1.
$$\frac{\partial f}{\partial x} = \cos(yz) \quad \frac{\partial^2 f}{\partial z \partial x} = -y\sin(yz) \quad \frac{\partial^3 f}{\partial y \partial z \partial x} = -\sin(yz) - yz\cos(yz)$$

2. If the surface is $z = f(x, y)$, then

$$f_x(x, y) = 6x - 6y \qquad f_y(x, y) = -6x + 6y^2$$
$$f_x(1, 2) = -6 \qquad f_y(1, 2) = 18$$

Since $f(1, 2) = 7$, the plane passes through the point $(1, 2, 7)$, and the equation of the plane is $z - 7 = -6(x - 1) + 18(y - 2)$ which simplifies to $z = 9x + 6y - 23$

3. Using f_x and f_y computed above, we get two critical points, $(0, 0)$ and $(1, 1)$. We then compute $f_{xx} = 6$, $f_{yy} = 12y$ and $f_{xy} = -6$. So $D = f_{xx}f_{yy} - (f_{xy})^2 = 72y - 36$. This is equal to -36 at $(0, 0)$, meaning that this point is a saddle point. $D = 36$ at $(1, 1)$, so this point is either a maximum or minimum. Since $f_{xx}(1, 1) = 6$, it must be a minimum.