



MATHS

BOOKS - VIKAS GUPTA MATHS (HINGLISH)

SOLUTION OF TRIANGLES

Exercise 1 Single Choice Problems

1. In a ΔABC if $9(a^2 + b^2) = 17c^2$ then the value of the $\frac{\cot A + \cot B}{\cot C}$ is

A. $\frac{13}{4}$

B. $\frac{7}{4}$

C. $\frac{5}{4}$

D. $\frac{9}{4}$

Answer: D

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2. Let H be the orthocenter of triangle ABC, then angle subtended by side BC at the centre of incircle of $\triangle CHB$ is :

A. $\frac{A}{2} + \frac{\pi}{2}$

B. $\frac{B + C}{2} + \frac{\pi}{2}$

C. $\frac{B - C}{2} + \frac{\pi}{2}$

D. $\frac{B + C}{2} + \frac{\pi}{4}$

Answer: B

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3. Circumradius of a $\triangle ABC$ is 3 units, let O be the circumcentre and H be the orthocentre then the value of $\frac{1}{64} (AH^2 + BC^2)(BH^2 + AC^2)(CH^2 + AB^2)$ equals :

A. 3^4

B. 9^3

C. 27^6

D. 81^4

Answer: B



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4. The angles A, B and C of a triangle ABC are in arithmetic progression. If $2b^2 = 3c^2$ then the angle A is :

A. 15°

B. 60°

C. 75°

D. 90°

Answer: C



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5. In a triangle ABC if $\tan. \frac{A}{2} \tan. \frac{B}{2} = \frac{1}{3}$ and $ab = 4$, then the value of c can be

A. 1

B. 2

C. 4

D. 6

Answer: B



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6. In a triangle ABC the expression

$a \cos B \cos C + b \cos C \cos A + c \cos A \cos B$ equals to :

A. $\frac{rs}{R}$

B. $\frac{r}{sR}$

C. $\frac{R}{rs}$

D. $\frac{Rs}{r}$

Answer: A



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7. The set of all real numbers a such that $a^2 + 2a$, $2a + 3$, and $a^2 + 3a + 8$ are the sides of a triangle is _____

A. $(0, \infty)$

B. $(5, 8)$

C. $\left(-\frac{11}{3}, \infty\right)$

D. $(5, \infty)$

Answer: D



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8. In a $\triangle ABC$, $\angle B = \frac{\pi}{3}$ and $\angle C = \frac{\pi}{4}$ let D divide BC internally in the ratio 1:3, then $\frac{\sin(\angle BAD)}{\sin(\angle CAD)}$ is equal to :

A. $\frac{1}{\sqrt{6}}$

B. $\frac{1}{3}$

C. $\frac{1}{\sqrt{3}}$

D. $\frac{\sqrt{2}}{3}$

Answer: A



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9. Let AD, BE, CF be the lengths of internal bisectors of angles A, B, C respectively of triangle ABC. Then the harmonic mean of $AD \sec \frac{A}{2}$, $BE \sec \frac{B}{2}$, $CF \sec \frac{C}{2}$ is equal to :

A. Harmonic mean of sides of $\triangle ABC$

B. Geometric mean of sides of $\triangle ABC$

C. Arithmetic mean of sides of $\triangle ABC$

D. Sum of reciprocals of the sides of $\triangle ABC$

Answer: A



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10. In a triangle ABC, if $2b = a + c$ and $A - C = 90$, then $\sin B$ equals

A. $\frac{\sqrt{7}}{5}$

B. $\frac{\sqrt{5}}{8}$

C. $\frac{\sqrt{7}}{4}$

D. $\frac{\sqrt{5}}{3}$

Answer: C



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11. In a triangle ABC , if $2a \cos\left(\frac{B - C}{2}\right) = b + c$, then $\sec A$ is equal to :

A. $\frac{2}{\sqrt{3}}$

B. $\sqrt{2}$

C. 2

D. 3

Answer: C



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12. In a triangle ABC if $BC = 1$ and $AC = 2$, then what is the maximum possible value of angle A ?

