

orior *v.* to rise (Latin)

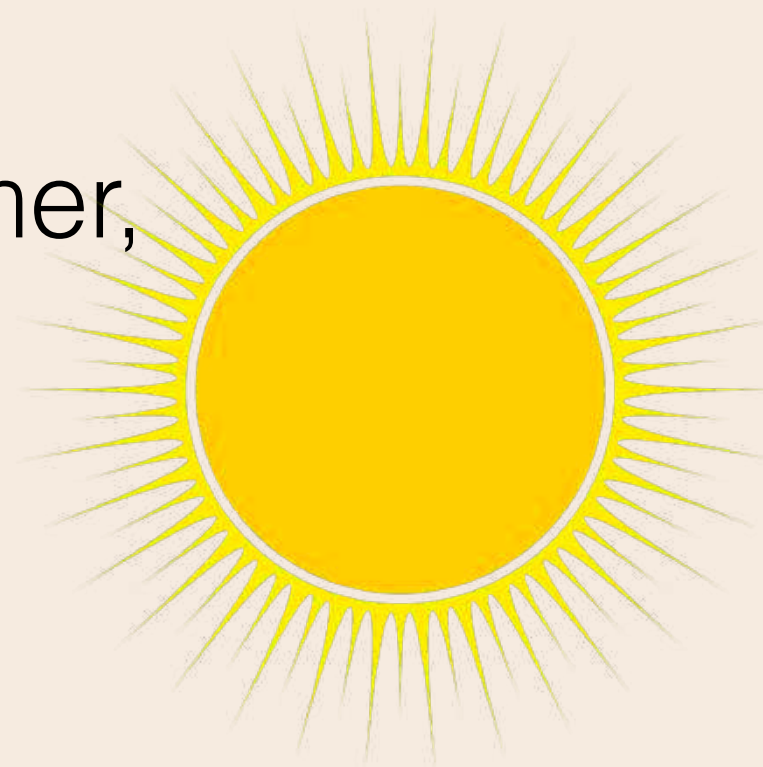
orient *n.*

1. The eastern part of the world, typically used to refer to East Asia.

Did you know?

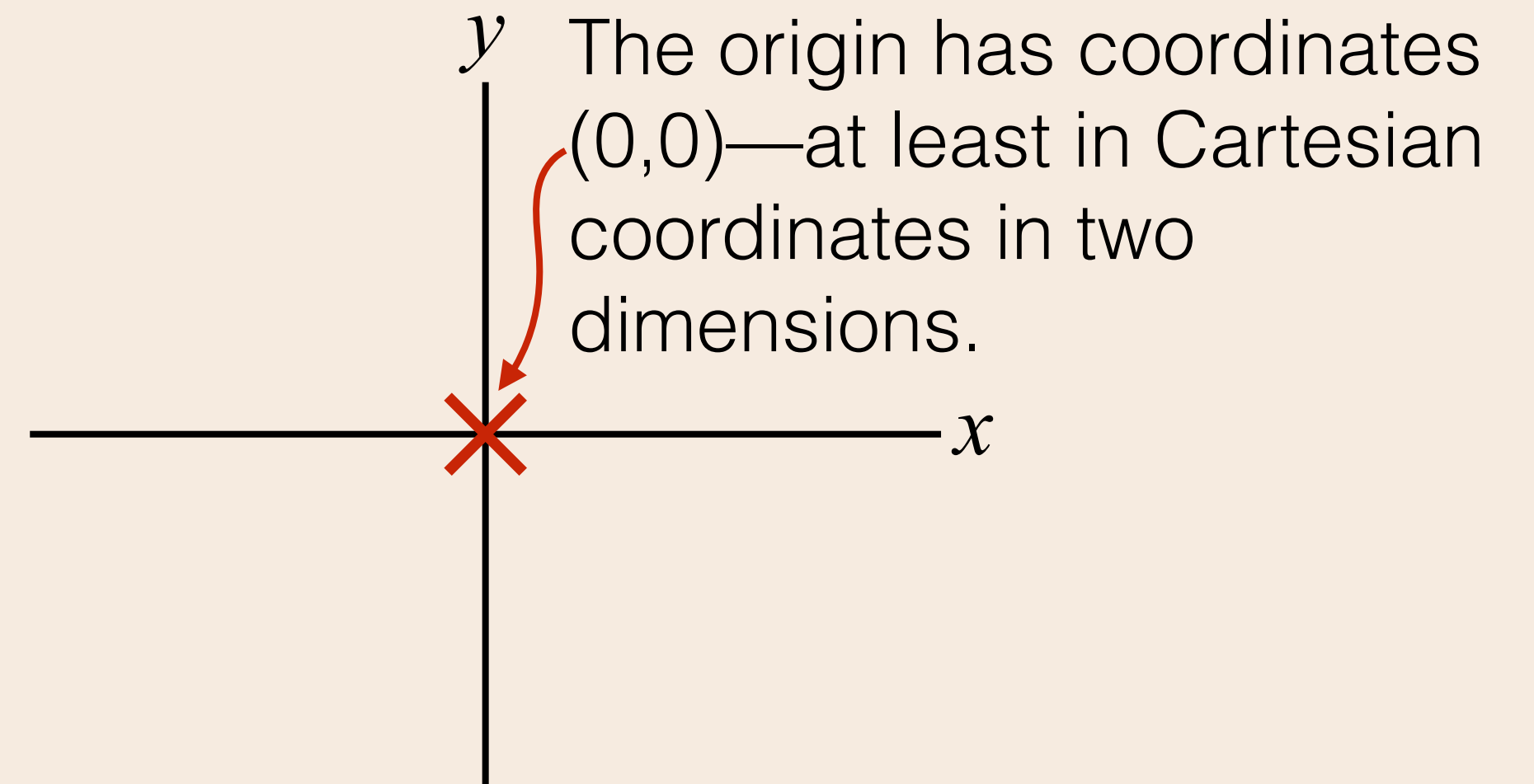
Although we often say that the sun rises in the east, this is only strictly true on two days each year.

In the Northern hemisphere's summer, the sun rises slightly north of east, and in the Northern winter, the sun rises slightly south of east.



origin *n.*

1. The location where something begins or arises.
2. A special point from which coordinates are measured.



The origin has coordinates (0,0)—at least in Cartesian coordinates in two dimensions.

vertere *v.* to turn (Latin)

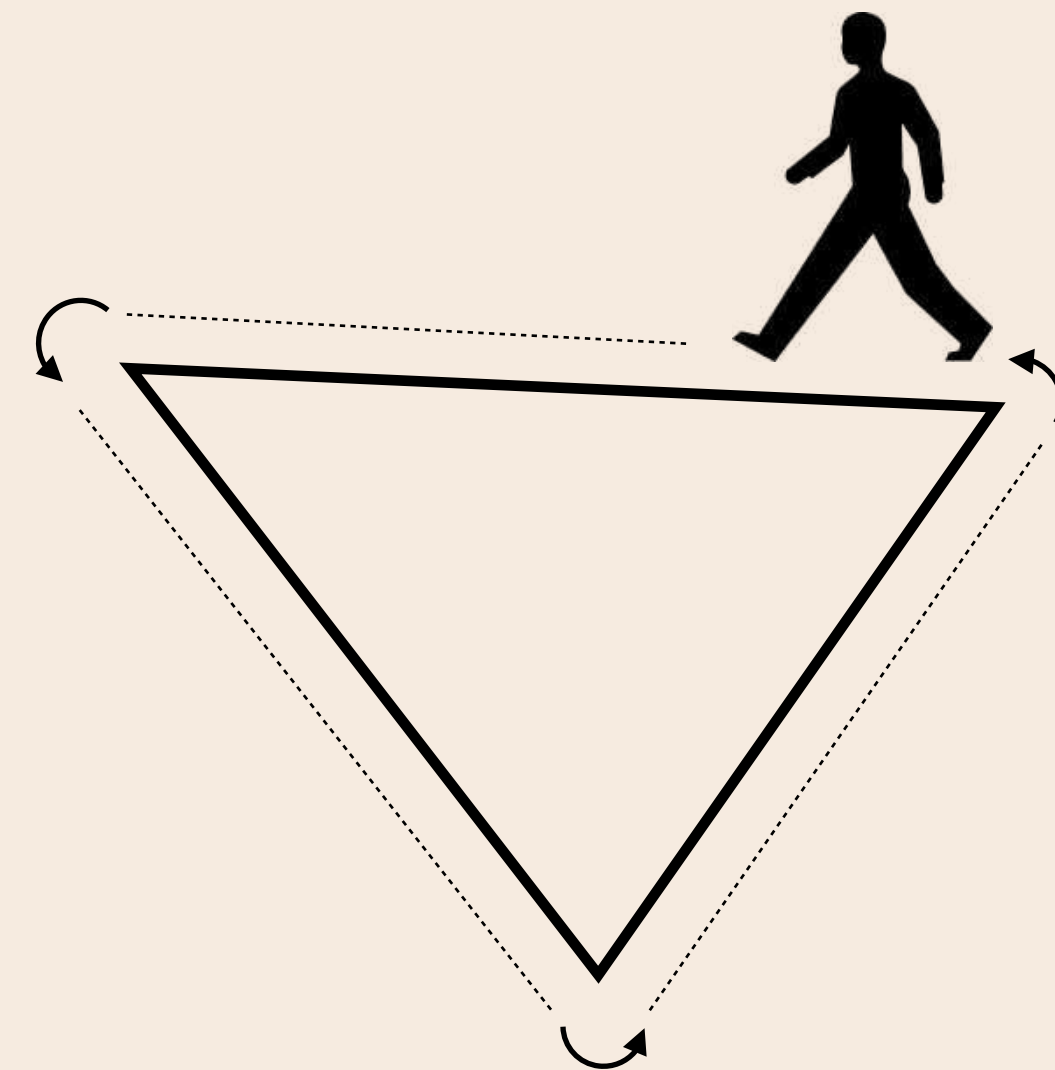
vertigo *n.*

1. A sensation of whirling and loss of balance, often caused by looking down from a great height.



vertex *n.* (pl. **vertices**)

1. The crown of the head.
2. In geometry, a point where lines or edges meet.



vehere *v.* to carry, transport (Latin)

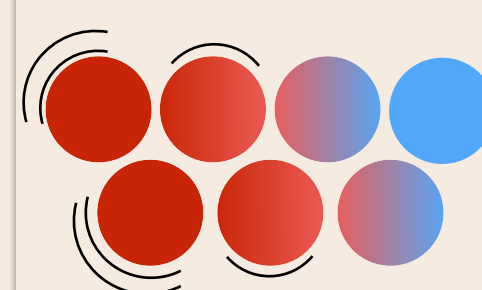
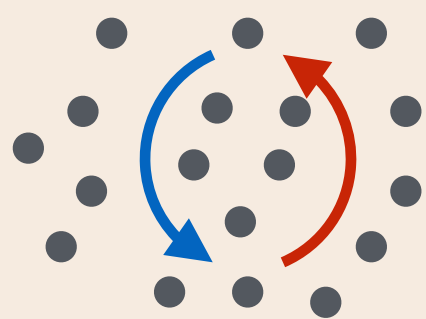
convection *n.*

1. In physics, heat transfer due to movement of molecules in liquids and gases.

Convection does *not* occur in most solids because the molecules are rigidly arranged. Heat transfer in solids is usually via *conduction*, which involves vibrations and collisions of adjacent molecules. In *convection*, the molecules themselves move around.

