*Formulas highlighted in yellow are found in the formula list of the exam paper.

Unit Conversion

Area

$1m^2 = 100cm \times 100cm = 10\ 000cm^2$

$1km^2 = 1000m \times 1000mv = 1\ 000\ 000m^2$

Volume

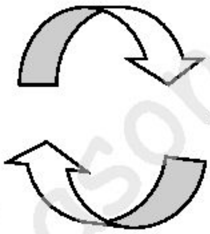
$1m^3 = 100cm \times 100cm \times 100cm = 1\ 000\ 000cm^3$

1 Litre $= 1000cm^3$ (As $1mg = 1cm^3$)

Mass 1 Ton = 1000kg

Time 1h = 60 min = 60x60=3600sec

Speed

km/h  m/s

Financial Math

Percentage Increase

$$= \frac{Increase}{Original} \times 100\%$$

Percentage Decrease

$$= \frac{Decrease}{Original} \times 100\%$$

Simple Interest

$$I = \frac{P \times R \times T}{100}$$

R-Interest (%) per year

T-Time (no. of years)

Compound Interest

$$P + I = P \times \left(1 + \frac{r}{100}\right)^n$$

r-Interest (%) in 1 period

n-Time (no. of periods)

P-Principal ($)

I- Interest ($)

Semi-Annually

n=2xT, r=R/2

Quarterly

n=4xT, r=R/4

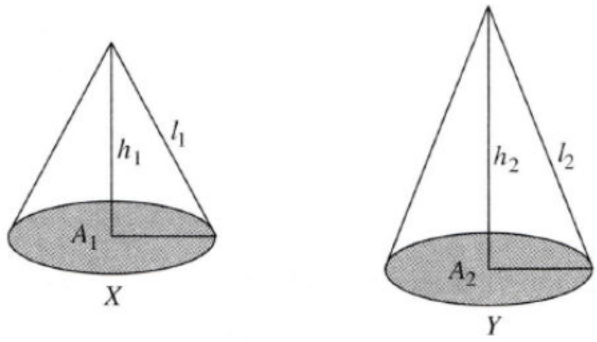
Monthly

n=12xT, r=R/12

Ratio and Proportion

X and Y are two

Similar Cones



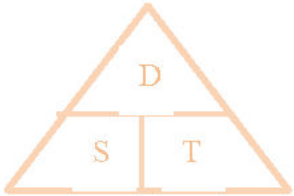
Ratio of heights equal ratio of lengths	Ratio of Areas equal Square of ratio of length	Ratio of Volume equal Cube of ratio of length
$\frac{h_1}{h_2} = \frac{l_1}{l_2}$	$\frac{A_1}{A_2} = \frac{(l_1)^2}{(l_2)^2}$ $\frac{\sqrt{A_1}}{\sqrt{A_2}} = \frac{l_1}{l_2}$	$\frac{V_1}{V_2} = \frac{(l_1)^3}{(l_2)^3}$ $\frac{\sqrt[3]{V_1}}{\sqrt[3]{V_2}} = \frac{l_1}{l_2}$

To convert Area to Volume & vice versa, first convert to <u>Length.</u>

$$\left(\frac{A_1}{A_2}\right) \underset{Square^2}{\overset{\sqrt{Square\ \ Root}}{\rightleftarrows}} \left(\frac{L_1}{L_2}\right) \underset{Cube^3}{\overset{\sqrt{Cube\ \ Root}}{\rightleftarrows}} \left(\frac{V_1}{V_2}\right)$$

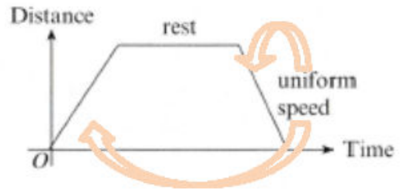
Speed and Distance

$$Speed = \frac{Distance}{Time}$$



$$Acceleration = \frac{Final\ Speed - Initial\ Speed}{Time\ Taken}$$

$$Average\ Speed = \frac{Total\ Distance}{Total\ Time}$$

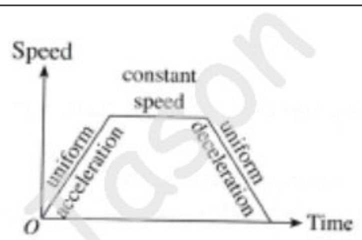


The steeper the gradient, the faster the speed.

You can also find the speed by using

$$\text{gradient} = \frac{\text{rise}}{\text{run}}$$

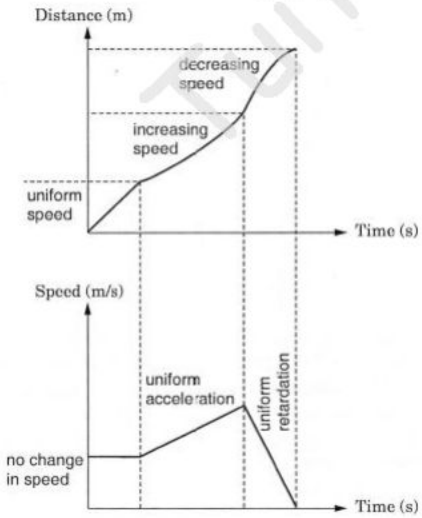
Negative gradient means that the object is moving in the opposite direction.



You can also find the acceleration by using

$$\text{gradient} = \frac{\text{rise}}{\text{run}}$$

The Area UNDER the graph is the distance travelled.



Relating the distance -time graph to the speed time graph.

When the line in the distance-time graph curve upward, the object is accelerating, when it curves downwards, the object is decelerating.