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{2}$

Answer: A



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13. $\Delta I_1 I_2 I_3$ is an excentral triangle of an equilateral triangle ΔABC such that $I_1 I_2 = 4$ unit, if ΔDEF is pedal triangle of

ΔABC , then $\frac{Ar(\Delta I_1 I_2 I_3)}{Ar(\Delta DEF)} =$

A. 16

B. 4

C. 2

D. 1

Answer: A



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14. Let ABC be a triangle with $\angle BAC = 2\pi/3$ and $AB = x$ such that $(AB)(AC) = 1$. If x varies, then find the longest possible length of the angle bisector AD

A. $\frac{1}{3}$

B. $\frac{1}{2}$

C. $\frac{2}{3}$

D. $\frac{\sqrt{2}}{3}$

Answer: B



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15. In an equilateral triangle r , R and r_1 form (where symbols used have usual meaning)

- A. an A.P.
- B. a G.P.
- C. an H.P.
- D. none of these

Answer: A

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16. In $\triangle ABC$ if $\frac{\sin A}{\sin C} = \frac{\sin(A - B)}{\sin(B - C)}$, then a^2, b^2, c^2 are in :

A. A.P.

B. G.P.

C. H.P.

D. none of these

Answer: A



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17. In $\triangle ABC$, $\tan A = 2$, $\tan B = \frac{3}{2}$ and $c = \sqrt{65}$, then circumradius of the triangle is :

A. 65

B. $\frac{65}{7}$

C. $\frac{65}{14}$

D. none of these

Answer: C



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18. If the sides a, b, c of a triangle ABC are the roots of the equation $x^3 - 13x^2 + 54x - 72 = 0$, then the value of $\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c}$ is equal to :

A. $\frac{61}{144}$

B. $\frac{61}{72}$

C. $\frac{169}{144}$

D. $\frac{59}{144}$

Answer: A





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19. In $\triangle ABC$, if $\angle C = 90^\circ$, then $\frac{a+c}{b} + \frac{b+c}{a}$ is equal to :

A. $\frac{c}{r}$

B. $\frac{1}{2Rr}$

C. 2

D. $\frac{R}{r}$

Answer: A



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20. In a $\triangle ABC$, if $a^2 \sin B = b^2 + c^2$, then :

A. $\angle A$ is obtuse

B. $\angle A$ is acute

C. $\angle B$ is obtuse

D. $\angle A$ is right angle

Answer: A



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21. If R and R' are the circumradii of triangles ABC and OBC , where O is the orthocenter of triangle ABC , then :

A. $R' = \frac{R}{2}$

B. $R' = 2R$

C. $R' = R$

D. $R' = 3R$

Answer: C



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22. The acute angle of a rhombus whose side is a mean proportional between its diagonals is

A. 15°

B. 20°

C. 30°

D. 60°

Answer: C



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23. In a $\triangle ABC$ right angled at A, a line is drawn through A to meet BC at D dividing BC in 2:1. If $\tan(\angle ADC) = 3$ then $\angle BAD$ is :

A. 30°

B. 45°

C. 60°

D. 75°

Answer: B



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24. A circle is circumscribed in an equilateral triangle of side ' l '.
The area of any square inscribed in the circle is :

A. $\frac{4}{3}l^2$

B. $\frac{2}{3}l^2$

C. $\frac{1}{3}l^2$

D. l^2

Answer: B



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25. if the sides of a triangle are in the ratio $2 : \sqrt{6} : \sqrt{3} + 1$, then the largest angle of the triangle will be (1) 60 (3) 90 (2) 75 (4) 120

A. 60°

B. 72°

C. 75°

D. 90°

Answer: C



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26. In a triangle ABC if a, b, c are in A.P. and $C - A = 120^\circ$, then

$\frac{s}{r} =$ (where notations have their usual meaning)

A. $\sqrt{15}$

B. $2\sqrt{15}$

C. $3\sqrt{15}$

D. $6\sqrt{15}$

Answer: C



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27. If in $\triangle ABC$, $a = 5$, $b = 4$ and $\cos(A - B) = \frac{31}{32}$, then

A. $\sqrt{6}$

B. $6\sqrt{6}$

C. 6

D. $(216)^{1/4}$

Answer: C



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28. If semiperimeter of a triangle is 15, then the value of $(b + c)\cos(B + C) + (c + a)\cos(C + A) + (a + b)\cos(A + B)$ is equal to :

(where symbols used have usual meanings)

A. -60

B. -15

C. -30

D. can not be determined

Answer: C



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29. Let triangle ABC be an isosceles with $AB=AC$. Suppose that the angle bisector of its angle B meets the side AC at a point D and that $BC = BD + AD$. Measure of the angle A in degrees, is :

A. 80

B. 100

C. 110

D. 130

Answer: B



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30. In triangle ABC if

$A : B : C = 1 : 2 : 4$, then $(a^2 - b^2)(b^2 - c^2)(c^2 - a^2) = \lambda a^2 b^2 c^2$

, where $\lambda =$

(where notations have their usual meaning)

