

# Quiz 11: Vector Calculus Summary

MATH 2339, Due May 1, 3:15 PM

1. What is the difference between a scalar function defined on  $\mathbb{R}^3$ , a vector function with 3 components, and a vector field defined on  $\mathbb{R}^3$ ? Describe the basic differences and give an example of each.
2. Write the formula for computing  $\oint_C f \, ds$ , where  $f$  is a scalar function. Write one physical application for the line integral of a scalar function.
3. Write the formula for computing  $\iint_S f \, dS$ , where  $f(x, y, z)$  is a scalar function. Write one physical application for the surface integral of a scalar function.
4. What are two ways in which one can differentiate a vector field? For each, write the formula for computing the operation and describe what the operation computes physically if the vector field is the velocity of a fluid.
5. Write the formula for computing  $\int_C \mathbf{F} \cdot d\mathbf{r}$ . Write one physical application for computing the line integral of a vector field.
6. Write the formula for computing  $\iint_S \mathbf{F} \cdot d\mathbf{S}$ . Write one physical application for computing the surface integral of a vector field.
7. Write the Fundamental Theorem of Line Integrals. Under what condition can the theorem be used to simplify the computation of  $\int_C \mathbf{F} \cdot d\mathbf{r}$  when  $\mathbf{F}$  is a vector field on  $\mathbb{R}^2$ ? What is the condition when  $\mathbf{F}$  is a vector field on  $\mathbb{R}^3$ ?
8. Write Green's Theorem. Describe one application of the theorem.
9. Write Stoke's Theorem. Describe one application of the theorem.
10. Write the Divergence Theorem. Describe one application of the theorem.