



# Angles

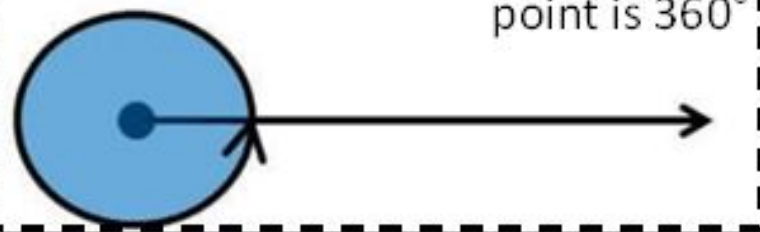


The angle measured in a straight line is  $180^\circ$

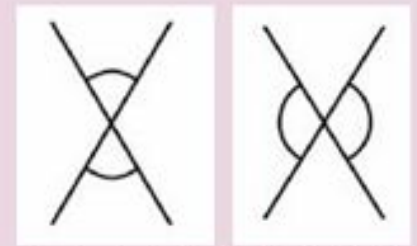


The angle measured in a quarter turn is  $90^\circ$

The Angle measured around a point is  $360^\circ$



**Vertically Opposite Angles are equal**



Isosceles triangles have two sides the same and two base angles the same

Equilateral triangles have the same sides and angles

Interior Angles of Quadrilaterals sum to  $360^\circ$

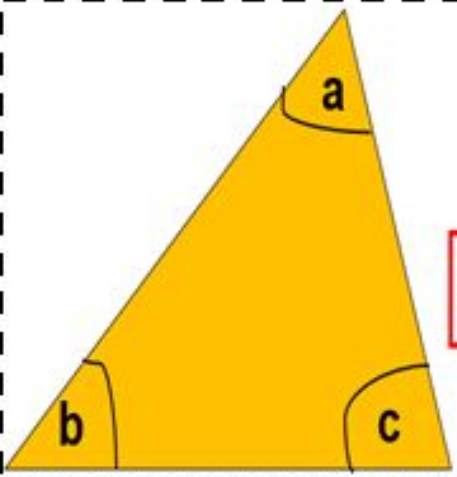
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Exam Questions




Answers




**$a + b + c = 180$  degrees!**

**Acute Angle**




between  $0^\circ$  and  $90^\circ$

**Right Angle**




equal to  $90^\circ$

**Obtuse Angle**



between  $90^\circ$  and  $180^\circ$

**Reflex Angle**



between  $180^\circ$  and  $360^\circ$

## Interior Angles in Regular Polygons

Calculate the size of one interior angle in a pentagon.

Step 1 – Calculate the sum of the interior angles

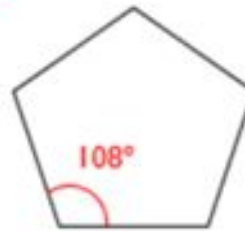
$$\text{Sum of interior angles} = (n - 2) \times 180$$

$n = \text{number of sides}$

Step 2 – Divide by the number of sides

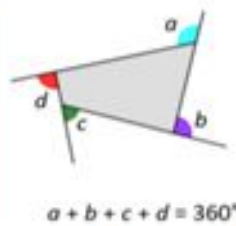
$$(5 - 2) \times 180 = 540$$

$$540 \div 5 = 108^\circ$$



## Exterior Angles in Polygons

Exterior angles in a polygon sum to  $360^\circ$ .



The exterior angle of a regular polygon is calculated using:  $360 \div n$   
 $n = \text{number of sides}$

Sum of the Interior Angles  $180(n - 2)$

Sum of the Exterior Angles Always  $360^\circ$

Each Interior Angle  $\frac{180(n - 2)}{n}$

Each Exterior Angle  $\frac{360^\circ}{n}$

Interior and exterior angles key formulae:

