MATHEMATICS IN DESIGN AND TECHNOLOGY

IMPORTANT

This mobile revision pdf is based on detailed work found in the ‘ Maths in Design and Technology’ section.
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MOBILE APPS FOR DESIGN AND TECHNOLOGY

IMPORTANT – BEFORE STARTING MATHS REVISION

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START MATHS REVISION

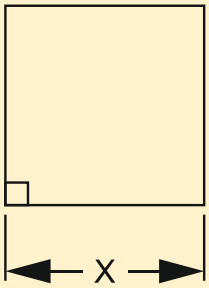
CALCULATING THE AREA OF A SQUARE

Definition: A square has four sides, with each being equal in length. Each of the four internal angles are right angles, 90 degrees.

FORMULA

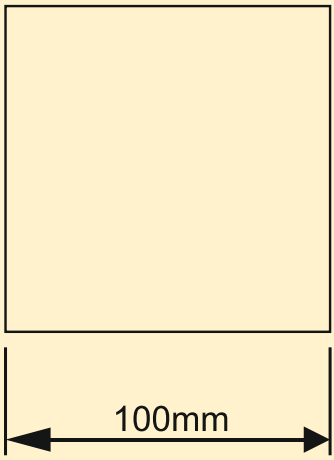
AREA = X2

OR X = X multiplied by X



X IS THE LENGTH OF ONE SIDE
REMEMBER, WITH A SQUARE,
EACH SIDE IS THE SAME LENGTH

SAMPLE QUESTION



Calculate the area of the square shown opposite. The length of one side is 100mm

AREA = X2
AREA = 100mm x 100mm
AREA = 10000mm2

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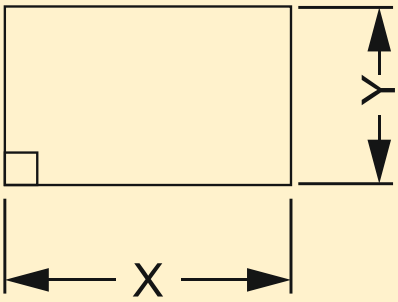
CALCULATING THE AREA OF A RECTANGLE

Definition: A rectangle has four sides, with the opposite sides being the same length and parallel. Each of the four internal angles are right angles, 90 degrees.

FORMULA

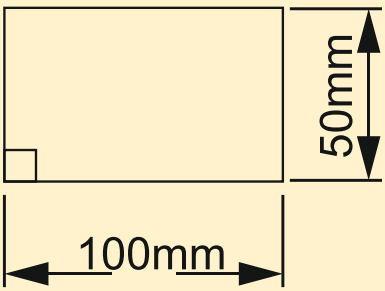
AREA = X multiplied by Y

AREA =LENGTH x HEIGHT



SAMPLE QUESTION

Calculate the area of the rectangle.



AREA = X multiplied by Y
AREA = 100mm x 50mm
AREA = 5000mm2

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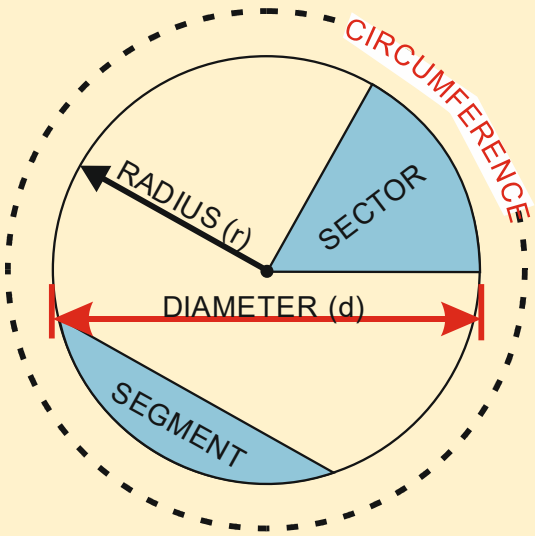
CALCULATING THE AREA OF A CIRCLE GIVEN THE RADIUS

Definition: A precise curve around a centre. Any point on the curve is an equal distance from the centre. A circle is composed of a circumference (the precise curve) and a diameter and radius.



FORMULA

AREA = πr 2

π (pi) = 3.14

SAMPLE QUESTION

A circle has a radius of 100mm. What is the area of the circle?