Convection

Molecules
carry heat

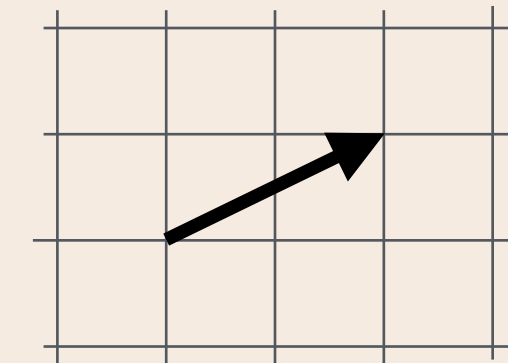


Conduction

Molecules
pass on heat

vector *n.*

1. In mathematics, a directed quantity, with both a magnitude and a direction.



2. In biology, a carrier of a disease-causing agent.
e.g. mosquitos are
vectors of malaria.



Penny, pennies, pence



Image credit: Royal Mint 2019

This is a one penny coin.



Image credit: Royal Mint 2019

This is a two pence coin.



Image credit: Royal Mint 2019

Here are two pennies.
They're worth two pence.

The penny dropped...

When people say the “penny dropped,” they mean that someone suddenly understood something. The phrase was first used in a 1911 article about thieves using fake pennies to steal from an early automatic vending machine in a shop. When a real penny was used, the shopkeeper could hear the sound of it dropping. When fake pennies were used, he could not hear anything because the fakes were made from paper. It wasn't until the 1930s that the phrase started to be used in the sense of the idiom we know today.

Source: wordhistories.net/2017/01/25/the-penny-dropped/

medius *n.* middle (Latin)

immediate *adj.*

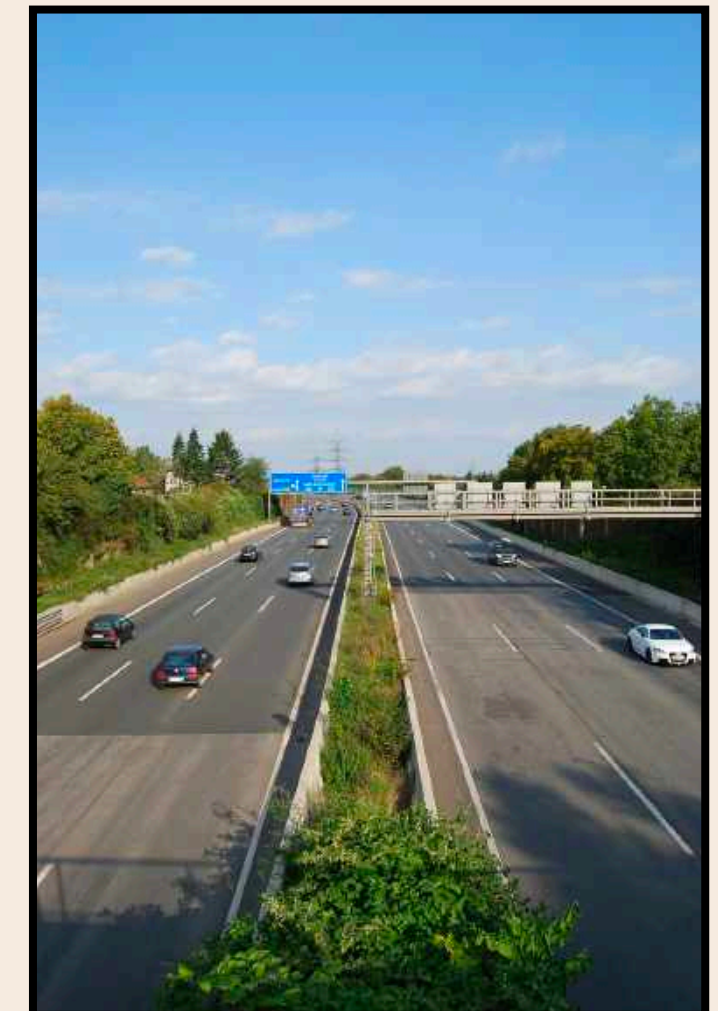
1. Happening right away.

The “***im***” in ***immediate*** signifies *opposite* in the same way that *improbable* is the opposite of *probable*.

The word ***immediate*** therefore literally means “**with nothing in between**” i.e. with no other event or delay in between now and the immediate thing.

median *n.*

1. In statistics, the number separating the upper and lower halves of a data sample or population.
2. In geometry, a line segment joining the vertex of a triangle to the midpoint of the opposite side.
3. The central reservation separating two sets of lanes of opposite-direction traffic.



secare v. to cut (Latin)

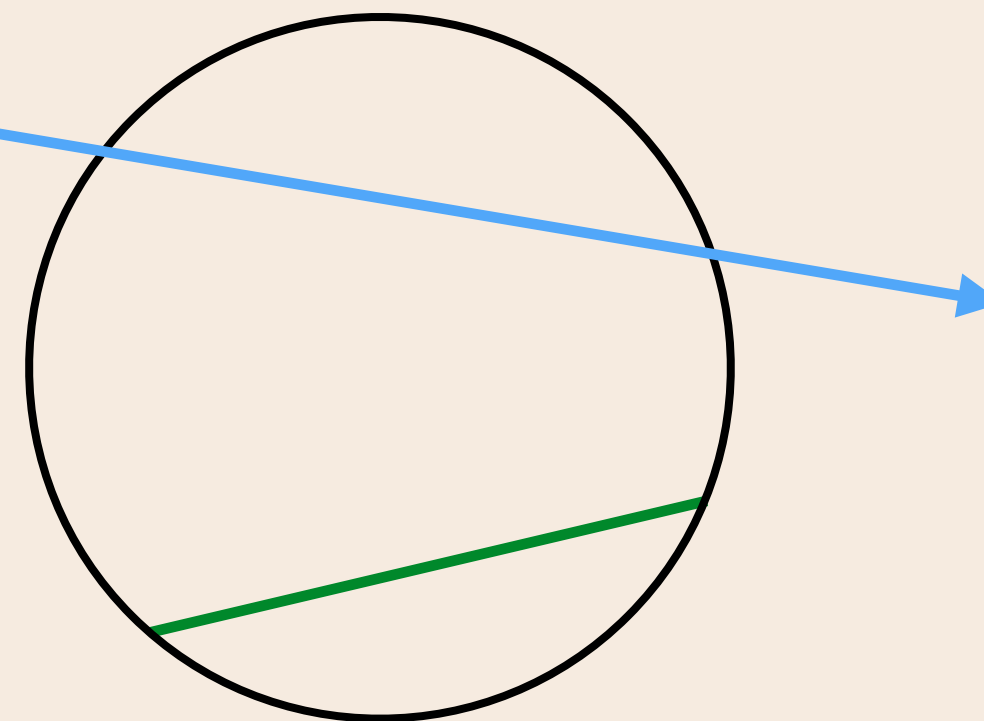
insect *n.*

1. A group of six-legged invertebrate creatures within the arthropod phylum.



The word comes from the idea that insects' bodies are “cut up into” main sections: the head, thorax, and abdomen.

The blue line is a **secant** of the circle.
Compare with the green line segment, which is a **chord** of the circle.



bisect v.

1. To divide an angle or line segment into two equal parts.

Compare with **bicycle** and **biplane**.