Step 1 – Calculate the size of the exterior angle

$$\text{Interior angle} + \text{exterior angle} = 180^\circ$$

Step 2 – Divide by the number of sides

$$(5 - 2) \times 180 = 540$$

$$540 \div 5 = 108^\circ$$

## KEYWORDS

**QUADRILATERAL:** A four sided 2D shape

**POLYGON:** A 2 sided shape with straight edges

**REGULAR POLYGON:** A shape where all sides are of equal length

**IRREGULAR POLYGON:** A shape where all sides are NOT of equal length

**PARALLEL:** Two lines that are always the same distance apart and never touching

**PERPENDICULAR:** Two lines are perpendicular if the Angle formed where they meet is  $90^\circ$ .

Video



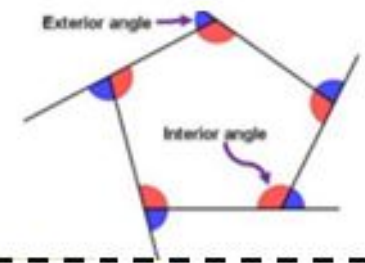
Exam Questions



Answers



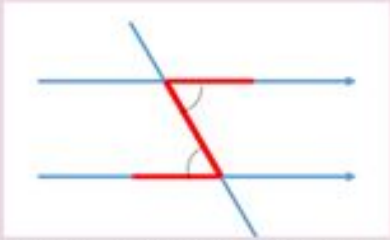
When asked to calculate the number of sides when given the interior angle



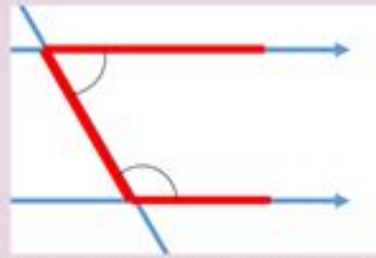


# Angles in Parallel lines

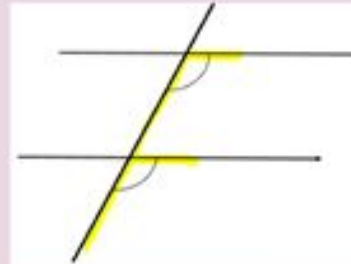
Alternate Angles  
are equal



Co-interior  
Angles sum to  
 $180^\circ$



Corresponding  
Angles are equal



## KEYWORDS

**LINE SEGMENT:** A line between two points

**INTERSECTING:** The common point where two or more lines cross

**PARALLEL:** Always the same distance apart and never touching

**VERTEX (PLURAL VERTICES):** A corner where two lines or edges meet.

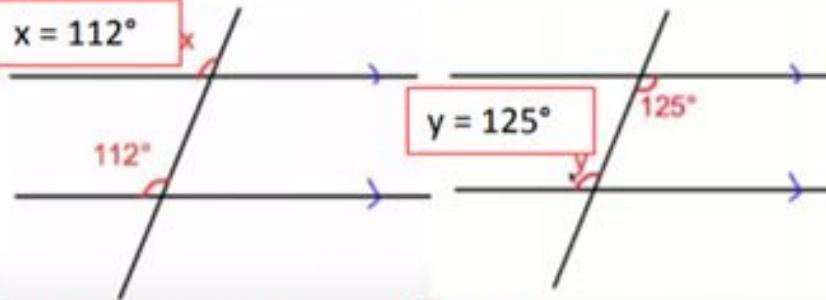
**ACUTE:** An angle which measures less than  $90^\circ$ .

**OBTUSE:** An angle which measures more than  $90^\circ$  and less than  $180^\circ$ .

**REFLEX:** An angle which measures greater than  $180^\circ$ .

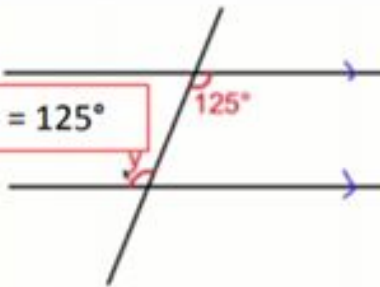
Examples -

$x = 112^\circ$



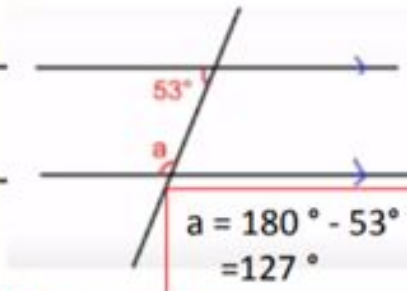
The 'F' can go in any direction.

$y = 125^\circ$



The 'Z' can go in any direction.

$53^\circ$



$a = 180^\circ - 53^\circ$   
 $= 127^\circ$

The 'C' can go in any direction.

