

### Question

- (i) The following equations are written in terms of cylindrical co-ordinates.  
What curves or surfaces do they represent?

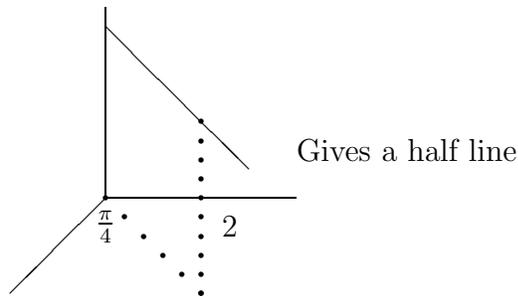
- (a)  $\phi = \frac{\pi}{4}, z = 2$
- (b)  $R^2 + z^2 = 9$
- (c)  $R = z \tan \alpha$  where  $\alpha$  is a constant
- (d)  $R \sin \phi = 1, z = 0$

- (ii) The following equations are written in terms of spherical co-ordinates.  
What curves do they represent?

- (a)  $r \cos \theta = 1$
- (b)  $\sin \theta = \frac{\pi}{4}$
- (c)  $\theta = \frac{\pi}{2}, r = \cos \phi = 0$
- (d)  $\theta = \frac{\pi}{4}, r = \cos \theta = 1$

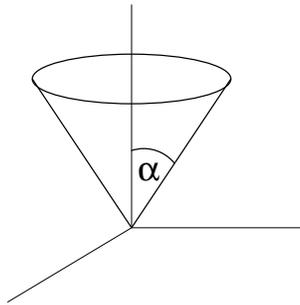
### Answer

- (i) (a)  $\phi = \frac{\pi}{4}, z = 2$



- (b)  $R^2 + z^2 = 9 \Rightarrow x^2 + y^2 + z^2 = 1$  gives a sphere.

(c)  $R = z \tan \alpha$  where  $\alpha$  is a constant



Gives a half cone

(d)  $R \sin \phi = 1, \quad z = 0$   
 $y = 1 \quad z = 0$  gives a line.

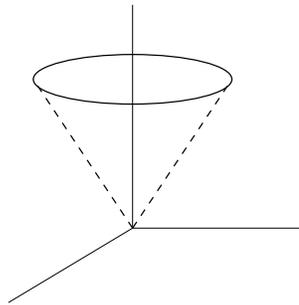
(ii)

(a)  $r \cos \theta = 1 \Rightarrow z = 1$  gives a plane

(b)  $\sin \theta = \frac{\pi}{4} \Rightarrow \theta = \text{constant}$ . Gives a double cone.

(c)  $\theta = \frac{\pi}{2}, r = \cos \phi = 0$  Gives the y axis.

(d)  $\theta = \frac{\pi}{4}, r = \cos \theta = 1$



circle centre is at  $(0, 0, 1)$  and the radius is 1 in the plane  $z = 1$