A. 1

B. 2

C. 4

D. 9

Answer: A



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31. In a triangle ABC with altitude AD , $\angle BAC = 45^\circ$, $DB = 3$ and $CD = 2$. The area of the triangle ABC is :

A. 6

B. 15

C. $15/4$

D. 12

Answer: B



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32. A triangle has base 10 cm long and the base angles of 50° and 70° . If the perimeter of the triangle is $x + y \cos z^\circ$ where $z \in (0, 90)$ then the value of $x + y + z$ equals :

A. 60

B. 55

C. 50

D. 40

Answer: D



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33. Let H be the orthocenter of triangle ABC, then angle subtended by side BC at the centre of incircle of $\triangle CHB$ is :

A. $\frac{A}{2} + \frac{\pi}{2}$

B. $\frac{B + C}{2} + \frac{\pi}{2}$

C. $\frac{B - C}{2} + \frac{\pi}{2}$

D. $\frac{B + C}{2} + \frac{\pi}{4}$

Answer: B



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34. Triangle ABC is right angle at A. The points P and Q are on hypotenuse BC such that $BP = PQ = QC$.if $AP = 3$ and $AQ = 4$, then length BC is equal to

A. $\sqrt{27}$

B. $\sqrt{36}$

C. $\sqrt{45}$

D. $\sqrt{54}$

Answer: C



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35. In a $\triangle ABC$ if $b = a(\sqrt{3} - 1)$ and $\angle C = 30^\circ$ then the measure of the angle A is

A. 15°

B. 45°

C. 75°

D. 105°

Answer: D



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36. Through the centroid of an equilateral triangle, a line parallel to the base is drawn. On this line, an arbitrary point P is taken inside the triangle. Let h denote the perpendicular distance of P from the base of the triangle. Let h_1 and h_2 be the perpendicular distance of P from the other two sides of the triangle. Then :

A. $h = \frac{h_1 + h_2}{2}$

B. $h = \sqrt{h_1 h_2}$

C. $h = \frac{2h_1 h_2}{h_1 + h_2}$

D. $h = \frac{(h_1 + h_2)\sqrt{3}}{4}$

Answer: A



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37. The angles A, B and C of a triangle ABC are in arithmetic progression. $AB=6$ and $BC=7$. Then AC is :

A. $\sqrt{41}$

B. $\sqrt{39}$

C. $\sqrt{42}$

D. $\sqrt{43}$

Answer: D



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38. In $\triangle ABC$, if $A - B = 120^\circ$ and $R = 8r$, then the value of $\frac{1 + \cos C}{1 - \cos C}$ equals :

(All symbols used have their usual meaning in a triangle)

A. 12

B. 15

C. 21

D. 31

Answer: B



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39. The lengths of the sides CB and CA of a triangle ABC are given by a and b and the angle C is $\frac{2\pi}{3}$. The line CD bisects the angle C and meets AB at D. Then the length of CD is :

A. $\frac{1}{a+b}$

B. $\frac{a^2 + b^2}{a+b}$

C. $\frac{ab}{2(a+b)}$

D. $\frac{ab}{a+b}$

Answer: D



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40. In $\triangle ABC$, angle A is 120° , $BC + CA = 20$, and $AB + BC = 21$. Find the length of the side BC.

A. 13

B. 15

C. 17

D. 19

Answer: A



41. A triangle has sides 6,7, and 8. The line through its incenter parallel to the shortest side is drawn to meet the other two sides at P and Q. Then find the length of the segment PQ.

A. $\frac{12}{5}$

B. $\frac{15}{4}$

C. $\frac{30}{7}$

D. $\frac{33}{9}$

Answer: C



42. The perimeter of a $\triangle ABC$ is 48 cm and one side is 20 cm.

Then remaining sides of $\triangle ABC$ must be greater than :

- A. 8 cm
- B. 9 cm
- C. 12 cm
- D. 4 cm

Answer: D



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43. In a equilateral triangle r , R and r_1 form (where symbols used

have usual meaning)

- A. an A.P.