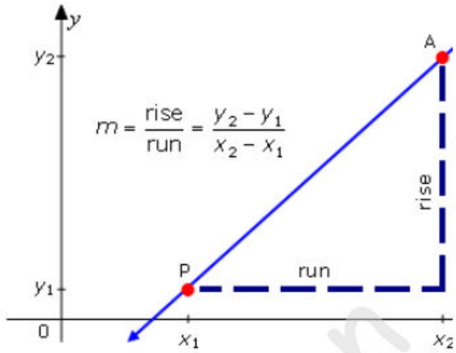
Indices	
$x^a \times x^b = x^{a+b}$ $a^m \times b^m = (a \times b)^m$	Base No. same→ Power add Power same→ Base No. multiply
$\frac{x^a}{x^b} = x^{a-b}$ $\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$	Base No. same→ Power minus Power same→ Base No. divide
Note: $\left(x^a\right)^b = x^{a \times b}$ $\left(x^a\right)^b \neq x^{a+b}$	**NOTE**: You can only use the laws of indices if either the base number or the power is the same.
$x^0 = 1$ $\quad x^{-a} = \frac{1}{x^a}$ $\quad \frac{1}{x^{-a}} = x^a$	
$\left(\frac{x}{y}\right)^{-a} = \left(\frac{y}{x}\right)^a$ $\quad x^{\frac{1}{b}} = \sqrt[b]{x^1}$ $\quad x^{\frac{a}{b}} = \sqrt[b]{x^a}$	
$x^{-\frac{1}{b}} = \frac{1}{x^{\frac{1}{b}}} = \frac{1}{\sqrt[b]{x^1}}$ $\quad x^{-\frac{a}{b}} = \frac{1}{x^{\frac{a}{b}}} = \frac{1}{\sqrt[b]{x^a}}$	

Coordinate Geometry

Linear Graph

Y= m x + c **where** m= gradient

and c= y-intercept



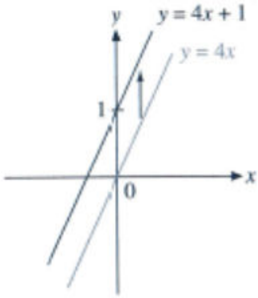
Gradient(m) = $\dfrac{y_2 - y_1}{x_2 - x_1}$

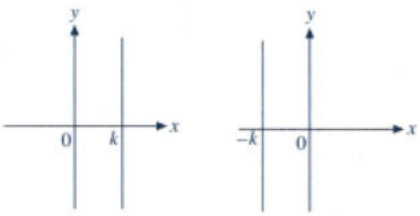
Distance between two points

$= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Parallel lines have the same gradient

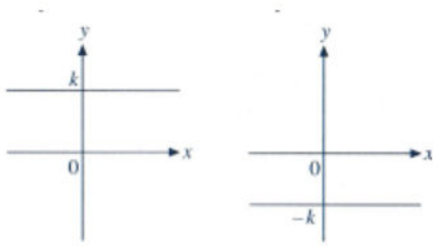
Both values are the same ($m_1 = m_2$).





Vertical lines have gradient that is infinity

m = ∞



Horizintal lines have gradient that is 0

m = 0

Polygons

Sum of interior angles of an n-sided polygon.	Sum of exterior angles of of ANY polygon $= 360^0$
$(n-2)\times 180^0$	

Each interior angle of an n-sided polygon.

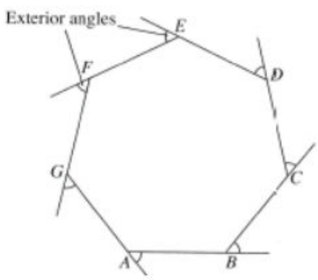
$$\frac{(n-2)\times 180^o}{n}$$

Each exterior angle of an n-sided polygon

$$= \frac{360^0}{n}$$

Names of Polygons

Pentagon		5
Hexagon		6
Octagon		8
Decagon		10



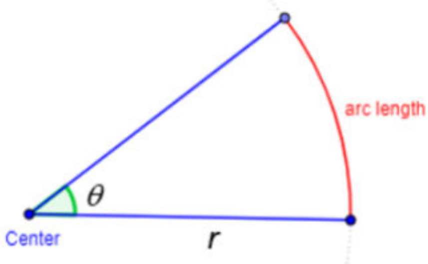
An Exterior ∡ + An Interior ∡ = 180^0

Arc Length, Sector and Segment

Arc Length

S= $\frac{\theta^0}{360^0} \times 2\pi r$ Or S= $r \times \theta$

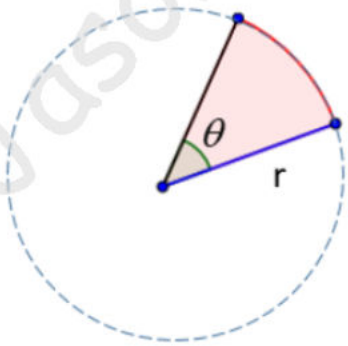
θ^0 in Degrees θ^0 in Radian



Area of Sector

A= $\frac{\theta^0}{360^0} \times \pi r^2$ Or $A = \frac{1}{2} \times r^2 \times \theta$

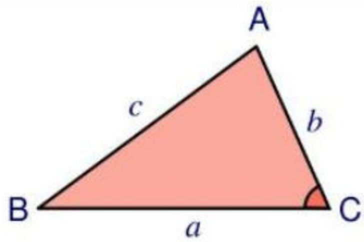
θ^0 in Degrees θ^0 in Radian



Area of Triangle

A = $\frac{1}{2} \times a \times b \times \sin C$

C may be in degree or radian.



Note: π radian = 180° degrees

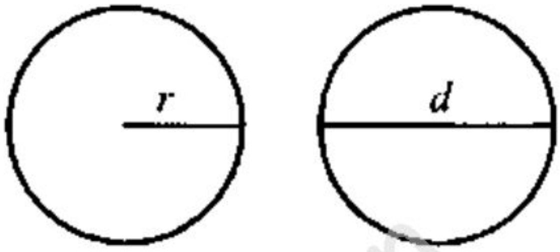
Mensuration

Circles

Area = $\pi \times r^2$

Circumference = $2 \times \pi \times r$

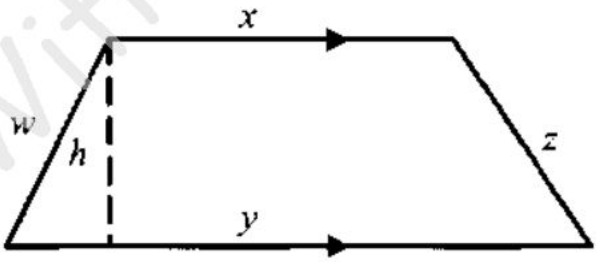
Or $\pi \times d$



Trapezium

Perimeter = w + x + y + z

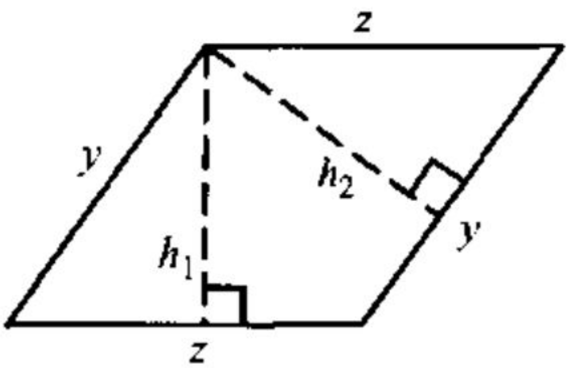
Area= $\frac{1}{2} \times (x+y) \times h$



