JEE 2020

•LIVE

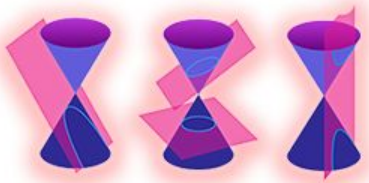
MATH

Revise all

CONIC SECTION FORMULAS

in 1 SHOT

With Neha Ma'am



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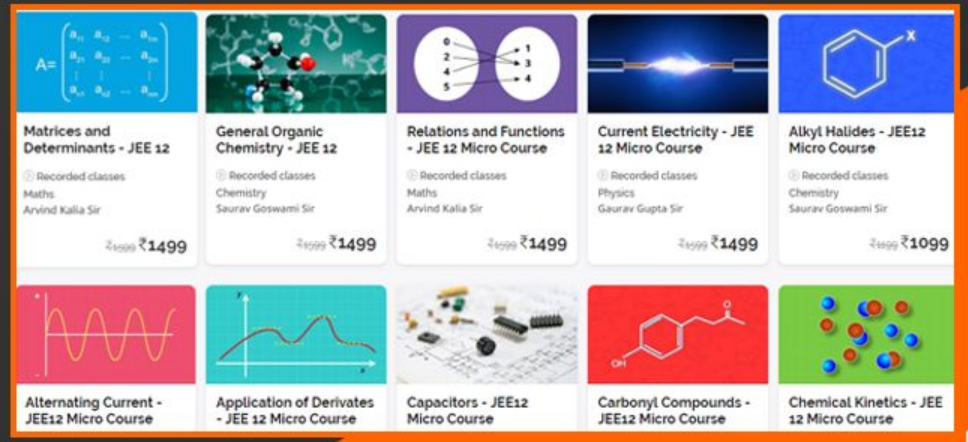

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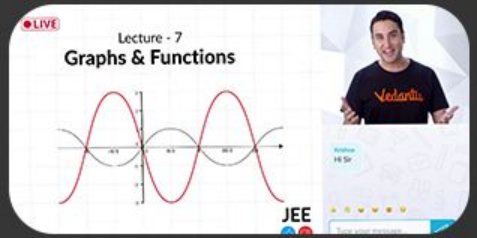

QUIZ

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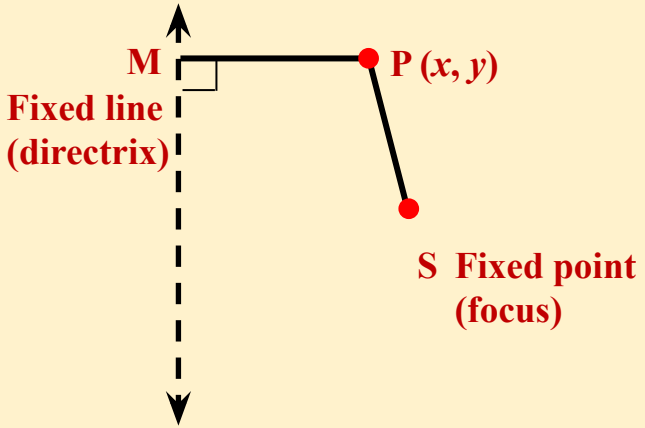
PARABOLA

Definition

A parabola is the locus of a point which moves in a plane in such a way that its distance from a fixed point is always equal to its distance from a fixed straight line.

$$\frac{PS}{PM} = e\,(\text{eccentricity})$$

If **e = 1**, the conic is called as parabola.



