3D Gradients of an Ellipse

1. Find the equation of the tangent to the ellipse with equation $\frac{x^2}{9} + \frac{y^2}{4} = 1$ at the point $(3\cos\theta, 2\sin\theta)$

2. Show that the equation of the normal to the ellipse with equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at the point $P(a\cos\theta, b\sin\theta)$ is $by\cos\theta = ax\sin\theta + (b^2 - a^2)\cos\theta\sin\theta$

Notes on tangents and normals to an ellipse

3. The point $P\left(2, \frac{3\sqrt{3}}{2}\right)$ lies on the ellipse E with parametric equations $x = 4\cos\theta$, $y = 3\sin\theta$.

a) Find the value of θ at the point P.

b) Find the equation of the normal to the ellipse at point P.

4. Show that the condition for $y = mx + c$ to be a tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is

$$a^2m^2 + b^2 = c^2$$

5. The ellipse C has the equation $\frac{x^2}{5^2} - \frac{y^2}{3^2} = 1$. The line l is normal to the ellipse at the point P and passes through the point Q, where C cuts the y-axis, as shown in the diagram.
Find the exact coordinates of the point R, where l cuts the positive x-axis.