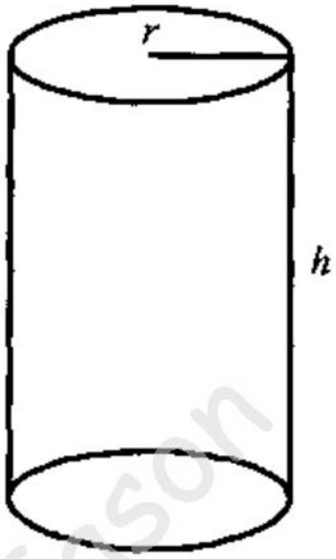
Parallelogram

Perimeter = 2×y+2×z

Area= y × z



Cylinder



Total Surface Area

(close cylinder)

$2\times\pi\times r^2$ (top & bottom circles)

$+2\times\pi\times r\times h$ (curved side)

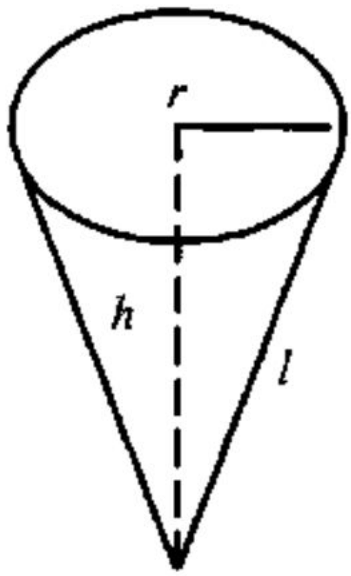
Total Surface Area

(open cylinder)

= $\pi\times r^2$ (bottom circle) + $2\times\pi\times r\times h$ (curved side)

Volume = $\pi\times r^2\times h$

Cone



Total Surface Area =

$\pi\times r\times l+\pi\times r^2$

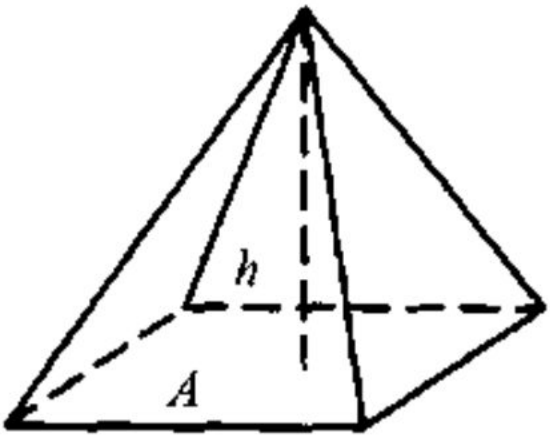
Volume = $\frac{1}{3}\times\pi\times r^2\times h$

l=slant height

h=vertical height

(Note the difference)

Pyramid



Total Surface Area =

Sum of all surface areas

Volume = $\frac{1}{3} \times A \times h$

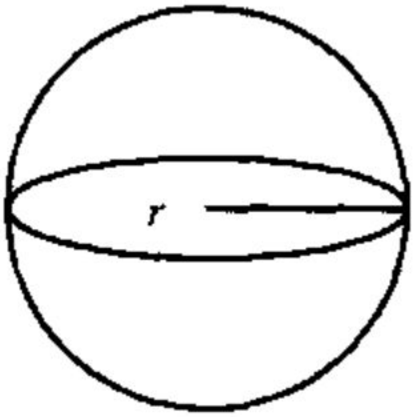
A=base area

h=vertical height

Note: The formula for A depends on the base area.

Pyramids have square, rectangle or triangle base are.

Sphere



Total Surface Area = $4 \times \pi \times r^2$

Volume = $\frac{4}{3} \times \pi \times r^3$

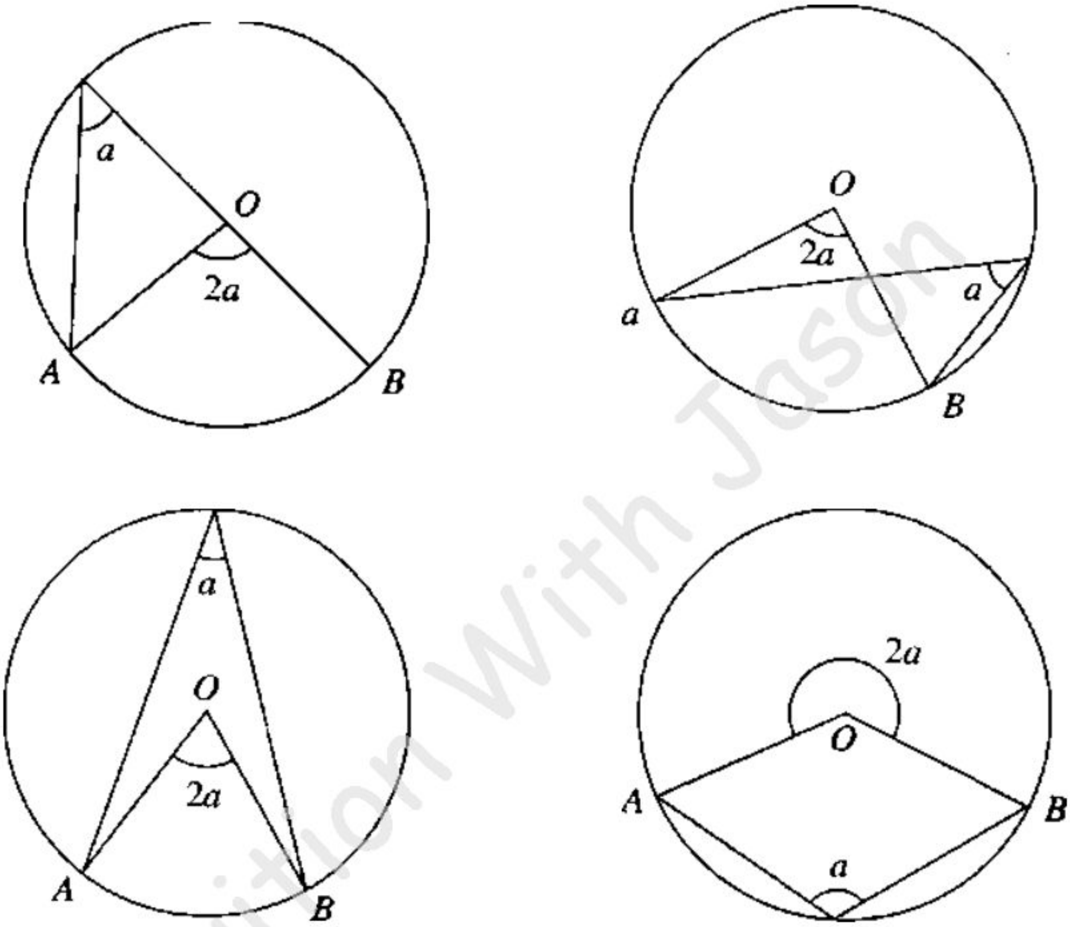
Hemisphere (half-sphere)