Quick Revision- Parabola

Standard form	$y^2 = 4ax$	$y^2 = -4ax$	$x^2 = 4ay$	$x^2 = -4ay$
Coordinates of vertex	(0, 0)	(0, 0)	(0, 0)	(0, 0)
Coordinates of focus	(a, 0)	(-a, 0)	(0, a)	(0, -a)
Equation of the directrix	x = -a	x = a	y = -a	y = a
Equation of the axis	y = 0	y = 0	x = 0	x = 0
Length of the latusrectum	4a	4a	4a	4a
Focal distance of a point P(x, y)	x + a	a - x	y +a	a - y
Parametric coordinates	$(at^2, 2at)$	$(-at^2, 2at)$	$(2at, at^2)$	$(2at, -at^2)$
Parametric equations	$x = at^2$, $y = 2at$	$x = -at^2$, $y = 2at$	$x = 2at$, $y = at^2$	$x = 2at$, $y = -at^2$

Quick Revision- Parabola

Parabola	Line	Points of contact	Condition of tangency
$y^2 = 4ax$	$y = mx + c$	$\left(\frac{a}{m^2}, \frac{2a}{m}\right)$	$c = \frac{a}{m}$
$y^2 = -4ax$	$y = mx + c$	$\left(-\frac{a}{m^2}, -\frac{2a}{m}\right)$	$c = -\frac{a}{m}$
$x^2 = 4ay$	$x = my + c$	$\left(\frac{2a}{m}, \frac{a}{m^2}\right)$	$c = \frac{a}{m}$
$x^2 = -4ay$	$x = my + c$	$\left(-\frac{2a}{m}, -\frac{a}{m^2}\right)$	$c = -\frac{a}{m}$

Equation of Tangent in different forms:

1. POINT FORM

The equation of the tangent to the parabola $y^2 = 4ax$ at the point (x_1, y_1) is $yy_1 = 2a(x + x_1)$.

2. PARAMETRIC FORM

The equation of tangent to the parabola $y^2 = 4ax$ at the point $(at^2, 2at)$ is $ty = x + at^2$.

3. SLOPE FORM

The equation of the tangent to parabola $y^2 = 4ax$ in terms of slope 'm' is $y = mx + \frac{a}{m}$.

The coordinates of the point contact are $\left(\frac{a}{m^2}, \frac{2a}{m}\right)$.

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ELLIPSE

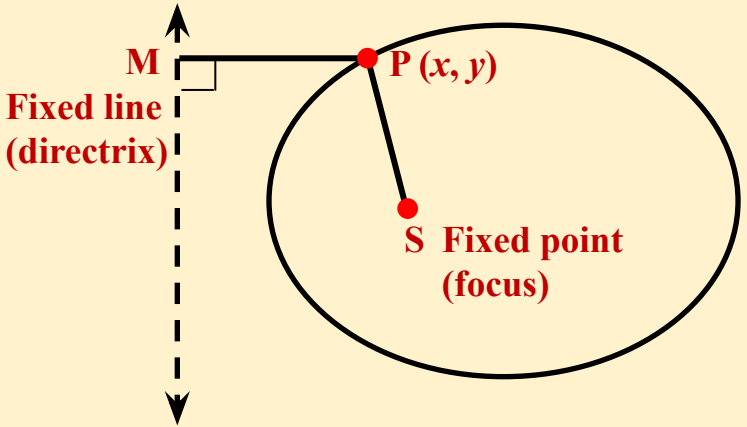
Definition

It is locus of a point which moves such that ratio of its distance from a fixed point to its distance from a fixed line is always a constant less than 1.

