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MATHEMATICS WORKSHEET – INTRODUCTION TO THREE DIMENSIONAL GEOMETRY

Prepared BY: ABDURAHIMAN K

Don't forget:-

Coordinate axes and coordinate planes:- In three-dimensions, the coordinate axes of a rectangular Cartesian system are *three mutually perpendicular lines*. The axes are called *x, y and z-axes*.

- The three planes determined by the pair of axes are the coordinate planes, called *XY, YZ and ZX-planes*. The three coordinate planes divide the space into eight parts known as *octants*.
- Any point on the x-axis is of the form (x, 0, 0).
- Any point on the y-axis is of the form (0, y, 0).
- Any point on the z-axis is of the form (0, 0, z).
- Coordinates of a point in the YZ-plane are of the form (0, y, z).
- Coordinates of a point in the XY-plane are of the form (x, y, 0).
- Coordinates of a point in the ZX-plane are of the form (x, 0, z).
- **Distance Formula:-** Distance between two points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$ is given by

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}.$$

- **Section formula:-** The coordinates of point R, which divides the line segment joining two points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$

Internally in the ratio $m:n$ are $\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}, \frac{mz_2 + nz_1}{m+n}\right)$.

Externally in the ratio $m:n$ are $\left(\frac{mx_2 - nx_1}{m-n}, \frac{my_2 - ny_1}{m-n}, \frac{mz_2 - nz_1}{m-n}\right)$.

- The coordinates of the mid-point of the line joining the points (x_1, y_1, z_1) and (x_2, y_2, z_2) are

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right).$$

- The coordinates of the centroid of a triangle whose vertices are $(x_1, y_1, z_1), (x_2, y_2, z_2)$ and (x_3, y_3, z_3) are given by $\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}, \frac{z_1 + z_2 + z_3}{3}\right)$

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1. Find the distance between the points $(1,\sqrt{3},0)$ and $\left(1,\frac{1}{\sqrt{3}},\frac{2\sqrt{2}}{\sqrt{3}}\right)$.
2. Find the point on Z-axis which is equidistant from the points $(3,2,1)$ and $(5,2,5)$.
3. Show that the points $(1,3,2)$, $(3,0,8)$ and $(9,-2,5)$ are the vertices of an isosceles right angled triangle.
4. Show that the points $(0,1,2)$, $(-3,2,3)$ and $(6,-1,0)$ are collinear.
5. Find the equation to the locus of a point whose distance from the point $(1,-1,2)$ is 5.
6. Find the points of trisection of the segment joining the points $(2,1,-3)$ and $(5,-8,3)$.
7. If A and B are the points $(0,1,2)$ and $(0,1,2)$ and P is a point such that $AP^2 - BP^2 = 10$. Find equation to the locus of P.
8. Find the equation to the locus of a point which is equidistant from the points $(1,2,3)$ and $(0,-1,2)$.
9. If three vertices of a parallelogram, taken in order are $(3,4,-1)$, $(7,10,-3)$ and $(8,1,0)$, find the fourth vertex.
10. Find the ratio in which the YZ-planes divides the segment joining the points $(1,2,4)$ and $(3,8,6)$. Also find the co-ordinates of the point of section.
11. Show that the points $(1,1,1)$, $(-2,4,1)$, $(-1,5,5)$ and $(2,2,5)$, taken in order, are the vertices of the square. Find the area of the square.
12. Find the centroid of the triangle, given that the midpoints of its sides are $(1,4,-3)$, $(3,2,1)$ and $(-1,3,-4)$.
13. Find the point equidistant from the points $(0,3,3)$, $(1,3,2)$, $(-1,1,4)$ and $(1,2,3)$.
14. Two vertices of a triangle are $(4,-6,3)$ and $(2,-2,1)$ and its centroid is $\left(\frac{8}{3},-1,2\right)$. Find the third vertex.
15. Show that the points $A(-2,3,5)$, $B(1,2,3)$ and $C(7,0,-1)$ are collinear. Find the ratio in which C divides $[AB]$.
16. Show that the points $A(4,7,8)$, $B(2,3,4)$, $C(-1,-2,1)$ and $D(1,2,5)$, taken in order, are the vertices of the parallelogram. Do they make a rectangle?

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17. Find the co-ordinates of the point which is three fifth of the way from $(3,4,5)$ to $(-2,-1,0)$.
18. Find the points of trisection of the segment joining the point $A(1,0,-6)$ and $B(-5,9,6)$.
19. Find the points on X-axis which are at a distance of $2\sqrt{6}$ units from the point $(1,-2,3)$.
20. Find x so that the points $(6,5,-3)$ is at a distance of 13 units from the point $(x,-7,0)$.
21. Find the ratio in which the line segment joining the points $(4,8,10)$ and $(6,10,-8)$ is divided by the yz –plane.
22. Given that $P(3,2,-4)$, $Q(5,4-6)$ and $R(9,8,-10)$ are collinear. Find the ratio in which Q divides PR.
23. Using section formula, show that the points $A(2,-3,4)$, $B(-1,2,1)$ and $C\left(0,\frac{1}{3},2\right)$ are collinear.
24. The centroid of a triangle ABC is at the points $(1,1,1)$. If the coordinates of A and B are $(3,-5,7)$ and $(-1,7,-6)$ respectively, find the coordinates of the point C.
25. Find the centroid of a triangle, mid-points whose sides are $(1,2,-3)$, $(3,0,1)$ and $(-1,1,-4)$.
26. The mid-points of the sides of a triangle ABC are given by $(-2,3,5)$, $(4,-1,7)$ and $(6,5,3)$. Find the coordinates of A, B and C.
27. The vertices of a triangle are $A(5,4,6)$, $B(1,-1,3)$ and $C(4,3,2)$. The internal bisector of angle A meets BC at D. Find the coordinates of D and the length AD.
28. Find the coordinates of the point which divides the line segment joining the points $P(2,-1,4)$ and $Q(4,3,2)$ in the ratio $2:3$ (i) internally (ii) externally.
29. Are the points $A(3,6,9)$, $B(10,20,30)$ and $C(25,-41,5)$, the vertices of a right angled triangle?
30. If $A(-2,2,3)$ and $B(13,-3,13)$ are two points. Find the locus of a point P which moves in such a way that $3PA = 2PB$.
31. Show that the points $A(1,3,4)$, $B(-1,6,10)$, $C(-7,4,7)$ and $D(-5,1,1)$ are the vertices of a rhombus.
32. Find the distance between the points P and Q having coordinates $(-2,3,1)$ and $(2,1,2)$.
33. Find the coordinates of a point equidistant from the four points $O(0,0,0)$, $A(a,0,0)$, $B(0,b,0)$ and $C(0,0,c)$.

Prepared BY: ABDURAHIMAN K
Al-HIJAS INTERNATIONAL SCHOOL, JEDDAH(IGCSE). rahman2ark@gmail.com, 00966501079040.

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