## TIP -

Sometimes you will need to use more than one angle fact to solve a problem

Video



Exam Questions



Answers

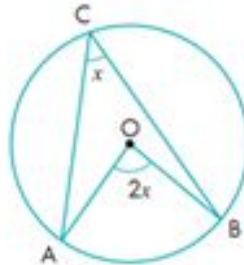


# Circle Theorems

## Circle Theorem 1:

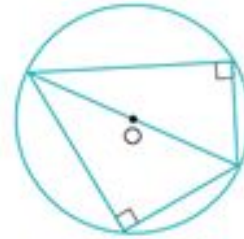
"The angle at the centre of a circle is twice the angle at the circumference."

$$\text{Angle } AOB = 2 \times \text{Angle } ACB$$



## Circle Theorem 2:

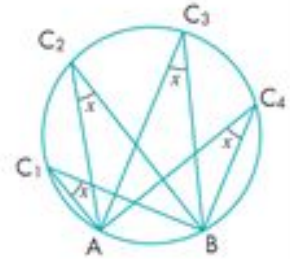
"Every angle at the circumference of a semicircle that is subtended by the diameter of the semicircle is a right-angle."



## Circle Theorem 3:

"Angles subtended at the circumference in the same segment of a circle are equal."

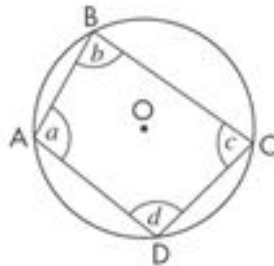
Points  $C_1$ ,  $C_2$ ,  $C_3$  and  $C_4$  on the circumference are subtended by the same arc, AB.



## Circle Theorem 4:

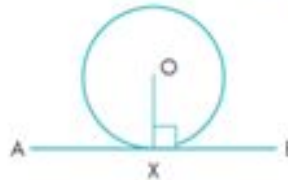
"The sum of the opposite angles in a cyclic quadrilateral is  $180^\circ$ ."

$$a + c = 180^\circ \text{ and } b + d = 180^\circ$$



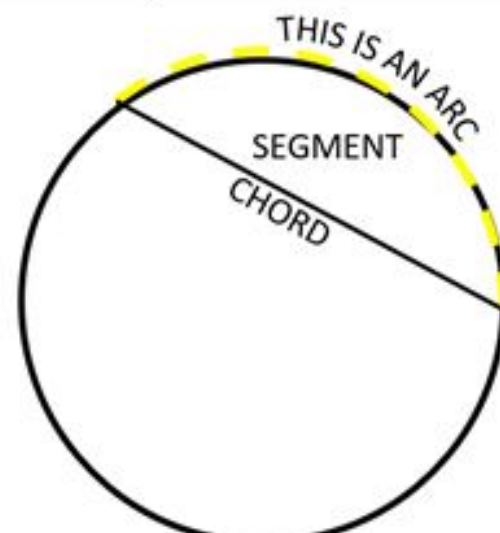
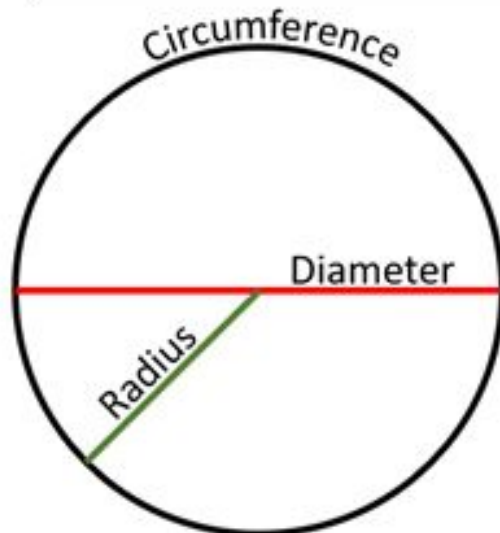
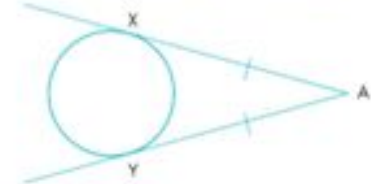
## Circle Theorem 5:

"When a radius meets a tangent, it always makes a  $90^\circ$  angle."



## Circle Theorem 6:

"Tangents to a circle from an external point to the points of contact are equal in length."