Total Surface Area = $2 \times \pi \times r^2 + \pi \times r^2$

Volume= $\frac{2}{3} \times \pi \times r^3$

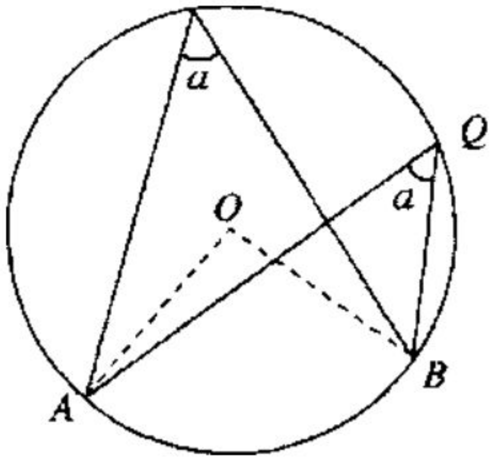
Properties of Circle

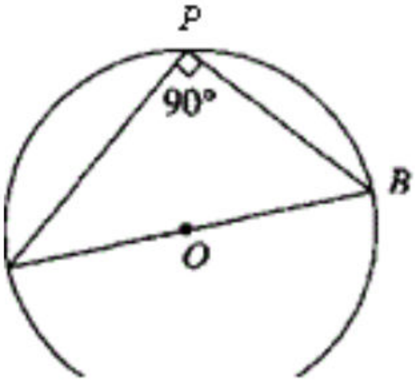
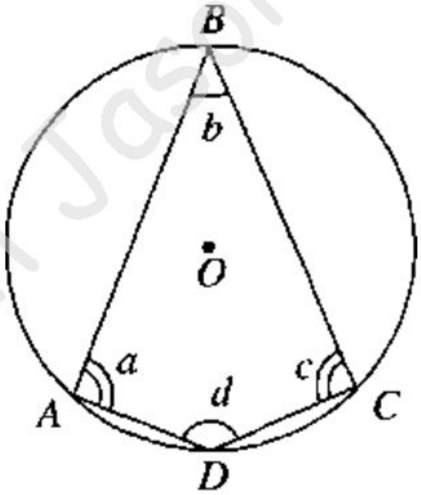
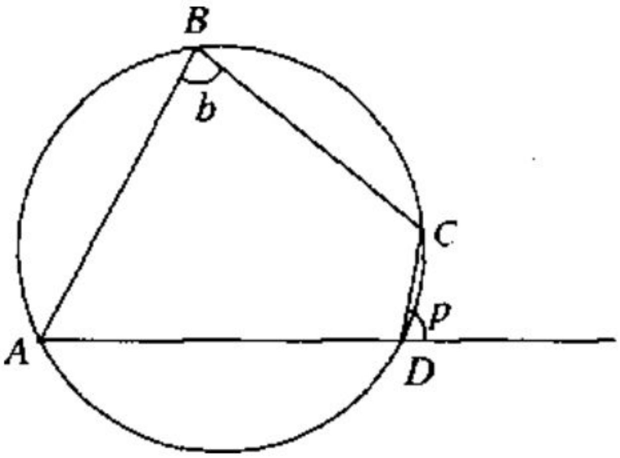
Angle at Centre =Twice Angle at Circumference



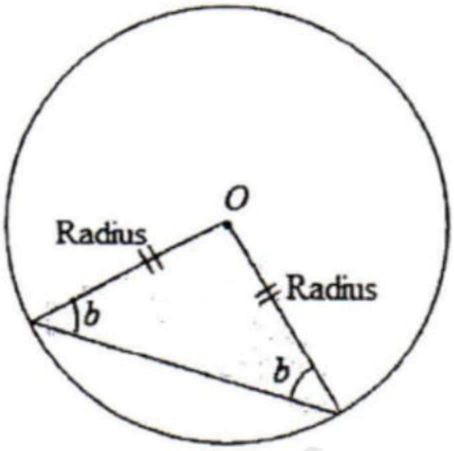
Angles in the Same Segment

Are Equal



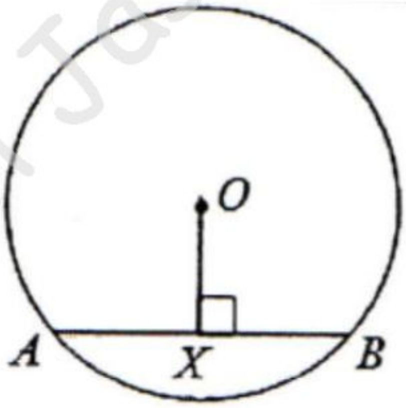
Angle in a Semi-circle =90°	
Angles in Opposite Segment (Add up to 180°) a°+c°=180° b°+d°=180°	
Exterior angle of a cyclic quadrilateral b°=p°	

