JEE Main Maths
Short Notes
Circles

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1. Circle

A circle is the locus of a point whose distance is constant from a given point around which it moves.

Equation of circle

A circle with center (a, b) and radius r is given as

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

3. The general equation of the circle

Any second order curve can be defined as

$Ax^2+Bxy+Cy^2+Gx+Hy+D=0$

The equation represents a circle on the conditions:

A=C and B=0.

Thus, the general equation of the circle is

$Ax^2+Ay^2+Dx+Ey+G=0$

Or

$x^2+y^2+2gx+2hy+c=0$

Rewrite the equation of the circle

$x^2+y^2+2gx+2hy+c=0$

$x^2+y^2+2gx+2hy+c+g^2+h^2 = g^2+h^2$

$(x + g)^2+(y + h)^2= g^2+h^2-c$

The center of the circle is (-g,-h) and the radius of the circle is $\sqrt{g^2 + h^2 - c}$

Note: For a real circle $g^2+h^2-c \geq 0$

4. Diametric form of a circle

If the endpoints of a diameter to the circle are (x_1,y_1) and (x_2,y_2)

$$\left(\frac{y - y_1}{x - x_1}\right)\left(\frac{y - y_2}{x - x_2}\right) = -1$$

Position of a point w.r.t circle

If S: $x^2 + y^2 + 2gx + 2hy + c = 0$

Let point be P (x_1, y_1)

S_p: $x_1^2 + y_1^2 + 2gx_1 + 2hy_1 + c = 0$

If $S_p > 0$ point lies outside the circle.

If $S_p = 0$ point lies on the circle.

If $S_p < 0$ point lies inside the circle.

If the point lies outside the circle, the greatest distance of the point from the circle is

(CP + r) and the least distance of the point from the circle is (CP – r).

Parametric equation of the circle

The parametric coordinates of the circle are $(x_1 + r\cos\theta, y_1 + r\sin\theta)$ where the (x_1, y_1) is the centre of the circle and r is the radius of the circle, is the angle made by the point from the centre.

The parametric equation is given by

$$\frac{x - x_1}{\cos\theta} = \frac{y - y_1}{\sin\theta} = r$$

Line and Circle

Solve the equation of circle by substituting any one variable from the equation of the line. A quadratic equation in any on a variable is formed. Evaluate the determinant of the equation.

If the discriminant, D > 0, the line is a secant.

If the discriminant, D = 0, the line is a tangent.

If the discriminant, D < 0, then the line doesn't touch the circle.

Equation of tangent of the circle

At a point (x_1, y_1)

Form the equation of tangent by replacing

$x^2 \rightarrow xx_1$

$y^2 \rightarrow yy_1$

$x \rightarrow (x+x_1)/2$

$y \rightarrow (y+y_1)/2$

in the equation of the circle.

Slope form

If the equation of the tangent is $y = mx + c$, where m is the slope of the tangent and c is arbitrary constant, then Slope of the tangent to a circle $x^2 + y^2 = r^2$ is

$$y = mx \pm a\sqrt{1+m^2}$$

9.Length of the tangent

If the equation of circle is given as, **S: $x^2 + y^2 +2gx+2hy+c=0$,** the length of tangent to the point $P(x_1,y_1)$ is given by

$L_T = \sqrt{S_P}$

Where S_p: $x_1^2 + y_1^2 +2gx_1+2hy_1 + c$

10. The equation of chord of a circle when the median of the chord is given.

If the median of the chord is (h, k), then the equation of chord to the circle

S: $(x + a)^2 + (y + b)^2 = r^2$

is

$xh+yk-r^2=h^2+k^2$

or

$(T=S_P)$

11. Equation of chord of contact

The equation of chord from the contact to the circle S: $(x + a)^2 + (y + b)^2 = r^2$ is

$xh+yk-r^2=0$

12. Equation of pair of tangents

If the circle is given as S: $x^2 + y^2 = r^2$

S_p: $x_1^2 + y_1^2 = r^2$

T_P: $xx_1+yy_1 = r^2$

$SS_P=T_P^2$

13. Family of circles passing the points of intersection of two circles

If the circle S' and S'' are intersecting, the family of circles that can be formed from the point of contacts S' and S'' is

$S' + \lambda S''=0$

14. Family of circles passing the points of intersection of a circle and a line

If the circle S and line L are intersecting, the family of circles that can be formed from the point of contacts S and L is

