



## MATHS

### BOOKS - VK JAISWAL ENGLISH

### SOLUTION OF TRIANGLES

#### Exercise 1 Single Choice Problems

1. In a  $\Delta ABC$  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 orthocentre 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. Circum radius of a  $\Delta ABC$  is 3 units, let O be the circum 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.  $15^\circ$

B.  $60^\circ$

C.  $75^\circ$

D.  $90^\circ$

**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  $\triangle ABC$ , if  $2b = a + c$  and  $A - C = 90^\circ$ , then  $\sin B$  equal

All symbols used have usual meaning in  $\triangle ABC$ . ]

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 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  $\Delta ABC$  such that  $I_1 I_2 = 4$  unit, if  $\Delta DEF$  is pedal triangle of

$\Delta ABC$ , 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  $\triangle ABC$ , (where symbols used have usual meanings), then  $r$ ,  $R$  and  $r_1$  form :

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

**Answer: A**

[!\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\) Watch Video Solution](#)

16. If  $\frac{\sin A}{\sin C} = \frac{\sin(A - B)}{\sin(B - C)}$ , prove that  $a^2, b^2, c^2$  are in A.P.

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

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 the geometric mean of its diagonals is

A.  $15^\circ$

B.  $20^\circ$

C.  $30^\circ$

D.  $60^\circ$

**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)  $30^\circ$  (b)  $45^\circ$  (c)  $60^\circ$  (d)  $75^\circ$

A.  $30^\circ$

B.  $45^\circ$

C.  $60^\circ$

D.  $75^\circ$

**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 (2) 72 (3) 75 (4) 90

A.  $60^\circ$

B.  $72^\circ$

C.  $75^\circ$

D.  $90^\circ$

**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**



27. In  $\triangle ABC$ , let  $a = 5$ ,  $b = 4$  and  $\cos\left(A - B = \frac{31}{32}\right)$ ,

then which of the following statement (s) is (are) correct ?

[Note All symbols used have usual meaning in a triangle]

A.  $\sqrt{6}$

B.  $6\sqrt{6}$

C. 6

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

**Answer: C**

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)  $\frac{15}{4}$  (d) 12

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  $50^\circ$  and  $70^\circ$ . 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**



33. Let H be the orthocentre 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**

34. Triangle ABC is right angles 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.  $15^\circ$

B.  $45^\circ$

C.  $75^\circ$

D.  $105^\circ$

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

$$C. h = \frac{2h_1h_2}{h_1 + h_2}$$

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

**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)  $\frac{ab}{a+b}$

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  $120^\circ$ ,  $BC + CA = 20$ , and  $AB + BC = 21$ . Find the length of the side BC

A. 13

B. 15

C. 17

D. 19

**Answer: A**



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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**



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

Then remaining sides of  $\triangle ABC$  must be greater than : (a)  $8\text{cm}$

(b)  $9\text{cm}$  (c)  $12\text{cm}$  (d)  $4\text{cm}$

A. 8 cm

B. 9 cm

C. 12 cm

D. 4 cm

**Answer: D**



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43. In an equilateral  $\triangle ABC$ , (where symbols used have usual meanings), then  $r$ ,  $R$  and  $r_1$  form :

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. Prove that

$$\frac{(a + b + c)(b + c - a)(c + a - b)(a + b - c)}{4b^2c^2} = \sin^2$$

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.  $\geq 0$

B.  $> 0$

C.  $\leq -1$

D.  $< 0$

**Answer: D**



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48. In triangle ABC if

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

, 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 a triangle ABC, side BC = 3, AC = 4 and AB = 5. The value of

$\sin A + \sin 2B + \sin 3C$  is equal to :

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**



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**

53. The sides of the triangle are  $\sin\alpha$ ,  $\cos\alpha$  and  $\sqrt{1 + \sin\alpha \cos\alpha}$  for some  $0 < \alpha < \frac{\pi}{2}$ . 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**



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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.  $\cot B \cot C$