$$\frac{PS}{PM} = \text{constant} = e$$

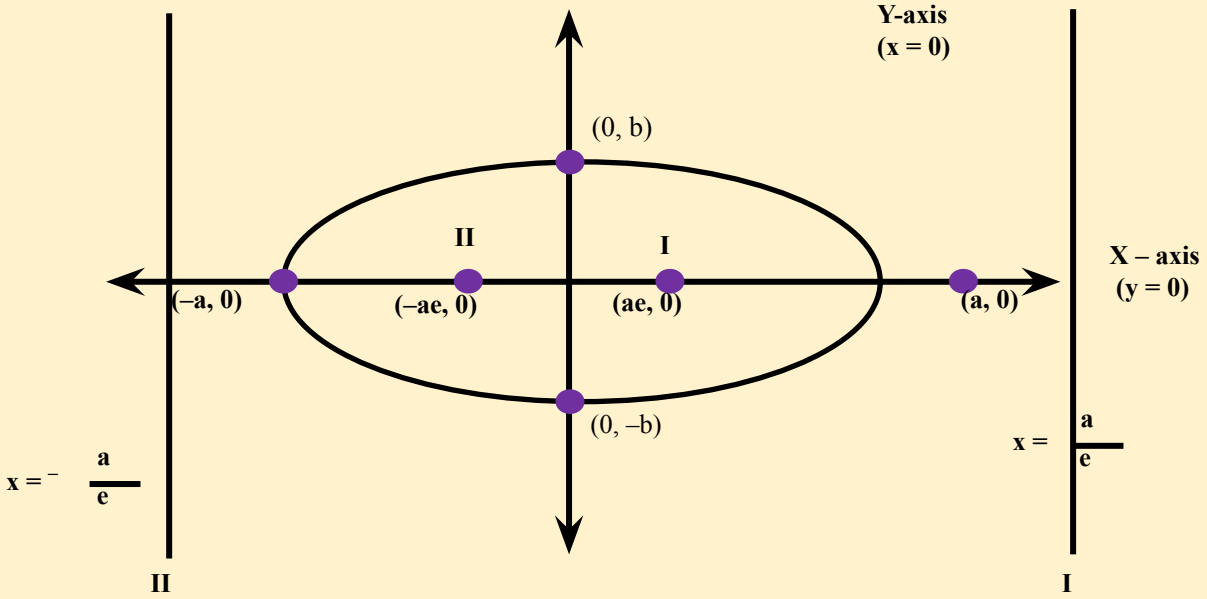
where e is eccentricity

$0 < e < 1$



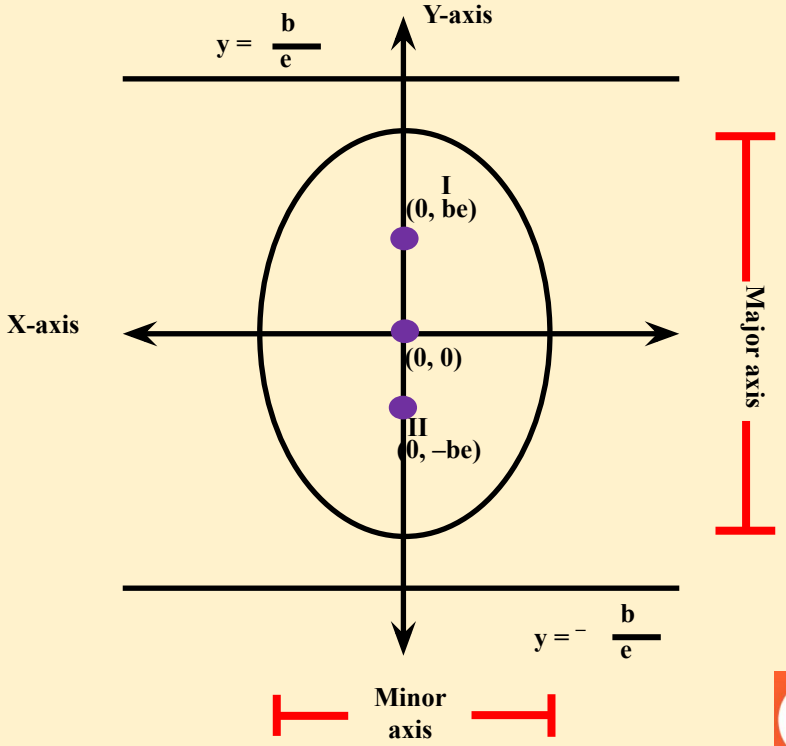
$$\frac{x^2}{a^2} + \frac{y^2}{a^2(1-e^2)} = 1$$