B. a G.P.

C. an H.P.

D. neither an A.P., G.P. nor H.P.

Answer: A



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44. The expression $\frac{(a + b + c)(b + c - a)(c + a - b)(a + b - c)}{4b^2c^2}$ is equal to

A. $\cos^2 A$

B. $\sin^2 A$

C. $\cos A \cos B \cos C$

D. $\sin A \sin B \sin C$

Answer: B



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45. Circumradius of an isosceles $\triangle ABC$ with $\angle A = \angle B$ is 4 times its in radius, then $\cos A$ is root of the equation :

A. $x^2 - x - 8 = 0$

B. $8x^2 - 8x + 1 = 0$

C. $x^2 - x - 4 = 0$

D. $4x^2 - 4x + 1 = 0$

Answer: B



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46. A is the orthocentre of $\triangle ABC$ and D is reflection point of A w.r.t. perpendicular bisector of BC, then orthocenter of $\triangle DBC$ is :

A. D

B. C

C. B

D. A

Answer: A



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47. If $a \neq b \neq c$ are all positive, then the value of the

determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ is

A. ≥ 0

B. > 0

C. ≤ -1

D. < 0

Answer: D



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48. In triangle ABC if

$A : B : C = 1 : 2 : 4$, then $(a^2 - b^2)(b^2 - c^2)(c^2 - a^2) = \lambda a^2 b^2 c^2$

, where $\lambda =$

(where notations have their usual meaning)

A. 1

B. 2

C. 3

D. $\frac{1}{3}$

Answer: A



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49. In any triangle, the minimum value of $r_1 r_2 r_3 / r^3$ is equal to

A. 1

B. 3

C. 8

D. 27

Answer: D



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50. In ΔABC , $a = 3$, $b = 4$ and $c = 5$, then value of $\sin A + \sin 2B + \sin 3C$ is

A. $\frac{24}{25}$

B. $\frac{14}{25}$

C. $\frac{64}{25}$

D. None

Answer: B



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51. In any triangle ABC, the value of $\frac{r_1 + r_2}{1 + \cos C}$ is equal to (where notation have their usual meaning) :

A. $2R$

B. $2r$

C. R

D. $\frac{2R^2}{r}$

Answer: A



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52. In a triangle ABC , medians AD and BE are drawn. If $AD = 4$, $\angle DAB = \frac{\pi}{6}$ and $\angle ABE = \frac{\pi}{3}$, then the area of the triangle ABC is-

A. $\frac{8}{3\sqrt{3}}$

B. $\frac{16}{3\sqrt{3}}$

C. $\frac{32}{3\sqrt{3}}$

D. $\frac{64}{3\sqrt{3}}$

Answer: C

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53. The sides of a triangle are $\sin \alpha$, $\cos \alpha$ and $\sqrt{1 + \sin \alpha \cos \alpha}$ for some α , $0 < \alpha < \frac{\pi}{2}$. Then the greatest angle of the triangle is

A. $\frac{\pi}{3}$

B. $\frac{\pi}{2}$

C. $\frac{2\pi}{3}$

D. $\frac{5\pi}{6}$

Answer: C



54. Let ABC be a right with $\angle BAC = \frac{\pi}{2}$, then $\left(\frac{r^2}{2R^2} + \frac{r}{R} \right)$ is equal to :

(where symbols used have usual meaning in a triangle)

A. $\sin B \sin C$

B. $\tan B \tan C$

C. $\sec B \sec C$

D. $\cot B \cot C$

Answer: A

55. In a $\triangle ABC$, with usual notations, if $b > c$ then distance between foot of median and foot of altitude both drawn from vertex A on BC is :

A. $\frac{a^2 - b^2}{2c}$

B. $\frac{b^2 - c^2}{2a}$

C. $\frac{b^2 + c^2 - a^2}{2a}$

D. $\frac{b^2 + c^2 - a^2}{2c}$

Answer: B



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56. In a triangle ABC the expression $a \cos B \cos C + b \cos A \cos B$ equals to :

A. $\frac{rs}{R}$

B. $\frac{r}{sR}$

C. $\frac{R}{rs}$

D. $\frac{Rs}{r}$

Answer: A



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57. In a acute triangle ABC, altitudes from the vertices A, B and C meet the opposite sides at the points D, E and F respectively. If the radius of the circumcircle of $\triangle AFE$, $\triangle BFD$, $\triangle CED$, $\triangle ABC$ be respectively R_1 , R_2 , R_3 and R . Then the maximum value of $R_1 + R_2 + R_3$ is :

A. $\frac{3R}{8}$

B. $\frac{2R}{3}$

C. $\frac{4R}{3}$

D. $\frac{3R}{2}$

Answer: D



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Exercise 2 One Or More Than One Answer Is Are Correct

1. If r_1, r_2, r_3 are radii of the escribed circles of a triangle ABC and r it the radius of its incircle, then the root(s) of the equation $x^2 - r(r_1r_2 + r_2r_3 + r_3r_1)x + (r_1r_2r_3 - 1) = 0$ is/are :

A. r_1

B. $r_2 + r_3$

C. 1

D. $r_1 r_2 r_3 - 1$

Answer: C::D



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2. In $\triangle ABC$, $\angle A = 60^\circ$, $\angle B = 90^\circ$, $\angle C = 30^\circ$. Let H be its orthocentre, then :