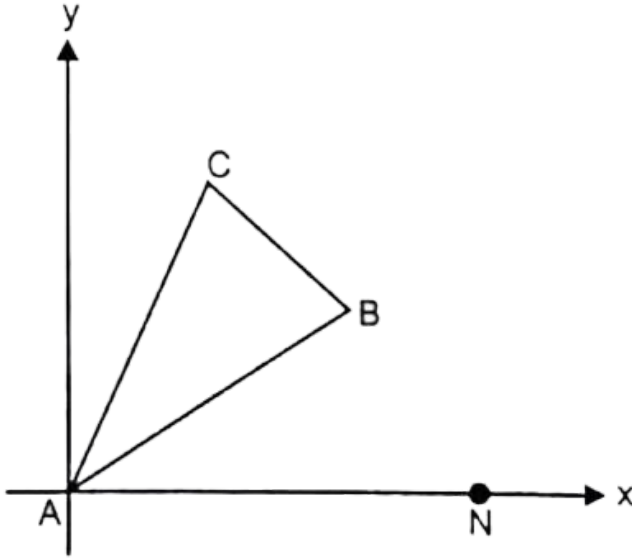
**Answer: A**



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**55.** Find the radius of the circle escribed to the triangle ABC (Shown in the figure below) on the side BC if

$\angle NAB = 30^\circ$ ,  $\angle BAC = 30^\circ$ ,  $AB=AC=5$ .



- A.  $\frac{(10\sqrt{2} + 5\sqrt{3} - 5)(2 - \sqrt{3})}{2\sqrt{2}}$
- B.  $\frac{(10\sqrt{2} + 5\sqrt{3} + 5)}{2\sqrt{2}}(2 - \sqrt{3})$
- C.  $\frac{(10\sqrt{2} + 5\sqrt{3} - 5)}{2\sqrt{2}}(2 + \sqrt{3})$
- D.  $\frac{(10\sqrt{2} + 5\sqrt{2} + 1)}{2\sqrt{3}}(\sqrt{3} - 1)$

**Answer: A**



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56. 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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57. 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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58. A circle of area 20 sq. units is centered at the point O. Suppose  $\triangle ABC$  is inscribed in that circle and has area 8 sq. units. The central angles  $\alpha, \beta$  and  $\gamma$  are as shown in the figure.

The value of  $(\sin \alpha + \sin \beta + \sin \gamma)$  is equal to



A.  $\frac{4\pi}{5}$

B.  $\frac{3\pi}{4}$

C.  $\frac{2\pi}{5}$

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

**Answer: A**



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## Exercise 2 One Or More Than One Answer Is Are Correct

1. 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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2. In an equilateral triangle, if inradius is a rational number then which of the following is/are correct ?

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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3. 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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4. 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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5. Find the perimeter of an equilateral triangle with side 9cm.



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6. 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



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7. 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**



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

A.  $45^\circ$

B.  $135^\circ$

C.  $30^\circ$

D.  $150^\circ$

**Answer: A**



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**9.** 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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10. In a  $\triangle ABC$ ,  $3 \sin A + 4 \cos B = 6$  and  $3 \cos A + 4 \sin B = 1$ , then  $\angle C$  can be

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

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

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

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

**Answer: B**



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11. 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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12. In a triangle, the lengths of the two larger sides are 10 and 9, respectively. If the angles are in A.P, then 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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**13.** If area of  $\triangle ABC(\Delta)$  and angle C are given and if c opposite to given angle is minimum, then

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

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



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

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

**Answer: A::B**



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14. In a triangle ABC, if  $\tan A = 2 \sin 2C$  and  $3 \cos A = 2 \sin B \sin C$  then possible values of C is/are

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. 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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2. 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.  $\geq 1$

B.  $\leq 1$

C.  $\geq 1/2$

D.  $\leq 1/2$

**Answer: B**



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

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

Q. Area of  $\Delta ABC$  is :

A. 720

B. 1440

C. 360

D. 480

**Answer: A**



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

$A < B$  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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5. 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.  $\lim_{n \rightarrow \infty} \angle A_n =$

A. 0

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

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

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

**Answer: D**



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6. 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  $\triangle A_4B_4C_4$ , 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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7. 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  $\triangle BDF = \Delta_1$ , Area of  $\triangle CEF = \Delta_2$  and area of  $\triangle ABC = \Delta$ .

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

satisfying  $\log\left(1 + \frac{c}{a}\right) + \log a - \log b = \log 2$ .  $a, b, c$  are in :

A. A.P.

B. G.P.

C. H.P.

D. None

**Answer: A**



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9.  $a, b, c$  are the length of sides  $BC, CA, AB$  respectively of  $\Delta ABC$  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.