**TIP -**  
Sometimes you will need to use more than one angle fact to solve a problem

Video



Exam Questions

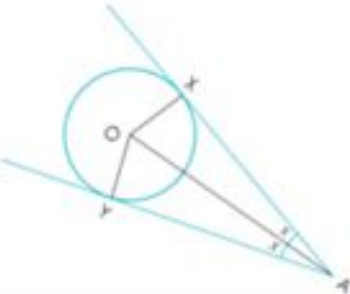


Answers





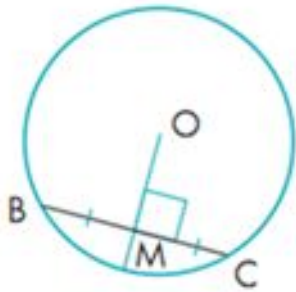
## Circle Theorem 7:



*"The line joining an external point to the centre of the circle bisects the angle between the tangents."*

## Circle Theorem 8:

*"A radius bisects a chord at 90°."*

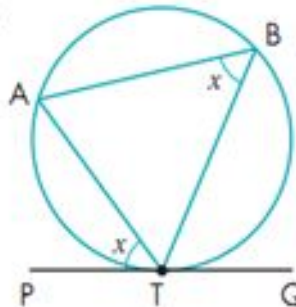


*If O is the centre of the circle, angle BMO = 90° and BM = CM.*

## Circle Theorem 9:

The Alternate Segment Theorem

*"The angle between a tangent and a chord through the point of contact is equal to the angle in the alternate segment."*



### KEYWORDS

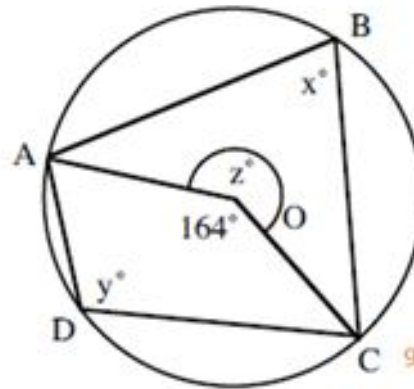
**SUBTEND:** The angle created by joining the ends of a straight line at a singular point

**CYCLIC QUADRILATERAL:** A four sided-shape whose vertices all lie on the circumference of a circle.

**BISECTS:** Split into two equal parts

When answering Circle Theorem questions, state each rule you have used

E.g.



Calculate the size of angle x, giving a reason

Calculate the size of angle y, giving a reason

9.  $x = 82$ , 'angle at centre is twice angle at circumference'  
 $y = 98$ , 'opposites angles in a cyclic quadrilateral sum to 180 degrees'

Video



Exam Questions

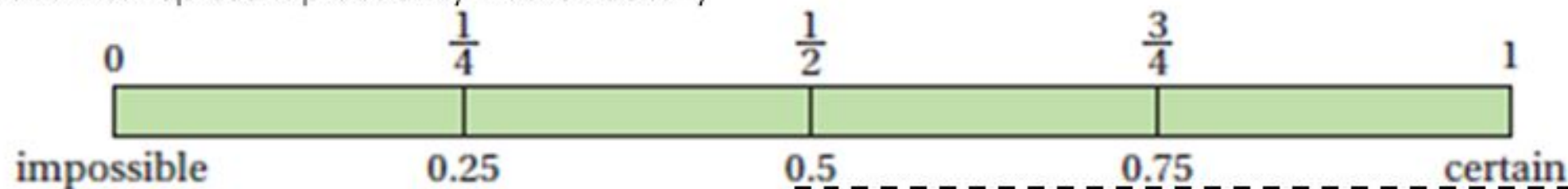


Answers



impossible    very unlikely    unlikely    even chance    likely    very likely    certain

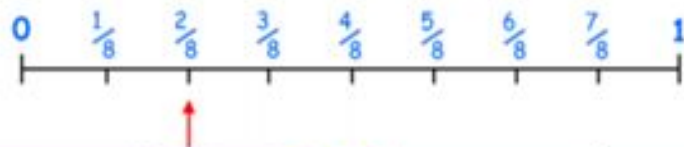
In order to determine which events have a higher probability than others, we use a numerical scale between 0 and 1 to represent probability mathematically



1) What is the probability that a bead chosen will be **yellow**.  
Show the answer on a number line.

