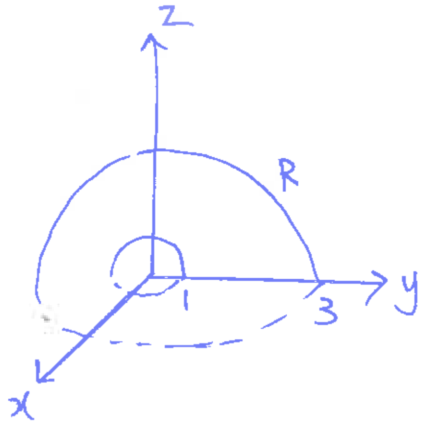
Symmetry Q5.



R is symmetric in the yz-plane (i.e. in x)
and symmetric in the xz-plane (i.e. in y)

So volume of R $= 2\times$ volume of (part of R with $x \geq 0$) $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$

$= 4\times$ volume of (part of R with $x, y \geq 0$) $0 \leq \theta \leq \frac{\pi}{2}$

$0 \leq \theta \leq 2\pi$

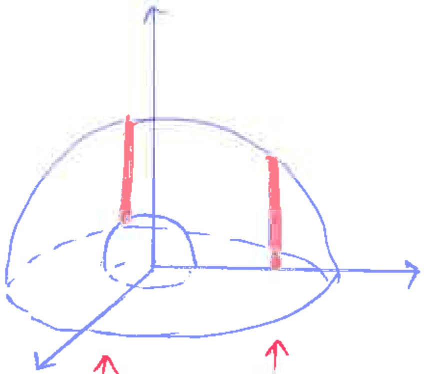
But: $\iiint_R \delta(x,y,z)\, dV = 2\times \iiint_{R \text{ with } x\geq 0} \delta(x,y,z)\, dV$ only when $\delta(x,y,z) = \delta(-x,y,z)$

i.e. δ is an even function of x.

symmetry depends on the <u>integrand</u> as well as the domain.

Why is it hard to describe the region in Q5 in cylindrical coordinates.

r, θ, z



if $1 \le r \le 3$:

$0 \le z \le \sqrt{9-r^2}$

if $0 \le r \le 1$

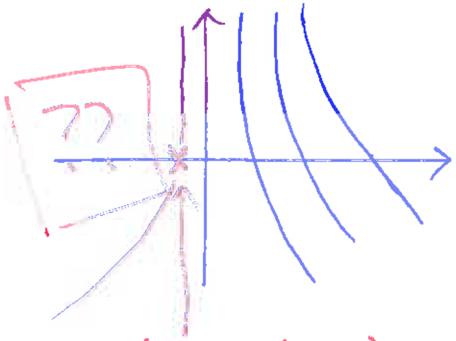
$\sqrt{1-r^2} \le z \le \sqrt{9-r^2}$

$$\text{mass} = \int_0^{2\pi} \int_0^1 \int_{\sqrt{1-r^2}}^{\sqrt{9-r^2}} \delta r \, dz \, dr \, d\theta$$

$$+ \int_0^{2\pi} \int_1^3 \int_0^{\sqrt{9-r^2}} \delta r \, dz \, dr \, d\theta$$

Drawing level sets (Q3a)

<u>common answer:</u>



$(x,y)=(-1,0)$

$f(x,y) = (-1)e^0 = -1$

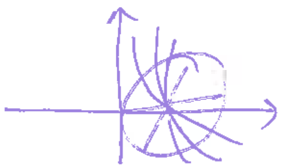
so $f(x,y)=-1$ goes through this point

* make sure your level sets "fill" the domain.

- evaluate the function in any "unfilled" areas
- check $c = -1, -2, \cdots$

  $c = \frac{1}{2}, \frac{1}{3}, \cdots$

  $c = -\frac{1}{2}, -\frac{1}{3}, \cdots$



* level sets for different c <u>cannot</u> intersect because a function cannot have 2 values at one point.