Common tangent to two circles

There are two types of common tangents to two circles,
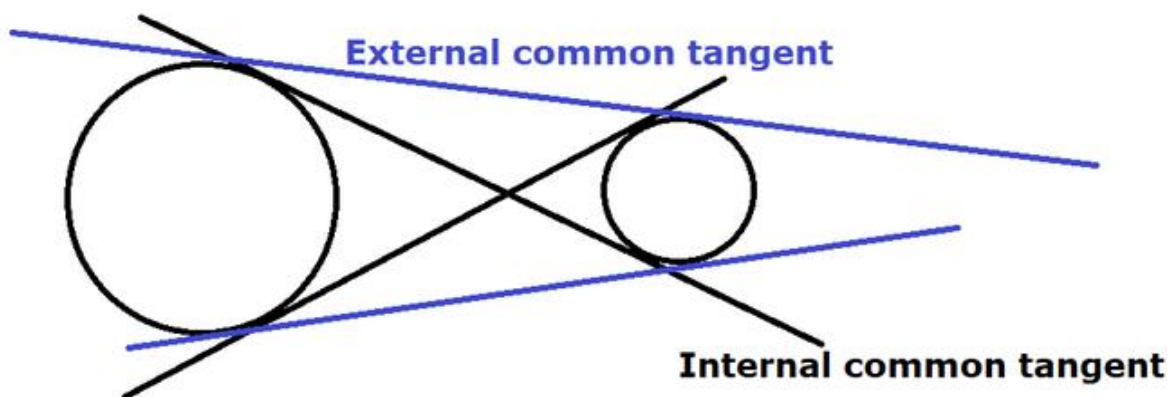
Internal common tangent

External common tangent
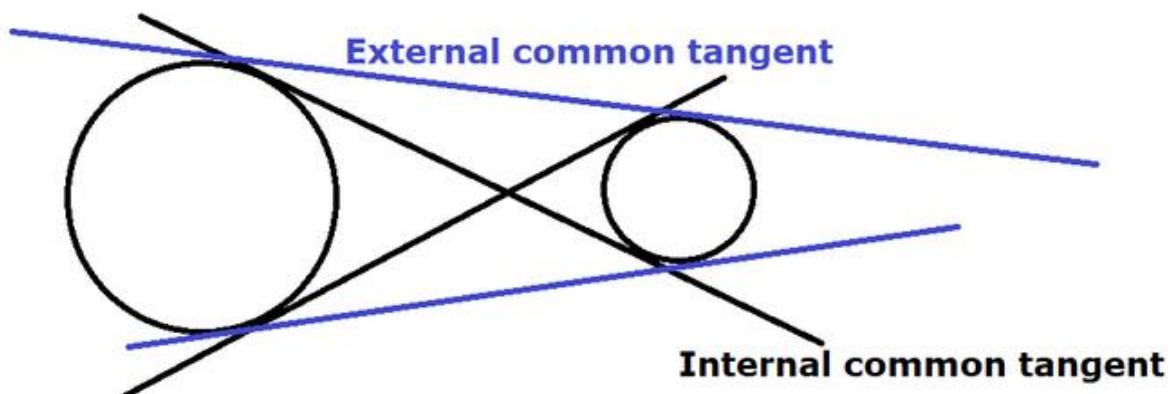
External common tangent

Internal common tangent

16. Position of circles and the number of common tangents

Let C_1 and C_2 denote the centre of the circles, r_1 & r_2 be the radii of the circles and C_1C_2 be the distance between the centres.

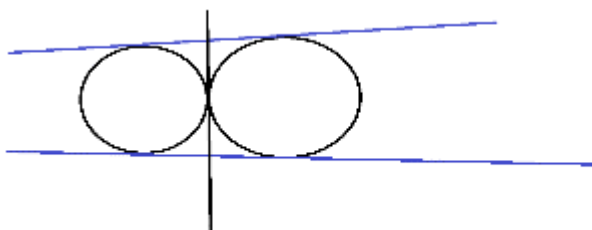(a) If $C_1C_2 > r_1 + r_2$

There are 4 common tangents

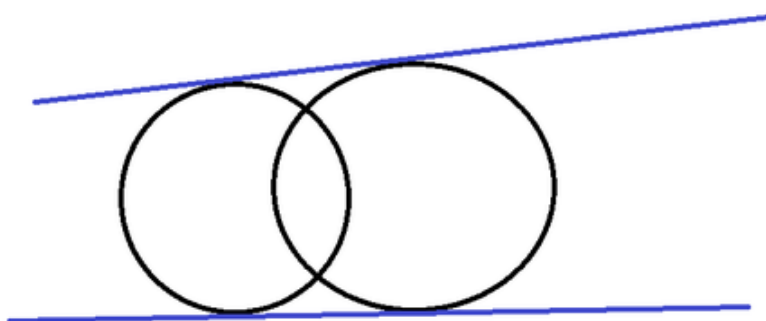

External common tangent

Internal common tangent

(b) If $C_1C_2 = r_1 + r_2$

There are 3 common tangents.

