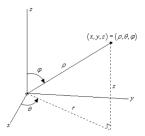
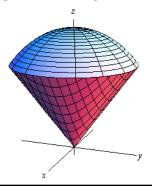
16.4 Integration in Spherical Coordinates Multivariable Calculus



Conversion formulas for spherical coordinates:

$$egin{aligned} x &=
ho \sin arphi \cos heta & y &=
ho \sin arphi \sin heta & z &=
ho \cos arphi \ x^2 + y^2 + z^2 &=
ho^2 \
ho &\geq 0 & 0 &\leq arphi \leq \pi \end{aligned}$$

We will be slicing our solid into spherical wedges to calculate the integrals:



Triple Integrals in Spherical Coordinates:

$$\iiint\limits_{E}f\left(x,y,z
ight)\,dV=\int_{-\delta}^{-\gamma}\int_{-lpha}^{-eta}\int_{a}^{b}
ho^{2}\sinarphi\,f\left(
ho\sinarphi\cos heta,
ho\sinarphi\sin heta,
ho\cosarphi
ight)\,d
ho\,d heta\,darphi$$

Evaluate
$$\mathop{\iiint}\limits_E 16z\,dV$$
 where E is the upper half of the sphere $x^2+y^2+z^2=1.$

Evaluate
$$\iiint\limits_E 10xz+3\,dV$$
 where E is the region portion of $x^2+y^2+z^2=16$ with $z\geq 0$.

Evaluate
$$\iiint_E 3z\,dV$$
 where E is the region inside both $x^2+y^2+z^2=1$ and $z=\sqrt{x^2+y^2}$.

Evaluate
$$\iiint_E z\,x\,dV$$
 where E is inside both $x^2+y^2+z^2=4$ and the cone (pointing upward) that makes an angle of $\frac{\pi}{3}$ with the negative z -axis and has $x\leq 0$.

16.4 Integration in Spherical Coordinates Multivariable Calculus

Convert
$$\int_0^3\int_0^{\sqrt{9-y^2}}\int_{\sqrt{x^2+y^2}}^{\sqrt{18-x^2-y^2}}x^2+y^2+z^2\,dz\,dx\,dy$$
 into spherical coordinates.