






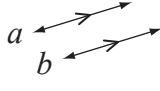
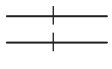


# MATHS FACTS

## SYMBOLS

### Number

+	plus or add
-	minus or subtract
×	multiplied by, times, lots of
÷	divided by, into groups of
=	equals, is equal to
≠	is not equal to
≈	is approximately equal to
<	is less than, $4 < 6$
>	is greater than, $8 > 5$
≤	is less than or equal to
≥	is greater than or equal to
()	brackets, a grouping symbol
%	percent, $12\% = \frac{12}{100}$
.	decimal point as in 7.9
-3	negative 3
$6^3$	6 raised to the 3 <sup>rd</sup> power, $6 \times 6 \times 6$
$\sqrt{9}$	square root of 9
$\frac{4}{7}$	fraction, $4 \div 7$ , four sevenths
$a:b$ or $\frac{a}{b}$	ratio of $a$ to $b$
2.4̄	recurring decimal
2.13̄	recurring decimal

### Geometry

$\pi$ (pi)	$\approx 3.14$ or $\frac{22}{7}$
	ratio of the circumference to the diameter of a circle
°	degree (a right angle measures $90^\circ$ )
≡	is congruent to,  ≡ 
~	is similar to,  ~ 
	is parallel to
⊥	is perpendicular to
$\triangle ABC$	triangle with vertices A, B and C
	right angle
$\overleftrightarrow{AD}$	line AD
$\overline{BC}$	segment BC
	parallel lines (line $a$ is parallel to line $b$ )
	congruent segments
	equal angles
	equal side lengths

### Algebra

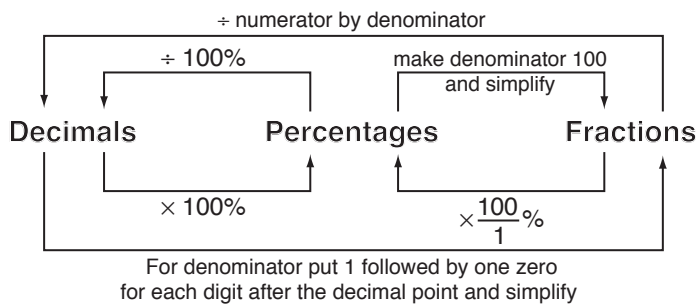
$3x$	3 times $x$ , 3 lots of $x$ , $3 \times x$ , $3(x)$
$x^2$	$x$ raised to the 2 <sup>nd</sup> power, $x \times x$
$-x$	opposite of $x$
$\frac{1}{x}$	reciprocal of $x$
$(x,y)$	coordinates in a Cartesian plane
$m$	gradient of a linear graph
$c$	$y$ -intercept of a linear graph

## NUMBER FACTS (1)

### Place value

millions	hundreds of thousands	tens of thousands	thousands	hundreds	tens	units	decimal point	tenths	hundredths	thousandths
1 000 000	100 000	10 000	1 000	100	10	1		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$

### Decimals / Fractions / Percentages



Fraction	Decimal	Percentage
$\frac{1}{1}$	1	100%
$\frac{1}{2}$	0.5	50%
$\frac{1}{3}$	$0.\dot{3}$	33.33%
$\frac{2}{3}$	$0.\dot{6}$	66.66%
$\frac{1}{4}$	0.25	25%
$\frac{3}{4}$	0.75	75%
$\frac{1}{5}$	0.2	20%
$\frac{2}{5}$	0.4	40%
$\frac{3}{5}$	0.6	60%
$\frac{4}{5}$	0.8	80%
$\frac{1}{8}$	0.125	12.5%
$\frac{1}{9}$	$0.\dot{1}$	11.11%

### 0

Subtraction  $a - 0 = a$

Multiplication  $a \times 0 = 0$  and  $0 \times a = 0$

Division  $0 \div a = 0$

### 1

Multiplication  $a \times 1 = a$  and  $1 \times a = a$

Division  $a \div 1 = a$

### Prime numbers < 100

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97

### Perfect squares of numbers 0 to 30

0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225, 256, 289, 324, 361, 400, 441, 484, 529, 576, 625, 676, 729, 784, 841 and 900

## NUMBER FACTS (2)

### Real Numbers $\mathbb{R}$

#### IRRATIONAL

$\pi$ ,  $\phi$ ,  $e$ ,  $\sqrt{2}$ ,  $\sqrt{3}$ ,  $\sqrt{5}$ ,  
2.6293045632....  
 $\cos 30^\circ$

$\mathbb{Q}$

#### RATIONAL

$-2\frac{3}{7}$ , 3.010101...,  
 $\frac{4}{10}$ , 0.56,  $\sqrt{\frac{4}{9}}$

$\mathbb{Z}$

#### Integers

..., -3, -2, -1, 0, 1, 2, 3, ...

