Tangent Planes and Normal Lines

Finding a unit normal vector to the surface at the given point.

1. Find: $\nabla f(x,y,z) = f_x(x,y,z)\boldsymbol{i} + f_y(x,y,z)\mathbf{j} + f_z(x,y,z)\mathbf{k}$
2. Find $\nabla f(x_o, yo, z_o)$
3. Find $\|\nabla f(x_o, yo, zo)\|$
4. Find Unit normal vector:

$$\mathbf{n} = \frac{\nabla f(x_o,yo,zo)}{\|\nabla f(x_o,yo,zo)\|}$$

1. Find a unit normal vector to the surface at the given point.
(Similar to p.951 #5-16)

$$5x - 2y + 3z = 0, \quad (2,5,0)$$

2. Find a unit normal vector to the surface at the given point.
(Similar to p.951 #5-16)

$$z = \sqrt[3]{x^2 + y}, \quad (3,-1,2)$$

Finding an equation of the tangent plane to the surface at the given point (x_o, y_o, z_o)

1. Find: $f_x(x,y,z), f_y(x,y,z), and\ f_z(x,y,z)$
2. Find $f_x(x_o, yo, zo), f_y(x_o, yo, zo),$ $and\ f_z(x_o, yo, zo)$
3. Equation of the plane is

$f_x(x_o, yo, zo)(x-x_o) + f_y(x_o, yo, zo)(y-y_o) + f_z(x_o, yo, zo)(z-z_o) = 0$

3. Find an equation of the tangent plane to the surface at the given point
(Similar to p.951 #17-30)

$$f(x,y) = x^2 - 3y + y^2, \quad (3,1,7)$$

4. Find an equation of the tangent plane to the surface at the given point
(Similar to p.951 #17-30)

$$f(x,y) = e^{3x-2y}, \quad (2,3,1)$$

5. Find an equation of the tangent plane to the surface at the given point
(Similar to p.951 #17-30)

$$4y = 2(x+5z), \quad (1,8,3)$$

Finding an equation of the tangent plane to the surface at the given point and symmetric equations

1. Find: $f_x(x,y,z), f_y(x,y,z), and\ f_z(x,y,z)$
2. Find $f_x(x_o, yo, zo), f_y(x_o, yo, zo),$ $and\ f_z(x_o, yo, zo)$
3. Equation of the plane is
$f_x(x_o, yo, zo)(x\text{-}x_o) + f_y(x_o, yo, zo)(y\text{-}y_o) + f_z(x_o, yo, zo)(z\text{-}z_o) = 0$
4. Symmetric Equations:
$\frac{x-x_o}{f_x(x_o,yo,zo)} = \frac{y-y_o}{f_y(x_o,yo,zo)} = \frac{z-z_o}{f_z(x_o,yo,zo)}$

6. Find an equation of the tangent plane and find symmetric equations of the normal line to the surface at the given point.
(Similar to p.951 #31-40)

$$x^2 - 2y^2 + 7z^2 = 0, \quad (1,2,1)$$

7. Find an equation of the tangent plane and find symmetric equations of the normal line to the surface at the given point.
(Similar to p.951 #31-40)

$$z = e^{xy^2}, \quad (0,2,0)$$

Finding angle of inclination θ of the tangent plane to the surface at the given point

1. Find: $\nabla f(x,y,z) = f_x(x,y,z)\boldsymbol{i} + f_y(x,y,z)\mathbf{j} + f_z(x,y,z)\mathbf{k}$
2. Find $\nabla f(x_o, yo, z_o)$
3. Find $\|\nabla f(x_o, yo, zo)\|$
4. Find angle:

$$\cos\theta = \frac{|\nabla f(x_o,yo,zo)\cdot\mathbf{k}|}{\|\nabla f(x_o,yo,zo)\|}$$

8. Find the angle of inclination θ of the tangent plane to the surface at the given point.
(Similar to p.951 #47-50)

$$x^2 + y^2 - 5z = 0, \quad (3,1,2)$$