

Name _____ Date _____

Instructions: Please show all of your work as partial credit will be given where appropriate, **and** there may be no credit given for problems where there is no work shown. All answers should be completely simplified, unless otherwise stated.

1. (14 points) Evaluate $\int_{-3}^3 \int_{-\sqrt{9-x^2}}^{\sqrt{9-x^2}} \int_{-\sqrt{9-x^2-z^2}}^{\sqrt{9-x^2-z^2}} (x^2 + y^2 + z^2)^{3/2} dy dz dx$.

Answer : _____

2. (14 points) Calculate the determinant of the Jacobian $J(u,v)$ for the change of variables $x = u^2 - 2uv$ $y = v^3 + 3uv^2$

Answer : _____

3. (3 points each) If $f(x,y,z)$ is a scalar function and $\mathbf{F}(x,y,z)$ is a vector field, which of the following make sense (circle one):

- | | | |
|--|--------------|----------------------|
| a) $\nabla \cdot \nabla(f)$ | Makes sense. | Does not make sense. |
| b) $\text{div}(\text{grad}(f))$ | Makes sense. | Does not make sense. |
| c) $\text{grad}(\text{div}(\mathbf{F}))$ | Makes sense. | Does not make sense. |
| d) $\nabla \times \nabla(f)$ | Makes sense. | Does not make sense. |