$\mathbb{N}$

Natural (Whole Numbers)  
0, 1, 2, 3, 4, 5, 6, ...

### Operation terminology

Addition: sum, altogether, in total, more than

Subtraction: difference, less than, change

Multiplication: product, times, lots of

Division: a fraction (half, third, quarter) of,  
quotient

### Applied number - money

Percentage = Fraction  $\times \frac{100}{1}$  %

$$\frac{P}{100} = P\%$$

Commission = %  $\times$  Selling price

### Order of Operations

The order of doing operations is:

- 1) Simplify inside all brackets.
- 2) Evaluate powers and square roots.
- 3) Calculate  $\times$  and  $\div$  from left to right.
- 4) Calculate  $+$  and  $-$  from left to right.

Simple Interest = Principal  $\times$  rate  $\times$  time

$$SI = PRT$$

Percentage change =  $\frac{\text{amount of change}}{\text{original amount}} \times \frac{100}{1}$  %

### Sign Rules

$$++ = +$$

$$-- = +$$

$$+- = -$$

$$-+ = -$$

### Applied number - distance

Distance ( $d$ ) = average speed ( $v$ )  $\times$  time taken ( $t$ )

$$d = vt$$

$$v = \frac{d}{t}$$

$$t = \frac{d}{v}$$

### Rates and Proportions

$$a : b = \frac{a}{b}$$

$$a : b = c : d$$

$$\frac{a}{b} = \frac{c}{d}$$

$$a \times d = b \times c$$

$$ad = bc$$

### Applied number - rates

Rate ( $r$ ) =  $\frac{\text{amount (a)}}{\text{time (t)}}$

$$r = \frac{a}{t}$$

$$a = rt$$

$$t = \frac{a}{r}$$

## ALGEBRA FACTS

### Identity Properties

Addition  $a + 0 = a$  and  $0 + a = a$

Multiplication  $a \times 1 = a$  and  $1 \times a = a$

### Associative Properties

Addition  $(a + b) + c = a + (b + c)$

Multiplication  $(a \times b) \times c = a \times (b \times c)$

### Commutative Properties

Addition  $a + b = b + a$

Multiplication  $a \times b = b \times a$

### Distributive Properties

$$a(b + c) = ab + ac$$

$$a(b - c) = ab - ac$$

### Perfect square rules

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

### Difference of two squares rule

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

### Inverse number rules

Addition  $a + -a = 0$  and  $-a + a = 0$

Multiplication  $a \times \frac{1}{a} = 1$  and  $\frac{1}{a} \times a = 1$

### Inverse operation rules

Operation	Inverse Operation	Operation	Inverse Operation	Operation	Inverse Operation	Operation	Inverse Operation
+	-	-	+	×	÷	÷	×
$x + 3 = 6$		$x - 3 = 6$		$3x = 6$		$\frac{x}{3} = 6$	
$x + 3 - 3 = 6 - 3$		$x - 3 + 3 = 6 + 3$		$\frac{3x}{3} = \frac{6}{3}$		$\frac{x}{3} \times 3 = 6 \times 3$	
$x = 3$		$x = 9$		$x = 2$		$x = 18$	

### Index Laws

$a^0 = 1$  Zero exponent

$a^{-n} = \frac{1}{a^n}$  Negative exponent

$a^m \times a^n = a^{m+n}$  Product of powers

$\frac{a^m}{a^n} = a^{m-n}$  Quotient of powers

$(a^m)^n = a^{mn}$  Power to power

$(ab)^n = a^n b^n$  Product to power

$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$  Quotient to power

### Square root rules

$$\sqrt{a} \times \sqrt{b} = \sqrt{a \times b}$$

$$\sqrt{a} \times \sqrt{a} = \sqrt{a \times a} = a$$

$$\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$$

$$\frac{\sqrt{a}}{\sqrt{a}} = \sqrt{\frac{a}{a}} = 1$$

### Properties of Equality

Addition  $a = b$   
 $a + c = b + c$

Subtraction  $a = b$   
 $a - c = b - c$

Multiplication  $a = b$   
 $ac = bc$

Division  $a = b$   
 $\frac{a}{c} = \frac{b}{c}, c \neq 0$

## MEASUREMENT FACTS (1)

### CONVERSIONS

#### Length

10 millimetres (mm) = 1 centimetre (cm)

$$\begin{array}{l} 100 \text{ cm} = \\ 1000 \text{ mm} = \end{array} \left. \vphantom{\begin{array}{l} 100 \text{ cm} = \\ 1000 \text{ mm} = \end{array}} \right] 1 \text{ metre (m)}$$