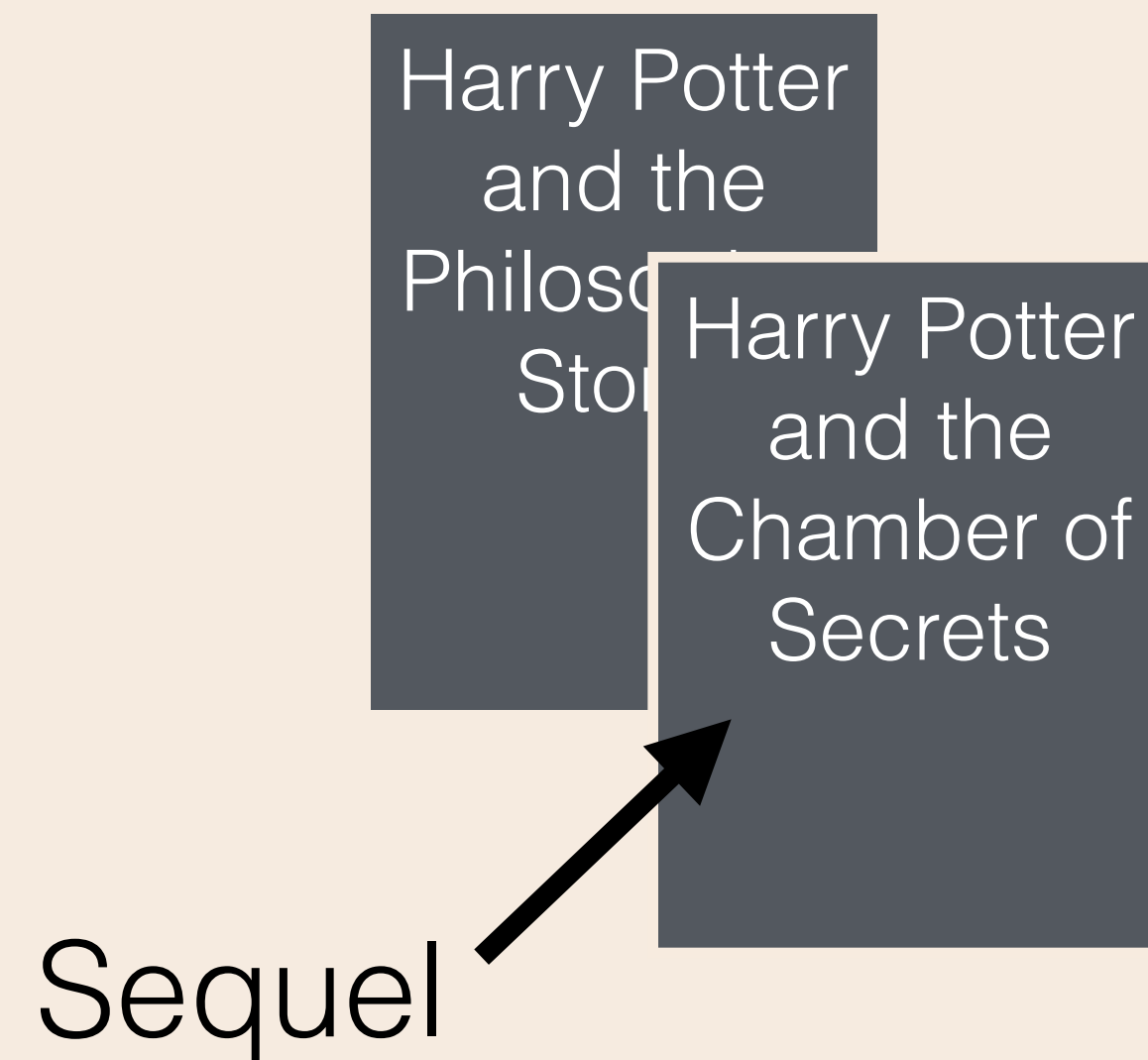
secant *n.*

1. In geometry, a line that intersects a curve in at least two distinct points.

sequor *v.* to follow (Latin)

sequel *n.*

1. Something that follows as a continuation, especially a literary or cinematic work.



sequence *n.*

1. An ordered list of objects.

Examples:

5, 8, 11, 14, 17, ...

3, 6, 12, 24, 48, ...

▲, ■, ◆, ◆, ...

{1}, {1, 1}, {1, 1, 1}, ...

a , $3a + 1$, $5a + 2$, ...

fractura *n.* a breach or break (Latin)

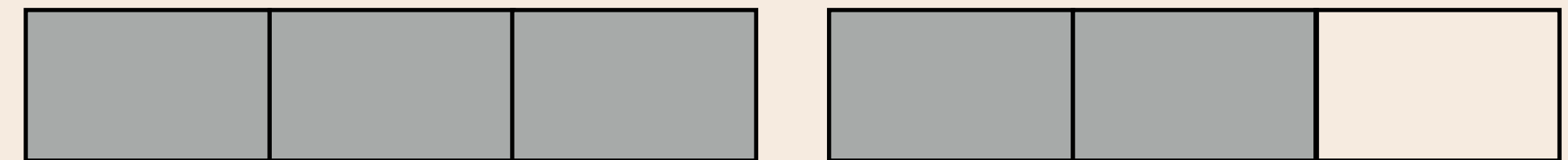
fracture *n.*

1. An instance of breaking or a place where something is broken.
2. A break in a bone.



fraction *n.*

1. In everyday English, a part of a whole, especially a very small part
e.g. *she only spends a fraction of her time doing any work.*
2. In mathematics, a ratio of two numbers written as a numerator and denominator separated by a horizontal line.



$\frac{5}{3}$ or $1\frac{2}{3}$ bars are shaded

rota *n.* wheel (Latin)

rota *n.*

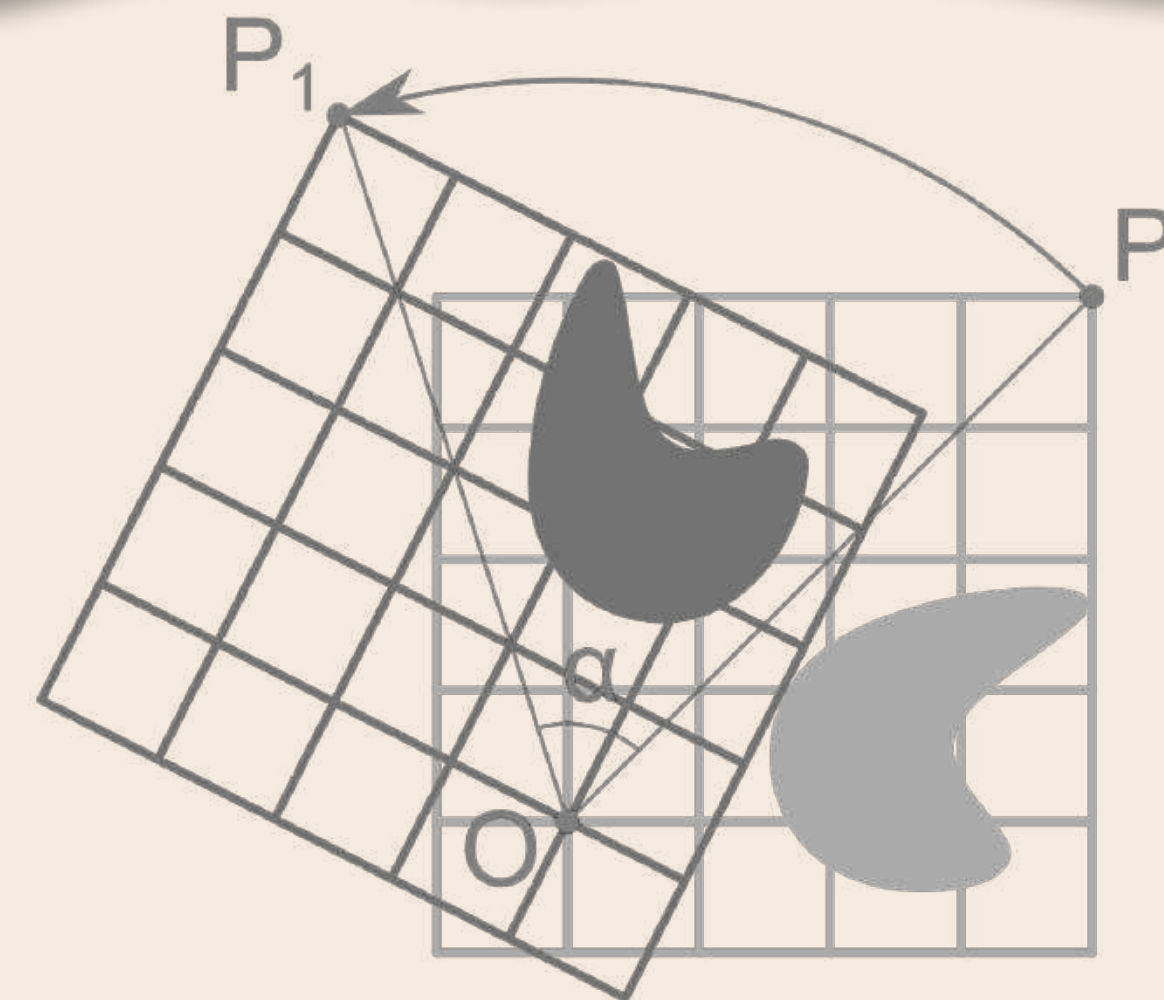
1. A schedule allocating tasks, duties, or privileges on a cyclical basis.

Nurse night duty rota

Mon	Tue	Wed	Thu	Fri	Sat	Sun
Jack	Jill	Jack	Pam	Jill	Sam	Sam

rotate *v.*

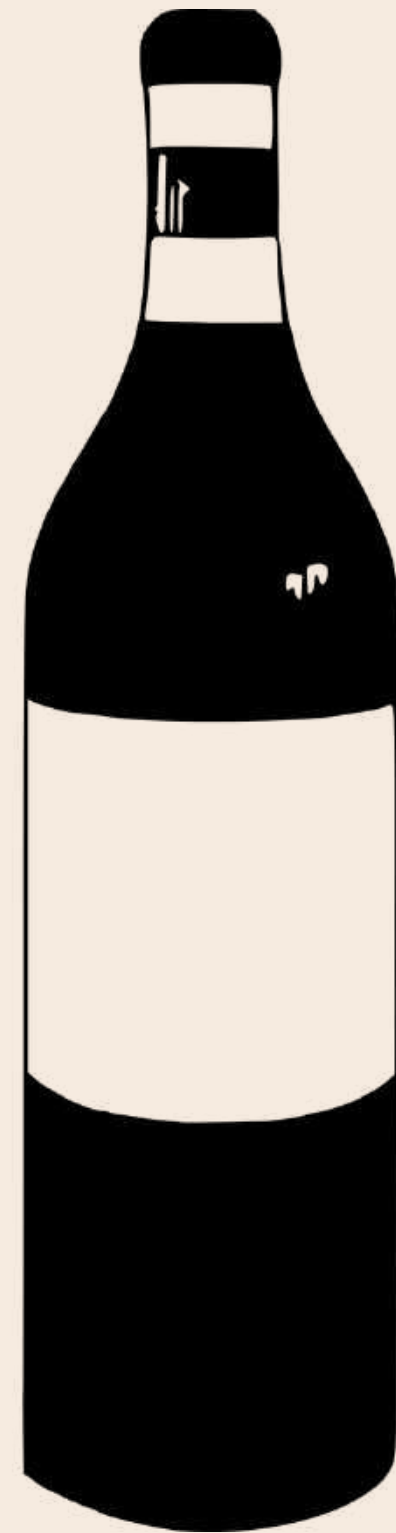
1. To spin.
2. To take turns.
3. In mathematics, to move a space around a certain fixed point.



veritas v. truth (Latin)

in vino veritas *idiom.*

Literally “in wine, there is truth.” Used to suggest that things people say under the influence of alcohol may reveal true beliefs they would not express when sober.



