LOCUS

SYNOPSIS

- The locus is the set of those points which satisfy a given condition or a well defined property.
- The locus of a point which is equidistant from two fixed points A and B is the perpendicular bisector of the line segment AB.
- Given A and B are two fixed points. The locus of a point P such that the area of Δ PAB is a constant is a pair of lines parallel to AB.
- The locus of a point which is at a constant distance from a fixed point is a circle
- If the join of two fixed points A,B subtends a right angle at P, then the locus of P is a circle on AB as diameter.
- A,B are two fixed points and PA + PB = k then
  - If k > AB, locus of P is an ellipse
  - If k =AB, locus of P is line segment AB
  - If k < AB, locus of P does not exist
- A,B are two fixed points and |PA - PB| = k, then
  - If k >AB, Locus of P does not exist
  - If k = AB, Locus of P is line through A and B except line segment AB
  - If k < AB, Locus of P is a hyperbola
- The locus of the point which moves equidistance from a fixed point and fixed st. line is a parabola.
- A and B are fixed points. P is the point moves such that $\frac{PA}{PB} = k(k \neq 1)$ then locus of the P is a circle.

LEVEL - I

1. The locus of the point which is at a distance 5 unit from (-2, 3) is

   1) $x^2-y^2+4x-6y+12=0$

   2) $x^2+y^2+4x-6y-12=0$

   3) $x^2-y^2+4x-6y-12=0$

   4) $x^2+y^2+4x-6y+12=0$

2. The equation of the locus of the points equidistant from the points A(-2,3) and B(6, -5) is

   1) x+y=3 2) x-y=3

   3) 2x+y=3 4) 2x-y=3

3. The locus of the point which is at a distance 5 unit from x-axis is

   1) $y^2+25=0$ 2) $y^2-25=0$

   3) y+25=0 4) y-25=0

4. The locus of the point, for which the sum of the squares of distances from the coordinate axes is 25 is

   1) $x^2+y^2=25$ 2) $x^2+y^2=19$

   3) $x^2+y^2=32$ 4) $x^2+y^2=29$

5. If the distance of P from the origin is twice the distance from (1, 2) the equation to the locus of P is

   1) $3(x^2+y^2)-8x-16y+20=0$

   2) $3(x^2+y^2)-8x+16y-20=0$

   3) $x^2+y^2+8x+16y+20=0$

   4) $x^2+y^2-8x-16y-20=0$

6. The equation to the locus of a point P for which the distance from P to (-4, 0) is double the distance from P to x-axis is

   1) $x^2 + 3y^2 + 8x + 16 = 0$

   2) $x^2 + 3y^2 - 8x + 16 = 0$

   3) $x^2 - 3y^2 + 8x - 16 = 0$

   4) $x^2 - 3y^2 + 8x + 16 = 0$

7. The equation to the locus of a point P for which the distance from P to (0, 5) is double the distance from P to y-axis is