1000 m = 1 kilometre (km)

#### Area

100 square mm (mm<sup>2</sup>) = 1 square cm (cm<sup>2</sup>)

10 000 cm<sup>2</sup> = 1 square metre (m<sup>2</sup>)

10 000 m<sup>2</sup> = 1 hectare (ha)

1 000 000 m<sup>2</sup> = 1 square km (km<sup>2</sup>)

#### Liquid Capacity

1000 millilitres (mL) = 1 litre (L)

1 000 000 L = 1 megalitre (ML)

1000 cubic cm (cm<sup>3</sup>) = 1 L

1000 L = 1 cubic metre (m<sup>3</sup>)

#### Volume

1000 cubic mm (mm<sup>3</sup>) = 1 cubic cm (cm<sup>3</sup>)

1 000 000 cm<sup>3</sup> = 1 cubic metre (m<sup>3</sup>)

#### Time

60 seconds (s) = 1 minute (min)

60 minutes (min) = 1 hour (h)

24 hours (h) = 1 day

7 days = 1 week

2 weeks = 1 fortnight

4 weeks (approx.) = 1 month

$$\begin{array}{l} 365 = \\ 52 \text{ weeks (approx.)} = \\ 12 \text{ months} = \end{array} \left. \vphantom{\begin{array}{l} 365 = \\ 52 \text{ weeks (approx.)} = \\ 12 \text{ months} = \end{array}} \right] 1 \text{ year}$$

366 days = 1 leap year

10 years = 1 decade

100 years = 1 century

#### Temperature - degrees Celsius (°C)

0°C = freezing point of water

100°C = boiling point of water

37°C = human body temperature

#### Mass

1000 milligrams (mg) = 1 gram (g)

1000 g = 1 kilogram (kg)

1000 kg = 1 tonne (t)

### METRIC PREFIXES

**giga (G)** = 1 billion = 1 000 000 000

**mega (M)** = 1 million = 1 000 000

**kilo (k)** = 1 thousand = 1000

**hecto (h)** = 1 hundred = 100

**deca (da)** = 1 ten = 10

**micro (μ)** = 1 millionth =  $\frac{1}{1\,000\,000}$

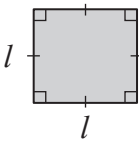

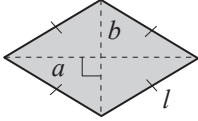
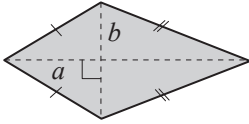
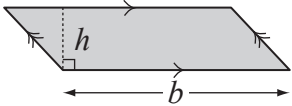
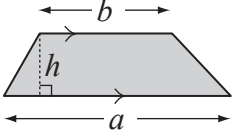
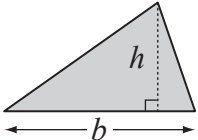
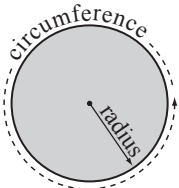
**milli (m)** = 1 thousandth =  $\frac{1}{1000}$

**centi (c)** = 1 hundredth =  $\frac{1}{100}$

**deci (d)** = 1 tenth =  $\frac{1}{10}$

## MEASUREMENT FACTS (2)

### 2D shapes - Formulae

Name	Shape	Perimeter	Area
Square		$P = 4 \times l$ $= 4l$	$A = l \times l$ $= l^2$
Rectangle		$P = 2l + 2w$ $= 2(l + w)$	$A = l \times w$ $= lw$
Rhombus		$P = 4 \times l$ $= 4l$	$A = \frac{a \times b}{2}$ $= \frac{1}{2}ab$
Kite		$P = \text{Sum of all sides}$	$A = \frac{a \times b}{2}$ $= \frac{1}{2}ab$
Parallelogram		$P = \text{Sum of all sides}$	$A = b \times h$ $= bh$
Trapezium		$P = \text{Sum of all sides}$	$A = \frac{1}{2}(a + b)h$
Triangle		$P = \text{Sum of all sides}$	$A = \frac{b \times h}{2}$ $= \frac{1}{2}bh$
Circle		$C = 2\pi r$	$A = \pi r^2$ where $\pi \approx 3.14$ or $\frac{22}{7}$

