BAAP OF ALL FORMULA LISTS

FOR IIT JEE

GEOMETRY

SL#	FORMULA
1	$\alpha + \beta = 90^\circ$
2	$\sin\alpha = \frac{a}{c} = \cos\beta$
3	$\cos\alpha = \frac{b}{c} = \sin\beta$
4	$\tan\alpha = \frac{a}{b} = \cot\beta$
5	$\cot\alpha = \frac{b}{a} = \tan\beta$
6	$\sec\alpha = \frac{c}{b} = \cos ec\beta$
7	$\cos ec\alpha = \frac{c}{a} = \sec\beta$
8	**Pythagorean Theorem** $a^2 + b^2 = c^2$
9	$a^2 = fc, b^2 = gc,$ **where f and c are projections of the legs a and b, respectively, onto the hypotenuse c.**
10	$h^2 = fg,$ **where h is the altitude from the right angle.**
11	$m_a^2 = b^2 - \frac{a^2}{4}, m_b^2 = a^2 - \frac{b^2}{4},$ **where m_a and m_b are the medians to the legs a and b.**
12	$m_c = \frac{c}{2},$

	where m_c is the median to the hypotenuse c.
13	$R = \frac{c}{2} = m_c$
14	$r = \frac{a+b-c}{2} = \frac{ab}{a+b+c}$
15	$ab = ch$
16	$S = \frac{ab}{2} = \frac{ch}{2}$
17	$\beta = 90^\circ - \frac{\alpha}{2}$
18	$h^2 = b^2 - \frac{a^2}{4}$
19	$L = a + 2b$
20	$S = \frac{ah}{2} = \frac{b^2}{2}\sin\alpha$
21	$h = \frac{a\sqrt{3}}{2}$
22	$R = \frac{2}{3}h = \frac{a\sqrt{3}}{3}$
23	$r = \frac{1}{3}h = \frac{a\sqrt{3}}{6} = \frac{R}{2}$
24	$L = 3a$
25	$S = \frac{ah}{2} = \frac{a^2\sqrt{3}}{4}$
26	$\alpha + \beta + \gamma = 180^\circ$
27	**In a** $\triangle ABC$ **with sides** a, b **and** c $a + b > c,$ $b + c > a,$ $a + c > b.$

28	**In a** $\triangle ABC$ **with sides** a, b **and** c $\lvert a-b\rvert < c,$ $\lvert b-c\rvert < a,$ $\lvert a-c\rvert < b.$
29	**Midline** $q = \frac{a}{2}, q \mid\mid a.$
30	**Law of Cosines** $a^2 = b^2 + c^2 - 2bc\cos\alpha,$ $b^2 = a^2 + c^2 - 2ac\cos\beta,$ $c^2 = a^2 + b^2 - 2ab\cos\gamma$
31	**Law of Sines** $\frac{a}{\sin\alpha} = \frac{b}{\sin\beta} = \frac{c}{\sin\gamma} = 2R,$ **where R is the radius of the circumscribed circle.**
32	$R = \frac{a}{2\sin\alpha} = \frac{b}{2\sin\beta} = \frac{c}{2\sin\gamma} = \frac{bc}{2h_a} = \frac{ac}{2h_b} = \frac{ab}{2h_c} = \frac{abc}{4S}$
33	$R = \frac{bc}{2h_a} = \frac{ac}{2h_b} = \frac{ab}{2h_c} = \frac{abc}{4S}$
34	$r^2 = \frac{(p-a)(p-b)(p-c)}{p},$ $\frac{1}{r} = \frac{1}{h_a} + \frac{1}{h_b} + \frac{1}{h_c}$
35	$\sin\left(\frac{\alpha}{2}\right) = \sqrt{\frac{(p-b)(p-c)}{bc}},$ $\cos\left(\frac{\alpha}{2}\right) = \sqrt{\frac{p(p-a)}{bc}},$ $\tan\left(\frac{\alpha}{2}\right) = \sqrt{\frac{(p-b)(p-c)}{p(p-a)}}.$
36	$h_a = \frac{2}{a}\sqrt{p(p-a)(p-b)(p-c)},$ $h_b = \frac{2}{b}\sqrt{p(p-a)(p-b)(p-c)},$