Isosceles Triangle

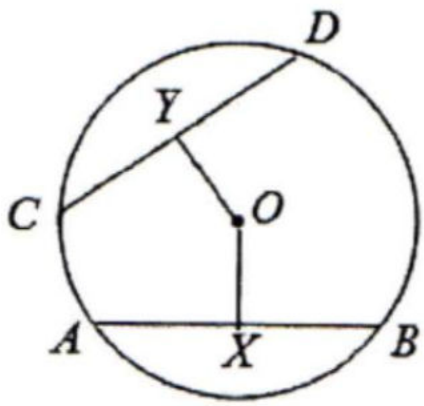


Perpendicular from Centre Bisects Chord

$\angle OXA = \angle OXB = 90^0$

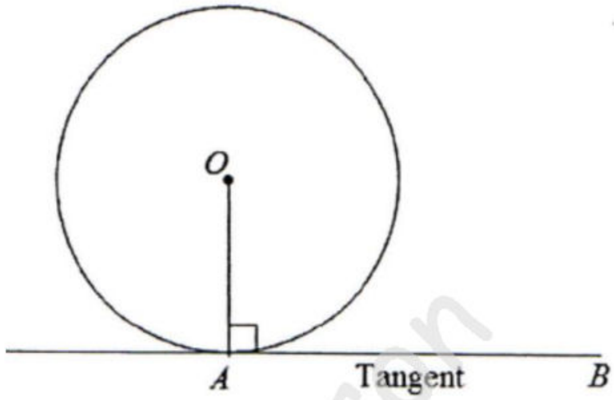


Equal Chord, Equal Distance from Centre



Tangent Perpendicular Radius

$\angle OAB = 90^0$

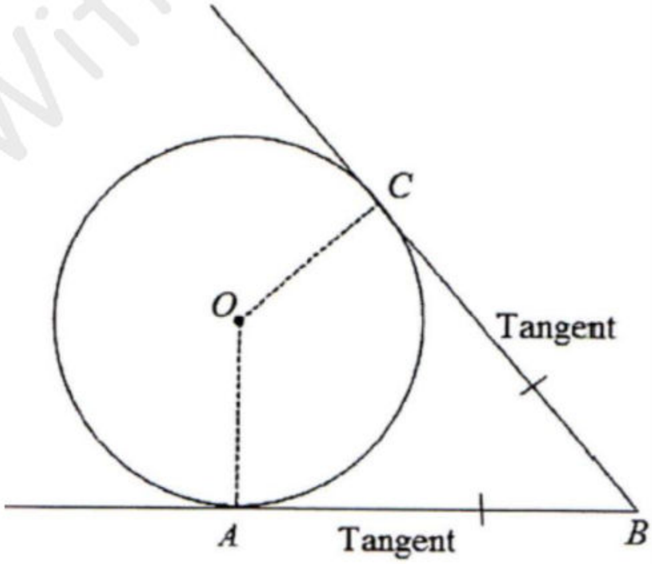


Tangents from External Point

BC=BA

$\angle OCB = \angle OAB = 90^0$

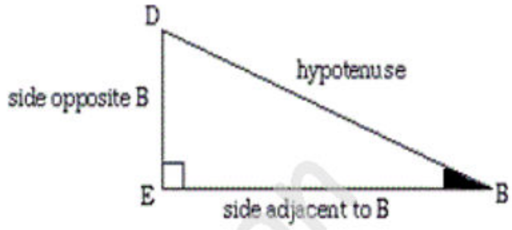
OA = OC (radius)



Trigonometry

Note: Use on a Right Angle Triangle

$$\text{Tan B} = \frac{\text{Opposite (DE)}}{\text{Adjacent (EB)}} \text{ (TOA)}$$



$$\text{Cos B} = \frac{\text{Adjacent (EB)}}{\text{Hypotenuse (DB)}} \text{ (CAH)}$$

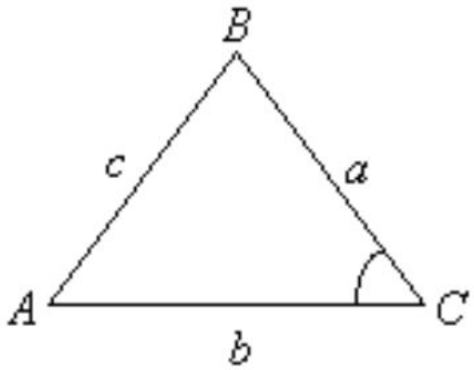
$$\text{Sin B} = \frac{\text{Opposite (DE)}}{\text{Hypotenuse (DB)}} \text{ (SOH)}$$

Pythagoras Theorem $DB^2 = DE^2 + EB^2$

Note: Use when the triangle is NOT Right Angle.

Area of Triangle $= \frac{1}{2} \times a \times b \times Sin\,C$

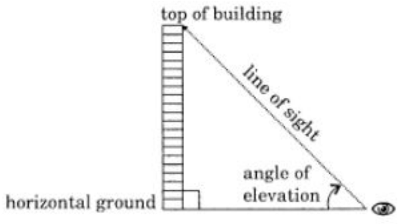
Sine Rule $\frac{a}{Sin\ A} = \frac{b}{Sin\ B} = \frac{c}{Sin\ C}$



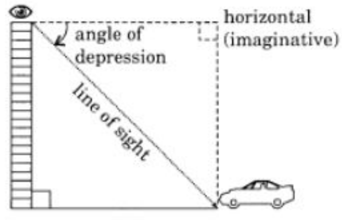
Cosine Rule

$c^2 = a^2 + b^2 - 2ab \times Cos\,C$

∡ of Elevation & ∡ of Depression are measured from the horizonal line.



(a right-angled triangle is formed)



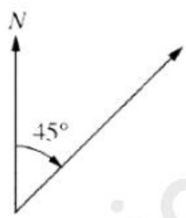
(a right-angled triangle is formed)

Bearing is use to describe direction.

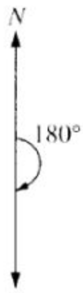
It is measured from North in a Clockwise direction and

It is represented by a 3-digit number.

