Directional Derivatives and Gradients- HW Problems

Find the directional derivative at the given point in the direction of $\vec{v}$.

1. $f(x,y) = e^{xy} + x^2 + y^2$ at $(1,2)$, $\vec{v} = -4\vec{\imath} + 3\vec{\jmath}$
2. $f(x,y) = xy^2 + x^3y$ at $(-1,1)$, $\vec{v} = \vec{\imath} + \vec{\jmath}$
3. $f(x,y,z) = x^3y^2 + e^{(y+z)} - 2xsin(z)$ at $(1,0,0)$, $\vec{v} = 2\vec{\imath} - 2\vec{\jmath} + \vec{k}$

4. Find a vector perpendicular to the curve $x^2 - 2xy + y^3 = 5$ at $(1,2)$.

Find the tangent plane and normal line to the surface at the given point.

5. $x^2 + y^2 - z^2 + 2xy - 2xz = 2$ at $(-1,2,1)$.
6. $xe^y + y^2 + z^2 = 7$ at $(-2,0,3)$

7. The electrical potential V at a point in space is given by $V(x,y,z) = 4x^2 + 2xz - xyz$.

a. Find the rate of change of V at the point $A(1,2,-3)$ in the direction $\vec{v} = \vec{\imath} - \vec{\jmath} + \vec{k}$.

b. In which direction does V change the fastest at $A(1,2,-3)$?

c. What is the maximum rate of change of V at $A(1,2,-3)$?