#### Prefixes

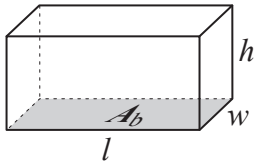
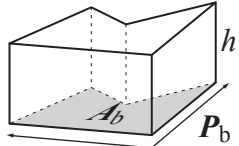
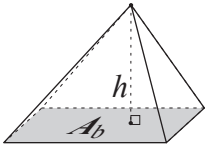
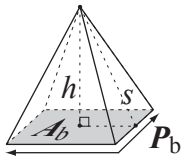
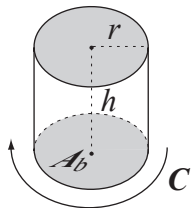
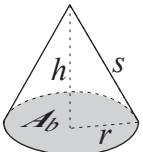
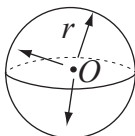
<b>poly</b> - many	<b>mono</b> - one
<b>equi</b> - equal	<b>bi or di</b> - two
<b>hedra</b> - face	<b>tri</b> - three
<b>gon</b> - angle	<b>quad or tetra</b> - four
<b>lateral</b> - side	<b>penta</b> - five
	<b>hexa</b> - six
	<b>hepta</b> - seven
	<b>octa</b> - eight
	<b>nona</b> - nine
	<b>deca</b> - ten

#### Abbreviations

<i>l</i>	length
<i>w</i>	width
<i>h</i>	height
<i>b</i>	base length
<i>P</i>	perimeter
<i>r</i>	radius
<i>C</i>	circumference
<i>A</i>	area

## MEASUREMENT FACTS (3)

### 3D shapes - Formulae

Name	Shape	Surface Area	Volume
Rectangular Prism		$TSA = 2lw + 2wh + 2lh$ $= 2(lw + wh + lh)$	$V = lwh \text{ or}$ $= A_b h$
Prism - (All)		$TSA = P_b \times h + 2A_b$ $= P_b h + 2A_b$	$V = A_b h$
Pyramid		$TSA = \text{Sum of all areas of faces}$	$V = \frac{1}{3} A_b h$
Regular Pyramid		$TSA = \frac{P_b \times s}{2} + A_b$ $= \frac{P_b s}{2} + A_b$	$V = \frac{1}{3} A_b h$
Cylinder		$TSA = 2\pi r^2 + 2\pi r h$ $= 2\pi r(r + h)$	$V = A_b \times h$ $= \pi r^2 h$
Cone		$TSA = \pi r^2 + \pi r s$ $= \pi r(r + s)$	$V = \frac{1}{3} A_b \times h$ $= \frac{1}{3} \pi r^2 h$
Sphere		$TSA = 4\pi r^2$	$V = \frac{4}{3} \pi r^3$

### Abbreviations

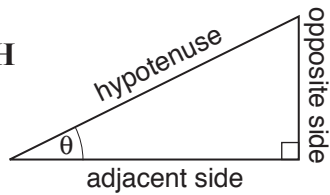
$l$	length
$w$	width
$h$	height
$b$	base length
$P$	perimeter
$r$	radius
$C$	circumference
$A$	area

$TSA$	total surface area
$V$	volume
$A_b$	base area
$P_b$	perimeter of base
$s$	slant height