AREA = πr 2 π (pi) = 3.14

AREA = 3.14 x (100 x 100)

AREA = 3.14 x (10000)

AREA = 31400mm2

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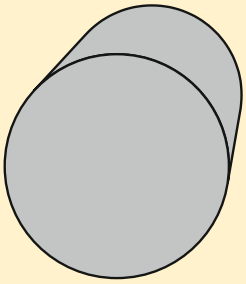
CIRCLE AREA AND CIRCUMFERENCE EXAMINATION QUESTIONS



The round section mild steel bar seen opposite, has a radius of 65mm.
What is the area of the 'circle' at one end?
What is the circumference of the round section bar?

FORMULA

AREA = πr 2

π (pi) = 3.14

AREA = 3.14 x (65 x 65)

AREA = 3.14 x (4225)

AREA = 13266.5mm2

FORMULA

CIRCUMFERENCE = 2 x π x r

π (pi) = 3.14

C = 2 x π x r
C = 2 x 3.14 x 65
C = 408.2mm

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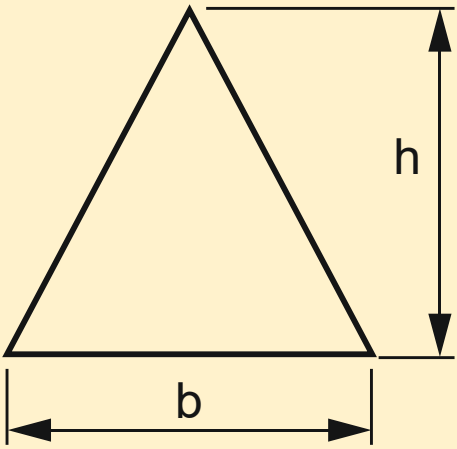
CALCULATING THE AREA OF A TRIANGLE



Definition: A triangle can be regarded as a polygon with three sides.

FORMULA

AREA = 1/2 X BASE X HEIGHT

AREA = 1/2 b x h

$$\text{AREA} = \frac{b \times h}{2}$$

SAMPLE QUESTION

AREA = 1/2 X BASE X HEIGHT

$$\text{AREA} = \frac{60 \times 80}{2}$$

$$\text{AREA} = \frac{4800}{2}$$

AREA = 2400mm2

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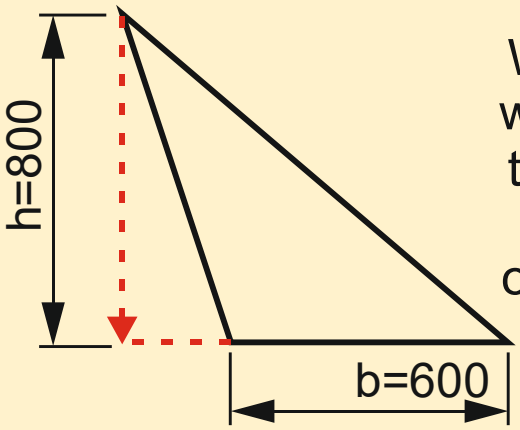
WHAT HAPPENS WHEN THE 'HEIGHT' FALLS OUTSIDE THE BASE?



With an obtuse triangle, where the top (vertex) of the triangle falls outside the base, as seen opposite - simply draw a line down, as if with a plumb line.

FORMULA - REMAINS THE SAME

AREA = 1/2 X BASE X HEIGHT

AREA = 1/2 b x h

$$\textbf{AREA} = \frac{\textbf{b x h}}{\textbf{2}}$$

AREA = 1/2 X BASE X HEIGHT

$$\text{AREA} = \frac{600 \times 800}{2}$$

$$\text{AREA} = \frac{480000}{2}$$

AREA = 240000mm2

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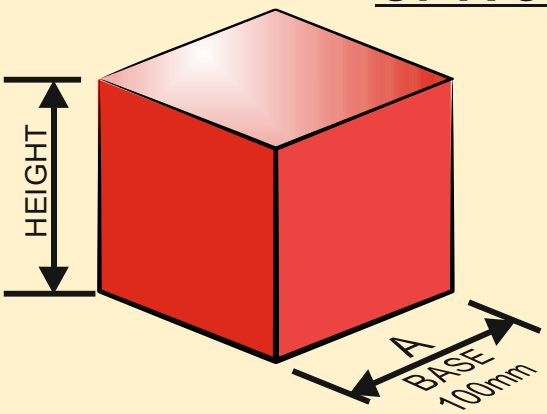
HOW TO CALCULATE THE VOLUME OF A CUBE



DEFINITION: A cube is a solid object, composed of six equal squares, with a 90 degree angle between adjacent sides.

