CG

MATHEMATICS · CLASS XI / XII

Coordinate Geometry

FORMULA SHEET

COMPLETE REFERENCE

EXAM READY

POINTS & DISTANCE

D Distance Formula

Distance between two points (x_1, y_1) and (x_2, y_2)

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

- Always take the positive square root

M Midpoint Formula

Midpoint of segment joining (x_1, y_1) and (x_2, y_2)

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

- Special case of section formula with ratio 1:1

G Centroid of Triangle

For vertices $(x_1, y_1), (x_2, y_2), (x_3, y_3)$

$$G = \left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$$

- Centroid divides each median in ratio 2 : 1

SECTION FORMULAS

I Internal Division

Point P divides $A(x_1, y_1)B(x_2, y_2)$ internally in ratio $m : n$

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

- Point lies between A and B

E External Division

Point P divides AB externally in ratio $m : n$

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

- Point lies outside segment AB; denominator $m \neq n$

STRAIGHT LINES

m Slope Formula

Gradient of line through (x_1, y_1) and (x_2, y_2)

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

- Undefined for vertical lines ($x_1 = x_2$)
- $\tan\theta$ where θ is inclination with x-axis

θ Angle Between Two Lines

If slopes are m_1 and m_2

$$\tan\theta = \left|\frac{m_2 - m_1}{1 + m_1 m_2}\right|$$

PARALLEL

$m_1 = m_2$

PERPENDICULAR

$m_1 \cdot m_2 = -1$

y= Slope-Intercept Form

$$y = mx + c$$

- m = slope, c = y-intercept

P Point-Slope Form

$$y - y_1 = m(x - x_1)$$

- Use when slope + one point are known

2P Two-Point Form

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$$

- Derived from slope between two points

ab Intercept Form

$$\frac{x}{a} + \frac{y}{b} = 1$$

- a = x-intercept, b = y-intercept

G General Form

$$Ax + By + C = 0$$

- Slope $= -A/B$;\ \ y-intercept $= -C/B$

⊥d Point-to-Line Distance

Distance from (x_1, y_1) to $Ax + By + C = 0$

$$d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$$

H Horizontal Line

$$y = k \quad (k \text{ is constant})$$

- Slope = 0; parallel to x-axis

V Vertical Line

$$x = k \quad (k \text{ is constant})$$

- Slope undefined; parallel to y-axis

AREA & COLLINEARITY

△ Area of Triangle

For vertices (x_1, y_1), (x_2, y_2), (x_3, y_3)

$$\text{Area} = \frac{1}{2}|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$$

- Always take absolute value — area is non-negative

— Collinearity Condition

Three points are collinear if the triangle they form has zero area

$$x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2) = 0$$

- Equivalent: slopes of any two pairs of points are equal

CIRCLES

○ Centre-Radius Form

Centre (h, k), radius r

$$(x - h)^2 + (y - k)^2 = r^2$$

- Standard / most common form

○ General Form

$$x^2 + y^2 + 2gx + 2fy + c = 0$$

- Centre $= (-g, -f)$
- Radius $= \sqrt{g^2 + f^2 - c}$

T Tangent to Circle

Tangent at (x_1, y_1) on circle $x^2 + y^2 = r^2$

$$xx_1 + yy_1 = r^2$$

- Tangent ⊥ radius at point of contact

In Incenter

Intersection of angle bisectors; a, b, c are opposite side lengths

$$I = \left(\frac{ax_1 + bx_2 + cx_3}{a+b+c}, \frac{ay_1 + by_2 + cy_3}{a+b+c}\right)$$

- Also the centre of the inscribed circle (incircle)

Ci Circumcenter

Intersection of perpendicular bisectors of sides

Solve the system of perpendicular bisector equations of any two sides simultaneously

- Equidistant from all three vertices

REFLECTIONS & TRANSFORMATIONS

↔ Reflection Formulas

X-AXIS	Y-AXIS	ORIGIN	LINE $Y = X$
$(x, y) \to (x, -y)$	$(x, y) \to (-x, y)$	$(x, y) \to (-x, -y)$	$(x, y) \to (y, x)$