1) $3x^2 + y^2 + 10y - 25 = 0$

2) $3x^2 - y^2 + 10y + 25 = 0$

3) $3x^2 - y^2 + 10y - 25 = 0$

4) $3x^2 + y^2 - 10y - 25 = 0$

8. If the distance from P to the points (5, -4), (7, 6) are in the ratio 2 : 3, then the locus of P is

1) $5x^2 + 5y^2 - 12x - 86y + 17 = 0$

2) $5x^2 + 5y^2 - 34x + 120y + 29 = 0$

3) $5x^2 + 5y^2 - 5x + y + 14 = 0$

4) $3x^2 + 3y^2 - 20x + 38y + 87 = 0$

9. The locus of the point P such that $PA^2+PB^2=10$. Where A(2,0) and B(4,0) is

1) $x^2 + y^2 + 6x + 5 = 0$

2) $x^2 + y^2 - 6x + 5 = 0$

3) $x^2 + y^2 - 6x - 5 = 0$

4) $x^2 + y^2 + 6x - 5 = 0$

10. If A(a, O), B (-a, O) are two points. The locus of the point C if $\angle ACB = 90^o$ is

1) $x^2 - y^2 = a^2$ 2) $a(x^2 + y^2) = 0$

3) $x^2 + y^2 = 2a^2$ 4) $x^2 + y^2 = a^2$

11. The equation of the locus of the point whose distance from the x-axis is twice that of from the y-axis is

1) $y^2=4x^2$ 2) $4y^2 = x^2$

3) $y = 2x$ 4) $x = 2y$

12. The equation of the locus of the point which moves equidistant form the coordinate axes is

1) x-y=0 2) x+y = 0

3) $x^2 - y^2 = 0$ 4) $x^2 + y^2 = 0$

13. The locus of a point whose distance form the y-axis is half its distance from the origin is

1) $2x^2-y^2 = 0$ 2) $x^2 - 3y^2 = 0$

3) $3x^2 - y^2 = 0$ 4) $x^2 - 2y^2 = 0$

14. The locus of a point whose distance from the x-axis is one-third of its distance from the origin is

1) $x^2 = 8y^2$ 2) $y^2 = 8x^2$

3) $x^2 = 9y^2$ 4) $y^2 = 9x^2$

15. A(0,4), B(0,-4) are two points. The locus of P which moves such that |PA-PB| =6 is

1) $9x^2-7y^2+63=0$ 2)$9x^2+7y^2-63=0$

3) $9x^2+7y^2+63=0$ 4) $9x^2-7y^2 - 63 = 0$

16. If A = (4, 0), B = (-4, 0) are any two points and |PA - PB| = 4. The locus of P is

1) $3x^2 + y^2 = 12$ 2) $3x^2 - y^2 = 12$

3) $3x^2 - 3y^2 = 9$ 4) $3x^2 + y^2 =8$

17. A(2,3), B(2,-3) are two points. The equation to the locus of P such that PA + PB=8 is

1)$16x^2+7y^2-64x-48=0$

2)$16x^2+7y^2-64x+48=0$

3) $16x^2-7y^2+64x-48=0$

4) $16x^2-7y^2+64x+48=0$

18. If A = (-6, 0), B = (6, 0) and |AP - PB| = 8 then the locus of P is

1) $5x^2-4y^2+80=0$ 2) $4x^2-5y^2+80=0$

3) $4x^2-5y^2=80$ 4) $5x^2-4y^2=80$

19. Let A=(1,0), B=(-1,0),C=(2,0) the locus of a point P such that $PB^2+PC^2=2PA^2$ is

1) a straight line parallel to x-axis

2) a straight line parallel to y-axis

3) pair of straight line

4) combined equation of coordiante axes

20. If A(a,0), B(-a,0) then the locus of the point P such that $PA^2+PB^2=2c^2$ is :

1) $x^2+y^2+a^2-c^2=0$

2) $x^2+y^2+a^2+c^2=0$

3) $2x^2+y^2+3a^2-c^2=0$

4) $x^2+y^2+a^2+2c^2=0$

21. If P = (1,0), Q= (-1,0) and R = (2,0) then the locus of the point S such that $SQ^2 + SR^2 = 2SP^2$ is a

1) A straight line parallel to x-axis

2) Circle with centre (0,0)

3) Circle through (0,0)

4) A straight line parallel to y-axis

22. The locus of the point equidistant from the points (a+b, a-b) and (a-b, a+b) is

1) bx - ay = 0 2) bx + ay = 0

3) ax - by = 0 4) x - y = 0

23. If A(0,4), B(6,0) and O be the origin. A point P moves such that $\Delta POA = 2\Delta POB$. The locus of P is

1) $x^2+9y^2=0$ 2) $9x^2+y^2=0$

3) $x^2-9y^2=0$ 4) $9x^2-y^2=0$

24. The locus of a point which is colliner with the points (3, 4) and (-4, 3) is

1) 2x+3y-12=0 2) 2x+3y+12=0

3) 2x+3y+12=0 4) x-7y+25=0

25. The ends of hypotenuse of a right angled triangle are (a, 0), (-a, 0) then the locus of third vertex is :

1) $x^2-y^2=a^2$ 2) $x^2+y^2=a^2$

3) $x^2+y^2+a^2=0$ 4) $x^2-y^2+a^2=0$

26. The locus of the point ($a\sec\theta + b\tan\theta$, $a\tan\theta + b\sec\theta$) is

1) $x^2 + y^2 = a^2 + b^2$

2) $(x^2 + y^2) = a^2 - b^2$

3) $x^2 - y^2 = a^2 + b^2$

4) $x^2 - y^2 = a^2 - b^2$

27. Locus of centroid of the triangle whose vertices are (a cos t, a sin t), (b sin t,-bcost) and (1, 0) where t is parameter is

