45. Substitute the parametric equations of the line into the equation of the plane: $(3-t)-(2+t)+2(5t)=9 \quad \Rightarrow$ $8t=8 \quad \Rightarrow \quad t=1$. Therefore, the point of intersection of the line and the plane is given by $x=3-1=2$, $y=2+1=3$, and $z=5(1)=5$, that is, the point $(2,3,5)$.

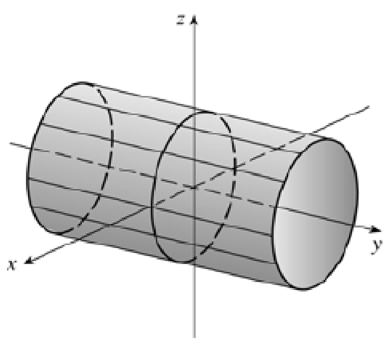
57.

(a) To find a point on the line of intersection, set one of the variables equal to a constant, say $z=0$. (This will fail if the line of intersection does not cross the xy-plane; in that case, try setting x or y equal to 0.) The equations of the two planes reduce to $x+y=1$ and $x+2y=1$. Solving these two equations gives $x=1$, $y=0$. Thus a point on the line is $(1,0,0)$.

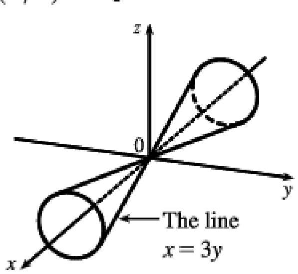
A vector $\mathbf{v}$ in the direction of this intersecting line is perpendicular to the normal vectors of both planes, so we can take $\mathbf{v}=\mathbf{n}_1\times\mathbf{n}_2=\langle 1,1,1\rangle\times\langle 1,2,2\rangle=\langle 2-2,1-2,2-1\rangle=\langle 0,-1,1\rangle$. By Equations 2, parametric equations for the line are $x=1$, $y=-t$, $z=t$.

(b) The angle between the planes satisfies $\cos\theta=\dfrac{\mathbf{n}_1\cdot\mathbf{n}_2}{|\mathbf{n}_1|\,|\mathbf{n}_2|}=\dfrac{1+2+2}{\sqrt{3}\,\sqrt{9}}=\dfrac{5}{3\sqrt{3}}$. Therefore $\theta=\cos^{-1}\left(\dfrac{5}{3\sqrt{3}}\right)\approx 15.8^\circ$.

3. Since y is missing from the equation, the vertical traces $x^2+z^2=1$, $y=k$, are copies of the same circle in the plane $y=k$. Thus the surface $x^2+z^2=1$ is a circular cylinder with rulings parallel to the y-axis.



44. The surface is a right circular cone with vertex at $(0,0,0)$ and axis the x-axis. For $x=k\neq 0$, the trace is a circle with center $(k,0,0)$ and radius $r=y=\dfrac{x}{3}=\dfrac{k}{3}$. Thus the equation is $(x/3)^2=y^2+z^2$ or $x^2=9y^2+9z^2$.



27. First we parametrize the curve C of intersection. The projection of C onto the xy-plane is contained in the circle $x^2+y^2=25$, $z=0$, so we can write $x=5\cos t$, $y=5\sin t$. C also lies on the cylinder $y^2+z^2=20$, and $z\geq 0$ near the point $(3,4,2)$, so we can write $z=\sqrt{20-y^2}=\sqrt{20-25\sin^2 t}$. A vector equation then for C is

$$\mathbf{r}(t)=\left\langle 5\cos t, 5\sin t, \sqrt{20-25\sin^2 t}\right\rangle \quad\Rightarrow\quad \mathbf{r}'(t)=\left\langle -5\sin t, 5\cos t, \tfrac{1}{2}(20-25\sin^2 t)^{-1/2}(-50\sin t\cos t)\right\rangle.$$

The point $(3,4,2)$ corresponds to $t=\cos^{-1}\left(\frac{3}{5}\right)$, so the tangent vector there is

$$\mathbf{r}'\left(\cos^{-1}\left(\tfrac{3}{5}\right)\right)=\left\langle -5\left(\tfrac{4}{5}\right), 5\left(\tfrac{3}{5}\right), \tfrac{1}{2}\left(20-25\left(\tfrac{4}{5}\right)^2\right)^{-1/2}\left(-50\left(\tfrac{4}{5}\right)\left(\tfrac{3}{5}\right)\right)\right\rangle=\langle -4,3,-6\rangle.$$

The tangent line is parallel to this vector and passes through $(3,4,2)$, so a vector equation for the line is $\mathbf{r}(t)=(3-4t)\mathbf{i}+(4+3t)\mathbf{j}+(2-6t)\mathbf{k}$.