Also consider: *veritaserum*, which is not a real word but the name given to the truth potion in the Harry Potter series.

verify *n.*

1. Confirm that something is true.

Example:

Question

Verify that the point $(3, 19)$ lies on the line $y = 2x + 13$.

Answer

Substituting $x = 3$, we find $y = 2 \times 3 + 13$, i.e. $y = 19$. Therefore $(3, 19)$ does lie on the given line.

quadratum v. a square (Latin)

quadrat *n*.

1. A square frame, used to mark out an area of land to study its plants, animals, soil or other natural processes.



quadratic *n*.

1. A polynomial where the highest power of the variable is the second power (i.e. square).

Examples:

$x^2 + 3x - 5$ is a quadratic expression in x .

$t^2 - 9$ is a quadratic expression in t .

$5n^2 + n$ is a quadratic expression in n .

κῶνος (konos) n. cone (Ancient Greek)

conifer *n.*

1. A plant, usually a tree, whose seeds are produced by cones

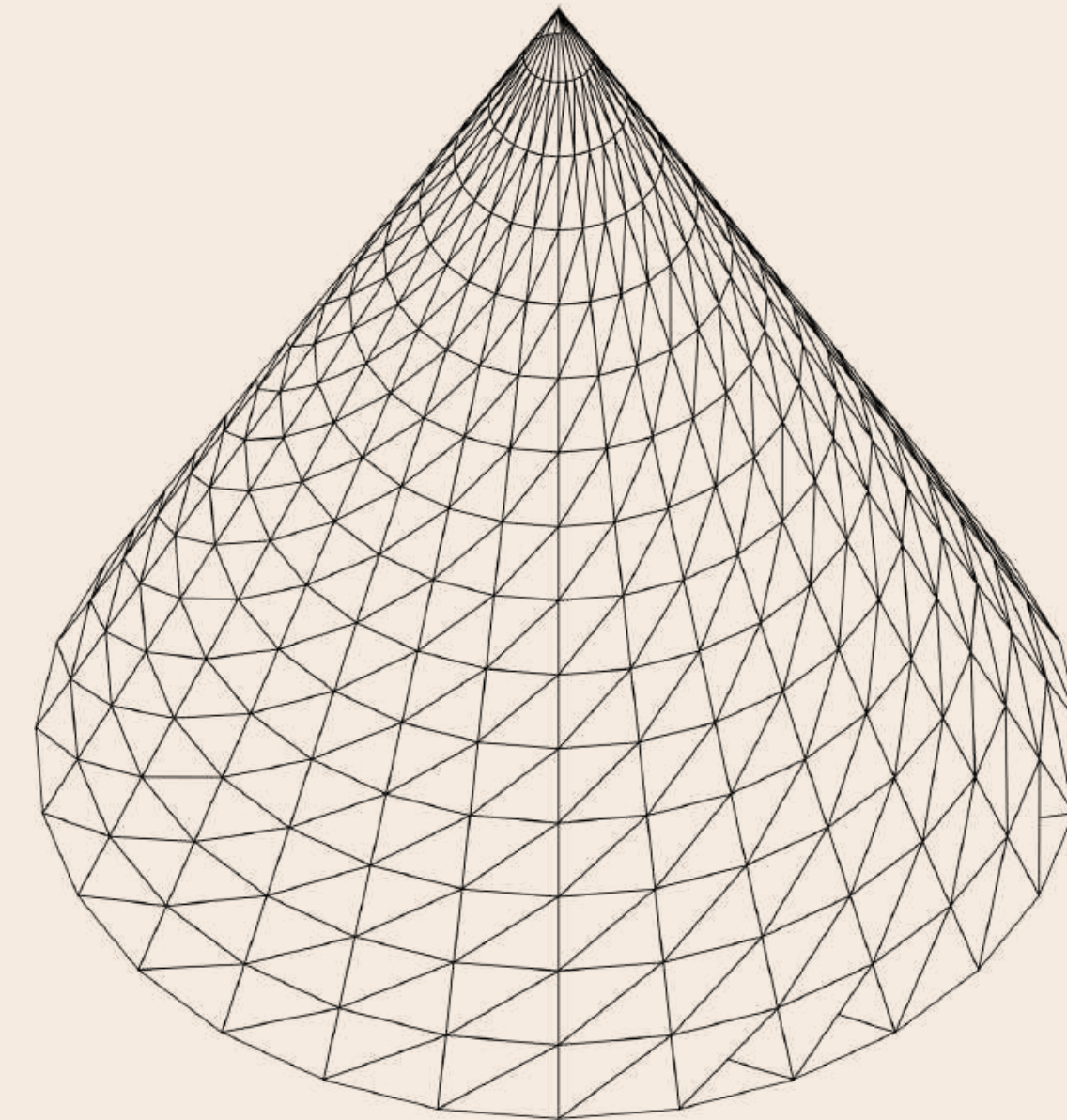


A pine cone is made up of several scales. On the upper side of each scale are ovules that develop into seeds after fertilisation by pollen grains.



cone *n.*

1. A three-dimensional geometric shape that tapers smoothly from a flat base.



pendere v. to drop or hang (Latin)

suspend *n.*

1. To stop something temporarily.
2. To hang freely.

The deck of a suspension bridge is hung by vertical suspenders from suspension cables.

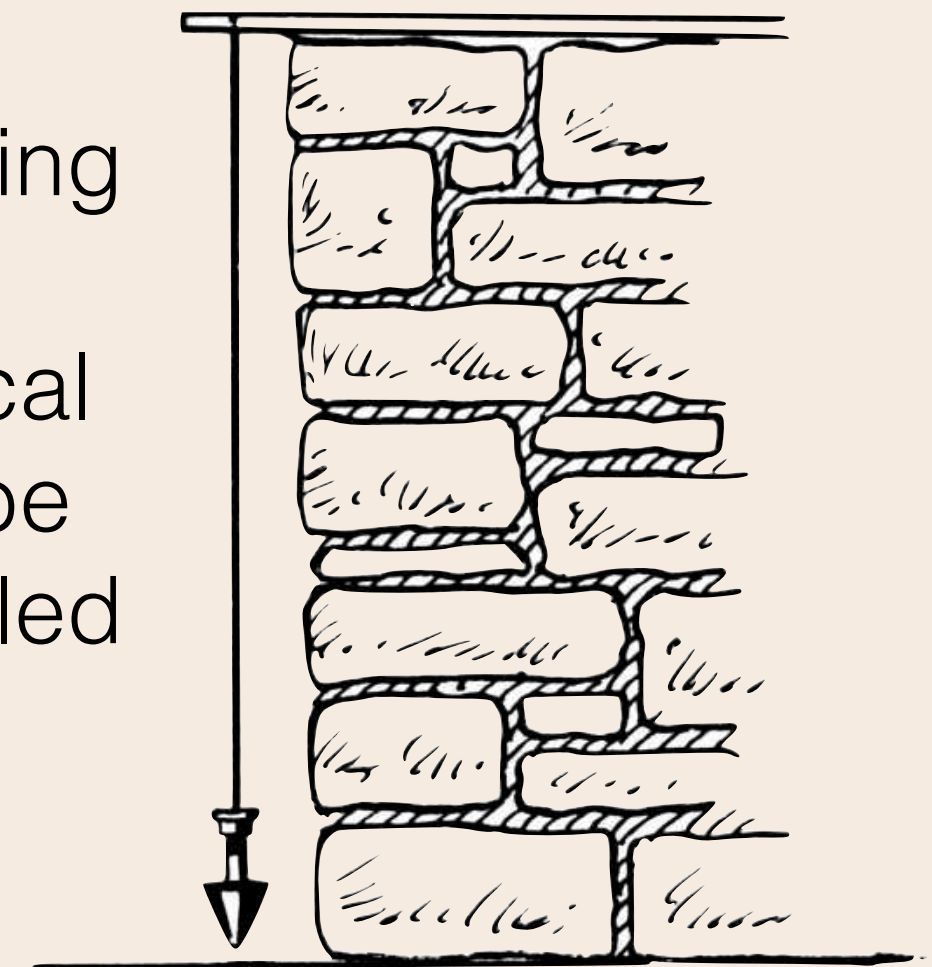


perpendicular *n.*

1. At or forming a right angle to something.

This word comes from *perpendicularum*, (Latin for plumb line), which itself comes from *pendere*.

A plumb line is just a string with a weight attached, used to produce a vertical line. This will of course be at right angles to a levelled ground surface.



παρά (para) *prep.* beside (Ancient Greek)

paramedic *n.*

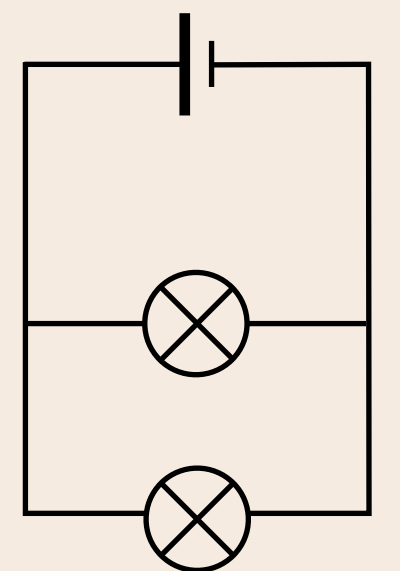
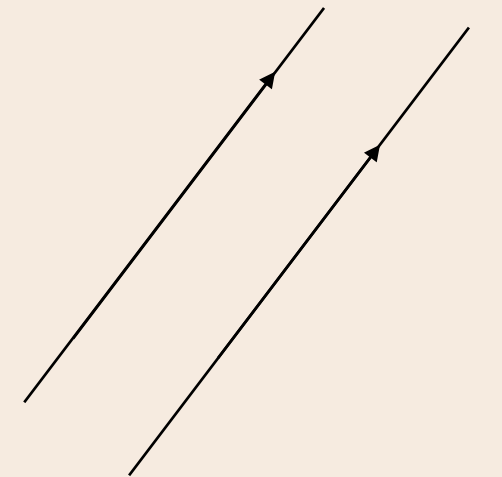
1. Someone who responds to emergency calls for medical help away from hospitals.

paralegal *n.*

1. Someone who works beside a lawyer to assist them, but is not a qualified lawyer themselves.

parallel

1. *adj.* In geometry, of two lines: equally distant from each other at all points.
2. *n.* A line of latitude e.g. the 62nd parallel passes through the island.
3. *v.* Be similar or identical in key aspects e.g. Alice's story paralleled Olivia's.
4. *n.* An arrangement of electrical components in a circuit where current flows along two or more paths.