1) $(3x-1)^2 + (3y)^2 = a^2-b^2$

2) $(3x-1)^2 + (3y)^2 = a^2+b^2$

3) $(3x+1)^2 + (3y)^2 = a^2+b^2$

4) $(3x+1)^2 + (3y)^2 = a^2-b^2$

28. The locus of the point $x = a + b\sec\theta$, $y = b + a\tan\theta$ is

1) $(x-a)^2 + (y-b)^2 = (ab)^2$

2) $\left(\frac{x-a}{b^2}\right)^2 + \left(\frac{y-b}{a}\right)^2 = 2(ab)^2$

3) $\left(\frac{x-a}{b}\right)^2 - \left(\frac{y-b}{a}\right)^2 = 1$

4) $(y-b)^2 = 4ab\,(x-a)$

29. The locus of the point $x = a(\cos\theta + \sin\theta)$, $y = b(\cos\theta - \sin\theta)$ is

1) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ 2) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=2$

3) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1/2$ 4) $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$

30. If t is parameter, A = (aSec t, bTan t) and B = (-aTan t, bSec t), O = (0, 0) then the locus of the centroid of ΔOAB is

1) 9xy = ab 2) xy = 9ab

3) $x^2-9y^2 = a^2-b^2$ 4) $x^2-y^2= \frac{1}{9}(a^2-b^2)$

31. If A = ($a\cos\theta$, $b\sin\theta$), B = ($-a\sin\theta$, $b\cos\theta$), O is the origin θ is a parameter, then the locus of the centroid of ΔAOB is $\frac{x^2}{a^2}+\frac{y^2}{b^2}=$

1) 2/9 2) 1/9 3) 9/2 4) 1

32. The equation of locus of a point which moves so that the sum of the square of its distance from the coordinate axes is 15 is

1) $x^2+15y^2=1$ 2) $x^2+y^2+15=0$

3) $15(x^2+y^2)=1$ 4) $x^2+y^2=15$

33. The locus of P such that $\Delta PAB=12$ sq units where A(2,3) and B(-4,5) is

1) $x^2 - 6xy + 9x^2 + 66y - 23 = 0$

2) $x^2 + 9y^2 + 6xy - 22x - 66y-23 = 0$

3) $x^2 + 9y^2 - 6xy - 22x - 66y-23 = 0$

4) $x^2 - 6xy - 9y^2 - 22x - 66y+23 = 0$

34. A(2,3), B(-3,4) are two points. If a point P moves such that the area of ΔPAB is 8.5 sq.units then the locus of P is

1) $x^2+10xy+25y^2-34x-170y=0$

2) $x^2+10xy-25y^2-34x-170y=0$

3) $x^2-10xy+25y^2-34x+170y=0$

4) $x^2-10xy-25y^2+34x-170y=0$

35. A straight line segment AB of length 'a' moves with its ends on the axes. The locus of the point P which divides the segment in the ratio 1 : 2 is

1) $9x^2+4y^2 = a^2$ 2) $9(x^2+4y^2)=4\ a^2$

3) $9(x^2+4y^2)=8a^2$ 4) $9x^2+9y^2=4a^2$

36. The ends of a rod of length 'r' move on two mutually perpendicular lines. The locus of the point on the rod which divides it in the ratio 1 : 1 is

1) $4x^2+4y^2 = r^2$ 2) $x^2+y^2=r^2$

3) $4x^2+4y^2=3r^2$ 4) $2(x^2+y^2)=r^2$

37. The ends of a rod of length 'l' move on two positive coordinate axes. The locus of the point on the rod which divides it in the ratio 1:3 is

1) $9x^2+36y^2 = 4l^2$ 2) $9x^2+36y^2=16l^2$

3) $16x^2+144y^2=9l^2$ 4) $4x^2+36y^2=9l^2$

38. A line segment of 2 units is sliding with its ends on two perpendicular lines. Then the locus of the middle point is

1) x+2y+1=0 2) $x^2+y^2=1$

3) $y^2 = 4ax$ 4) $x^2 = 4ay$

39. The variable line $\frac{x}{a}+\frac{y}{b}=1$ is such that a+b=10. The locus of the mid-point of the portion of the line intercepted between the axes is

