# Math 3214: HW4 (Due Friday 2/21, 5pm)

**To obtain (full) credit, show all reasoning and work.**

**No calculator or other electronic devices for HWs.**

1. Section 4.3: 17. Include the formula for a flow line.
2. Compute **and** sketch the flow lines of the vector field $\boldsymbol{v}(x, y) = (y, x)$. Include all different types of flow lines and the direction of the flow lines.
3. Let $f(x, y, z) = x^2y^2 + y^2z^2$.
   (a) Compute $\boldsymbol{\nabla} \cdot (\boldsymbol{\nabla} f)$.
   (b) Verify that $\boldsymbol{\nabla} \times (\boldsymbol{\nabla} f) = \mathbf{0}$ (for the given function $f$).
4. Section 4.4: 19. Include the formula.
5. Section 4.4: 23. Include the formulas.
6. Section 4.4: 33.
7. Let $f$ be a scalar function of class $C^1$ and $\boldsymbol{F}$ a vector field in space of class $C^1$.
   Verify that $\boldsymbol{\nabla} \times (f\boldsymbol{F}) = f\boldsymbol{\nabla} \times \boldsymbol{F} + (\boldsymbol{\nabla} f) \times \boldsymbol{F}$ for any functions $f$ and $\boldsymbol{F}$ of class $C^1$. Show carefully all work and reasoning.
8. Let $\boldsymbol{r} = (x, y, z)$ and $r = \|\boldsymbol{r}\|$. Prove the following identities. Carefully show all reasoning.
   (a) $\boldsymbol{\nabla}(1/r) = -\boldsymbol{r}/r^3$.
   (b) $\boldsymbol{\nabla} \times \boldsymbol{r} = \mathbf{0}$.
9. Section 3.1: 3.
10. Section 3.2: 5. Use $(x - x_0), (y - y_0)$ notation, not the $h_1, h_2$ notation.
11. Let $f(x, y) = (xe^y)^2$.
    (a) Write the formulas for $T_2(x, y)$ and $T_3(x, y)$. Use $(x - x_0), (y - y_0)$ notation.
    (b) Compute the second order Taylor polynomial $T_2(x, y)$ at $(1, 0)$.
    (c) Compute the third order Taylor polynomial $T_3(x, y)$ at $(1, 0)$.
    (d) Use your $T_2$ from part (a) to estimate $(0.99e^{0.02})^2$.