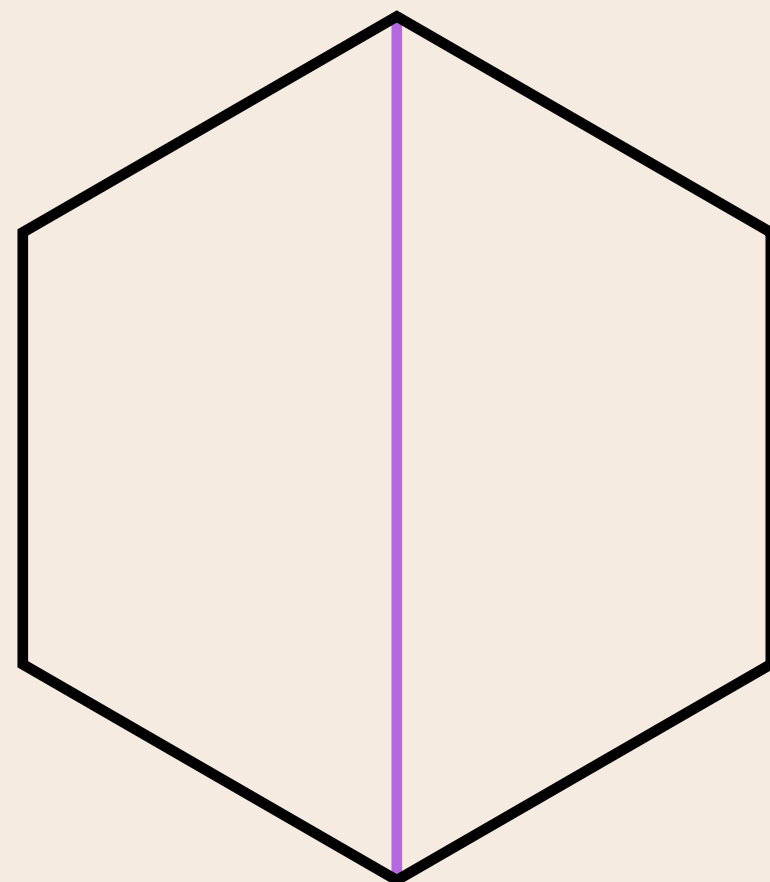


διά (dia) *prep.* across (Ancient Greek)

diagonal *adj.*

1. In geometry, joining two non-adjacent vertices.
2. In everyday English, slanted.

See also: *gonia* (Ancient Greek) meaning *angle*.

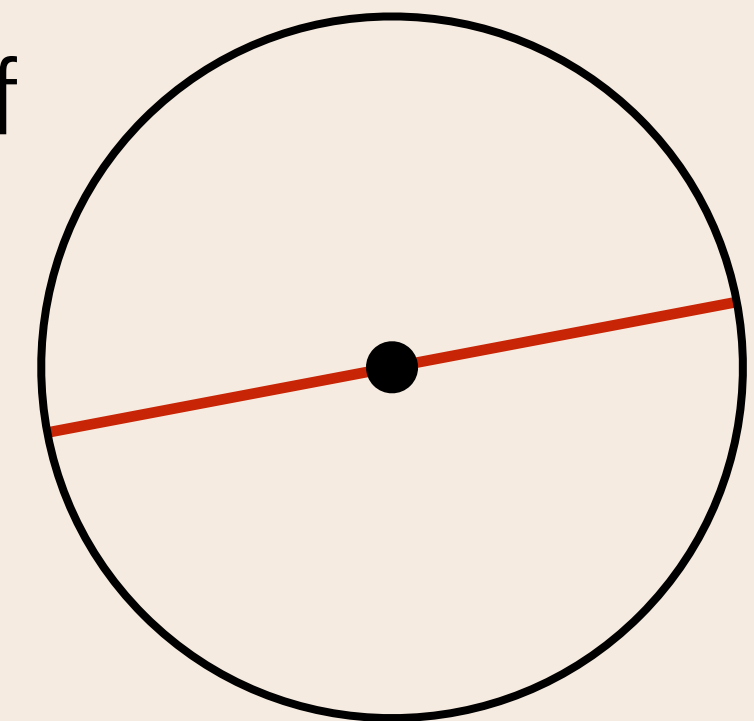


Here is a diagonal of this hexagon.
Note that it is does not appear slanted in this orientation.

diameter *n.*

1. Any straight line between two points on the circumference of a circle that passes through the centre of the circle.
2. The length of such a line.

Here is a diameter of the circle.



arcus *n.* bow, arc, rainbow (Latin)

arcade *n.*

1. In architecture, a row of arches, often part of a covered passage with shops on both sides.
2. An establishment that runs coin-operated games.

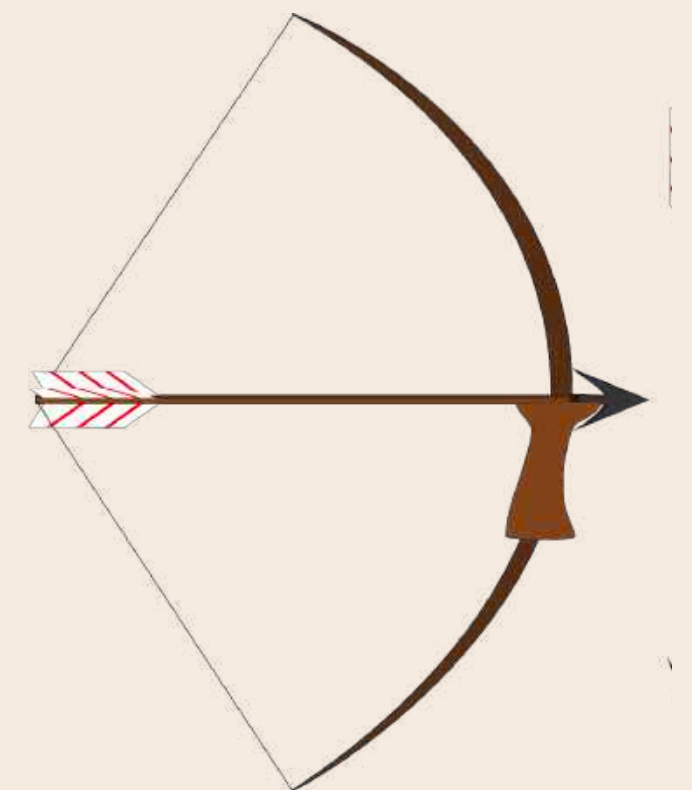
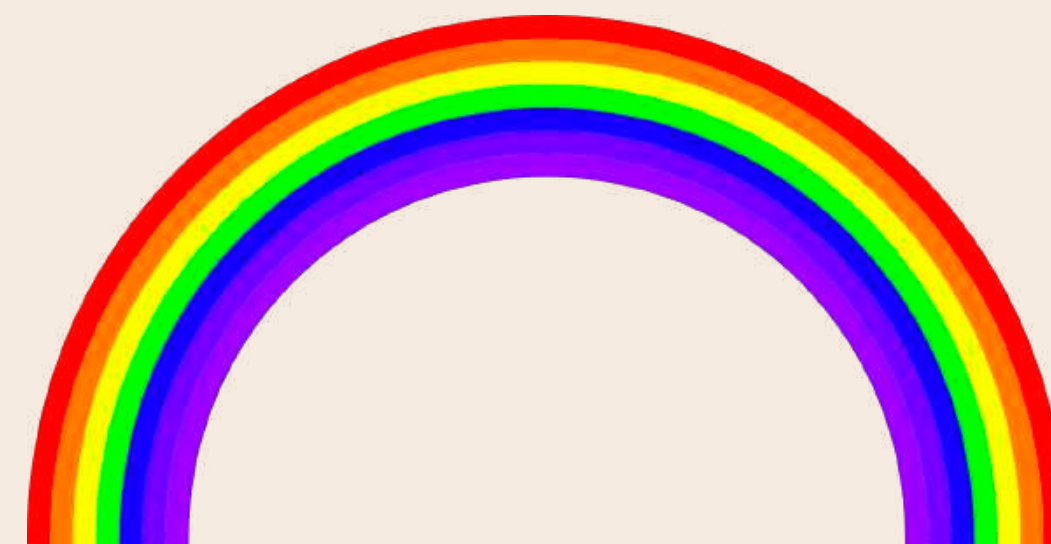


arc *n.*

1. A continuous part of the circumference of a circle.

Did you know?

The French for rainbow is *arc-en-ciel*, which literally translates to arc in the sky.



dividere *v.* to divide, distribute (Latin)

dividend *n.*

1. In finance, a share or profits that is paid by a company to its shareholders or owners.
2. A number that is to be divided by another.

$$\begin{array}{r} 180 \\ 2 \overline{) 360} \end{array}$$

divisor → 2 ← dividend

← quotient

divide *v.*

1. To split something into two or more parts.
2. In arithmetic, to calculate the number by which you must multiply a given number to produce a second given number.

divisor *n.*

1. A number or expression that another is to be divided by.

minuere *v.* to lessen, diminish (Latin)

minuet *n.*

1. A slow, graceful dance for two, involving very small steps.
2. A tune for a minuet dance, commonly in triple time, popular in the 18th century.