1) x + y = 10 2) 10x + 5y = 1

3) x + y = 5 4) 5x + 10y = 1

40. The equation $\sqrt{(x-2)^2+y^2}+\sqrt{(x+2)^2+y^2} \ll 4$ represents

1) circle 2) A parabola

3) Line segment 4) Ellipse

41. A (5,3), B = (3,-2), C (2,-1) are three points. If P moves such that area of Quadrilateral PABC is10 sq. units , locus of Pis

1) (4x-3y)(4x+3y)=100

2) $16x^2-9y^2-24xy-80=0$

3) $9x^2-16y^2 - 6y +2x = 0$

4) (4x - 3y-38)(4x-3y+2)=0

KEY

1)2	2) 2	3)2	4)1	5)1
6)4	7)3	8)2	9)2	10)4
11)1	12)3	13)3	14)1	15)4
16)2	17)1	18)4	19)2	20)1
21)4	22)4	23)3	24)4	25)2
26)4	27)2	28)3	29)2	30)1
31)1	32)4	33)2	34)1	35)2
36)1	37)3	38)2	39)3	40)3
41)4				

LEVEL - II

1. P is a point on the circle of radius 2 units with its centre at the origin. If Q is a point dividing the line segment joining P and (-1,1) in the ratio 3:2 then the locus of Q is

1) $25\ (x^2 + y^2) + 30x - 30y = 0$

2) $x^2+y^2+30x-30y+2 = 0$

3) $25\ (x^2 + y^2) + 30y+2 = 0$

4) $25\ (x^2 + y^2) + 30x - 30y + 2 = 0$

2. The base of a triangle lies along x = a and is of length a. The area of triangle is a^2. The locus of vertex is

1) (x+a)(x-3a) = 0 2) (x-a)(x+3a)=0

3) (x+a)(x+3a) = 0 4) (x+2a)(x-a)=0

3. If the sum of the distances of a point from two perpendicular lines in a plane is a constant, then its locus is

1) a square

2) a circle

3) a straight line

4) two intersecting lines

4. A = (2, 5), B = (4, -11) and the locus of C is $9x + 7y + 4 = 0$ then the locus of the centroid of ΔABC is

1) $27x+21y-8=0$ 2) $3x+4y-2=0$

3) $24x+22y-6=0$ 4) $5x+3y-7=0$

5. A = (1, -1) locus of B is $x^2+y^2=16$. If P divides AB in the ratio 3:2 then locus of P is

1) $(x-2)^2 + (y-3)^2 = 4$

2) $(x+1)^2 + (y-2)^2 = 4$

3) $(x-3)^2 + (y-2)^2 = 4$

4) $(5x-2)^2 + (5y+2)^2 = 144$

6. P and Q are two variable points on the axes of x and y respectively such that $|OP| + |OQ|=a$, then the locus of foot of perpendicular from origin on PQ is

1) $(x - y)(x^2 + y^2) = axy$

2) $(x + y)(x^2 + y^2) = axy$

3) $(x + y)(x^2 + y^2) = a(x - y)$

4) $(x + y)(x^2 - y^2) = axy$

7. The locus of foot of the perpendicular drawn from a fixed point (a, b) to the variable line $y = mx$, m being variable is

1) $x^2+y^2-ax+by=0$ 2) $x+y-(a+b)=0$

3) $x^2+y^2-ax-by=0$ 4) $xy-bx-ay+ab=0$

8. A variable line $\frac{x}{a}+\frac{y}{b}=1$ moves in such a manner so that the length of the perpendicular from origin on the line is constant and equal to p. If the line meets x-axis and y-axis at A and B respectively then the locus of the point of intersection of lines through A and B and perpendicular to axes is

1) $x^2+y^2=p^2$ 2) $x+y=p$

3) $x^2+y^2 = p^2x^2y^2$ 4) $p^2(x^2+y^2)=x^2y^2$

9. The locus of point of intersection of the lines $y + mx = \sqrt{a^2m^2 + b^2}$ and $my-x = \sqrt{a^2 + b^2m^2}$ is

1) $x^2+y^2 = \frac{1}{a^2}+\frac{1}{b^2}$ 2) $x^2+y^2 = a^2+b^2$

3) $x^2 - y^2 = a^2 - b^2$ 4) $\frac{1}{x^2}+\frac{1}{y^2}=a^2-b^2$

10. A point P moves such that the sum of the squares of its distances from the three vertices of a triangle ABC is a constant. The locus of the point P is a circle whose centre is _____ of Δ ABC.

