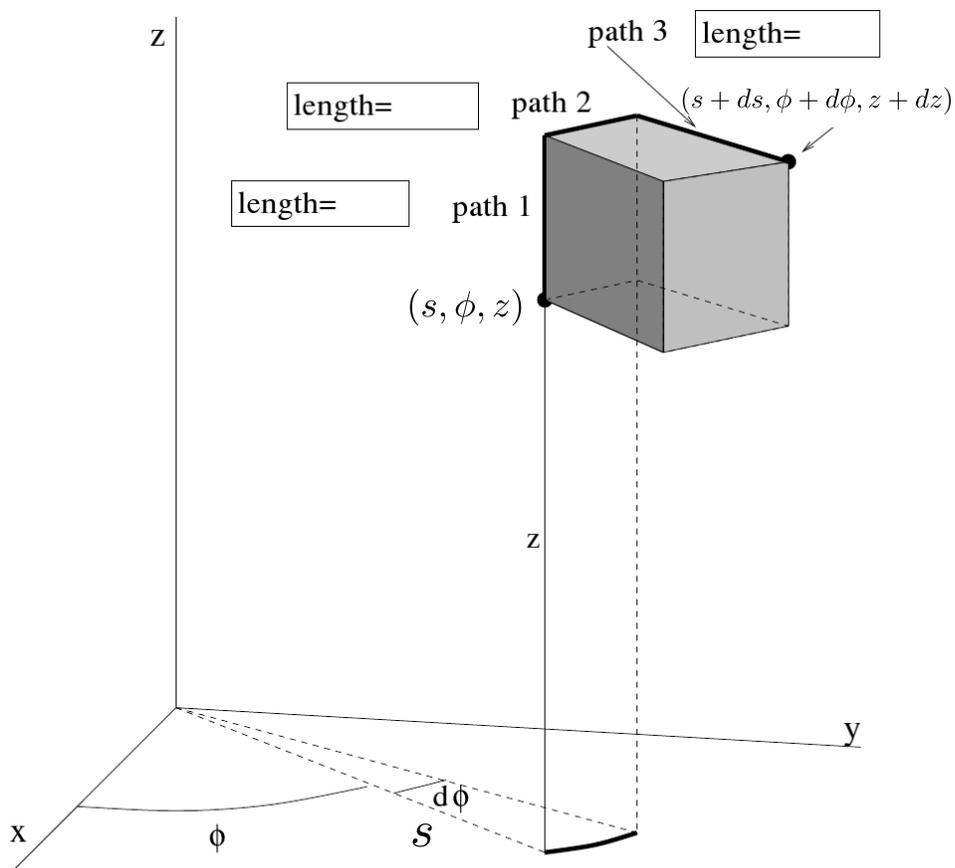**Cylindrical Coordinates:**

You will now derive expressions for infinitesimal lengths, areas and volumes in cylindrical coordinates by determining the lengths $d\ell$ along the specific paths below.

Geometrically determine the length of the three paths leading from a to b and write these lengths below. Then solve for the area of each surface, and the volume of the "pineapple chunk."
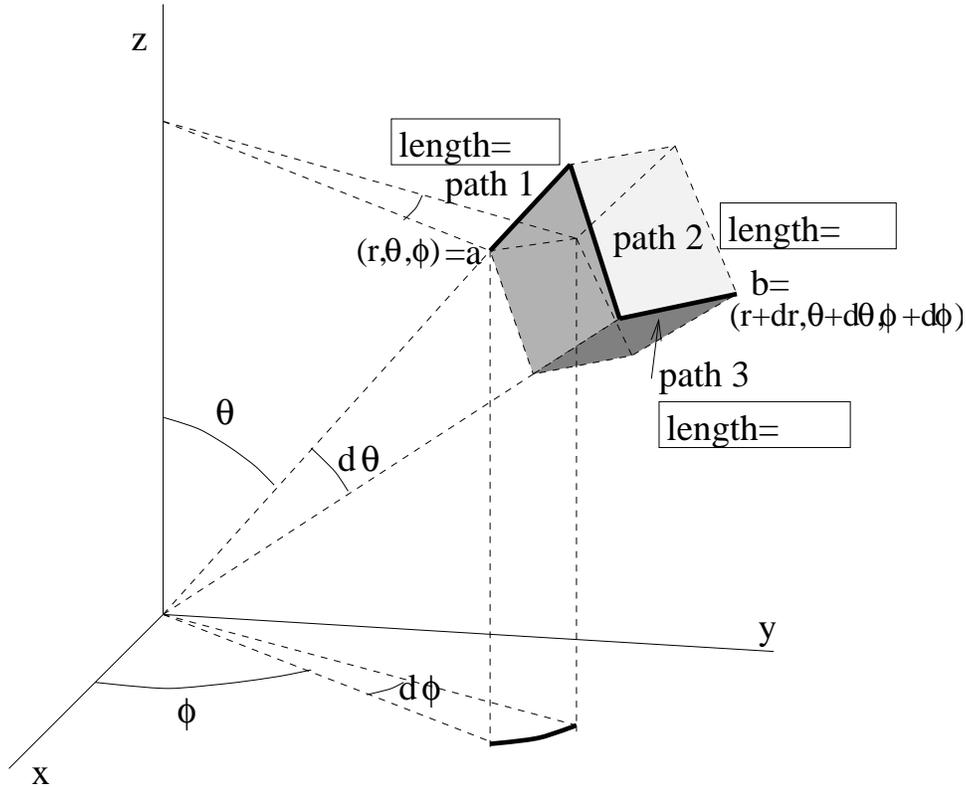

Cylindrical Coordinates

Path 1: $d\ell =$ Side 1: $dA =$

Path 2: $d\ell =$ Side 2: $dA =$

Path 3: $d\ell =$ Side 3: $dA =$

Volume: $d\tau =$

1

Spherical Coordinates:

You will now derive the expressions for infinitesimal lengths, areas and volumes in spherical coordinates by determining $d\ell$ along the specific paths below. Geometrically determine the length of the three paths leading from a to b and write these lengths below. Then solve for the area of each side of the "pumpkin chunk," and finally for its volume. Notice that, along any of these three paths, only one coordinate r, θ, or ϕ is changing at a time. (i.e. along path 1, $d\theta \neq 0$, but r and ϕ do not change).

z

length=
path 1

$(r,\theta,\phi)=a$

path 2   length=

b=
$(r+dr,\theta+d\theta,\phi+d\phi)$

path 3

length=

θ

$d\theta$

$d\phi$

ϕ

y

x

Line Elements in Spherical Coordinates

Path 1: $d\ell =$ Side 1: $dA =$

Path 2: $d\ell =$ Side 2: $dA =$

Path 3: $d\ell =$ Side 3: $dA =$

Volume: $d\tau =$