People might often refer to -4 as “minus 4” but mathematicians prefer to call this “negative 4”.

minus *prep.*

1. prep. Without e.g. I left my house minus my wallet.
2. prep. In mathematics, less or reduced by. Used to find the difference between two quantities.
3. n. A symbol, $-$, used to denote the operation of subtraction.
4. Often used to mean *negative*.

γωνία (gonia) *n.* angle (Ancient Greek)

diagonal *adj.*

1. In geometry, joining two non-adjacent vertices.
2. In everyday English, slanted.

See also: *dia-* (Ancient Greek) meaning *across*.

polygon *n.*

1. A plane figure bounded by edges that are all straight lines.

See also: *polus* (Ancient Greek) meaning *many*.



pentagon *n.*

1. A polygon with five sides and five angles.

The Pentagon is the name of the headquarters of the US Department of Defense.

μέτρον (metron) *n.* measure (Ancient Greek)

perimeter *n.*

1. In mathematics, the length of the boundary of an object. For a straight-sided shape, this is the sum of the lengths of the sides of an object.

See also: *peri-* (Ancient Greek) meaning *around*.



diameter *n.*

1. Any straight line between two points on the circumference of a circle that passes through the centre of the circle.
2. The length of such a line.

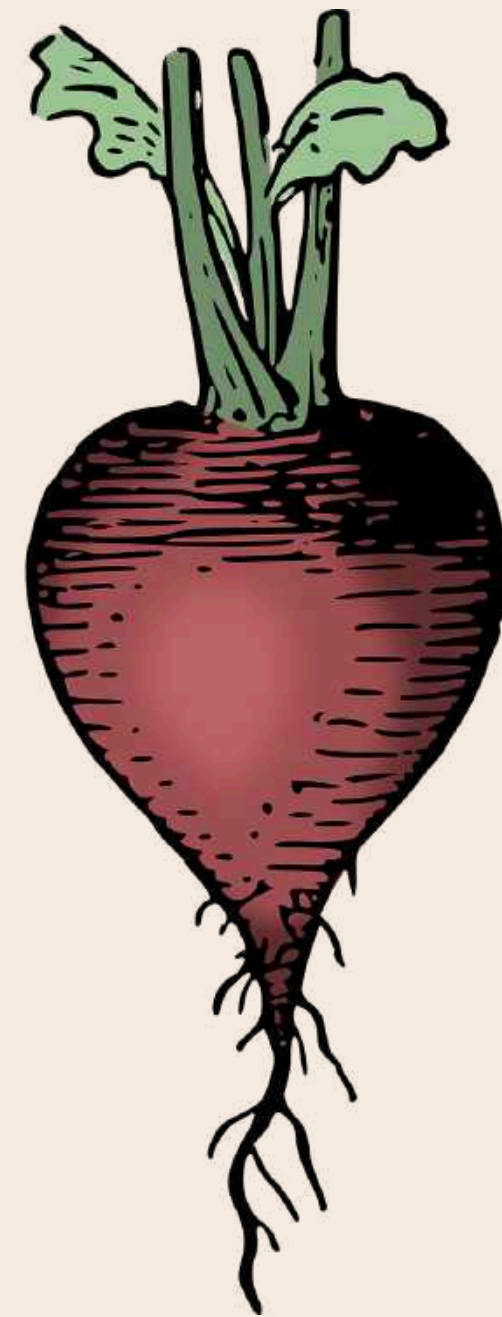
See also: *dia-* (Ancient Greek) meaning *across*.

Buildings such as schools and airports are surrounded by secure **perimeter fences**.

radix *n.* root (Latin)

radish *n.*

1. An edible root vegetable of the Brassica family.



radical *adj.*

1. Favours major change at the root cause of the matter; far-reaching.
2. In botany, relating to a root of a plant.
3. In mathematics, another word for root.

$$\sqrt{17}$$

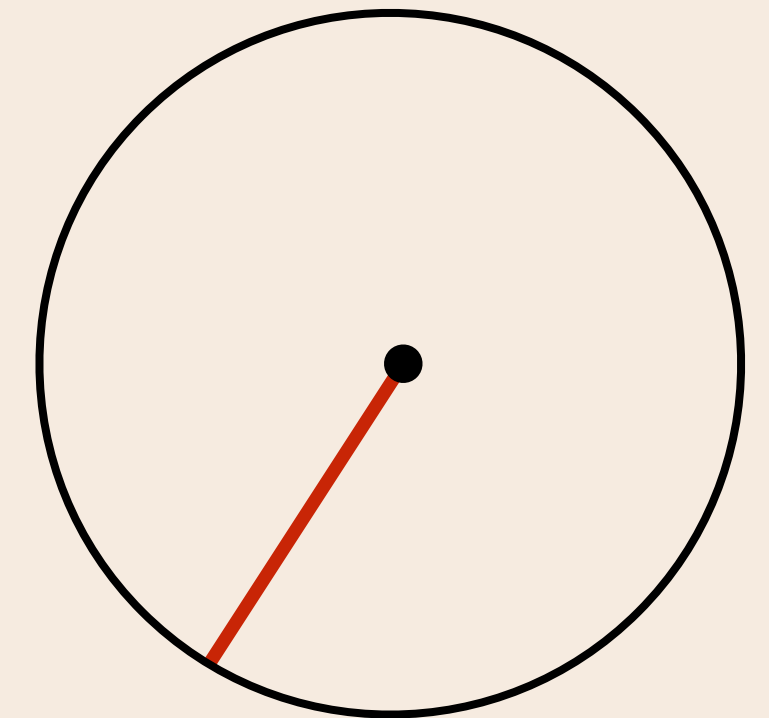
radius n . beam of light, spoke of a wheel (Latin)

radiation n .

1. The emission or transmission of energy from a source through space or a medium
e.g. electromagnetic radiation.

radius n .

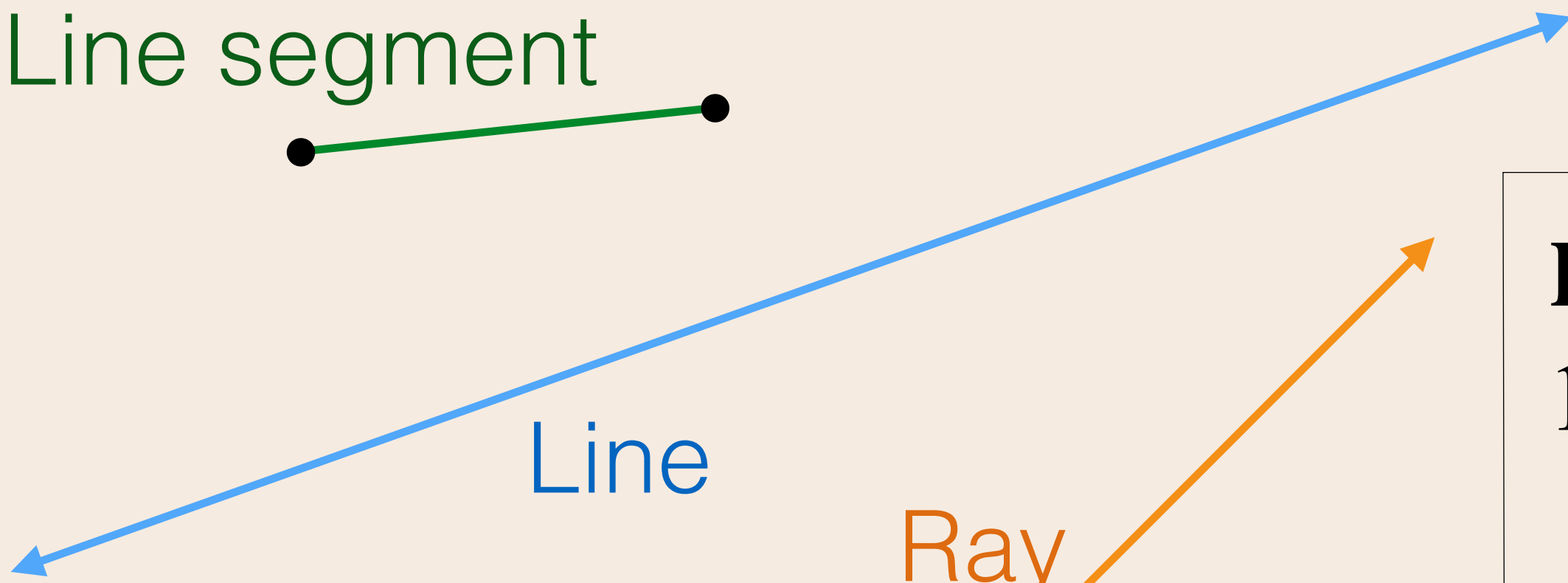
1. A line segment between a point on a circle or sphere and its centre.
2. The length of this line segment.
3. The larger bone in a forearm.



Line segment



Line



Ray



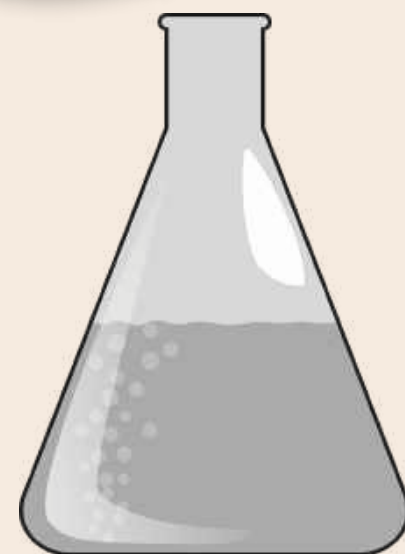
ray n .

1. In geometry, a half-line i.e. the part of an (infinite) line extending in one direction from a given point on the line.

solvere *v.* loosen, set free, solve (Latin)

dissolve *v.*

1. In chemistry, disintegrate a chemical into a solution by immersing it in a solvent e.g. dissolving salt in water.
2. End a union of members e.g. dissolving parliament before an election or the dissolution of the monasteries by Henry VIII.



solve *v.*

1. In everyday English, find an answer to a problem.
2. In mathematics, find the values of variables that satisfy a system of equations or inequalities.

e.g. Solve $3x + 4 = 19$

$$x = 5$$

The x has been set free!
It is no longer tied up in a more complicated expression.

