Name: ———————————————————————————   **/ 25**

30 minutes maximum. No aids (book, calculator, etc.) are permitted. Show all work and use proper notation for full credit. Answers should be in reasonably-simplified form. 25 points possible.

1. **[4 points]** Sketch the vector field $\mathbf{F}(x, y) = \mathbf{i} - \mathbf{j}$. Describe the vector field in a sentence. (*Draw at least 6 vectors in your sketch. Regarding the sentence, what is the length of the vectors, and their directions?*)

2. **[3 points]** Compute the gradient vector field of $f(x, y, z) = xy - yz + z^3$.

3. **[6 points]** Find the work done by the force field $\mathbf{F}(x,y) = -2y\mathbf{i} + 2x\mathbf{j} + (x+y)\mathbf{k}$ in moving an object along the curve $\mathbf{r}(t) = \cos(t)\mathbf{i} + \sin(t)\mathbf{j} - 3\mathbf{k}$, where $0 \le t \le \pi$.

4. **[3 points]** Find $\mathbf{T}(t)$, the unit tangent vector field, for the curve $\mathbf{r}(t) = \langle t, t^2, t^3 \rangle$.

5. **[6 points]** Evaluate the line integral $\int_C f(x,y)\,ds$ of the scalar function $f(x,y) = x + y$ along the straight-line path connecting the origin to the point $(1,1)$.
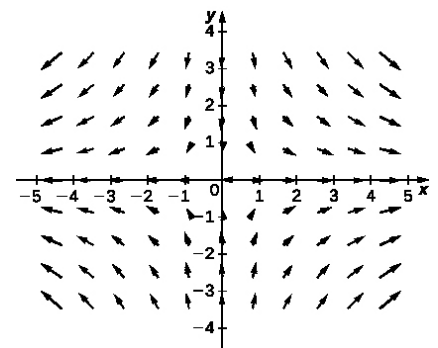
6. **[3 points]** Consider the vector fields $\mathbf{F} = -y\mathbf{i} + x\mathbf{j}$, $\mathbf{G} = x\mathbf{i} + y\mathbf{j}$, and $\mathbf{H} = x\mathbf{i} - y\mathbf{j}$. Match $\mathbf{F}, \mathbf{G}, \mathbf{H}$ to their graphs below. In particular, write the variable name below the matching graph.

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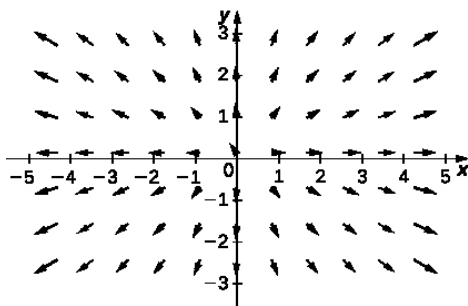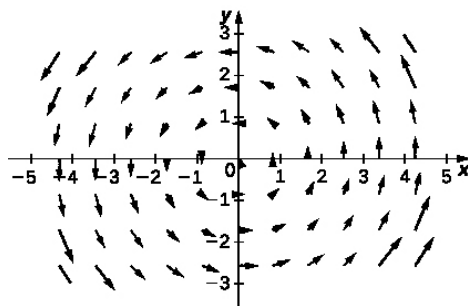
Extra Credit. [1 point]   I claim $\mathbf{F}(x,y) = \langle e^x, y + e^x \rangle$ is a conservative vector field. Find a potential $f(x,y)$.

EXTRA SPACE FOR ANSWERS