	$h_c = \frac{2}{c}\sqrt{p(p-a)(p-b)(p-c)}.$
37	$h_a = b\sin\gamma = c\sin\beta,$ $h_b = a\sin\gamma = c\sin\alpha,$ $h_c = a\sin\beta = b\sin\alpha.$
38	$m_a^2 = \frac{b^2+c^2}{2} - \frac{a^2}{4},$ $m_b^2 = \frac{a^2+c^2}{2} - \frac{b^2}{4}$ $m_c^2 = \frac{a^2+b^2}{2} - \frac{c^2}{4}.$
39	$AM = \frac{2}{3}m_a, BM = \frac{2}{3}m_b, CM = \frac{2}{3}m_c$
40	$t_a^2 = \frac{4bcp(p-a)}{(b+c)^2},$ $t_b^2 = \frac{4acp(p-b)}{(a+c)^2},$ $t_c^2 = \frac{4abp(p-c)}{(a+b)^2}.$
41	$S = \frac{ah_a}{2} = \frac{bh_b}{2} = \frac{ch_c}{2},$ $S = \frac{ab\sin\gamma}{2} = \frac{ac\sin\beta}{2} = \frac{bc\sin\alpha}{2},$ $S = \sqrt{p(p-a)(p-b)(p-c)}$ **(Heron\'s Formula),** $S = pr,$ $S = \frac{abc}{4R},$ $S = 2R^2\sin\alpha\sin\beta\sin\gamma,$ $S = p^2\tan\left(\frac{\alpha}{2}\right)\tan\left(\frac{\beta}{2}\right)\tan\left(\frac{\gamma}{2}\right).$
42	$d = a\sqrt{2}$
43	$R = \frac{d}{2} = \frac{a\sqrt{2}}{2}$
44	

	$r = \frac{a}{2}$
45	$L = 4a$
46	$S = a^2$
47	$d = \sqrt{a^2 + b^2}$
48	$R = \frac{d}{2}$
49	$L = 2(a + b)$
50	$S = ab$
51	$\alpha + \beta = 180^\circ$
52	$d_1^2 + d_2^2 = 2\left(a^2 + b^2\right)$
53	$h = b \sin \alpha = b \sin \beta$
54	$L = 2(a + b)$
55	$S = ah = ab \sin \alpha,\ S = \frac{1}{2} d_1 d_2 \sin \varphi$
56	$\alpha + \beta = 180^\circ$
57	$d_1^2 + d_2^2 = 4a^2$
58	$h = a \sin \alpha = \frac{d_1 d_2}{2a}$
59	$r = \frac{h}{2} = \frac{d_1 d_2}{4a} = \frac{a \sin \alpha}{2}$
60	$L = 4a$
61	$S = ah = a^2 \sin \alpha,$ $S = \frac{1}{2} d_1 d_2$
62	$q = \frac{a + b}{2}$

63	$S = \frac{a+b}{2} \cdot h = qh$
64	$q = \frac{a+b}{2}$
65	$d = \sqrt{ab + c^2}$
66	$h = \sqrt{c^2 - \frac{1}{4}(b-a)^2}$
67	$R = \frac{c\sqrt{ab+c^2}}{\sqrt{(2c-a+b)(2c+a-b)}}$
68	$S = \frac{a+b}{2} \cdot h = qh$
69	$a + b = 2c$
70	$q = \frac{a+b}{2} = c$
71	$d^2 = h^2 + c^2$
72	$r = \frac{h}{2} = \frac{\sqrt{ab}}{2}$
73	$R = \frac{cd}{2h} = \frac{cd}{4r} = \frac{c}{2}\sqrt{1 + \frac{c^2}{ab}} = \frac{c}{2h}\sqrt{h^2 + c^2} = \frac{a+b}{8}\sqrt{\frac{a}{b} + 6 + \frac{b}{a}}$
74	$L = 2(a+b) = 4c$
75	$S = \frac{a+b}{2} \cdot h = \frac{(a+b)\sqrt{ab}}{2} = qh = ch = \frac{Lr}{2}$
76	$a + b = c + d$
77	$q = \frac{a+b}{2} = \frac{c+d}{2}$
78	$L = 2(a+b) = 2(c+d)$
79	$S = \frac{a+b}{2} \cdot h = \frac{c+d}{2} \cdot h = qh,$

