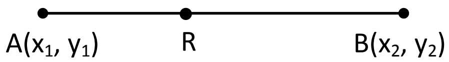
1. Coordinate of a point in the cartesian plane is (x, y) in which the **abscissa** is x and **ordinate** is y.
2. (x, y) = (a, b) iff' x = a and y = b.
3. A point on x – axis is (x, 0) and a point on y – axis is (0, y).
4. Equation of x – axis is y = 0 and that of y – axis is x = 0. Equation of any vertical line is of the form x = a and any horizontal line is of the form y = b.
5. **Distance Formula:** distance between two points A (x_1, y_1) and B (x_2, y_2) is $\boxed{AB=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}}$
6. **Section formula:**

   i) *internal division*

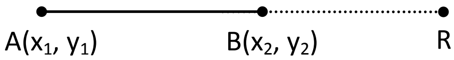
   $\boxed{R=\left(\frac{mx_2+nx_1}{m+n},\frac{my_2+ny_1}{m+n}\right)}$



   AR:RB = m:n

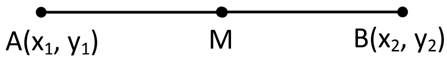
   ii) *external division*

   $\boxed{R=\left(\frac{mx_2-nx_1}{m-n},\frac{my_2-ny_1}{m-n}\right)}$



7. **Mid point formula:** The midpoint M of line segment joining the points A (x_1, y_1) and B (x_2, y_2) is

   $\boxed{M=\left(\frac{x_1+x_2}{2},\frac{y_1+y_2}{2}\right)}$



8. **Centroid:** A line segment joining the vertex of a triangle with the midpoint of its opposite side is known as median. The point of intersection of the medians of a triangle is known as centroid.

   Centroid divides the median in the ratio 2:1. The coordinates of Centroid of a triangle with vertices $(x_1,y_1),(x_2,y_2)\,\&\,(x_3,y_3)$ is $\boxed{G=\left(\frac{x_1+x_2+x_3}{3},\frac{y_1+y_2+y_3}{3}\right)}$

9. **Area of a triangle:**

   with vertices $(x_1,y_1),(x_2,y_2)\,\&\,(x_3,y_3)$ is $\boxed{\Delta=\frac{1}{2}\left|x_1(y_2-y_3)+x_2(y_3-y_1)+x_3(y_1-y_2)\right|}$

   note: to solve an equation of the type $|ax+b|=k$, write it as ax + b = $\pm k$

10. **Slope of a line:**

    i) Slope of a line joining the points $(x_1,y_1)\,\&\,(x_2,y_2)$ is $\boxed{m=\frac{y_2-y_1}{x_2-x_1}}$

    ii) Slope of a line making an angle θ with the positive direction of x – axis is $\boxed{m=\tan\theta}$

    iii) Slope of a line in the form Ax + By + C = 0 is $\boxed{m=\frac{-A}{B}}$

11. **Collinear points:** Three or more points on a straight line are known as collinear points.

    to prove collinearity: To prove three points A, B and C are collinear(i.e. points lying on the same line)

    i) use area formula and show that the area(ABC) = 0 or

    ii) use distance formula, calculate length of AB, BC and AC & show that sum of any two lengths is equal to the third length or,

    iii) use slope formula and show that AB & BC have same slope. It implies they are parallel, but since one point is common in AB and BC; A, B and C are collinear.
12. **Locus:** It is a set of points satisfying a given condition.
13. **Orthocentre:** The point of intersection of the altitudes of a triangle is known as orthocenter.
14. **Incentre:** The point of intersection of the angle bisectors of a triangle is known as incentre.
15. **Circumcentre:** The point of intersection of the perpendicular bisectors of a triangle is known as circumcentre.
16. **Equation of a line – Various Forms:**

    i) ***General equation*** of a line is Ax + By + C = 0

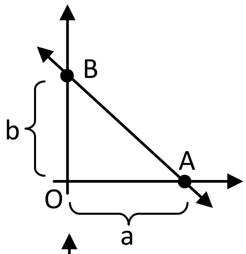
    ii) ***Slope – intercept form***: $\boxed{y = mx + c}$, where m is the slope of the line and c is the y – intercept.

    note: equation of a line passing through origin is y = mx.

iii) ***Point – slope form***: $\boxed{y - y_1 = m(x - x_1)}$, where m is the slope of the line and (x_1, y_1) is a point on the line.

iv) ***Two – point form***: $\boxed{y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)}$ *or* $\boxed{\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}}$

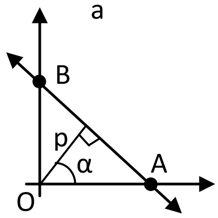
where (x_1, y_1) and (x_2, y_2) are two points on the line.



v) ***Intercept form***:

$\boxed{\frac{x}{a} + \frac{y}{b} = 1}$ where 'a' is the x – intercept and 'b' is the y – intercept.