(where symbols used have usual meanings)

A. $AH = c$

B. $CH = a$

C. $AH = a$

D. $BH = 0$

Answer: A::B::D



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3. In an equilateral triangle, if inradius is a rational number then

A. circumradius is always rational

B. exradii are always rational

C. area is always ir-rational

D. perimeter is always rational

Answer: A::B::C



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4. Let A, B, C be angles of a triangle ABC and let

$$D = \frac{5\pi + A}{32}, E = \frac{5\pi + B}{32}, F = \frac{5\pi + C}{32}, \text{ then :}$$

(where $D, E, F \neq \frac{n\pi}{2}, n \in I, I$ denote set of integers)

A. $\cot D \cot E + \cot E \cot F + \cot D \cot F = 1$

B. $\cot D + \cot E + \cot F = \cot D \cot E \cot F$

C. $\tan D \tan E + \tan E \tan F + \tan F \tan D = 1$

D. $\tan D + \tan E + \tan F = \tan D \tan E \tan F$

Answer: B::C



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5. In a triangle ABC , if $a=4, b=8$ and $\angle C = 60^\circ$, then :

(where symbols used have usual meanings)

A. $c = 6$

B. $c = 4\sqrt{3}$

C. $\angle A = 30^\circ$

D. $\angle B = 90^\circ$

Answer: B::C::D



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6. In a $\triangle ABC$ if $\frac{r}{r_1} = \frac{r_2}{r_3}$, then which of the following is/are true ?

(where symbols used have usual meanings)

A. $a^2 + b^2 + c^2 = 8R^2$

B. $\sin^2 A + \sin^2 B + \sin^2 C = 2$

C. $a^2 + b^2 = c^2$

$$D. \Delta = s(s + c)$$

Answer: A::B::C



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7. ABC is a triangle whose circumcentre, incentre and orthocentre are O, I and H respectively which lie inside the triangle, then :

A. $\angle BOC = A$

B. $\angle BIC = \frac{\pi}{2} + \frac{A}{2}$

C. $\angle BHC = \pi - A$

D. $\angle BHC = \pi - \frac{A}{2}$

Answer: B::C



8. In a triangle ABC, $\tan A$ and $\tan B$ satisfy the inequality $\sqrt{3}x^2 - 4x + \sqrt{3} < 0$, then which of the following must be correct ?

(where symbols used have usual meanings)

A. $a^2 + b^2 - ab < c^2$

B. $a^2 + b^2 > c^2$

C. $a^2 + b^2 + ab > c^2$

D. $a^2 + b^2 < c^2$

Answer: A::C

9. If in ΔABC , $\angle C = \frac{\pi}{8}$, $a = \sqrt{2}$ and $b = \sqrt{2 + \sqrt{2}}$ then find the measure of angle A (in degree).

A. 45°

B. 135°

C. 30°

D. 150°

Answer: A



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10. In triangle ABC, $a = 3$, $b = 4$, $c = 2$. Point D and E trisect the side BC. If $\angle DAE = \theta$, then $\cot^2 \theta$ is divisible by :

A. 2

B. 3

C. 5

D. 7

Answer: B::C



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11. In a triangle ABC, $3\sin A + 4\cos B = 6$ and $4\sin B + 3\cos A = 1$.

Find the measure of angle C.

A. $\frac{\pi}{4}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{3}$

D. $\frac{5\pi}{6}$

Answer: B

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12. If the line joining the incentre to the centroid of a triangle ABC is parallel to the side BC. Which of the following are correct ?

A. $2b = a + c$

B. $2a = b + c$

C. $\cot \frac{A}{2} \cot \frac{C}{2} = 3$

D. $\cot \frac{B}{2} \cot \frac{C}{2} = 3$

Answer: B::D

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13. In a triangle the lengths of the two larger are 10 and 9 respectively. If the angles are in A.P., the length of the third side can be (A) $5 - \sqrt{6}$ (B) $3\sqrt{3}$ (C) 5 (D) $5 + \sqrt{6}$

A. $5 - \sqrt{6}$

B. $5 + \sqrt{6}$

C. $6 - \sqrt{5}$

D. $6 + \sqrt{5}$

Answer: A::B



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14. If area of $\triangle ABC(\Delta)$ and angle C are given and if c opposite to given angle is minimum, then

$$\text{A. } a = \sqrt{\frac{2\Delta}{\sin C}}$$

$$\text{B. } b = \left(\frac{2\Delta}{\sin C}\right)$$

$$\text{C. } a = \frac{4\Delta}{\sin C}$$

$$\text{D. } b = \frac{4\Delta}{\sin^2 C}$$

Answer: A::B



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15. In a triangle ABC, if $\tan A = 2 \sin 2C$ and $3 \cos A = 2 \sin B \sin C$, then C=

