Maths Formula Sheet

Chapter by chapter, topic by topic. Written by the PadhoNa team for quick revision.

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CHAPTER 12

Solutions of Triangles

Sine, cosine and projection rules

SINE RULE

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$$

COSINE RULE

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

PROJECTION

$$a = b\cos C + c\cos B$$

NAPIER'S ANALOGY

$$\tan\frac{B-C}{2} = \frac{b-c}{b+c}\cot\frac{A}{2}$$

Half angles and area

HALF ANGLES

$$\sin\frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}, \qquad \cos\frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}}, \qquad \tan\frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$$

$s = \frac{a+b+c}{2}$.

AREA

$$\Delta = \frac{1}{2}bc\sin A = \sqrt{s(s-a)(s-b)(s-c)} = \frac{abc}{4R} = rs$$

Circles of a triangle

CIRCUMRADIUS

$$R = \frac{a}{2\sin A} = \frac{abc}{4\Delta}$$

INRADIUS

$$r = \frac{\Delta}{s} = (s-a)\tan\frac{A}{2} = 4R\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$$

EXRADII

$$r_1 = \frac{\Delta}{s-a} = s\tan\frac{A}{2}, \qquad \frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3} = \frac{1}{r}$$

DISTANCES

$$OI^2 = R^2 - 2Rr, \qquad \text{distance of orthocentre from } A = 2R\cos A$$

MEDIAN

$$m_a = \frac{1}{2}\sqrt{2b^2+2c^2-a^2}$$

m–n rule

$$(m+n)\cot\theta = m\cot\alpha - n\cot\beta = n\cot B - m\cot C$$

D divides BC in the ratio $m:n$; θ is the angle ADC, $\alpha = \angle BAD$, $\beta = \angle DAC$.

Heights and distances

$$\tan(\text{angle of elevation}) = \frac{\text{height}}{\text{horizontal distance}}$$

Draw the figure, mark right angles, and use the sine rule in non-right triangles.

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