This is standard equation of ellipse
With focus (ae, 0) and directrix $x = a/e$



Standard Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, when $b > a$

$e^2 = 1 - \frac{a^2}{b^2}$



Quick Revision- Ellipse

	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1,\ a>b$	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1,\ a<b$
Coordinates of the centre	(0, 0)	(0, 0)
Coordinates of the vertices	(a, 0) and (-a, 0)	(0, b) and (0, -b)
Coordinates of foci	(ae, 0) and (-ae, 0)	(0, be) and (0, -be)
Length of the minor axis	2 b	2 a
Length of the major axis	2 a	2 b
Equations of the minor axis	x = 0	y = 0
Equation of the major axis	y = 0	x = 0
Equations of the directrices	$x=\frac{a}{e}\ and\ x=-\frac{a}{e}$	$x=\frac{b}{e}\ and\ x=-\frac{b}{e}$

Quick Revision- Ellipse

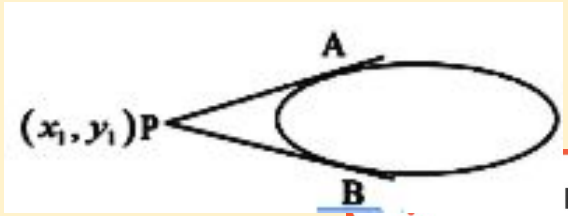
	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1,\ a>b$	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1,\ a<b$
Eccentricity	$e=\sqrt{1-\frac{b^2}{a^2}}$	$e=\sqrt{1-\frac{a^2}{b^2}}$
Length of the latusrectum	$\frac{2b^2}{a}$	$\frac{2a^2}{b}$
Focal distances of a point (x, y)	$a \pm ex$	$b \pm ex$

Equation of Tangent in different forms:

1. **Point form** : The equation of the tangent to the ellipse $\frac{xx_1}{a^2} + \frac{yy_1}{b^2} = 1$ at the point (x_1, y_1) is $\frac{xx_1}{a^2} + \frac{yy_1}{b^2}$

2. **Slopeform**: If the line $y = mx + c$ touches the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ then $c^2 = a^2m^2 + b^2$. Hence, the straight line $y = mx \pm \sqrt{a^2m^2 + b^2}$ always represents the tangent to the ellipse.

3. **Parametric form**: The equation of the tangent to any point $(a\cos\theta,\ b\ \sin\theta)\ is\ \frac{x}{a}\ \cos\theta + \frac{y}{b}\ \sin\theta = 1.$



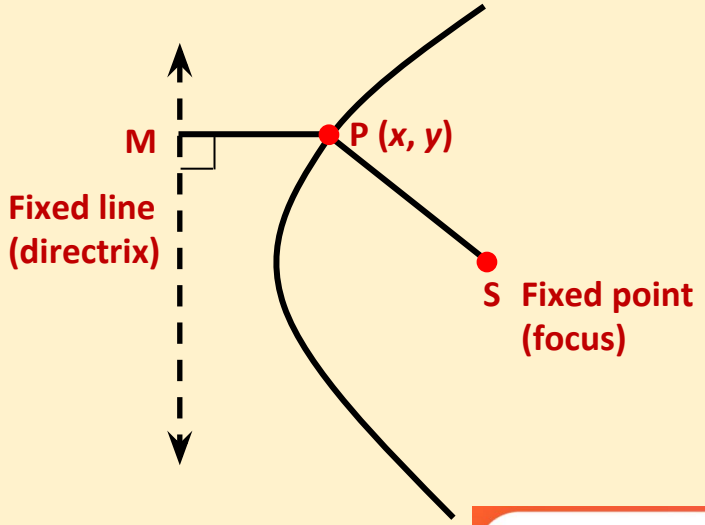
HYPERBOLA

Definition

It is locus of a point which moves such that ratio of its distance from a fixed point to its distance from a fixed line is always a constant greater than 1.