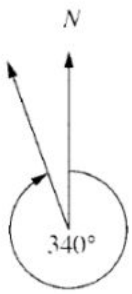
- Bearing of 045°



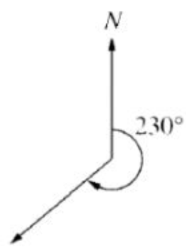
- Bearing of 180°



- Bearing of 340°



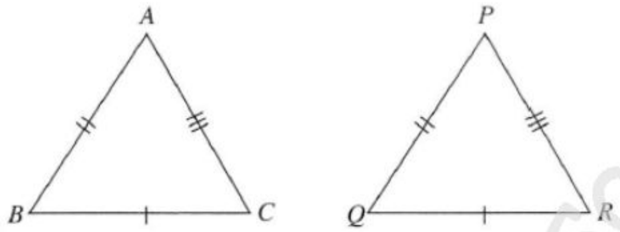
- Bearing of 230°



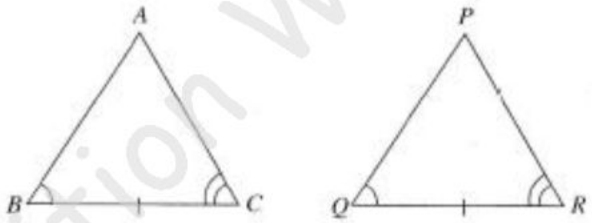
Congruent and Similarity

Congruent Triangles

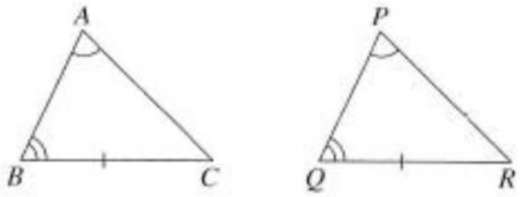
If $AB = PQ$, $BC = QR$ and $CA = RP$, then ΔABC is congruent to ΔPQR (SSS Congruence Test).



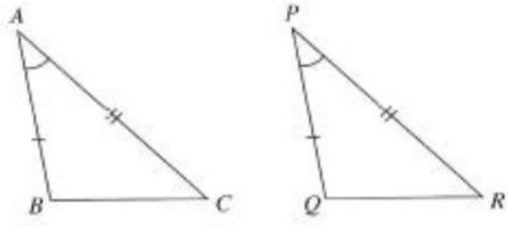
If $A\hat{B}C = P\hat{Q}R$, $A\hat{C}B = P\hat{R}Q$ and $BC = QR$, then ΔABC is congruent to ΔPQR (ASA Congruence Test).



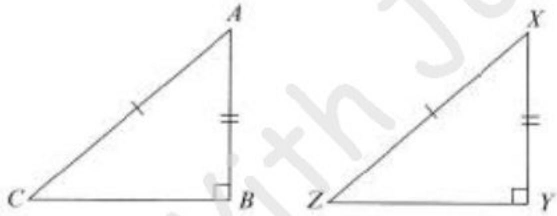
If $B\hat{A}C = Q\hat{P}R$, $A\hat{B}C = P\hat{Q}R$ and $BC = QR$, then ΔABC is congruent to ΔPQR (AAS Congruence Test).



If $AB = PQ$, $AC = PR$ and $B\hat{A}C = Q\hat{P}R$, then ΔABC is congruent to ΔPQR (SAS Congruence Test).

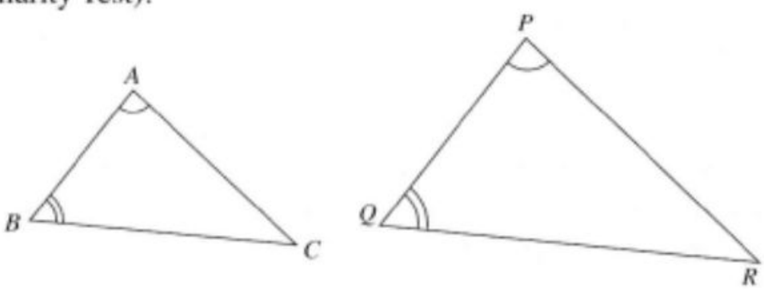


If $AC = XZ$, $AB = XY$ or $BC = YZ$, and $A\hat{B}C = X\hat{Y}Z = 90^\circ$, then ΔABC is congruent to ΔXYZ (RHS Congruence Test).

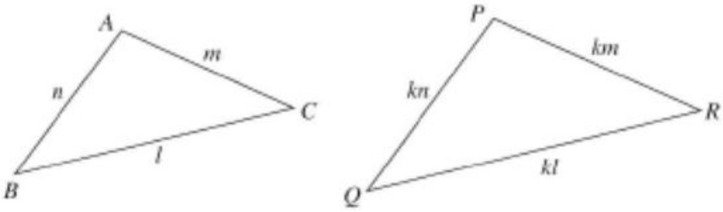


Similar Triangles

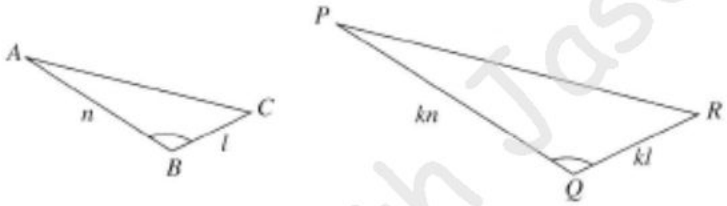
If $B\hat{A}C = Q\hat{P}R$ and $A\hat{B}C = P\hat{Q}R$, then ΔABC is similar to ΔPQR (AA Similarity Test).



If $\frac{PQ}{AB} = \frac{QR}{BC} = \frac{RP}{CA}$, then ΔABC is similar to ΔPQR (SSS Similarity Test).



If $\frac{PQ}{AB} = \frac{QR}{BC}$ and $A\hat{B}C = P\hat{Q}R$, then ΔABC is similar to ΔPQR (SAS Similarity Test).



