1. Consider the sphere centered at \((3, -4, 2)\) and radius 5.
1A. What is the equation of this sphere?

\[(x - 3)^2 + (y + 4)^2 + (z - 2)^2 = 5^2\]

1B. What is the equation of the plane tangent to this sphere at \((8, -4, 2)\)?

To "get from" the center \((3, -4, 2)\) to \((8, -4, 2)\),
we move \(5\) units parallel to the \(x\)-axis; the plane is \(y = \text{free}\) and \(z = \text{free}\);
the \(y\)-\(z\) plane also has \(x = 8\), \(y\) and \(z\) are "free" on both these planes.

1C. What is the equation of the plane tangent to this sphere at its "north pole", or, top?

This plane is parallel to the \(xy\) plane:
and contains the point \((3, -4, 7)\), so its equation is \(z = 7\).

2. On our standard \(xyz\) axis, draw the graph of \(z = |y - 1|\). Hint: Where does this function equal 0?

On the \(yz\) plane, the graph of this function is:

\[z = \begin{cases} 
&y - 1 \\
&1 - y
\end{cases}\]

and it is 0 when \(y = 1\); \(x\) is "free".

This suggests:
- The line \(y = 1\) in the \(x\)-\(y\) plane.
- Graph looks like a folded sheet of paper with the fold running along the line \(y = 1\) on the \(xy\) plane.

3. On the accompanying sheet are various graphs of three functions, \(f_1(x, y)\), \(f_2(x, y)\) and \(f_3(x, y)\). Which one is the graph of \(f(x, y) = \cos(y + x^2)\)? Explain your choice! Hint: The value of \(z\) will be constant when \(y + x^2\) is a constant. What do 2D graphs of \(y + x^2 = k\) look like for various values of \(k\)? [See the answer below.] When \(y + x^2\) is a constant, say \(K\), then \(z = \cos(K)\). So we seek a picture suggesting a surface whose constant height over curves of the form \(y + x^2 = K\) in the \(xy\) plane. These curves look like:

\[y = K - x^2\]

which picture suggests EXCEPT the axes have been oriented; indeed (1) has the correct set of curves.