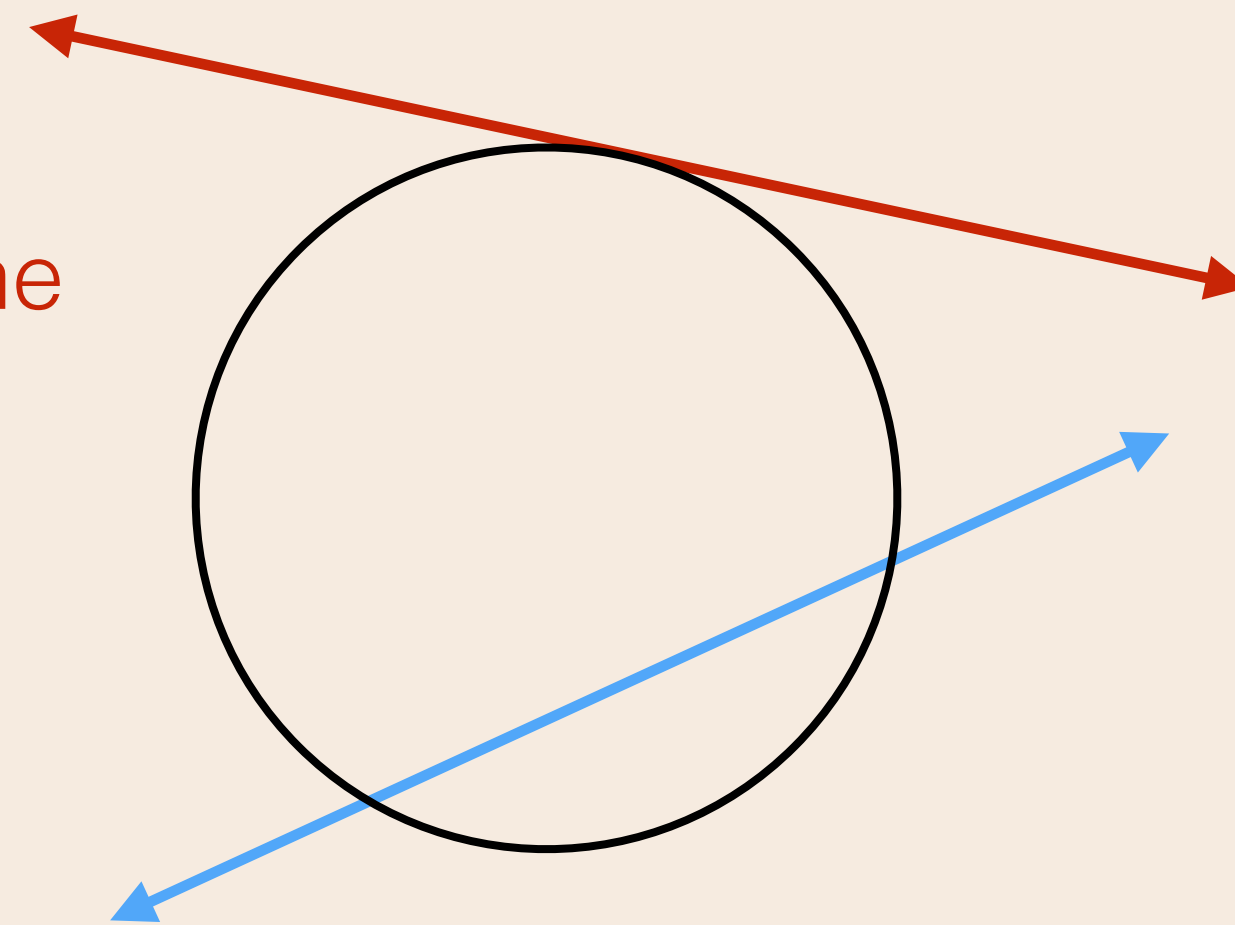
tangere v. to touch (Latin)

contagion *n.*

1. A disease spread by contact.

The red line is **tangent** to the circle.

Compare with the blue line, which is a **secant** of the circle. It is not a tangent.



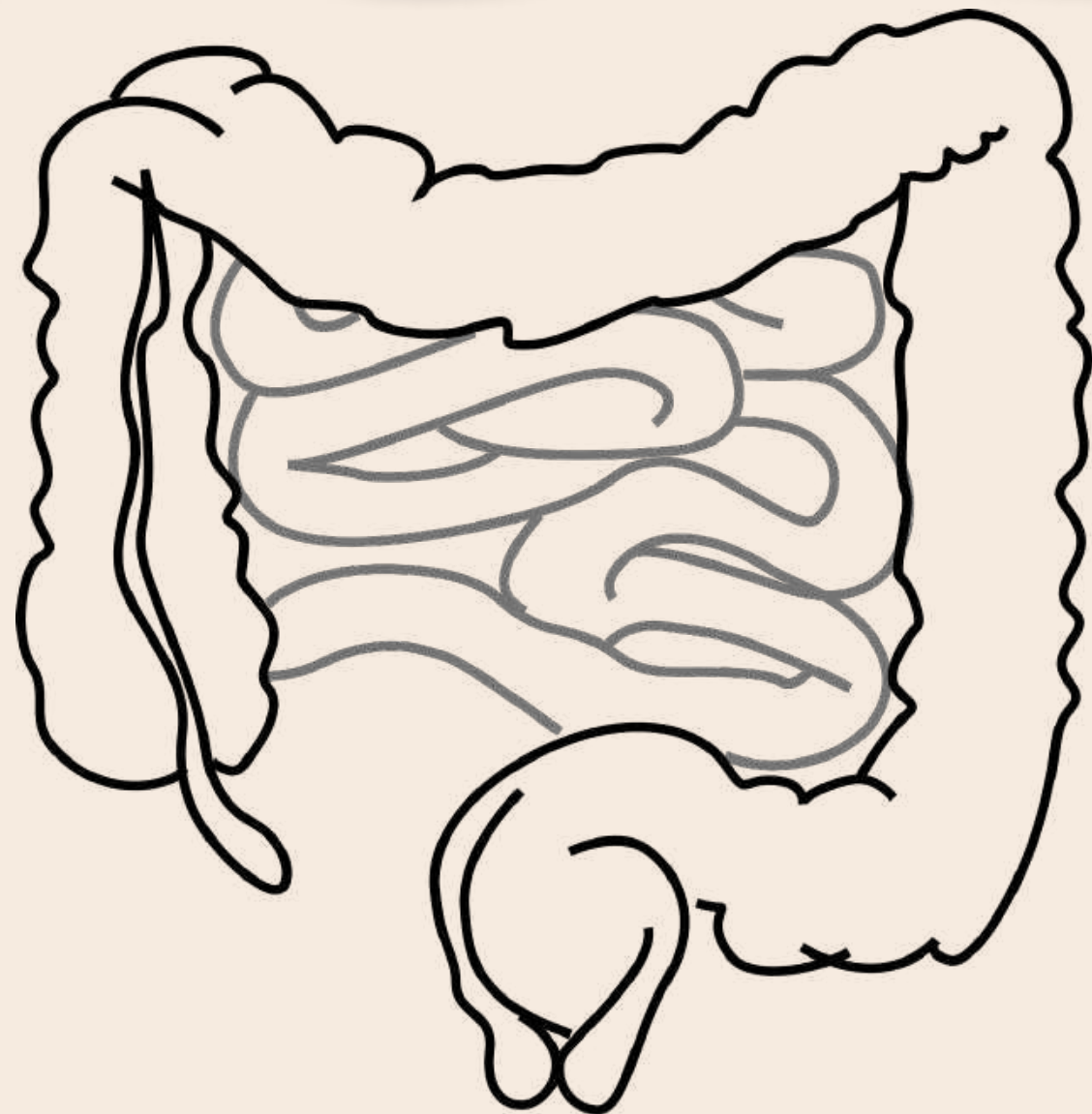
tangent *n.*

1. In geometry, a straight line touching a curve at a single point without crossing it there.
2. In mathematics, the ratio of the sine to the cosine of an angle.
3. A topic unrelated to the main topic apart from one point in common e.g. we were talking about cars but then went off on a tangent about trains.

rectus *adj.* ruled, straight, right (Latin)

rectum *n.*

1. The last part of the large intestine. Comes from an abbreviation of the Latin *rectum intestinum* (straight intestine).



rectangle *adj.*

A quadrilateral having four right angles.

Did you know?

The small intestine is much longer than the large intestine. The small intestine folds over itself, but the large intestine is straighter.

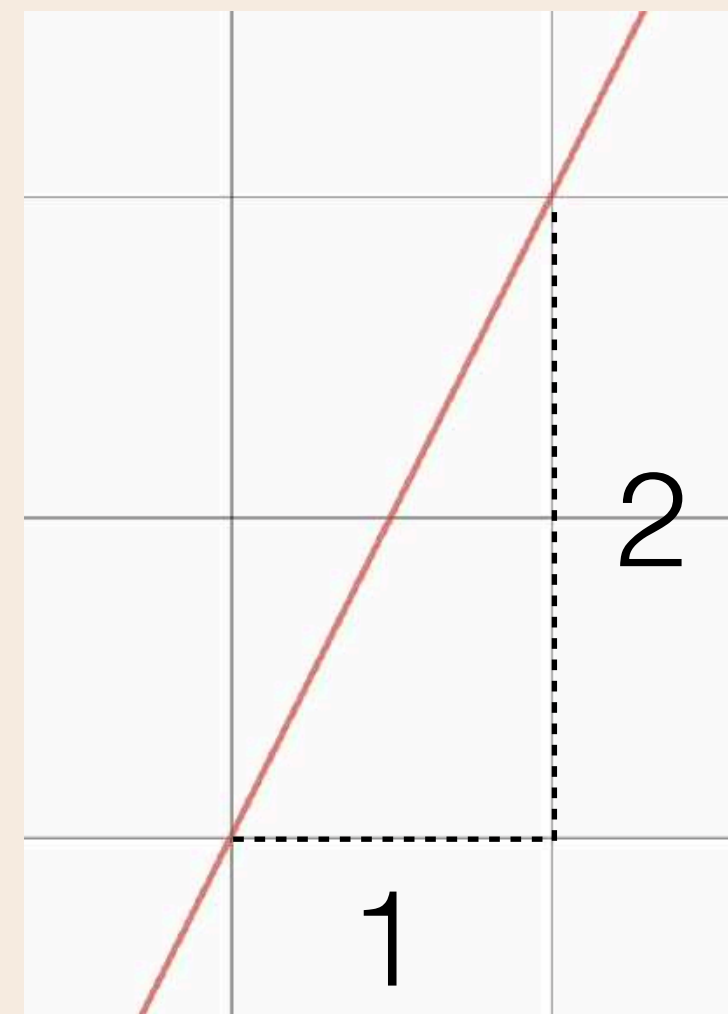
The large intestine has a greater diameter than the small intestine, however.

gradus n . a step or pace (Latin)

grade n .

