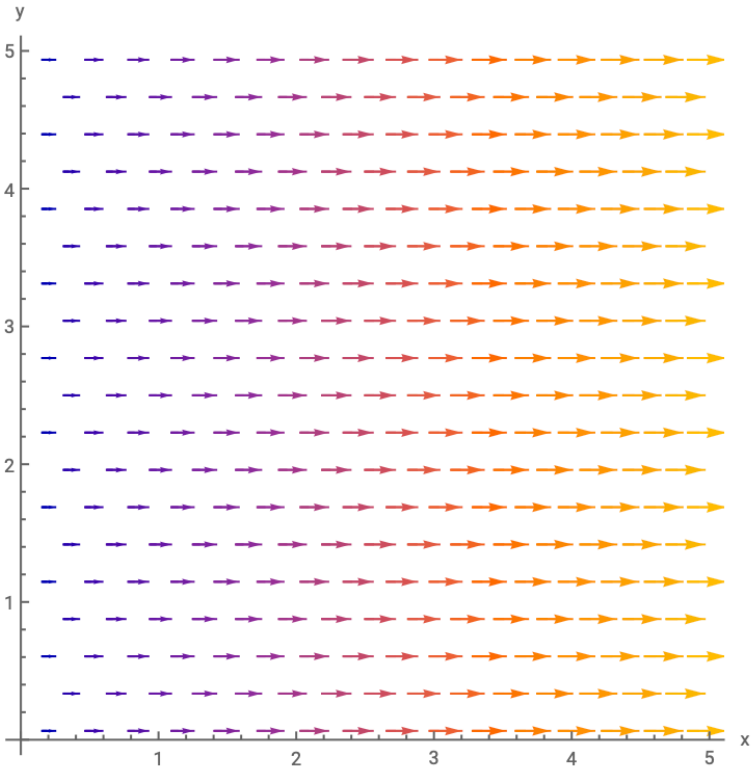
# 2 Line Integral Practice

For the given vector field $\vec{F}$, draw a path between two points for which the line integral is:

(a) $\int_{path1} \vec{F} \cdot d\vec{r} > 0$

(b) $\int_{path2} \vec{F} \cdot d\vec{r} < 0$

(c) $\int_{path3} \vec{F} \cdot d\vec{r} = 0$



# 3 Curvilinear coordinate drawings

(a) Using the conventions from class for cylindrical and spherical coordinates, draw each of the surfaces below *by hand*:

(a) $\phi = \frac{\pi}{3}$

(b) $\theta = \frac{3\pi}{4}$

(b) Using the conventions from class for cylindrical and spherical coordinates, draw each of the following vectors *by hand* at the indicated point.

(a) $\hat{\boldsymbol{\phi}}$ at the point where $s = 2$, $\phi = \frac{\pi}{3}$, and $z = 0$.

(b) $\hat{\boldsymbol{\theta}}$ at the point where $r = 1$, $\theta = \frac{3\pi}{4}$, and $\phi = \frac{\pi}{2}$.

# 4 Exponential and Logarithm Identities

Make sure that you have memorized the following identities and can use them in simple algebra problems:

$$\begin{aligned} e^{u+v} &= e^u\, e^v \\ \ln uv &= \ln u + \ln v \\ u^v &= e^{v \ln u} \end{aligned}$$

# 5 Derivative Rules

Make sure that you have memorized or can quickly find the derivative of all of the common transcendental functions: powers, trigonometric functions (especially sine and cosine), exponential, logarithms. Make sure that you can use these rules, even when the argument has parameters in it, e.g. $\sin kx$. Also, make sure you can use the chain rule.

# 6 Basic Calculus: Practice Exercises

Determine the following derivatives and evaluate the following integrals, all by hand. You should also learn how to check these answers on Wolfram Alpha.

(a) $\frac{d}{du}\left(u^2 \sin u\right)$

(b) $\frac{d}{dz}\left(\ln(z^2+1)\right)$

(c) $\displaystyle\int v \cos(v^2)\, dv$

(d) $\displaystyle\int v \cos v\, dv$