University of Kentucky, Physics 416G
EXAM 1, 2010-09-20

Instructions: The exam is closed book and timed (50 minutes). Show all steps of calculations. Be careful to pace yourself; you may want to set up all integrals before evaluation. [75 pts total]

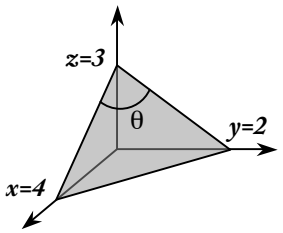
[25 pts] 1. Short calculations.

a) $(\vec{\boldsymbol{A}} \cdot \boldsymbol{\nabla})\vec{\boldsymbol{r}}$ where $\vec{\boldsymbol{A}}$ is constant

b) $\boldsymbol{\nabla} \sin(\vec{\boldsymbol{k}} \cdot \vec{\boldsymbol{r}})$ where $\vec{\boldsymbol{k}}$ is constant

c) $\int_{-\infty}^{\infty} \ln(x+3)\, \delta(x+2)\, dx$

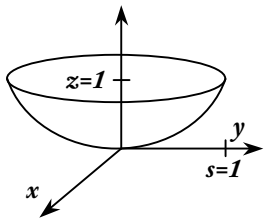
d) Calculate the angle θ.



e) Transform $\vec{\boldsymbol{F}} = (x^2 + y^2)\hat{\boldsymbol{x}} - x\,\hat{\boldsymbol{y}}$ into cylindrical coordinates.

[15 pts] 2. Calculate $\int_{\mathcal{V}} \boldsymbol{\nabla} \cdot \sin\theta\, \hat{\boldsymbol{\theta}}\, d\tau$, where $\mathcal{V}$ is a ball of radius $R = 2$ about the origin.

[20 pts] 3. Calculate $\int_{\mathcal{S}} \boldsymbol{\nabla} \times x\,\hat{\boldsymbol{y}} \cdot \vec{\boldsymbol{da}}$, where $\mathcal{S}$ is the side (not top) of the paraboloid $z = x^2 + y^2$ and $s < 1$, $z < 1$, using the inward normal.



[15 pts] 4. Calculate $\int_{\mathcal{P}} x\hat{\boldsymbol{y}} \cdot \vec{\boldsymbol{dl}}$ where $\mathcal{P}$ is the rim of the paraboloid, $x^2 + y^2 = 1$, $z = 1$, going counter-clockwise looking from the top.