	$S = \frac{1}{2} d_1 d_2 \sin \varphi$
80	$\alpha + \beta + 2\gamma = 360^\circ$
81	$L = 2(a + b)$
82	$S = \frac{d_1 d_2}{2}$
83	$\alpha + \gamma = \beta + \delta = 180^\circ$
84	**Ptolemy\'s Theorem** $ac + bd = d_1 d_2$
85	$L = a + b + c + d$
86	$R = \frac{1}{4} \sqrt{\frac{(ac + bd)(ad + bc)(ab + cd)}{(p - a)(p - b)(p - c)(p - d)}},$ **where** $p = \frac{L}{2}$
87	$S = \frac{1}{2} d_1 d_2 \sin \varphi,$ $S = \sqrt{(p - a)(p - b)(p - c)(p - d)},$ **where** $p = \frac{L}{2}$
88	$a + c = b + d$
89	$L = a + b + c + d = 2(a + c) = 2(b + d)$
90	$r = \frac{\sqrt{d_1^2 d_2^2 - (a - b)^2 (a + b - p)^2}}{2p},$ **where** $p = \frac{L}{2}$
91	$S = pr = \frac{1}{2} d_1 d_2 \sin \varphi$
92	$\alpha + \beta + \gamma + \delta = 360^\circ$

93	$L = a + b + c + d$
94	$S = \frac{1}{2} d_1 d_2 \sin \varphi$
95	$\alpha = 120^\circ$
96	$r = m = \frac{a\sqrt{3}}{2}$
97	$R = a$
98	$L = 6a$
99	$S = pr = \frac{a^2 3\sqrt{3}}{2},$ where $p = \frac{L}{2}$
100	$\alpha = \frac{n-2}{2} \cdot 180^\circ$
101	$R = \frac{a}{2\sin\left(\frac{\pi}{n}\right)}$
102	$r = m = \frac{a}{2\tan\left(\frac{\pi}{n}\right)} = \sqrt{R^2 - \frac{a^2}{4}}$
103	$L = na$
104	$S = \frac{nR^2}{2}\sin\left(\frac{2\pi}{n}\right),$ $S = pr = p\sqrt{R^2 - \frac{a^2}{4}},$ where $p = \frac{L}{2}$
105	$a = 2R\sin\left(\frac{\alpha}{2}\right)$
106	$a_1 a_2 = b_1 b_2$
107	$ee_1 = ff_1$
108	$g^2 = ff_1$
109	$\beta = \frac{\alpha}{2}$

110	$L = 2\pi R = \pi d$
111	$S = \pi R^2 = \frac{\pi d^2}{4} = \frac{LR}{2}$
112	$s = Rx$
113	$s = \frac{\pi R\alpha}{180^\circ}$
114	$L = s + 2R$
115	$S = \frac{Rs}{2} = \frac{R^2x}{2} = \frac{\pi R^2\alpha}{360^\circ}$
116	$a = 2\sqrt{2hR - h^2}$
117	$h = R - \frac{1}{2}\sqrt{4R^2 - a^2}, h < R$
118	$L = s + a$
119	$S = \frac{1}{2}[sR - a(R - h)] = \frac{R^2}{2}\left(\frac{\alpha\pi}{180^\circ} - \sin\alpha\right) = \frac{R^2}{2}(x - \sin x),$ $S \approx \frac{2}{3}ha$
120	$d = \left(a\sqrt{3}\right)$
121	$r = \frac{a}{2}$
122	$R = \frac{a\sqrt{3}}{2}$
123	$S = 6a^2$
124	$V = a^3$
125	$d = \sqrt{a^2 + b^2 + c^2}$
126	$S = 2(ab + ac + bc)$
127	$V = abc$

