Three-dimensional Space

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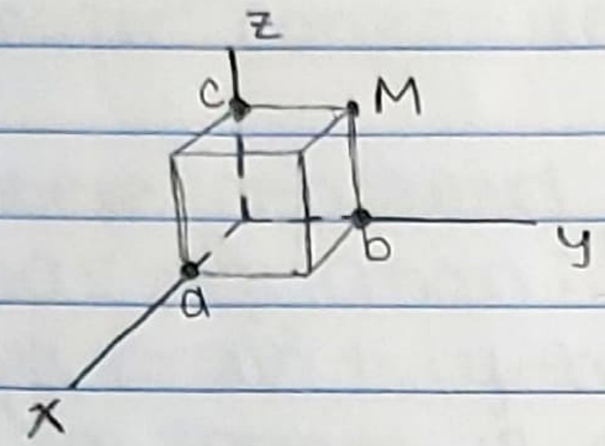
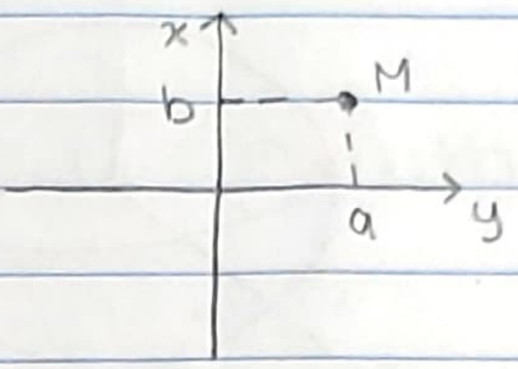
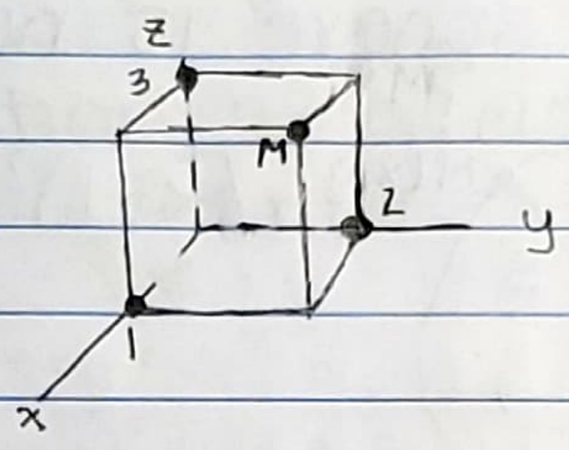
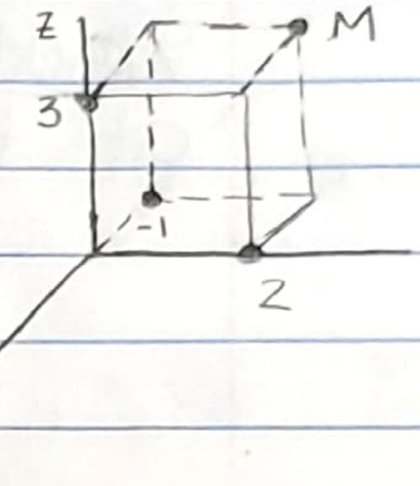




$M(1, 2, 3)$



$M(-1, 2, 3)$



xy-plane.
yz-plane
zx-plane
} coordinate planes

The collection of point M such that OM = constant is a sphere centered at the origin.

