3. The distance from a point to the xz-plane is the absolute value of the y-coordinate of the point. $Q(-5,-1,4)$ has the y-coordinate with the smallest absolute value, so Q is the point closest to the xz-plane. $R(0,3,8)$ must lie in the yz-plane since the distance from R to the yz-plane, given by the x-coordinate of R, is 0.

10. (a) The distance from a point to the xy-plane is the absolute value of the z-coordinate of the point. Thus, the distance is $|-5|=5$.

(b) Similarly, the distance to the yz-plane is the absolute value of the x-coordinate of the point: $|3|=3$.

(c) The distance to the xz-plane is the absolute value of the y-coordinate of the point: $|7|=7$.

(d) The point on the x-axis closest to $(3,7,-5)$ is the point $(3,0,0)$. (Approach the x-axis perpendicularly.) The distance from $(3,7,-5)$ to the x-axis is the distance between these two points:

$\sqrt{(3-3)^2+(7-0)^2+(-5-0)^2}=\sqrt{74}\approx 8.60.$

(e) The point on the y-axis closest to $(3,7,-5)$ is $(0,7,0)$. The distance between these points is

$\sqrt{(3-0)^2+(7-7)^2+(-5-0)^2}=\sqrt{34}\approx 5.83.$

(f) The point on the z-axis closest to $(3,7,-5)$ is $(0,0,-5)$. The distance between these points is

$\sqrt{(3-0)^2+(7-0)^2+[-5-(-5)]^2}=\sqrt{58}\approx 7.62.$

11. An equation of the sphere with center $(1,-4,3)$ and radius 5 is $(x-1)^2+[y-(-4)]^2+(z-3)^2=5^2$ or $(x-1)^2+(y+4)^2+(z-3)^2=25$. The intersection of this sphere with the xz-plane is the set of points on the sphere whose y-coordinate is 0. Putting $y=0$ into the equation, we have $(x-1)^2+4^2+(z-3)^2=25$, $y=0$ or $(x-1)^2+(z-3)^2=9$, $y=0$, which represents a circle in the xz-plane with center $(1,0,3)$ and radius 3.

14. If the sphere passes through the origin, the radius of the sphere must be the distance from the origin to the point $(1,2,3)$: $r=\sqrt{(1-0)^2+(2-0)^2+(3-0)^2}=\sqrt{14}$. Then an equation of the sphere is $(x-1)^2+(y-2)^2+(z-3)^2=14$.

17. Completing squares in the equation $2x^2-8x+2y^2+2z^2+24z=1$ gives

$2(x^2-4x+4)+2y^2+2(z^2+12z+36)=1+8+72 \quad\Rightarrow\quad 2(x-2)^2+2y^2+2(z+6)^2=81 \quad\Rightarrow$

$(x-2)^2+y^2+(z+6)^2=\frac{81}{2}$, which we recognize as an equation of a sphere with center $(2,0,-6)$ and radius $\sqrt{\frac{81}{2}}=9/\sqrt{2}$.

21. (a) Since the sphere touches the xy-plane, its radius is the distance from its center, $(2, -3, 6)$, to the xy-plane, namely 6. Therefore $r = 6$ and an equation of the sphere is $(x-2)^2 + (y+3)^2 + (z-6)^2 = 6^2 = 36$.

(b) The radius of this sphere is the distance from its center $(2, -3, 6)$ to the yz-plane, which is 2. Therefore, an equation is $(x-2)^2 + (y+3)^2 + (z-6)^2 = 4$.

(c) Here the radius is the distance from the center $(2, -3, 6)$ to the xz-plane, which is 3. Therefore, an equation is $(x-2)^2 + (y+3)^2 + (z-6)^2 = 9$.

28. The equation $z^2 = 1 \quad \Leftrightarrow \quad z = \pm 1$ represents two horizontal planes; $z = 1$ is parallel to the xy-plane, one unit above it, and $z = -1$ is one unit below it.

31. Here $x^2 + z^2 \leq 9$ or equivalently $\sqrt{x^2 + z^2} \leq 3$ which describes the set of all points in $\mathbb{R}^3$ whose distance from the y-axis is at most 3. Thus, the inequality represents the region consisting of all points on or inside a circular cylinder of radius 3 with axis the y-axis.

36. The solid sphere itself is represented by $\sqrt{x^2 + y^2 + z^2} \leq 2$. Since we want only the upper hemisphere, we restrict the z-coordinate to nonnegative values. Then inequalities describing the region are $\sqrt{x^2 + y^2 + z^2} \leq 2$, $z \geq 0$, or $x^2 + y^2 + z^2 \leq 4$, $z \geq 0$.