All the sides of a cube are the same measurement. There are two similar formulas for calculating a cube's volume.

VOLUME (V) = A x A x A
OR A^3

EXAMPLE 1

If the measurement of one side is 100mm:

VOLUME = 100mm x 100mm x 100mm

VOLUME = 1000000mm 3 or 1000cm 3

EXAMPLE 2

If the measurement of one side is 320mm:

VOLUME = 320mm x 320mm x 320mm

VOLUME =32768000mm 3or 32768cm 3

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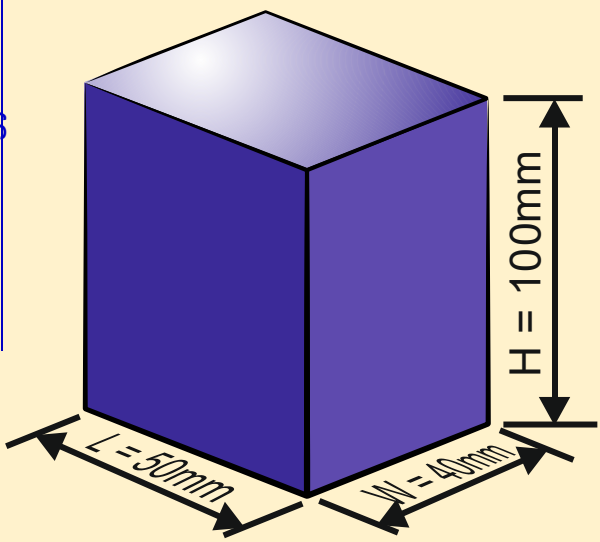
HOW TO CALCULATE THE VOLUME OF A RECTANGULAR PRISM

DEFINITION: A rectangular prism is a solid object, composed of six rectangles, with a 90 degree angle between adjacent sides. Opposite sides of a rectangular prism are equal and parallel.

Unlike a cube, the area of the sides of a rectangular prism / cuboid are not the same, consequently the formula for calculating the volume is as follows:

VOLUME = LENGTH X WIDTH X HEIGHT

V=L x W x H



EXAMPLE: What is the volume of the rectangular prism shown opposite?

V=L x W x H

V=50 x 40 x 100

V=200000mm3

or

V=200cm3

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HOW TO CALCULATE THE VOLUME OF A CYLINDER

DEFINITION: A three dimensional geometrical shape, that has a circle at each end of a single curved surface.

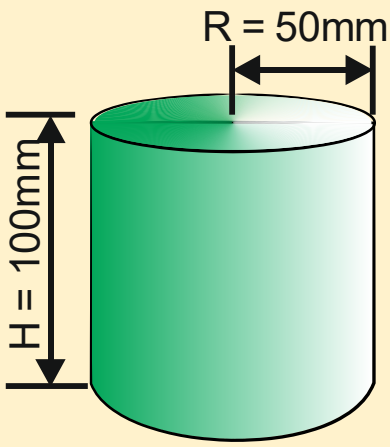
FIRST, AREA OF A CIRCLE = π X R^2

CIRCUMFERENCE = 2 X π X R

In order to calculate the volume of a cylinder, the height and radius of the circular top /bottom must be known. The following formula is used to calculate the volume.

π (pi) = 3.14 $v = \pi r2h$

volume (v) = pi xradius2x height



v = 3.14x 50mmx50mmx100mm

v = 785000mm3

or

v = 785cm3

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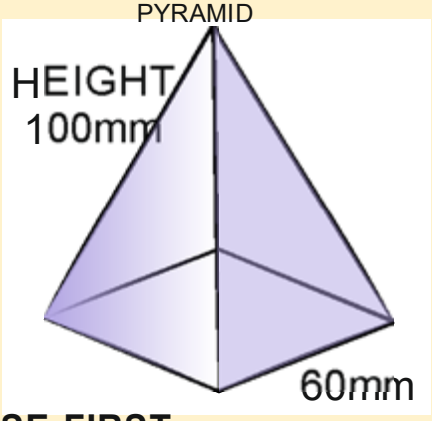
HOW TO CALCULATE THE VOLUME OF A REGULAR SQUARE PYRAMID

DEFINITION: A Regular Square Pyramid has a square base with triangular sides. The apex (highest point), is in line with the centre of the square base.