1) circumcentre 2) orthocentre

3) Incentre 4) centroid

11. If p, x_1 , x_2, x_3 ..... and q, y_1, y_2, y_3 ..... from two infinite AP's with common difference a and b respectively then the locus of P (α, β) where

$$\alpha = \frac{x_1 + x_2 ..... + x_n}{n}, \quad \beta = \frac{y_1 + y_2 ..... + y_n}{n}$$

l) $a(x-p) = b(y-1)$ 2) $p(x-a)=q(y-b)$

3) $p(x-p) = b|x-q|$ 4)$b(x-p)=a(y-q)$

12. The algebraic sum of the perpendicular distances from the points A (2,0), B(0,2) and C(1,1) to a variable line be zero, then all such lines

1) Are parallel

2) Passes through a fixed point(0,0)

3) From a square

4) passes through the centroid of Δ ABC.

13. From a point P perpendiculars PM, PN are drawn to x and y axes respectively. If MN passes through fixed point (a,b), locus of P is

1) $xy= ax+by$ 2) $xy = ab$

3) $xy = bx+ay$ 4) $x+y=xy$

KEY

1) 4	2)1	3)1	4)1	5)4
6)2	7)3	8)4	9)2	10)4
11)4	12)4	13)3		

LEVEL - III
NEW PATTERN QUESTIONS

1. Let A,B be two fixed points. If PA +PB = K then observe the following lists

LIST- I	LIST- II
A) K=AB, Locus of P is	1) A Hyperbola
B) K>AB, Locus of P is	2) A line segment
C) K<AB, Locus of P is	3) An Ellipse
	4) Empty set

A B C
1) 2 3 1
A B C
2) 2 3 4
A B C
3) 2 1 3
A B C
4) 2 4 1

2 Let $P(x_1,y_1)$ be any point on the locus then observe the following lists

LIST - I	LIST - II
A) The distance from P to x-axis	1) 0
B) The distance from P to y-axis	2) $\|y_1\|$
C) The distance from P to origin is	3) $\sqrt{x_1^2+y_1^2}$
	4) $\|x_1\|$

The correct matching is

A B C
1) 4 2 1
A B C
2) 2 4 3
A B C
3) 4 2 3
A B C
4) 2 4 1

3 The equation to the locus of points equidistant from the points (-2,3), (6,-5) is ax+by+c=0 then increasing order of a, b, c is

1) a, b, c 2) c, b, a
3) b, c, a 4) a, c, b

4. Statement I : The locus of the point, whose distance from the x-axis is twice its distance from the y-axis is $y^2 = 4x^2$

Statement II : The locus of the point $(\cot\theta+\cos\theta, \cot\theta-\cos\theta)$ is $(x^2-y^2)^2 = 16xy$

Which of the above are true

1) Only I 2) Only II
3) I & II 4) neither I nor II

5 Statement I : A(0,0), B($\cos\alpha$, $\sin\alpha$), C($\sin\alpha$, $\cos\alpha$) are vertices of a triangle then the locus of the centroid of triangle is $9x^2+9y^2= 4$

Statement II : The locus of the point (a $\cos\theta$, b $\sin\theta$) is $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

Which of the above statement is correct:

1) Only I 2) Only II
3) Both I and II 4) None

6. Assertion (A) : The equation to the locus of points which are equidistant from the points (-3,2), (0,4) is 6x+4y-3=0

Reason (R) : The locus of points which are equidistant to A,B is perpendicular bisector of AB

1) A true, R true and R is correct explanation of A

2) A true, R true but R is not correct explanation A

3) A true, R false

4) A false, R true

KEY

1) 2 2) 2 3) 2 4) 3 5) 2
6) 1

PREVIOUS EAMCET QUESTIONS

EAMCET 2005

1. If a point P moves such that the distance from the point A (1,1) and the line $x + y + 2 = 0$ are equal then the locus of P

