Find the $\operatorname{curl}\vec{\mathbf{F}}$ for the vector field at the given point.

1) $\vec{\mathbf{F}}(x, y, z) = xyz\,\mathbf{i} + xyz\,\mathbf{j} + xyz\,\mathbf{k}$, at the point $(2, 1, 3)$.

2) $\vec{\mathbf{F}}(x, y, z) = e^{-xyz}\left(\mathbf{i} + \mathbf{j} + \mathbf{k}\right)$, at the point $(3, 2, 0)$.

Find the $\operatorname{div}\vec{\mathbf{F}}$ for the vector field at the given point.

3) $\vec{\mathbf{F}}(x, y, z) = e^{x}\sin y\,\mathbf{i} - e^{x}\cos y\,\mathbf{j} + z^{2}\,\mathbf{k}$, at the point $(3, 0, 0)$.

4) $\vec{\mathbf{F}}(x, y, z) = \ln(xyz)\left(\mathbf{i} + \mathbf{j} + \mathbf{k}\right)$, at the point $(3, 2, 1)$.

5) Let f be a scalar field and $\vec{\mathbf{F}}$ a vector field. State whether each expression is meaningful. If not, explain why. If so, state whether it is a scalar field or a vector field.

a) $\text{curl}\, f$

b) $\text{grad}\, f$

c) $\text{div}\, \vec{\mathbf{F}}$

d) $\text{curl}\left(\text{grad}\, \vec{\mathbf{F}}\right)$

e) $\text{grad}\, \vec{\mathbf{F}}$

f) $\text{grad}\left(\text{div}\, \vec{\mathbf{F}}\right)$

g) $\text{div}\left(\text{grad}\, f\right)$

h) $\text{grad}\left(\text{div}\, f\right)$

i) $\text{curl}\left(\text{curl}\, \vec{\mathbf{F}}\right)$

j) $\text{div}\left(\text{div}\, \vec{\mathbf{F}}\right)$

k) $\left(\text{grad}\, f\right)\times\left(\text{div}\, \vec{\mathbf{F}}\right)$

l) $\text{div}\left(\text{curl}\left(\text{grad}\, f\right)\right)$

6) Determine whether or not the vector field $\vec{\mathbf{F}}(x, y, z) = ye^{-x}\,\mathbf{i} + e^{-x}\,\mathbf{j} + 2z\,\mathbf{k}$ is conservative.

7) Find the curl and the divergence of the vector field $\vec{\mathbf{F}}(x, y, z) = \left\langle xe^{-y},\ xz,\ ze^{y} \right\rangle$.