$$\frac{PS}{PM} = \text{constant} = e$$

where ‘e’ is eccentricity : $e > 1$



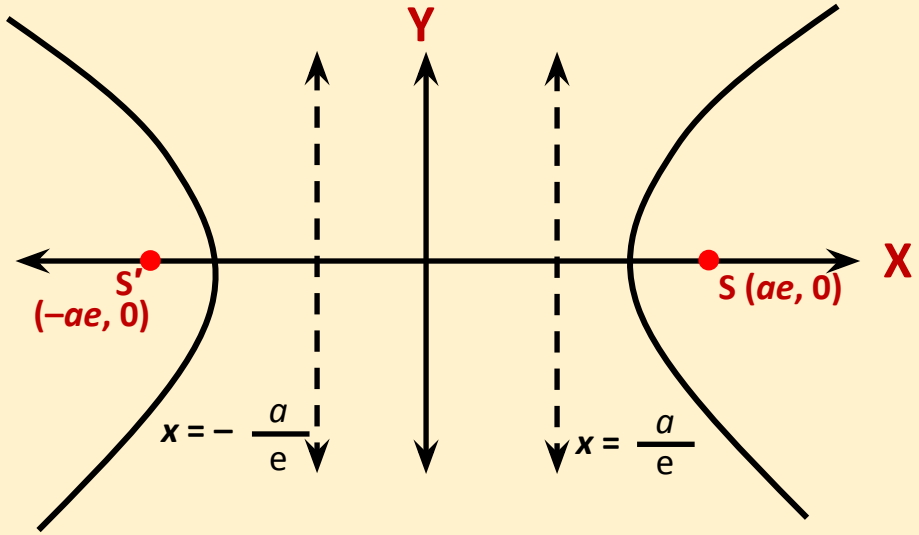
$$\frac{x^2}{a^2} + \frac{y^2}{a^2(1-e^2)} = 1$$

Here, $e > 1$ So, $a^2(1 - e^2)$ is negative

We put $a^2 (1 - e^2) = -b^2$

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

This is standard equation of hyperbola



Standard Hyperbola $\frac{y^2}{b^2} - \frac{x^2}{a^2} = 1$

Choice of transverse axis and conjugate axis depends on whose sign is negative in equation of hyperbola

- We have studied hyperbola

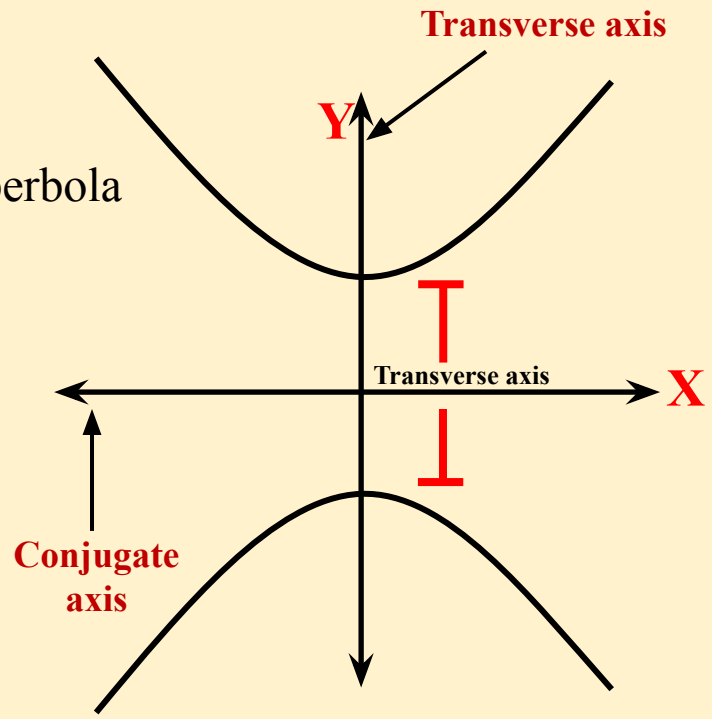
$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

where, transverse axis is along x-axis.

- For hyperbola

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

Transverse axis is along y-axis.