1) a straightline 2) a parabola
3) pair of st. lines 4) ellipse

EAMCET 2002

2. The Locus of the point ($\tan\theta + \sin\theta$, $\tan\theta - \sin\theta$)

   1) $\left((x^2y)^{2/3} + (xy^2)^{2/3} = 1\right)$

   2. $x^2-y^2 = xy$

   3) $x^2-y^2 = 12xy$ 4) $(x^2-y^2)^2 = 16xy$

EAMCET 2001

3. The curve with parametric equations x=3 (cost+sint), y = 4 (cost-sint) is

   1) Ellipse 2) Parabola

   3) Hyperbola 4) Circle

4. The equation $16x^2+y^2+8xy-74x-78y+212 = 0$ represents

   1) circle 2) parabola

   3) Ellipse 4) Hyperbola

EAMCET 2000

5. A variable circle passes through the fixed point (2,0) and touches y-axis. Then locus of centre of circle

   1) A parabola 2) A circle

   3) An ellipse 4) A hyperbola

6. The curve represented by x = 2 (Cost t+ sin t) and y = 5 (cot t - Sin t) is

   1) Circle 2) Parabola

   3) Ellipse 4) Hyperbola

7. A straight line of length 9 units slides with its ends A, B always on x and y axes respectively. Locus of centroid of Δ OAB is

   1) $x^2+y^2 = 3$ 2) $x^2+y^2 = 9$

   3) $x^2+y^2=1$ 4) $x^2+y^2=8$

EAMCET 1999

8. The locus of the point whose distance from x axis is twice its distance from y axis is

   1) $y^2 = 4x^2$ 2) $4y^2 = x^2$

   3) $y = 3x$ 4) $4x+y = 0$

EAMCET 1998

9. A(-9,0) B = (-1,0) are two points. If P (x,y) is a point such that 3PB = PA then locus of P is

   1)$x^2-y^2=9$ 2) $x^2-y^2 = -9$

   3) $x^2+y^2 = 9$ 4) $x^2+y^2 = 3$

EAMCET 1997

10. $a \neq 0$; A = (a,0) B = (-a,0) locus of P such that $PA^2 - PB^2 = 4a^2$ is

    1) A straight line 2) A circle

    3) An ellipse 4) A parabola

EAMCET 1994

11. Locus represented by x =a ($\cosh\theta+\sinh\theta$), y = b ($\cosh\theta-\sinh\theta$) is

    1) Hyperbola 2) Parabola

    3) Ellipse 4) Straight line

EAMCET 1993

12. The graph represented by $x=\sin^2 t$, y = 2cost is

    1) Parabola 2) Portion of parabola

    3) part of sine graph 4) Part of Hyperbola

EAMCET 1990

13. A and B are fixed points. If PA-PB is a constant, locus of P is

    1) Parabola 2) Ellipse

    3) Hyperbola 4) Circle

EAMCET 1989

14. Locus of P such that Δ PAB = 12sq. Units, where A = (2,3) , B = (-4,5) is

    1) $x^2+6xy+9y^2-22x-66y-23=0$

    2) $x^2+3xy+4x = 0$

    3) $x^2+3xy+y^2-x-2y = 0$

    4) $x^2+y^2+2x+4y=0$

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15. Locus of centroid of triangle with vertices (acost, asint), (bsint, - bcost) and (1,0) where 't' is parameter is

    1) $(3x-1)^2+(3y)^2= a^2+b^2$

    2) $(3x+1)^2+ (3y)^2= a^2+b^2$

    3) $(3x+1)^2-(3y)^2= a^2+b^2$

    4) $(3x-1)^2 - (3y)^2= a^2-b^2$

16. If the equation of locus of the point equidistant from the points (a_1, b_1) and (a_2,b_2) is $(a_1-a_2)x+(b_1-b_2)y+c=0$ then c =

    1) $a_1^2 - a_2^2 + b_1^2 - b_2^2$

    2) $\frac{1}{2}(a_1^2 + a_2^2 + b_1^2 + b_2^2)$

    3) $\sqrt{a_1^2 + b_1^2 - a_2^2 - b_2^2}$

    4) $\frac{1}{2}(a_2^2 + b_2^2 - a_1^2 - b_1^2)$

KEY

1)2	2)4	3)1	4)2	5)1
6)3	7) 2	8)1	9)3	10)1
11)1	12)1	13)3	14)1	15)1
16)4				