OA = a and OB = b ; A = (a, 0) and B = (0, b)



vi) ***Normal form***: $\boxed{x\cos\alpha + y\sin\alpha = p}$,

where p is the perpendicular distance of the line from origin and

α is the angle made by the perpendicular with the positive direction of x – axis.

17. **Intersection of Lines:** If $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ are the equations of two lines then they are:

    i) *parallel lines* if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c2}$ (in this case no solution as the lines do not intersect)

    ii) *intersecting lines* if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ (in this case unique solution; solve the eqns. to find the point of intersection)

    iii) *coincident lines* if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c2}$ (in this case infinitely many solutions)

18. **Concurrency of three lines:** Three or more lines are said to be concurrent if they pass through the same point. [Note:This can be verified by solving any two equations and substituting the solution in the third equation. If the third equation is satisfied then the lines are concurrent otherwise not.]

    System of lines $a_1x + b_1y + c_1 = 0$

    $a_2x + b_2y + c_2 = 0$ &

    $a_3x + b_3y + c_3 = 0$ are concurrent if $a_1(b_2c_3 - b_3c_2) + a_2(b_3c_1 - b_1c_3) + a_3(b_1c_2 - b_2c_1) = 0$

19. **Angle between two lines:** If θ is the angle between two lines with slopes m_1 and m_2 then $\boxed{\tan\theta = \left|\frac{m_2 - m_1}{1 + m_1m_2}\right|}$

20. **Perpendicular distance of a point from a line:** The perpendicular distance of a point

    P (x_1, y_1) from the line Ax + By + C = 0 is $\boxed{d = \left|\frac{Ax_1 + By_1 + C}{\sqrt{A^2 + B^2}}\right|}$

21. **Perpendicular distance between two parallel lines:** The distance between two parallel lines with equations

    $Ax + By + C_1 = 0$ and $Ax + By + C_2 = 0$ is given by $\boxed{d = \left|\frac{C_2 - C_1}{\sqrt{A^2 + B^2}}\right|}$

22. **Position of points w.r.t. a given line:** The points $P(x_1, y_1)$ and $Q(x_2, y_2)$ lie on the

    i) same side of the line Ax + By + C = 0, if the expressions $Ax_1 + By_1 + C$ and $Ax_2 + By_2 + C$ have the same sign (i.e. both are + or both are –)

    ii) opposite side of the line Ax + By + C = 0, if the expressions $Ax_1 + By_1 + C$ and $Ax_2 + By_2 + C$ have opposite signs.

23. **Concept of slopes:**

    i) Slope of a line parallel to x – axis (horizontal line) is zero and slope of a line parallel to y – axis (vertical line) is not defined.

    ii) Two lines are parallel if and only if their slopes are equal. $\boxed{m_1 = m_2}$

    iii) Two lines are perpendicular if and only if the product of their slopes is – 1. $\boxed{m_1m_2 = -1}$

    iv) if the angle made by a line with the positive direction of x – axis is acute, then the slope is positive (ascending line).

    v)) if the angle made by a line with the positive direction of x – axis is obtuse, then the slope is negative (descending line).

24. **Note:**

i) to prove a quadrilateral is parallelogram, show that

a) diagonals bisect each other(i.e. both diagonals have the same mid point) or

b) opposite sides are parallel (use slope formula) or

c) opposite sides are equal (use distance formula)

ii) rectangle: show that diagonals bisect each other and they are equal in length.

iii) rhombus: show that the diagonals bisect each other at right angles.

iv) right angled triangle: a) product of slopes of any two sides should be equal to – 1 or

b) Pythagoras theorem must be verified.

v) to find the intercepts made by a line: a) convert into intercept form or b) substitute x = 0 in the eqn to find y – intercept and then substitute y = 0 in the equation to find the x – intercept.

vi) to find the point of intersection of two lines, solve the equations.

vii) to reduce an equation to normal form, divide the eqn by $\sqrt{A^2+B^2}$

25. **Conversion from general form to slope intercept form:**

26. **Conversion from general form to intercept form:**

27. **Conversion from general form to normal form:**