SQUARE BASED PYRAMID



FORMULA

$$\text{Volume} = \frac{1}{3} \times \text{Base} \times \text{Height}$$

$$V = \frac{1}{3} \times B \times H$$

CALCULATE THE AREA OF BASE FIRST

AREA OF BASE = LENGTH2

AREA OF BASE = 60mm X 60mm = 3600mm2

THEN APPLY THE FOLLOWING FORMULA

$$\text{Volume} = \frac{1}{3} \times \text{Base} \times \text{Height}$$

$$V = \frac{1}{3} \times 3600\text{mm} \times 100\text{mm}$$

$$V = \frac{1}{3} \times 360000\text{mm}$$

$$V = \frac{360000\text{mm}}{3} = 120000\text{mm}3$$

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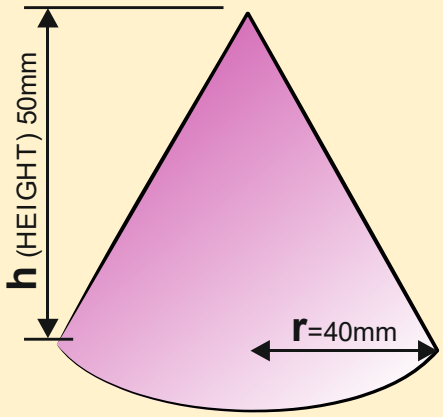
HOW TO CALCULATE THE VOLUME OF A CONE

DEFINITION: A cone has one surface with a circular base. The vertex is directly above the centre of the circular base.



FORMULA

$$v=1/3\ \pi r^2 h$$

the same as $v=\frac{\pi r^2 h}{3}$

pi (π) is 3.14

If the height (h) is 50mm and the radius is 40mm

Then:

$$v=1/3\ \pi r^2 h$$

$$v=\frac{1}{3}\ x\ 3.14\ x\ (40x40)x\ 50$$

$$v=\frac{1}{3}\ x\ 251200$$

$$v=\frac{25177}{3}=83733.33mm^3$$

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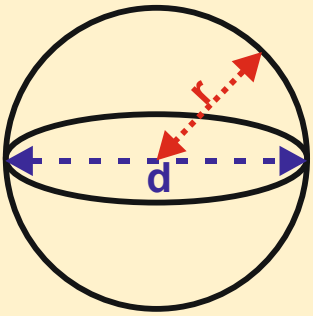
HOW TO CALCULATE THE VOLUME OF A SPHERE

DEFINITION: A sphere is an object that is absolutely symmetrical about it's centre. From any angle it appears to be a circle, but it is a true three dimensional object.



FORMULA

$v=4/3\pi r^3$

EXAMPLE CALCULATION

$V=4/3\pi r^3$

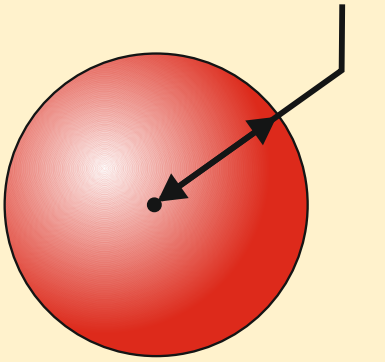
$$V = \frac{4}{3} \times \frac{3.14 \times (30 \times 30 \times 30)}{1}$$

$$V = \frac{4}{3} \times \frac{3.14 \times (27000)}{1}$$

$$V = \frac{4}{3} \times \frac{84780}{1}$$

$$V = \frac{339120}{3}$$

$$V = 113040mm3$$



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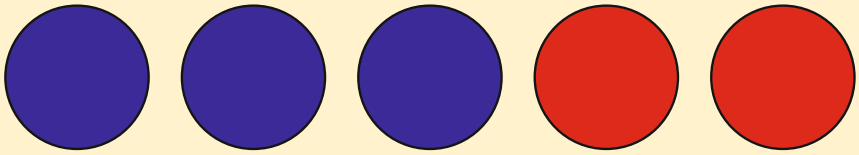
RATIOS - EXAMPLES

DEFINITION: A ratio is the mathematical relationship between two or more numbers.

