2. The region of integration is given in cylindrical coordinates by
\[ E = \{(r, \theta, z) \mid 0 \leq \theta \leq \pi/2, 0 \leq r \leq 2, 0 \leq z \leq 9 - r^2\}. \]
This represents the solid region in the first octant enclosed by the circular cylinder \( r = 2 \), bounded above by \( z = 9 - r^2 \), a circular paraboloid, and bounded below by the \( xy \)-plane.

\[
\int_0^{\pi/2} \int_0^2 \int_0^{9-r^2} r \, dz \, dr \, d\theta = \int_0^{\pi/2} \int_0^2 \left[ r z \right]_{z=0}^{9-r^2} \, dr \, d\theta
\]
\[
= \int_0^{\pi/2} \int_0^2 r(9 - r^2) \, dr \, d\theta
\]
\[
= \int_0^{\pi/2} \int_0^2 \left[ \frac{1}{3}r^3 - \frac{1}{4}r^4 \right]_0^2 \, dr \, d\theta
\]
\[
= \frac{8}{3} \left( 9 - 4 \right) = 7\pi
\]

4. The region of integration is given in spherical coordinates by
\[ E = \{(\rho, \theta, \phi) \mid 1 \leq \rho \leq 2, 0 \leq \theta \leq 2\pi, \pi/2 \leq \phi \leq \pi\}. \]
This represents the solid region between the spheres \( \rho = 1 \) and \( \rho = 2 \) and below the \( xy \)-plane.

\[
\int_0^{2\pi} \int_{\pi/2}^{\pi} \int_1^2 \rho^2 \sin \phi \, d\phi \, d\rho \, d\theta = \int_0^{2\pi} \int_1^2 \int_{\pi/2}^{\pi} \rho^2 \sin \phi \, d\phi \, d\rho \, d\theta
\]
\[
= \left[ \rho^2\left[ \frac{1}{3} \rho^3 \right]_1^2 \right]_{\pi/2}^{\pi} = 2\pi \left( \frac{1}{3} \right) = \frac{2\pi}{3}
\]

10. In cylindrical coordinates, \( E \) is bounded by the cylinder \( r = 1 \) and the planes \( z = 0, \ y = r \sin \theta \) with \( y \geq 0 \)
\[ 0 \leq \theta \leq \pi, \] so \( E \) is given by \( \{(r, \theta, z) \mid 0 \leq \theta \leq \pi, 0 \leq r \leq 1, 0 \leq z \leq r \sin \theta\}. \)

\[
\int \int \int_E xz \, dV = \int_0^{\pi} \int_0^1 \int_0^{r \sin \theta} r^2 \cos \theta \, dz \, dr \, d\theta
\]
\[
= \int_0^{\pi} \int_0^1 \left[ \frac{1}{2}r^4 \sin^2 \theta \cos \theta \right]_{r=0}^{r=1} \, dr \, d\theta
\]
\[
= \frac{1}{16} \int_0^{\pi} \sin^2 \theta \, d\theta = \frac{1}{16} \left[ \frac{1}{2} \sin^2 \theta \right]_0^{\pi} = 0
\]

16. In spherical coordinates, \( H \) is represented by \( \{(\rho, \theta, \phi) \mid 0 \leq \rho \leq 1, 0 \leq \theta \leq 2\pi, 0 \leq \phi \leq \frac{\pi}{2}\}. \)

\[
\int \int \int_H (x^2 + y^2) \, dV = \int_0^{2\pi} \int_0^{\pi/2} \int_0^1 (\rho^2 \sin^2 \phi) \rho^2 \sin \phi \, d\phi \, d\theta \, d\rho
\]
\[
= \left[ \rho^2 \sin \phi \left[ \frac{1}{3} \rho^3 \phi^{\pi/2} \right]_0^1 \right]_{\phi=0}^{\phi=\pi/2} = \frac{1}{48} \pi
\]

30. The region of integration \( E \) is the region above the cone \( z = \sqrt{x^2 + y^2} \) and below the sphere \( x^2 + y^2 + z^2 = 18 \)
in the first octant. Because \( E \) is in the first octant we have \( 0 \leq \theta \leq \frac{\pi}{2} \). The cone has equation \( \phi = \frac{\pi}{4} \)
as in Example 4) and so \( 0 \leq \phi \leq \frac{\pi}{4} \). Also \( 0 \leq \rho \leq \sqrt{18} = 3\sqrt{2} \). So the integral becomes

\[
\int_0^{\pi/4} \int_0^{3\sqrt{2}} \int_0^{9-r^2} r^2 \sin \phi \, d\rho \, d\phi \, d\theta
\]
\[
= \int_0^{\pi/4} \int_0^{\pi/4} \int_0^{3\sqrt{2}} \sin \phi \, d\rho \, d\phi \, d\theta
\]
\[
= \left[ \rho \sin \phi \right]_0^{3\sqrt{2}} \left[ \frac{1}{2} \rho^2 \right]_0^{3\sqrt{2}}
\]
\[
= \left( \frac{1}{2} \right) \left( 9 - \frac{9}{2} \right) \left( \frac{27}{2} \sqrt{2} \right) = 486\pi \left( \frac{3\sqrt{2} - 1}{2} \right)
\]