. Measure of angle  $C$  is :

A.  $30^\circ$

B.  $45^\circ$

C.  $60^\circ$

D.  $90^\circ$

**Answer: D**



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

D. 2

**Answer: B**



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11. 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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12. 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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## Exercise 4 Matching Type Problems

Column-I		Column-II	
(A)	Find the sum of the series $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{6} + \frac{1}{8} + \frac{1}{9} + \frac{1}{12} + \dots \infty$ , where the terms are the reciprocals of the positive integers whose only prime factors are two's and three's	(P)	7
(B)	The length of the sides of $\Delta ABC$ are $a, b$ and $c$ and $A$ is the angle opposite to side $a$ . If $b^2 + c^2 = a^2 + 54$ and $bc = \frac{a^3}{\cos A}$ then the value of $\left(\frac{b^2 + c^2}{9}\right)$ , is	(Q)	10
(C)	The equations of perpendicular bisectors of two sides $AB$ and $AC$ of a triangle $ABC$ are $x + y + 1 = 0$ and $x - y + 1 = 0$ respectively. If circumradius of $\Delta ABC$ is 2 units and the locus of vertex $A$ is $x^2 + y^2 + gx + c = 0$ , then $(g^2 + c^2)$ , is equal to	(R)	13
(D)	Number of solutions of the equation $\cos \theta \sin \theta + 6(\cos \theta - \sin \theta) + 6 = 0$ in $[0, 30]$ , is equal to	(S)	3

1.



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2. In  $\triangle ABC$ , if  $r_1 = 21$ ,  $r_2 = 24$ ,  $r_3 = 28$ , then

Column-I		Column-II	
(A) $a =$		(P) 8	
(B) $b =$		(Q) 12	
(C) $s =$		(R) 26	
(D) $r =$		(S) 28	
		(T) 42	

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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  $\triangle ABC$ ; 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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3. If  $\Delta$  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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4. 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  $\Delta ABC$ . Find  $\frac{AH}{AD} + \frac{BH}{BE} + \frac{CH}{CF}$ .



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5. 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  $\Delta ABC$  respectively. Find the number of integers in the range of  $\frac{\sin A}{\sin C} + \frac{\sin C}{\sin A}$ .



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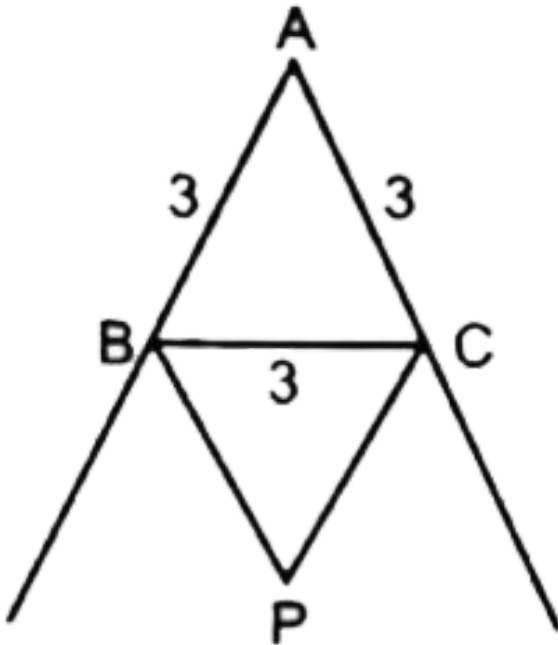
6. if  $ABC$  is a triangle and  $\tan\left(\frac{A}{2}\right), \tan\left(\frac{B}{2}\right), \tan\left(\frac{C}{2}\right)$  are in H.P. Then find the minimum value of  $\cot\left(\frac{B}{2}\right)$



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7. Sides AB and AC in an equilateral triangle ABC with side length 3 is extended to form two rays from point A as shown in the figure. Point P is chosen outside the triangle ABC and between the two rays such that  $\angle ABP + \angle BCP = 180^\circ$ . If the maximum length of CP is M, then  $M^2 / 2$  is equal to :



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8. Let  $a, b, c$  be sides of a triangle  $ABC$  and  $\Delta$  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  $\Delta ABC$ ).



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9. Circumradius of  $\Delta ABC$  is 3 cm and its area is  $6\text{cm}^2$ . 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  $\Delta DEF$  (in cm) is \_\_\_\_\_



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