

Math 370 – Take Home Quiz 3

This quiz should take you approximately 25 minutes. You may use your calculator, your book, and your notes, but do not work together and do not get help.

- (10) 1. Compute the line integral $\int_C xdy + y^2dz$ along the straight line segment C from $(0,0,0)$ to $(4,5,3)$.
- (10) 2. Vector or scalar? Let $\mathbf{F} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ and $\varphi(x, y, z) = xyz$. For each part, write if the quantity is a vector or a scalar.
- (a) $\nabla(\mathbf{F} \cdot \mathbf{F})$
 - (b) $\nabla \cdot (\mathbf{F} \times \mathbf{F})$
 - (c) $\nabla\varphi \times \mathbf{F}$
 - (d) $(\nabla \times \mathbf{F}) \cdot \nabla\varphi^2$
 - (e) $\varphi \operatorname{curl}(\varphi\mathbf{F})$
- (10) 3. Show that $\mathbf{F} = xy^2\mathbf{i} + yz^2\mathbf{j} + zx^2\mathbf{k}$ has divergence 0 at the origin, and positive divergence everywhere else.

(10) 4. For $\varphi(x, y, z) = y \sin(x) + xz + y^3z$, compute the gradient vector field $\mathbf{F} = \nabla\varphi$.

(10) 5. Let $\mathbf{F} = \nabla\varphi$ as in problem 4. Find the work done by \mathbf{F} to move along the ‘slinky’ curve

$$\mathbf{r}(t) = \left(\cos(t)(\cos(10t) + 2), \sin(t)(\cos(10t) + 2), \frac{2t}{3} + \sin(10t) \right)$$

from $t = 0$ to $t = 2\pi$.