(c) If $|r_1 - r_2| < C_1C_2 < r_1 + r_2$

There are 2 common tangents.

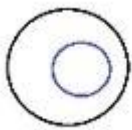(d) If $C_1C_2 = |r_1 - r_2|$

There is one common tangent.

(e) If $C_1C_2 < |r_1 - r_2|$

There is no common tangent.

17. Length of common tangent

(a) External tangent

$$L_{ET} = \sqrt{(C_1C_2)^2 - (r_1 - r_2)^2}$$

(b) Internal tangent

$$L_{IT} = \sqrt{(C_1C_2)^2 - (r_1 + r_2)^2}$$

18. The condition of orthogonality of two circles

Two circles intersect each other at 90° when

$2g_1g_2 + 2f_1f_2 = c_1 + c_2$

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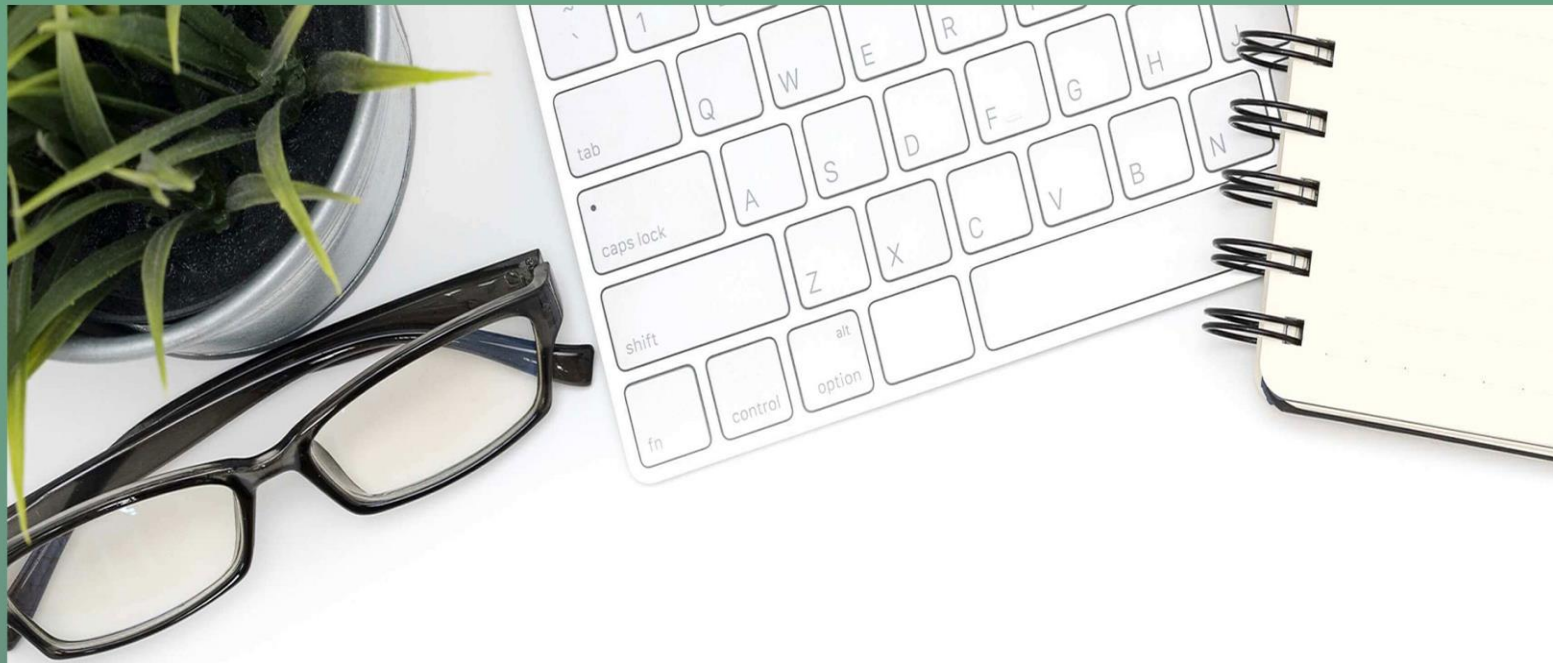**All the best!**
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Current Electricity and E...

The circuit shown consists of a switch (S), a battery B. of emf E, a resistance R, and an inductor L

The current in the circuit at the instant the switch is closed is

A   E/R