Quick Revision- Hyperbola

	Hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	Conjugate Hyperbola $-\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
Coordinates of the centre	(0, 0)	(0, 0)
Coordinates of the vertices	(a, 0) and (-a, 0)	(0, b) and (0, -b)
Coordinates of foci	(±ae, o)	(0, ±be)
Length of the transverse axis	2 a	2 b
Length of the conjugate axis	2 b	2 a
Equations of the directrices	$x = \pm\frac{a}{e}$	$y = \pm\frac{b}{e}$
Eccentricity	$e = \sqrt{\frac{a^2+b^2}{a^2}}$ *or* $b^2 = a^2\left(e^2 - 1\right)$	$e = \sqrt{\frac{b^2+a^2}{b^2}}$ *or* $a^2 = b^2\left(e^2 - 1\right)$

Quick Revision- Hyperbola

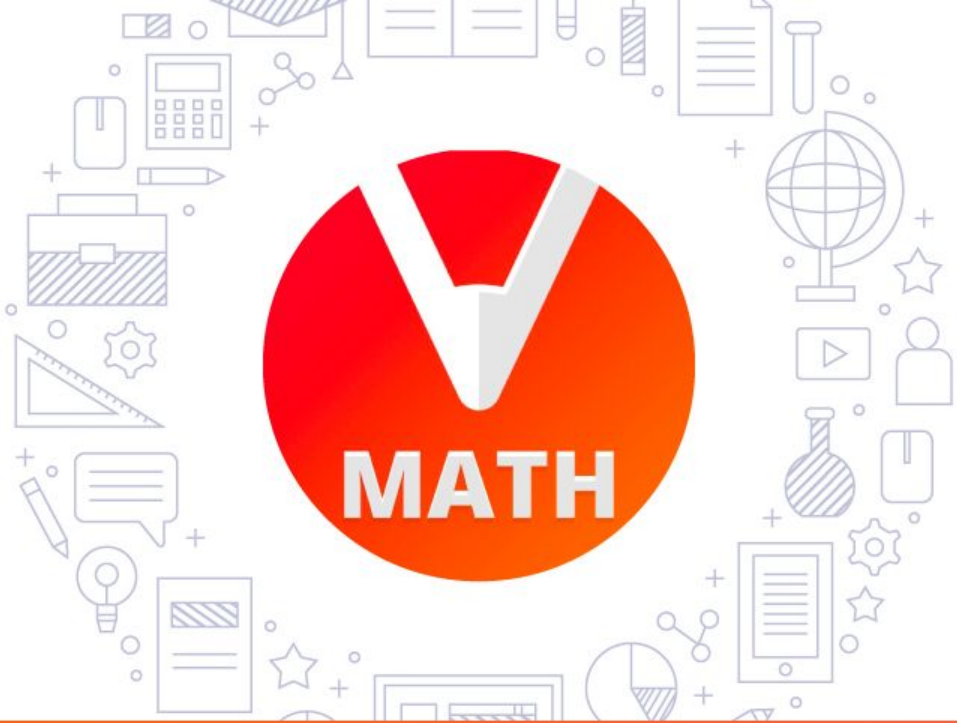
	Hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	Conjugate Hyperbola $-\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
Length of the latusrectum	$\frac{2b^2}{a}$	$\frac{2a^2}{b}$
Equation of the transverse axis	y = 0	x = 0
Equation of the conjugate axis	x = 0	y = 0

Equation of Tangent in different forms:

(i) **Slope Form** : $y = mx \pm \sqrt{a^2m^2 - b^2}$ can be taken as the tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

(ii) **Point Form** : Equation of tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ at the point $(x_1\ y_1)$ *is* $\frac{xx_1}{a^2} - \frac{yy_1}{b^2} = 1$

(iii) **Parametric Form** : Equation of the tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ at the point $(a\ \sec\theta,\ b\ \tan\theta)$ $\frac{x\sec\theta}{a} - \frac{y\tan\theta}{b} = 1$



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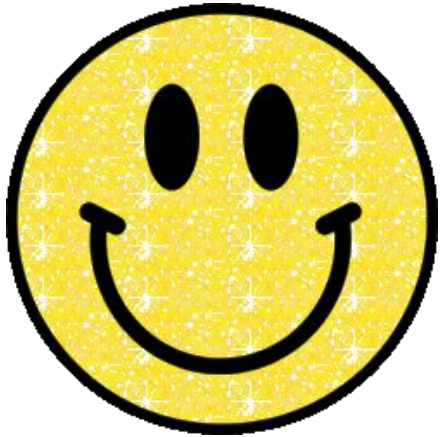

Thank You