## TRIGONOMETRY FACTS

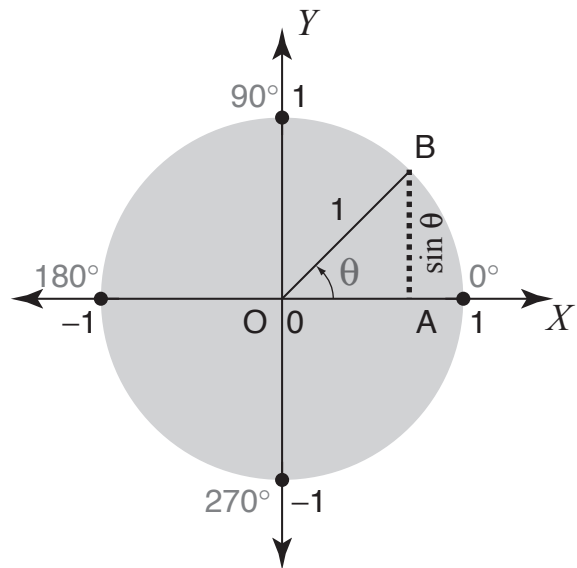
### Sine

$$\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}} \quad \text{SOH}$$



$$\sin \theta = \frac{AB}{OB} = \frac{AB}{1} = AB$$

Degree	0°	30°	45°	60°	90°	180°
sin	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	0

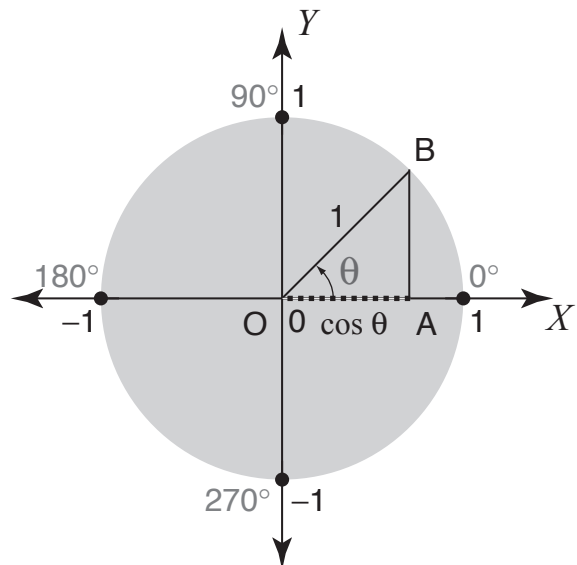


### Cosine

$$\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}} \quad \text{CAH}$$

$$\cos \theta = \frac{OA}{OB} = \frac{OA}{1} = OA$$

Degree	0°	30°	45°	60°	90°	180°
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	-1

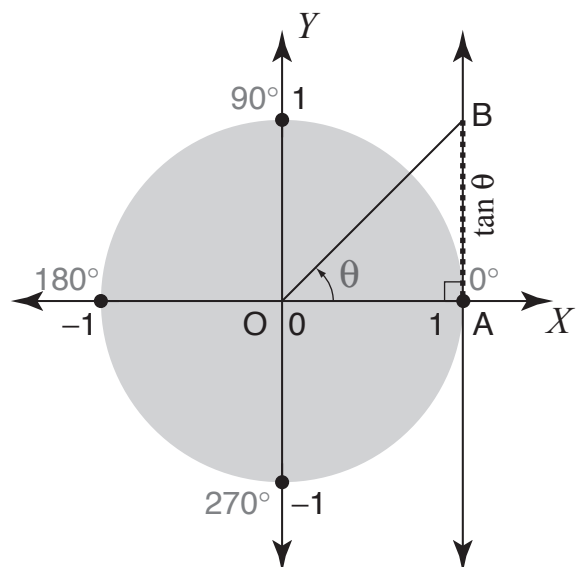


### Tangent

$$\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}} \quad \text{TOA}$$

$$\tan \theta = \frac{AB}{OA} = \frac{AB}{1} = AB$$

Degree	0°	30°	45°	60°	90°	180°
tan	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	X	0



**Trigonometry hint: SOH - CAH - TOA**

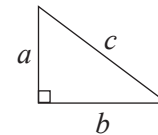
## GEOMETRY FACTS (1)

### Euler's formula

For any polyhedra:  
Edges = Vertices + Faces - 2  
**E = V + F - 2**

### Pythagoras' theorem

$$a^2 + b^2 = c^2$$



### Angle types

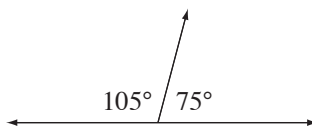
Acute $< 90^\circ$	Right $90^\circ$	Obtuse more than $90^\circ$ less than $180^\circ$	Straight $180^\circ$	Reflex more than $180^\circ$ less than $360^\circ$	Revolution $360^\circ$

### Properties of angles

Vertically opposite	Corresponding	Alternate	Co-interior
$\angle a = \angle b$ and $\angle c = \angle d$	$\angle a = \angle b$	$\angle a = \angle b$	$\angle a + \angle b = 180^\circ$