128	$S = S_L + 2S_B$
129	**Lateral Area of a Right Prism** $S_L = (a_1 + a_2 + a_3 + \ldots + a_n)l$
130	**Lateral Area of an Oblique Prism** $S_L = pl,$ **where p is the perimeter of the cross section.**
131	$V = S_B h$
132	**Cavalieri\'s Principle** **Given two solids included between parallel planes. If every plane cross section parallel to the given planes has the same area in both solids, then the volumes of the solids are equal.**
133	$h = \sqrt{\frac{2}{3}}a$
134	$S_B = \frac{\sqrt{3}a^2}{4}$
135	$S = \sqrt{3}a^2$

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136	$V = \frac{1}{3}S_B h = \frac{a^3}{6\sqrt{2}}$
137	$m = \sqrt{b^2 - \frac{a^2}{4}}$
138	$h = \frac{\sqrt{4b^2 \sin^2\left(\frac{\pi}{n}\right) - a^2}}{2\sin\left(\frac{\pi}{n}\right)}$
139	$S_L = \frac{1}{2}nam = \frac{1}{4}na\sqrt{4b^2 - a^2} = pm$
140	$S_B = pr$
141	$S = S_B + S_L$
142	$V = \frac{1}{3}S_B h = \frac{1}{3}prh$
143	$\frac{b_1}{a_1} = \frac{b_2}{a_2} = \frac{b_3}{a_3} = \ldots = \frac{b_n}{a_n} = \frac{b}{a} = k$

144	$\frac{S_2}{S_1} = k^2$
145	$S_L = \frac{m(P_1 + P_2)}{2}$
146	$S = S_L + S_1 + S_2$
147	$V = \frac{h}{3}\left(S_1 + \sqrt{S_1 S_2} + S_2\right)$
148	$V = \frac{hS_1}{3}\left[1 + \frac{b}{a} + \left(\frac{b}{a}\right)^2\right] = \frac{hS_1}{3}\left[1 + k + k^2\right]$
149	$S_L = \frac{1}{2}(a + c)\sqrt{4h^2 + b^2} + b\sqrt{h^2 + (a - c)^2}$
150	$S_B = ab$
151	$S = S_B + S_L$

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152	$V = \frac{bh}{6}(2a + c)$

153

Five Platonic Solids: The platonic solids are convex polyhedra with equivalent faces composed of congruent convex regular polygons.

Solid	No. of Vertices	No. of Edges	No. of Faces	Section
Tetrahedron	4	6	4	3.25
Cube	8	12	6	3.22
Octahedron	6	12	8	3.27
Icosahedron	12	30	20	3.27
Dodecahedron	20	30	12	3.27

154	$r = \frac{a\sqrt{6}}{6}$
155	$R = \frac{a\sqrt{2}}{2}$
156	$S = 2a^2\sqrt{3}$