A. $\frac{\pi}{8}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{4}$

D. $\frac{\pi}{3}$

Answer: C::D



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Exercise 3 Comprehension Type Problems

1. Let $\angle A = 23^\circ$, $\angle B = 75^\circ$ and $\angle C = 82^\circ$ be the angles of $\triangle ABC$.

The incircle of $\triangle ABC$ touches the sides BC, CA, AB at points D, E, F respectively. Let r' , r'_1 respectively be the inradius, exradius opposite to vertex D of $\triangle DEF$ and r be inradius of $\triangle ABC$, then

Q. $\frac{r'}{r} =$

A. $\sin\frac{A}{2} + \sin\frac{B}{2} + \sin\frac{C}{2} - 1$

$$\text{B. } 1 - \sin \frac{A}{2} + \sin \frac{B}{2} + \sin \frac{C}{2}$$

$$\text{C. } \cos \frac{A}{2} + \cos \frac{B}{2} + \cos \frac{C}{2} - 1$$

$$\text{D. } 1 - \cos \frac{A}{2} + \cos \frac{B}{2} + \cos \frac{C}{2}$$

Answer: A



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2. Let $\angle A = 23^\circ$, $\angle B = 75^\circ$ and $\angle C = 82^\circ$ be the angles of $\triangle ABC$.

The incircle of $\triangle ABC$ touches the sides BC, CA, AB at points D, E, F respectively. Let r' , r_1' respectively be the inradius, exradius opposite to vertex D of $\triangle DEF$ and r be inradius of $\triangle ABC$, then

$$\text{Q. } \frac{r_1'}{r} =$$

A. $\sin \frac{A}{2} + \sin \frac{B}{2} + \sin \frac{C}{2} - 1$

B. $1 - \sin \frac{A}{2} + \sin \frac{B}{2} + \sin \frac{C}{2}$

C. $\cos \frac{A}{2} + \cos \frac{B}{2} + \cos \frac{C}{2} - 1$

D. $1 - \cos \frac{A}{2} + \cos \frac{B}{2} + \cos \frac{C}{2}$

Answer: B



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3. Internal bisectors of $\triangle ABC$ meet the circumcircle at point D, E, and F

Area of $\triangle DEF$ is

A. $2R^2 \cos^2 \left(\frac{A}{2} \right) \cos^2 \left(\frac{B}{2} \right) \cos^2 \left(\frac{C}{2} \right)$

B. $2R^2 \sin \left(\frac{A}{2} \right) \sin \left(\frac{B}{2} \right) \sin \left(\frac{C}{2} \right)$

C. $2R^2 \sin^2 \left(\frac{A}{2} \right) \sin^2 \left(\frac{B}{2} \right) \sin^2 \left(\frac{C}{2} \right)$

$$D. 2R^2 \cos\left(\frac{A}{2}\right) \cos\left(\frac{B}{2}\right) \cos\left(\frac{C}{2}\right)$$

Answer: D



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4. Internal angle bisectors of $\triangle ABC$ meet its circumcircle at D, E and F where symbols have usual meaning.

Q. The ratio of area of triangle ABC and triangle DEF is :

A. ≥ 1

B. ≤ 1

C. $\geq 1/2$

D. $\leq 1/2$

Answer: B





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5. Let triangle ABC is right triangle right angled at C such that

$A < B$ and $r = 8, R = 41$.

Q. Area of $\triangle ABC$ is :

A. 720

B. 1440

C. 360

D. 480

Answer: A



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6. Let triangle ABC is right triangle right angled at C such that

$$A < B \text{ and } r = 8, R = 41.$$

Q. $\tan \frac{A}{2} =$

A. $\frac{1}{18}$

B. $\frac{1}{3}$

C. $\frac{1}{6}$

D. $\frac{1}{9}$

Answer: D



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7. Let the incircle of ΔABC touches the sides BC, CA, AB at A_1, B_1, C_1 respectively. The incircle of $\Delta A_1B_1C_1$ touches its sides of B_1C_1, C_1A_1 and A_1B_1 at A_2, B_2, C_2 respectively

and so on.