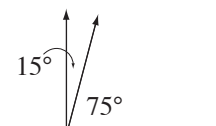
### Supplementary Angles

Add to  $180^\circ$



### Complementary Angles

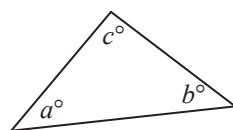
Add to  $90^\circ$



### Properties of angles in a triangle

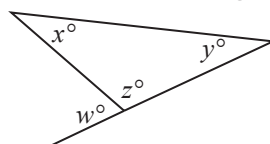
The sum of interior angles of a triangle is  $180^\circ$ .

$$a^\circ + b^\circ + c^\circ = 180^\circ$$



An exterior angle of a triangle is equal to the sum of the two opposite interior angles of the triangle.

$$w^\circ = x^\circ + y^\circ$$

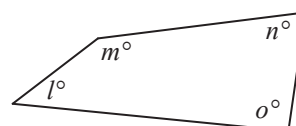


Sides and angles	Triangle type
no equal sides/angles	<b>scalene</b>
two equal sides/angles	<b>isosceles</b>
three equal sides/angles	<b>equilateral</b>
all acute angles	<b>acute-angled</b>
one right angle	<b>right-angled</b>
one obtuse angle	<b>obtuse-angled</b>

### Properties of angles in a quadrilateral

The sum of interior angles of a quadrilateral is  $360^\circ$ .

$$l^\circ + m^\circ + n^\circ + o^\circ = 360^\circ$$

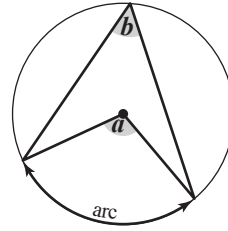


## GEOMETRY FACTS (2)

### Properties of angles in a circle

#### Property 1

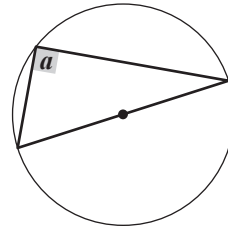
The angle that an arc forms at the centre of a circle is twice the size of the angle formed by the same arc on the circumference.



$$\angle a = 2 \times \angle b$$

#### Property 2

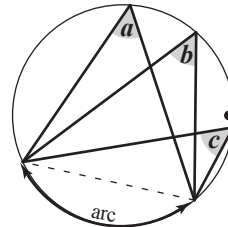
The angle formed on the circumference from a diameter of a circle is always a right angle.



$$\angle a = 90^\circ$$

#### Property 3

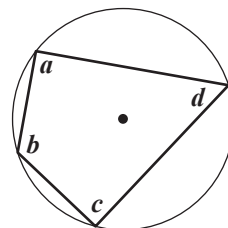
All angles at the circumference standing on the same arc, in the same segment, are equal.



$$\angle a = \angle b = \angle c$$

#### Property 4

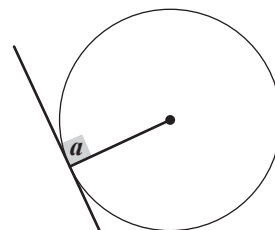
the opposite angles in a cyclic quadrilateral (all 4 vertices are on the circumference) add up to  $180^\circ$  (are supplementary).



$$\begin{aligned} \angle a + \angle c &= 180^\circ \\ \angle b + \angle d &= 180^\circ \end{aligned}$$

#### Property 5

Any tangent drawn on a circle meets the radius of the circle at right angles.

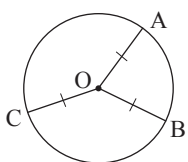


$$\angle a = 90^\circ$$

### Properties of lines related to a circle

#### Property 1

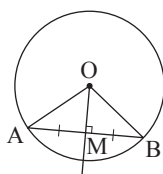
The radii in a circle are the same length.



$$\overline{OA} \equiv \overline{OB} \equiv \overline{OC}$$

#### Property 2

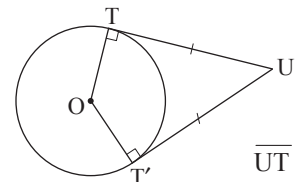
A line through the circle centre perpendicular to a chord bisects the chord.



$$\overline{AM} \equiv \overline{MB}$$

#### Property 3

The common tangents from a point to a circle are equal in length.



$$\overline{UT} \equiv \overline{UT'}$$