$$\text{Probability} = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}$$

$$P(\text{Yellow}) = \frac{2}{8} = \frac{1}{4}$$



**Tip**  
Probabilities always add up to 1.

**Formula**  
 $\text{Expectation} = \text{Probability} \times \text{no. of trials}$

### KEYWORDS

**PROBABILITY:** The chance of something happening as a numerical value.

**EXPECTATION:** The amount of times you expect an outcome to happen based on probability.

**OUTCOME:** A single result of an experiment or situation

**RANDOM:** Something that cannot be predicted, or predetermined and cannot be made exact

**THEORETICAL:** Theoretical probability is what should happen if all variables were fair.

Video



Exam Questions



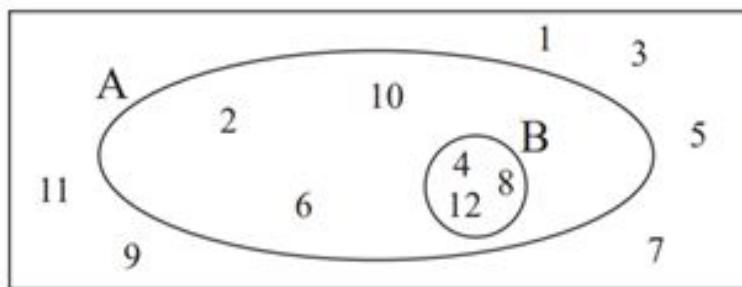
Answers





Venn diagrams show all possible relationships between different sets of data. Probabilities can be derived from Venn diagrams. Specific notation is used for this:

The whole numbers 1 to 12 are included in the Venn diagram.



The elements in A are 2, 4, 6, 8, 10, 12. This can be written as  $A = \{2, 4, 6, 8, 10, 12\}$ .

The elements in B are 4, 8 and 12. This can be written as  $B = \{4, 8, 12\}$

The elements in  $\xi$  are all elements in the Venn Diagram.

## KEYWORDS

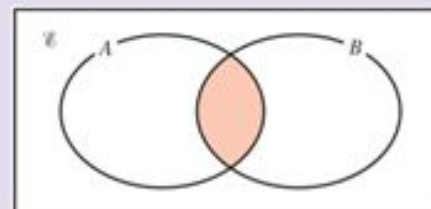
**PROBABILITY:** The chance of something happening as a numerical value.

**MUTUALLY EXCLUSIVE:** Two events that cannot both occur at the same time.

**UNION:** The union of two or more sets is the set of all elements in all sets.

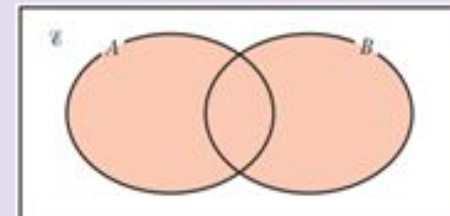
**INTERSECTION:** The intersection of two or more sets is the set of elements that appear in both sets.

## Intersection: $A \cap B$

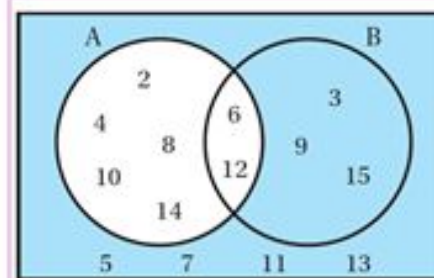


The symbol  $\cap$  is used to represent the **intersection** of two sets. This includes all the elements that are in **both** sets.

## Union: $A \cup B$



The symbol  $\cup$  is used to represent the **union** of two sets. This includes all the elements that are in at least one set.



$A'$

- The complement of A
- The numbers not in Set A

Video



Exam Questions



Answers



Tree Diagrams are used to represent two events that happen either simultaneously or one after the other, and easily display all possible combinations of outcomes. The probabilities are multiplied through the probability tree.



	London	York	Total
Girls	19	24	43
Boys	23	14	37
Total	42	38	80

Two way tables can be used to show a number of pieces of information, when split into categories. Probabilities can be formulated easily from two way tables.

From the above table 14 of the 80 students who went on a school trip were boys who went to York.

Therefore, the probability of randomly choosing a Boy who went to York is:  $\frac{14}{80}$

### KEYWORDS

**INDEPENDENT:** Two events are independent if the outcome of one, does not change the probability of the outcome of the other.

**DEPENDENT:** Two events are dependent if the outcome of one changes the probability of the outcome of the other

**CONDITIONAL:** Conditional probability involves calculating dependent probabilities examining all possible sets of outcomes.

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Exam Questions



Answers