Q. $\lim_{n \rightarrow \infty} \angle A_n =$

A. 0

B. $\frac{\pi}{6}$

C. $\frac{\pi}{4}$

D. $\frac{\pi}{3}$

Answer: D



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8. Let the incircle of $\triangle ABC$ touches the sides BC, CA, AB at A_1, B_1, C_1 respectively. The incircle of $\triangle A_1B_1C_1$ touches its sides of B_1C_1, C_1A_1 and A_1B_1 at A_2, B_2, C_2 respectively

and so on.

Q. In $\Delta A_4 B_4 C_4$, the value of $\angle A_4$ is:

A. $\frac{3\pi + A}{6}$

B. $\frac{3\pi - A}{8}$

C. $\frac{5\pi - A}{16}$

D. $\frac{5\pi + A}{16}$

Answer: D



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9. Let ABC be a given triangle. Points D and E are on sides AB and AC respectively and point F is on line segment DE. Let

$\frac{AD}{AB} = x$, $\frac{AE}{AC} = y$, $\frac{DF}{DE} = z$. Let area of $\Delta BDF = \Delta_1$, Area

of $\Delta CEF = \Delta_2$ and area of $\Delta ABC = \Delta$.

Q. $\frac{\Delta_1}{\Delta}$ is equal to :

A. xyz

B. $(1 - x)y(1 - z)$

C. $(1 - x)yz$

D. $x(1 - y)z$

Answer: C



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10. Let ABC be a given triangle. Points D and E are on sides AB and AC respectively and point F is on line segment DE. Let $\frac{AD}{AB} = x$, $\frac{AE}{AC} = y$, $\frac{DF}{DE} = z$. Let area of $\Delta BDF = \Delta_1$, Area

of $\Delta CEF = \Delta_2$ and area of $\Delta ABC = \Delta$.

Q. $\frac{\Delta_2}{\Delta}$ is equal to :

A. $(1 - x)y(1 - z)$

B. $(1 - x)(1 - y)z$

C. $x(1 - y)(1 - z)$

D. $(1 - x)yz$

Answer: C



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11. a, b, c are the lengths of sides BC, CA, AB respectively of ΔABC

satisfying $\log\left(1 + \frac{c}{a}\right) + \log a - \log b = \log 2$. Also the

quadratic equation $a(1 - x^2) + 2bx + c(1 + x^2) = 0$ has two

equal roots. Q. a, b, c are in :

A. A.P.

B. G.P.

C. H.P.

D. None

Answer: A



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12. a, b, c are the lengths of sides BC, CA, AB respectively of $\triangle ABC$

satisfying $\log\left(a + \frac{c}{a}\right) + \log a - \log b = \log 2$.

Also the quadratic equation $a(1 - x^2) + 2bx + c(1 + x^2) = 0$

has two equal roots.

Q. Measure of angle C is :

A. 30°

B. 45°

C. 60°

D. 90°

Answer: D



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13. If a, b, c are the sides of triangle ABC satisfying

$$\log\left(1 + \frac{c}{a}\right) + \log a - \log b = \log 2.$$

Also

$a(1 - x^2) + 2bx + c(1 + x^2) = 0$ has two equal roots. Find

the value of $\sin A + \sin B + \sin C$.

A. $\frac{5}{2}$

B. $\frac{12}{5}$

C. $\frac{8}{3}$

Answer: B



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14. Let ABC be a triangle inscribed in a circle and let $l_a = \frac{m_a}{M_a}$, $l_b = \frac{m_b}{M_b}$, $l_c = \frac{m_c}{M_c}$ where m_a, m_b, m_c are the lengths of the angle bisectors of angles A, B and C respectively, internal to the triangle and M_a, M_b and M_c are the lengths of these internal angle bisectors extended until they meet the circumcircle.

Q. l_a equals :

A. $\frac{\sin A}{\sin\left(B + \frac{A}{2}\right)}$

B. $\frac{\sin B \sin C}{\sin^2\left(\frac{B+C}{2}\right)}$

C. $\frac{\sin B \sin C}{\sin^2\left(B + \frac{A}{2}\right)}$

D. $\frac{\sin B + \sin C}{\sin^2\left(B + \frac{A}{2}\right)}$

Answer: C



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15. Let ABC be a triangle inscribed in a circle and let $l_a = \frac{m_a}{M_a}$, $l_b = \frac{m_b}{M_b}$, $l_c = \frac{m_c}{M_c}$ where m_a, m_b, m_c are the lengths of the angle bisectors of angles A, B and C respectively, internal to the triangle and M_a, M_b and M_c are the lengths of these internal angle bisectors extended until they meet the circumcircle.