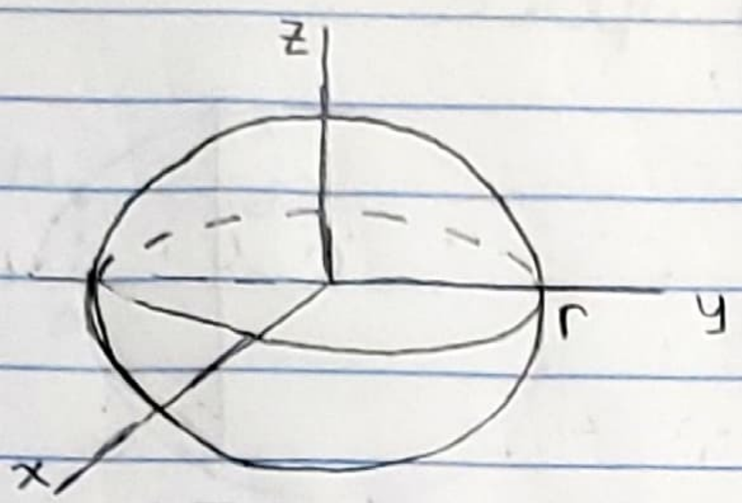
Eq of sphere: $M(x, y, z)$

$OM = \sqrt{x^2+y^2+z^2} = r \longrightarrow x^2+y^2+z^2 = r^2$

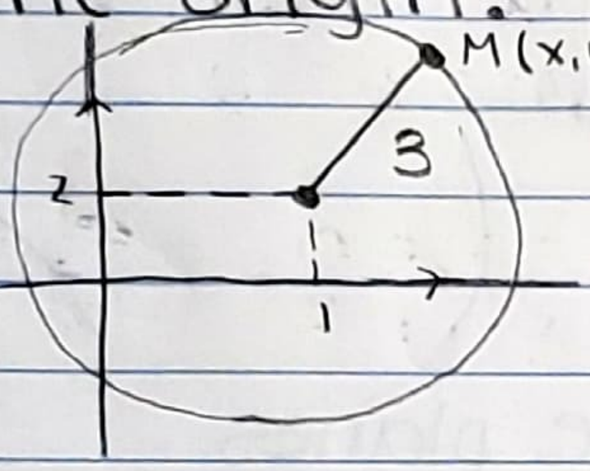
The equation of the sphere centered at the origin with radius r.

ex. Which of the following points lie on, inside, outside the sphere centered at the origin with radius 3?

$A(-1, 2, 2)$	$B(1, -2, 1)$	$C(2, 1, -3)$
$1+4+4 = 9$	$1+4+1 = 9$	$4+1+9 = 9$
$9 = 9$	$6 < 9$	$14 > 9$
A lies on.	B lies inside.	C lies outside



What if the sphere is not centered at the origin?

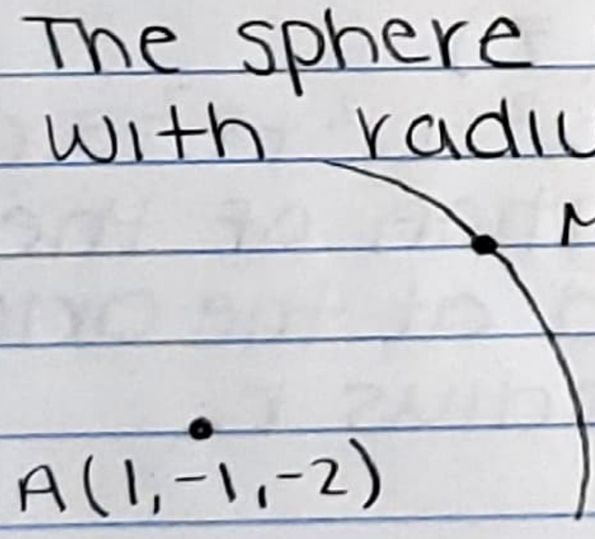


$(x-1)^2+(y-2)^2=3^2$

The distance between $P(a,b,c)$ and $Q(d,e,f)$ is given by

$$PQ=\sqrt{(a-d)^2+(b-e)^2+(c-f)^2}$$

ex. The sphere centered at $(1,-1,-2)$ with radius 5 is:



$AM^2=5^2$

$(x-1)^2+(y+1)^2+(z+2)^2=25$

ex. $x^2+y^2+z^2-2x+4y+2z=10$

$(x^2-2x)+(y^2+4y)+(z^2+2z)=10$