

1. For each of the following find the gradient

- a. $f_1 = xy$
- b. $f_2 = re^r$
- c. $f_3 = 1/r^2$
- d. $f_4 = (x+y) \sin(z)$
- e. $f_5 = r^n$, where $n > 1$
- f. $f_6 = x^2 r$

2. For each of the following find both its divergence and its curl

- a. $\mathbf{Q}_1 = \mathbf{r}$
- b. $\mathbf{Q}_2 = 4x \mathbf{i} + 6y \mathbf{j} - 2(x+z) \mathbf{k}$
- c. $\mathbf{Q}_3 = \mathbf{r}/r^3$
- d. $\mathbf{Q}_4 = r^2 \sin(\theta) \cos(\phi) \hat{\mathbf{r}} + (r+a)^2 \cos(\theta) \hat{\boldsymbol{\theta}} + \frac{r^3}{r+a} \sin(\theta) \hat{\boldsymbol{\phi}}$, where a is a constant
- e. $\mathbf{Q}_5 = x \mathbf{r}$