Q. The maximum value of the product

$$(l_a l_b l_c) \times \cos^2\left(\frac{B - C}{2}\right) \times \frac{\cos^2(C - A)}{2} \times \cos^2\left(\frac{A - B}{2}\right)$$

is equal to :

A. $\frac{1}{8}$

B. $\frac{1}{64}$

C. $\frac{27}{64}$

D. $\frac{27}{32}$

Answer: C



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16. Let ABC be a triangle inscribed in a circle and let

$$l_a = \frac{m_a}{M_a}, l_b = \frac{m_b}{M_b}, l_c = \frac{m_c}{M_c} \quad \text{where } m_a, m_b, m_c \text{ are the}$$

lengths of the angle bisectors of angles A, B and C respectively ,

internal to the triangle and M_a, M_b and M_c are the lengths of

these internal angle bisectors extended until they meet the circumcircle.

Q. The minimum value of the expression

$$\frac{l_a}{\sin^2 A} + \frac{l_b}{\sin^2 B} + \frac{l_c}{\sin^2 C} \text{ is :}$$

A. 2

B. 3

C. 4

D. none of these

Answer: B



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Exercise 5 Subjective Type Problems

1. If the median AD of triangle ABC makes an angle $\frac{\pi}{4}$ with the side BC, then find the value of $|\cot B - \cot C|$.



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2. In a ΔABC , $a = \sqrt{3}$, $b = 3$ and $\angle C = \frac{\pi}{3}$. Let internal angle bisectors of angle C intersects side AB at D and altitude from B meets the angle bisector CD at E. If Q_1 and Q_2 are incentres of ΔBEC and ΔBED . Find the distance between the vertex B and orthocentre of ΔO_1EO_2 .



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3. In a ΔABC ; inscribed circle with centre I touches sides AB , AC and BC at D , E , F respectively. Let area of

quadrilateral ADIE is 5 units and area of quadrilateral BFID is 10

units. Find the value of $\frac{\cos\left(\frac{C}{2}\right)}{\sin\left(\frac{A-B}{2}\right)}$.



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4. If Δ be area of incircle of a triangle ABC and $\Delta_1, \Delta_2, \Delta_3$ be the area of excircles then find the least value of $\frac{\Delta_1 \Delta_2 \Delta_3}{729 \Delta^3}$



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5. In $\triangle ABC$, $b = c$, $\angle A = 106^\circ$, M is an interior point such that

$\angle MBA = 7^\circ$, $\angle MAB = 23^\circ$ and $\angle MCA = \theta^\circ$, then $\frac{\theta}{2}$

is equal to

(where notations have their usual meaning)



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6. In an acute angled triangle ABC , $\angle A = 20^\circ$, let DEF be the feet of altitudes through A, B, C respectively and H is the orthocentre of $\triangle ABC$. Find $\frac{AH}{AD} + \frac{BH}{BE} + \frac{CH}{CF}$.

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7. Let $\triangle ABC$ be inscribed in a circle having radius unity. The three internal bisectors of the angles A, B and C are extended to intersect the circumcircle of $\triangle ABC$ at A_1, B_1 and C_1 respectively. Then $\frac{AA_1 \cos \frac{A}{2} + BB_1 \cos \frac{B}{2} + CC_1 \cos \frac{C}{2}}{\sin A + \sin B + \sin C} =$

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8. If the quadratic equation $ax^2 + bx + c = 0$ has equal roots where a, b, c denotes the lengths of the sides opposite to vertex A, B and C of the $\triangle ABC$ respectively then find the number of integers in the range of $\frac{\sin A}{\sin C} + \frac{\sin C}{\sin A}$

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9. If in the triangle ABC , $\tan \frac{A}{2}, \tan \frac{B}{2}$ and $\tan \frac{C}{2}$ are in harmonic progression then the least value of $\cot^2 \frac{B}{2}$ is equal to :

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10. In $\triangle ABC$, if circumradius ' R ' and inradius ' r ' are connected by relation $R^2 - 4Rr + 8r^2 - 12r + 9 = 0$, then the greatest

integer which is less than the semiperimeter of $\triangle ABC$ is :



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11. Let a, b, c be sides of a triangle ABC and Δ denotes its area .

If $a = 2, \Delta = \sqrt{3}$ and $a \cos C + \sqrt{3}a \sin C - b - c = 0$, then

find the value of $(b + c)$.

(symbols used have usual meaning in $\triangle ABC$).



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12. Circumradius of $\triangle ABC$ is 3 cm and its area is 6cm^2 . If DEF is

the triangle formed by feet of the perpendicular drawn from A, B

and C on the sides BC, CA and AB , respectively, then the

perimeter of $\triangle DEF$ (in cm) is _____



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