4:1

Here we see 4 blue circles compared to 1 red circle.

3:2



Here we see 3 blue circles compared to 2 red circles.

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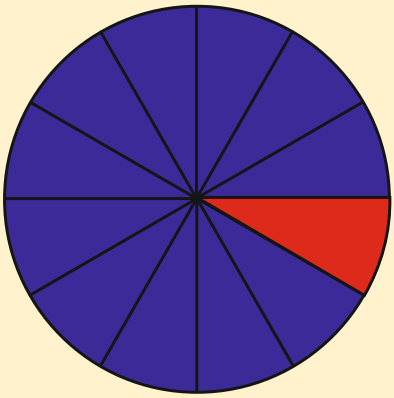
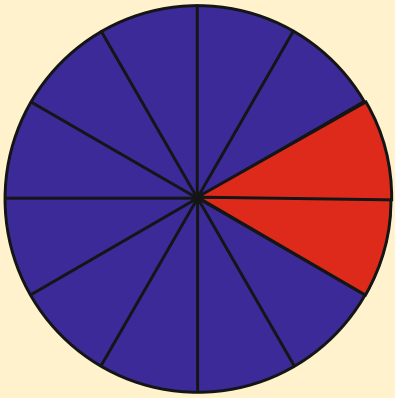
RATIOS - EXAMPLES

What is the ratio of the blue area to the red area?



BLUE : RED

11:1



BLUE : RED

10:2

Which is the same as,

5:1

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RATIOS - EXAMPLES

Part of a recipe to serve two people, requires 4 cups of flour and 1 cup of water.

If the has to be scaled up to serve 10 people, how many cups of flour and water will be required as part of the recipe?

	FLOUR		WATER
SERVES TWO PEOPLE =	4	:	1

To find the number by which the original ratio numbers are multiplied, divide the new number of people to be served (10) by the old number of people to be served (2).

$$\frac{10 \text{ PEOPLE}}{2 \text{ PEOPLE}} = 5$$

Then, multiply each number of the original ratio by the answer 5, to find the new amount of flour and water.

4x5	:	1x5

The new number of cups of flour and water are seen opposite

FLOUR		WATER
20	:	5

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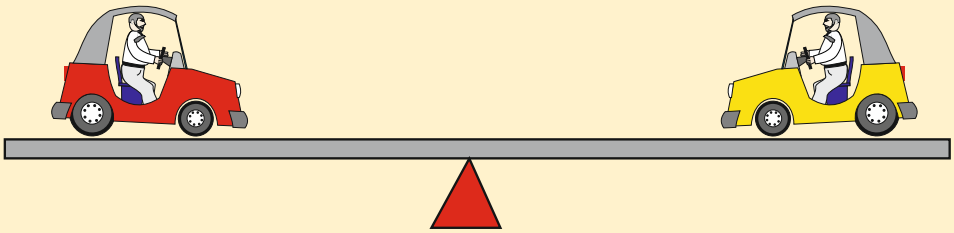
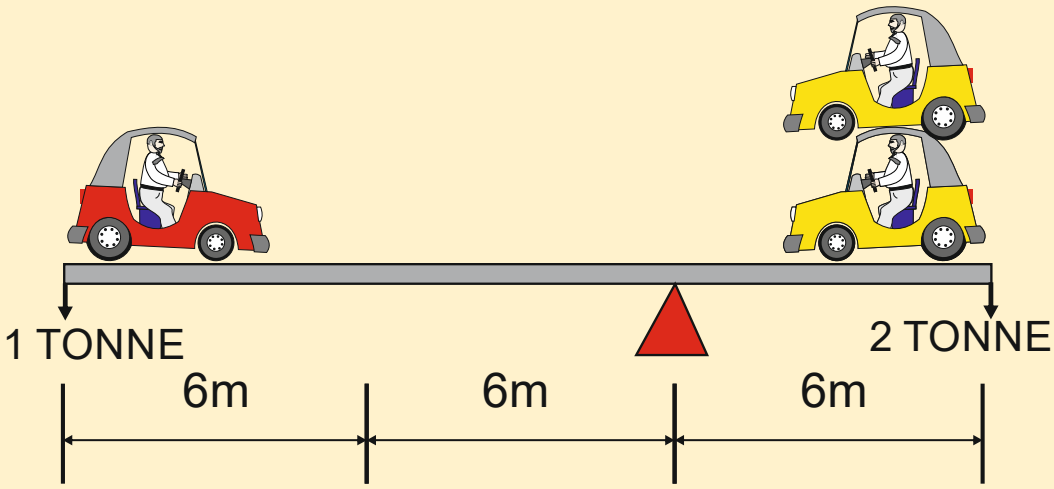
MOMENTS OF FORCE AND EQUILIBRIUM