157	$V = \frac{a^3\sqrt{2}}{3}$
158	$r = \frac{a\sqrt{3}\left(3+\sqrt{5}\right)}{12}$
159	$R = \frac{a}{4}\sqrt{2\left(5+\sqrt{5}\right)}$
160	$S = 5a^2\sqrt{3}$
161	$V = \frac{5a^3\left(3+\sqrt{5}\right)}{12}$
162	$r = \frac{a\sqrt{10\left(25+11\sqrt{5}\right)}}{2}$
163	$R = \frac{a\sqrt{3}\left(1+\sqrt{5}\right)}{4}$
164	$S = 3a^2\sqrt{5\left(5+2\sqrt{5}\right)}$
165	$V = \frac{a^3\left(15+7\sqrt{5}\right)}{4}$
166	$S_L = 2\pi RH$
167	$S = S_L + 2S_B = 2\pi R(H+R) = \pi d\left(H+\frac{d}{2}\right)$
168	$V = S_B H = \pi R^2 H$
169	$S_L = \pi R(h_1+h_2)$
170	$S_B = \pi R^2 + \pi R\sqrt{R^2+\left(\frac{h_1-h_2}{2}\right)^2}$
171	$S = S_L + S_B = \pi R\left[h_1+h_2+R+\sqrt{R^2+\left(\frac{h_1-h_2}{2}\right)^2}\right]$
172	

	$V = \frac{\pi R^2}{2}(h_1 + h_2)$
173	$H = \sqrt{m^2 - R^2}$
174	$S_L = \pi R m = \frac{\pi m d}{2}$
175	$S_B = \pi R^2$
176	$S = S_L + S_B = \pi R(m + R) = \frac{1}{2}\pi d\left(m + \frac{d}{2}\right)$
177	$V = \frac{1}{3}S_B H = \frac{1}{3}\pi R^2 H$
178	$H = \sqrt{m^2 - (R - r)^2}$
179	$\frac{R}{r} = k$
180	$\frac{S_2}{S_1} = \frac{R^2}{r^2} = k^2$
181	$S_L = \pi m(R + r)$
182	$S = S_1 + S_2 + S_L = \pi\left[R^2 + r^2 + m(R + r)\right]$
183	$V = \frac{h}{3}\left(S_1 + \sqrt{S_1 S_2} + S_2\right)$
184	$V = \frac{hS_1}{3}\left[1 + \frac{R}{r} + \left(\frac{R}{r}\right)^2\right] = \frac{hS_1}{3}\left[1 + k + k^2\right]$
185	$S = 4\pi R^2$
186	$V = \frac{4}{3}\pi R^3 H = \frac{1}{6}\pi d^3 = \frac{1}{3}SR$
187	$R = \frac{r^2 + h^2}{2h}$
188	$S_B = \pi r^2$
189	$S_C = \pi\left(h^2 + r^2\right)$

190	$S = S_B + S_C = \pi\left(h^2 + 2r^2\right) = \pi\left(2Rh + r^2\right)$
191	$V = \frac{\pi}{6}h^2(3R - h) = \frac{\pi}{6}h\left(3r^2 + h^2\right)$
192	$S = \pi R(2h + r)$
193	$V = \frac{2}{3}\pi R^2 h$
194	$S_S = 2\pi Rh$
195	$S = S_S + S_1 + S_2 = \pi\left(2Rh + r_1^2 + r_2^2\right)$
196	$V = \frac{1}{6}\pi h\left(3r_1^2 + 3r_2^2 + h^2\right)$
197	$S_L = \frac{\pi R^2}{90}\alpha = 2R^2 x$
198	$S = \pi R^2 + \frac{\pi R^2}{90}\alpha = \pi R^2 + 2R^2 x$
199	$V = \frac{\pi R^3}{270}\alpha = \frac{2}{3}R^3 x$
200	$V = \frac{4}{3}\pi abc$
201	$S = 2\pi b\left(b + \frac{a\sin^{-1}e}{e}\right)$, **where** $e = \frac{\sqrt{a^2 - b^2}}{a}$.
202	$V = \frac{4}{3}\pi b^2 a$
203	$S = 2\pi b\left(b + \frac{a\sin^{-1}h\left(\frac{be}{a}\right)}{be/a}\right)$, **where** $e = \frac{\sqrt{b^2 - a^2}}{b}$
204	

	$V = \frac{4}{3}\pi b^2 a$
205	$S = 4\pi^2 Rr$
206	$V = 2\pi^2 Rr^2$