Matrix

$$A_1 + A_2 = \begin{pmatrix} a_1 & b_1 \\ c_1 & d_1 \end{pmatrix} + \begin{pmatrix} a_2 & b_2 \\ c_2 & d_2 \end{pmatrix} = \begin{pmatrix} a_1 + a_2 & b_1 + b_2 \\ c_1 + c_2 & d_1 + d_2 \end{pmatrix}$$

$$A_1 - A_2 = \begin{pmatrix} a_1 & b_1 \\ c_1 & d_1 \end{pmatrix} - \begin{pmatrix} a_2 & b_2 \\ c_2 & d_2 \end{pmatrix} = \begin{pmatrix} a_1 - a_2 & b_1 - b_2 \\ c_1 - c_2 & d_1 - d_2 \end{pmatrix}$$

$$k \times A = k\begin{pmatrix} a_1 & b_1 \\ c_1 & d_1 \end{pmatrix} = \begin{pmatrix} k \times a_1 & k \times b_1 \\ k \times c_1 & k \times d_1 \end{pmatrix}$$

$$A_1 B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} w & x \\ y & z \end{pmatrix} = \begin{pmatrix} aw + by & ax + bz \\ cw + dy & cx + dz \end{pmatrix}$$

Probability
$\text{Probability} = \dfrac{\text{Number Of Successful Outcome}}{\text{Total Number Of Outcomes}}$ If the probability of A AND B occurs, then P(A) X P(B). If the probability of A OR B occurs, then P(A) + P(B) If the probability of A DOES NOT occurring, then 1- P(A). Probability is between and include 0 to 1. If Probability (P) = 0, it means that there is NO CHANCE of success. If Probability (P) = 1 it means that success is CERTAIN.

Statistics	
Ungroup Data $\text{Mean}(\bar{X}) = \dfrac{\text{Sum Of All Data Values}}{\text{Number Of Data}}$ **Group Data** $Mean(\bar{X}) = \dfrac{\sum fx}{\sum f}$	
$Lower\ Quartile = \frac{1}{4}(n+1)th\ Term$	n is the total frequency.

$Median = (\frac{n+1}{2})th$ Term $Upper\ Quartile = \frac{3}{4}(n+1)th\ Term$	*These formulas give the POSITION where the value is located. It IS NOT the actual value.

Ungroup Data - Standard Deviation (σ)

$$\sigma = \sqrt{\frac{\sum (x-\bar{X})^2}{\sum f}} \text{ or } \sigma = \sqrt{\frac{\sum x^2}{n} - \bar{X}^2}$$

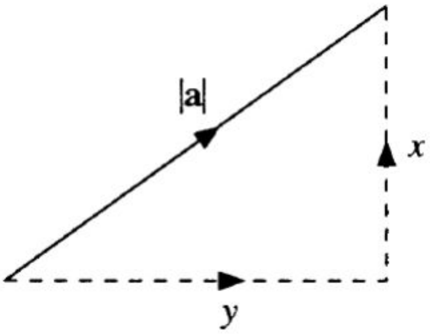
Group Data - Standard Deviation (σ)

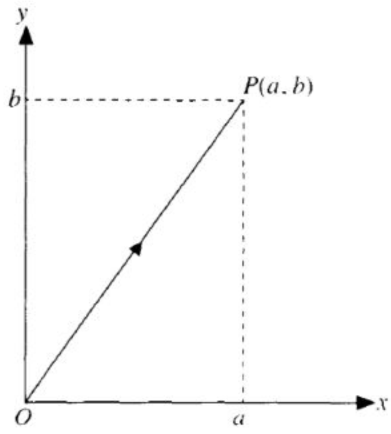
$$\sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2} \text{ or } \sigma = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\bar{X}\right)^2}$$

Vectors

The size (magnitude) of a vector a = $\begin{pmatrix} x \\ y \end{pmatrix}$ is

$$|a| = \sqrt{x^2 + y^2}$$

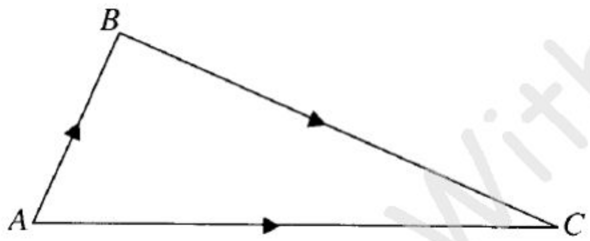




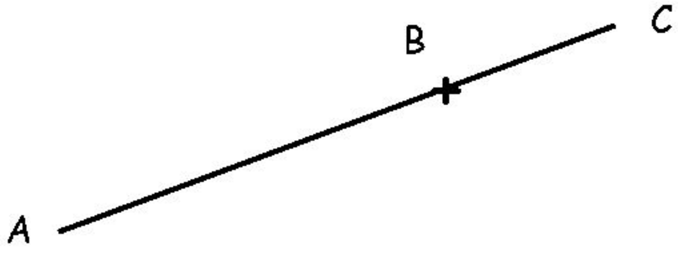
The position vector is always measured from the origin (0,0). The position vector of P is

$$\overrightarrow{OP} = \begin{pmatrix} a \\ b \end{pmatrix}$$

Triangle law of addition: $\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC}$



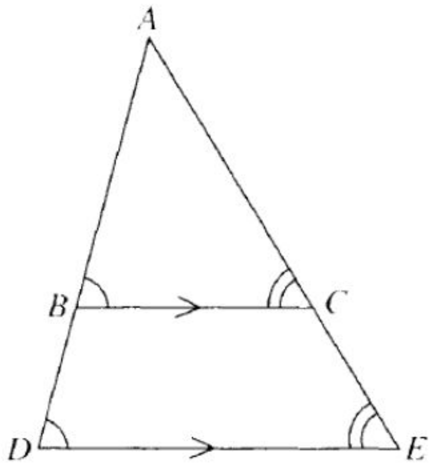
Collinear points



A, B and C are collinear if

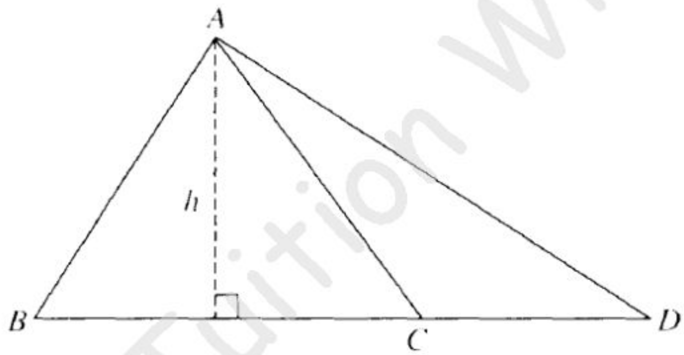
AB//BC (when $\overrightarrow{AB} = k\overrightarrow{BC}$) and if **B is a common point** on the line.