The cars are in a 'state of equilibrium' because the weight, on either side, is exactly the same. The distance from each car to the fulcrum, is also the same.

SAMPLE QUESTION



CLOCKWISE MOMENTS = ANTI-CLOCKWISE MOMENTS

1 TONNE X 12m = 2 TONNE x 6m

12 = 12

STATE OF EQUILIBRIUM

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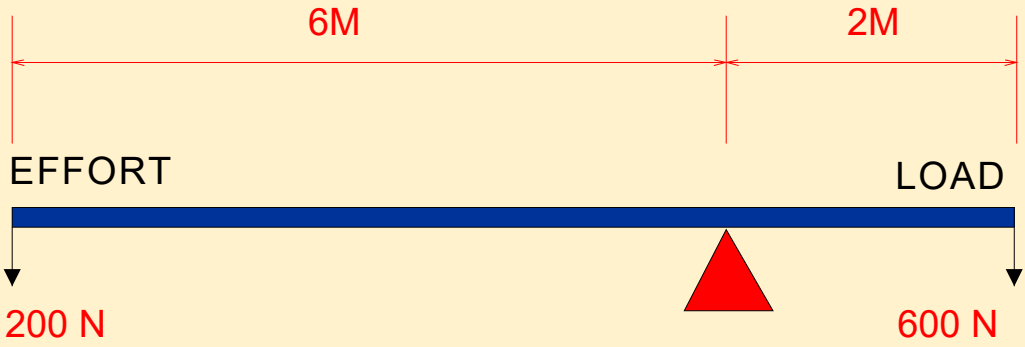
MOMENTS OF FORCE AND EQUILIBRIUM

1. The diagram below shows a lever where an effort of 200 N balances a load of 600 N. The effort force is 6 metres from the fulcrum. The load force is two metres from the fulcrum.

SAMPLE QUESTION



Clockwise moment = 600 x 2 Nm

Anti-clockwise moment = 200 x 6 Nm

In a state of equilibrium,

clockwise moments = anti-clockwise moments

600 X 2 Nm = 200 x 6 Nm

1200 = 1200

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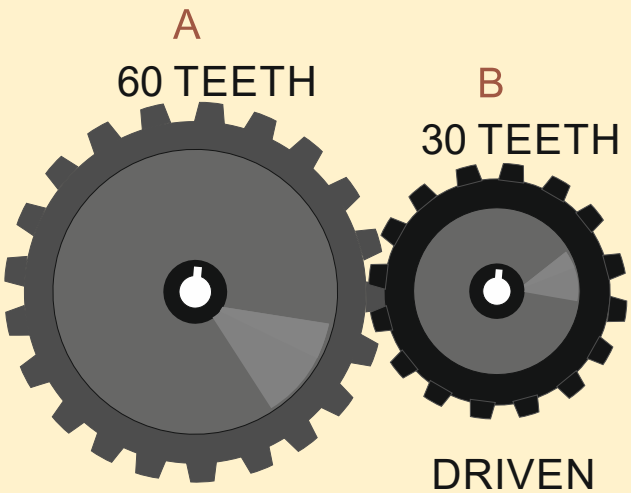
CALCULATING GEAR RATIO (VELOCITY RATIO)

In the example below, the DRIVER has 60 teeth and because it is the largest we say that it revolves once. The DRIVEN gear has 30 teeth. Simply divide 60 teeth by 30 teeth to work out the number of revolutions of the driven gear.



$$\frac{\text{Distance moved by Effort}}{\text{Distance moved by Load}} = \frac{\text{60T (GEAR A)}}{\text{30T (GEAR B)}}$$

$$= \frac{1}{2} = \frac{\text{Input movement}}{\text{Output movement}}$$

$$= \text{Driver : Driven}$$

$$1 : 2$$

Tap the red button to return to the first page