1. Assuming the first row of pictures is labeled I and II, the second is III and IV, and the third is V and VI:

$z = \frac{2}{15}e^{-x-y}$: III. This is the only graph which increases rapidly in Quadrant III (where $-x-y$ is positive, so e^{-x-y} is large) and very small in Quadrant I (where $-x-y<0$).

$z = \frac{7}{1+(x+y)^2}$: II. This is the only surface which has a height of 7 above every point on the line $y=-x$.

$z = \frac{6\sin\left(2(x^2+y^2)\right)}{x^2+y^2}$: V. The radial symmetry narrows it down to graph V or VI. The cross sections $x=0$ or $y=0$ in V are consistent with the function $f(u) = \frac{6\sin(2u)}{u}$.

$z = 5\sin(3x) + 5\cos(3y)$: IV. The cross sections $y=k$ are consistent with the graph of $f(u) = 5\sin(3x)+C$, where C is a constant. Similar arguments hold for the cross sections $x=k$.

2. The limit of $\frac{x^3y}{x^6+y^2}$ does not exist as $(x,y)\to(0,0)$. If you approach along the curve $y=x^3$, the limit is 1/2. If you approach along $y=-x^3$, the limit is $-1/2$.

Conversely, the limit of $\frac{x^3}{x^2+y^2+z^2}$ as $(x,y,z)\to(0,0,0)$ *does* exist. If we switch to spherical coordinates, the limit becomes

$$\begin{aligned}\lim_{(x,y,z)\to(0,0,0)} \frac{x^3}{x^2+y^2+z^2} &= \lim_{\rho\to 0}\frac{\rho^3\cos^3\theta\sin^3\phi}{\rho^2}\\ &= \lim_{\rho\to 0}\rho\cos^3\theta\sin^3\phi = 0\end{aligned}$$

3. In order,

(i) A particle traveling along the curve will approach the origin as $t\to 0^-$. At $t=0$ the particle will be at the origin, and as t increases further, the particle will "turn around" and retrace its path.

(ii) $\mathbf{r}'(t) = \langle t, \sqrt{2}t^3, t^5\rangle$. As $t\to 0$, this approaches $\langle 0,0,0\rangle$. As $t\to\infty$, this diverges to infinity.

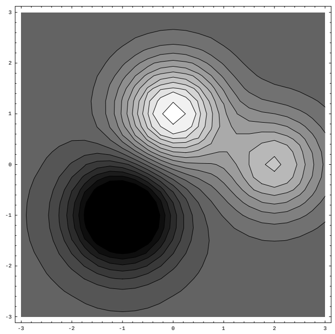
(iii) $\mathbf{T}(t) = \mathbf{r}'(t)/|\mathbf{r}'(t)| = \langle t,\sqrt{2}t^3,t^5\rangle/(t+t^5)$. The limit of $\mathbf{T}(t)$ as $t\to 0$ does not exist because the limit is $\langle 1,0,0\rangle$ as $t\to 0^+$, and $\langle -1,0,0\rangle$ as $t\to 0^-$. If $t\to\infty$, then the limit converges to $\langle 0,0,1\rangle$.

(iv) $\mathbf{T}(1) = \langle 1/2, 1/\sqrt{2}, 1/2\rangle$. To find $\mathbf{N}(1)$, we begin by calculating $\mathbf{T}'(t)$ and $\mathbf{T}'(1)$. This is a bit messy, but it's $\mathbf{T}'(1) = \langle -1,0,1\rangle$. Now $\mathbf{N}(1) = \mathbf{T}'(1)/|\mathbf{T}'(1)|$, which is $\langle -1/\sqrt{2}, 0, 1/\sqrt{2}\rangle$.

(v) One possible equation of the osculating plane is

$$\begin{aligned}\mathbf{p}(u,v) &= \mathbf{r}(1) + u\mathbf{T}(1) + v\mathbf{N}(1)\\ &= \langle 1/2, 1/2\sqrt{2}, 1/6\rangle + u\langle 1/2, 1/\sqrt{2}, 1/2\rangle + v\langle -1/\sqrt{2}, 0, 1/\sqrt{2}\rangle\end{aligned}$$

4. Here's a computer generated contour graph of the surface. Lighter shades indicate greater values of z.



5. Here are pictures of the grid curves and the surface itself. (You would have to do some more labeling, such as which grid curve is which.)