Ratio of areas of similar figures.



$$\frac{Area\ of\ \Delta\ ABC}{Area\ of\ \Delta\ ADC} = \left(\frac{BC}{DE}\right)^2$$

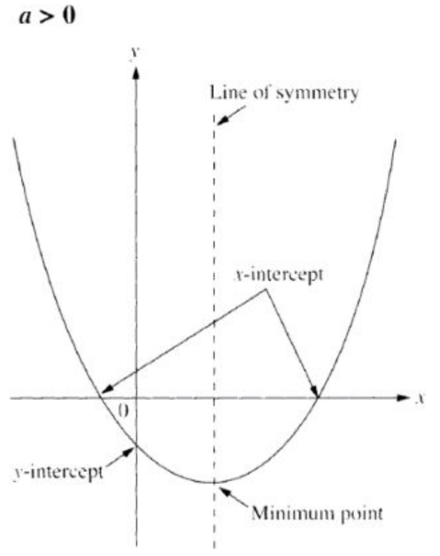
Ratio of areas of triangles with the same height.

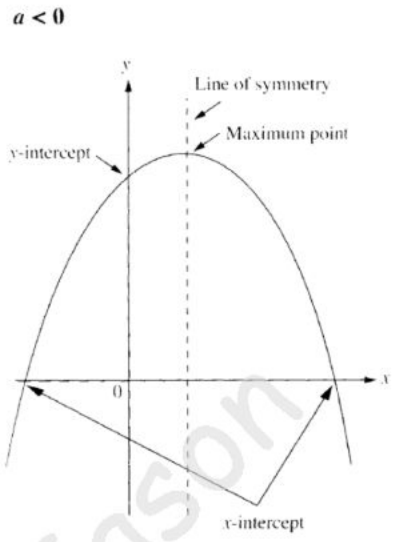


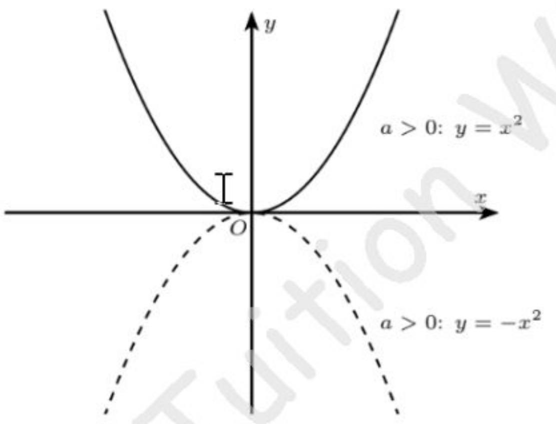
$$\frac{Area\ of\ \Delta\ ABC}{Area\ of\ \Delta\ ADC}$$

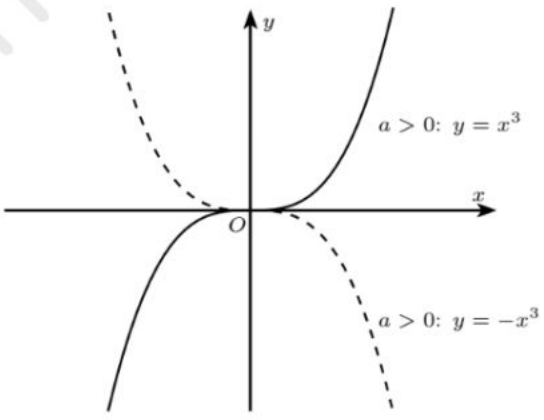
$$= \frac{\frac{1}{2} \times BC \times h}{\frac{1}{2} \times CD \times h} = \frac{BC}{CD}$$

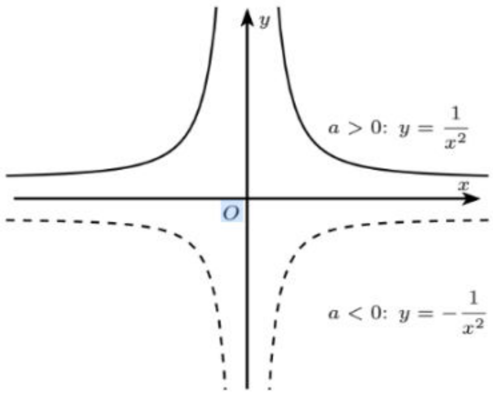
Graphs


a > 0
y
Line of symmetry
x-intercept
x
0
y-intercept
Minimum point

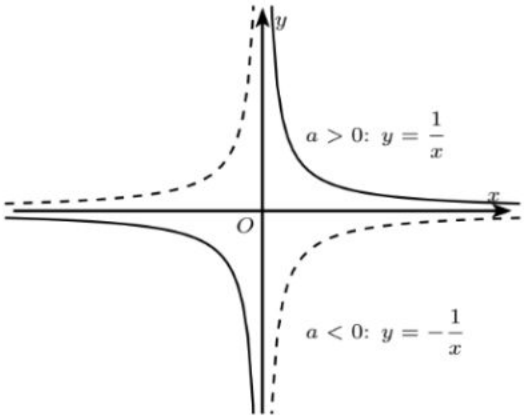

a < 0
y
Line of symmetry
Maximum point
y-intercept
0
x
x-intercept


y
a > 0: y = x^2
x
O
a > 0: y = −x^2

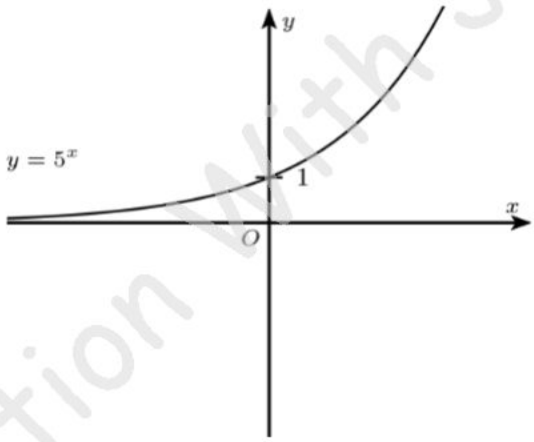

y
a > 0: y = x^3
x
O
a > 0: y = −x^3



y
$a > 0$: $y = \frac{1}{x^2}$
x
O
$a < 0$: $y = -\frac{1}{x^2}$



y
$a > 0$: $y = \frac{1}{x}$
x
O
$a < 0$: $y = -\frac{1}{x}$



y
$y = 5^x$
1
x
O

THE END