1. A rating.
2. A slope of a road or railway.

Given a straight-line graph with gradient m , for each step to the right, the line rises by m steps.



gradient n .

1. In everyday English, a slope or incline.
2. The rate at which a quantity changes with respect to a given variable.
3. In mathematics, a number that describes the steepness of a line or curve at a given point. Also known as **slope** in US English.

terminus *n.* boundary, limit, end (Latin)

terminate *v.*

1. End e.g. a train line.
2. Set a limit or boundary to.
3. Kill.

A terminating decimal has a limited number of digits after the decimal point.

0.5872 is a terminating decimal.

$0.\dot{2}\dot{1}$ is not a terminating decimal. It is a recurring decimal beginning 0.21212121...

$\pi \approx 3.141592653\dots$ is not a terminating decimal. It is not a recurring decimal either.

determine *v.*

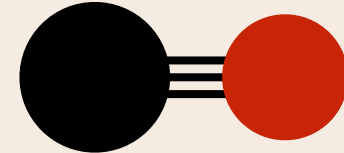
1. Set the boundaries or limits of.
2. Figure out or ascertain.
3. Fix the form or character of.

e.g. **Determine** the number of real roots of the equation $y = x^2 + 2x + 3$.

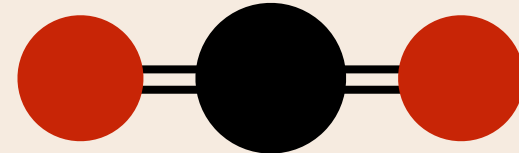
The discriminant is $2^2 - 4 \times 1 \times 3 = -8$.
Therefore, the equation has **no real roots**.

Greek prefixes in use

1 **mono-** Carbon monoxide



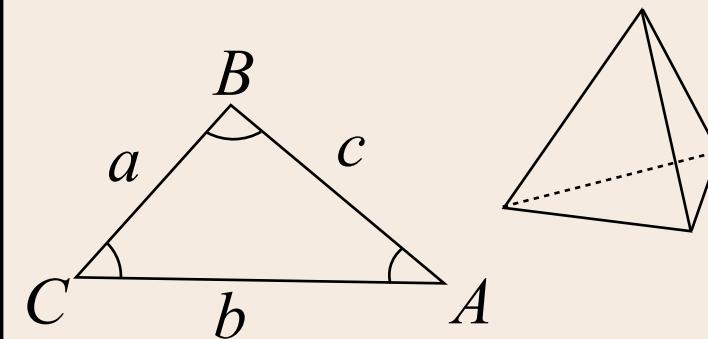
2 **di-** Carbon dioxide



3 **tri-**
4 **tetra-**

Trigon and tetragon are rarely used words for triangle and quadrilateral...

...but we do use the words *trigonometry* and *tetrahedron*.



5 **penta-** Pentagon

6 **hexa-** Hexagon

7 **hepta-** Heptagon

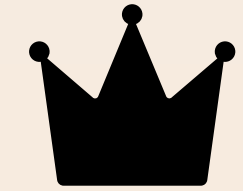
8 **octa-** Octagon

9 **ennea-** Enneagon

More commonly known as a *nonagon*, which is a weird mix of the Latin prefix for *nine* and the Greek suffix for *angle*.

10 **deca-** Decagon

Monarchy Rule by one person



Diarchy Rule by two people

Triarchy Rule by three people, known as *triumvirate* in Latin

Tetrarchy The name given when the Roman Empire had four co-emperors

Pentarchy Governance by five heads of the Eastern Orthodox Church

Multi-sport events

Triathlon

Pentathlon

Heptathlon

Decathlon



Latin prefixes in use

1	uni-	Unicycle, universe, unit, unite
2	bi-	Bicycle, bimetallic, biennial, biannual
3	tri-	Triplets, triangle, trinity
4	quad-	Quadruplets, quadrilateral
5	quin-	Quintuplets, quintile, quinqucentenary
6	sex-	Sexagenarian, sextuplets
7	sept-	Septuagenarian, septuplets
8	octo-	Octogenarian, octopus
9	nona-	Nonagenarian

quintessential *n.*

1. Being the most perfect or typical example of a particular type
e.g. James Bond is the quintessential British spy.

Where does “five” come into this?

Quintessence refers to the fifth essence or element. It was once thought that the five elements were earth, air, fire, water, and aether—with the fifth, aether, being superior to the other four.

valere v. to be worth (Latin)

valour *n.*

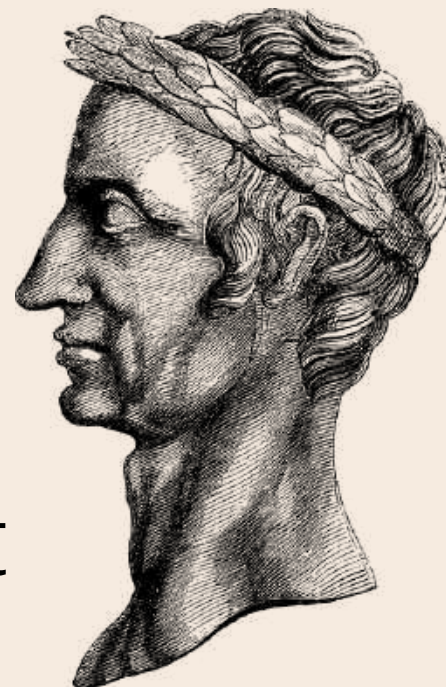
1. The value or worth of something.
2. Bravery, courage.

We get the adjective *valiant* from *valour*.

*Cowards die many times before their deaths;
The valiant never taste of death but once.*

Act II, Scene 2, Julius Caesar

Of course people don't literally die many times. Shakespeare is using death as a metaphor in the first part of the quotation.



value

1. *n.* The quality that makes something desirable e.g. her childhood diaries are precious to her but have little value to anyone else.
2. *n.* In mathematics, a numerical quantity.
3. *n.* The amount of money something is worth.
4. *n.* Something strongly-held like one's morals or belief system e.g. he shared his family's values
5. *v.* To judge the worth of something e.g. a surveyor valued the house at £400,000.

flectere *v.* to bend, turn, curve (Latin)

flexible *adj.*

1. Capable of being bent, turned, or twisted without breaking.
2. Willing or able to change to suit others e.g. “We can meet any day next week; I’m flexible.”

reflex

1. *n.* An automatic reaction or response to a stimulus.
2. *adj.* Of an angle, greater than 180° but less than 360° .

reflect *v.*

1. To turn back (e.g. light) from a surface.
2. To mirror or show the image of something.
3. To agree with e.g. his views reflected hers.
4. To give evidence of something e.g. her grades reflect how hard she has worked.
5. To consider, think seriously about e.g. she reflected on her behaviour that day.

bhendh- v. bind, tie (Proto-Indo-European)

Did you know? Most languages from Europe, the Middle East, and the Indian subcontinent share a common ancestor. Linguists have reconstructed this language and refer to it Proto-Indo-European.

bandana *n.*

A large (often colourfully-dyed) cloth usually tied around the head. Originates from a Hindi and Urdu word meaning *tie dyeing*.

*My bounty is as boundless as the sea,
My love as deep; the more I give to thee,
The more I have, for both are infinite.*

Act II, Scene 2, Romeo and Juliet

bound

1. *v.* Past tense of *bind* e.g. I bound all the sticks together with string.
2. *adj.* Very likely or certain e.g. Following the Archduke's assassination, war was bound to break out.
3. *adj.* Obligated e.g. you are legally bound to pay.
4. *adj.* Constrained or limited. Compare with boundless (see left) and unbounded.
5. *n.* In maths, an upper or lower limit.

fīnire *v.* to finish, limit (Latin)

finish *n.*

1. *n.* An end.
2. *n.* A polish or protective coating given to a surface.
3. *n.* In sports, a shot such as a strike at a goal.
4. *v.* To complete.
5. *v.* To come to an end.
6. *v.* To apply a finish (see sense 2).

infinite *n.*

∞

1. In everyday English, very large or immense.
2. In maths, not finite; greater than any positive quantity or magnitude; with no limit.

Did you know?

It is thought that there are between 10^{78} and 10^{82} atoms in the known universe. i.e. a finite number.

finite *adj.*

1. Having an end or limit; constrained by bounds

computare *v.* to compute, calculate (Latin)

computer *n.*

1. A programmable device that performs calculations and operations to store, process, and retrieve large amounts of data.
2. Historically, a person employed to perform calculations.

count *v.* (compare with the French verb *compter* meaning “to count”)

1. To recite numbers in a sequence
2. To determine how many objects are in a group
3. To be an example e.g. that apple counts as one of my five a day!

Did you know?



Iceland's geographic isolation has meant its language has hardly changed for centuries. Icelandic people can read literature from 800 years ago without too much trouble, whereas most of us would struggle with 13th century English literature! To preserve their language, they carefully use combinations of old words when they need to introduce new vocabulary, rather than simply incorporating foreign words into Icelandic. For example, the Icelandic word for *computer* is *tölva*, a word created by combining the two Icelandic words for “number” and “witch”.

acus *n.* needle (Latin)

acumen *n.*

1. Quickness of perception and the ability to make good judgements.
Alan has considerable business acumen.
2. (Less commonly used) a sharpened point.

acute *adj.*

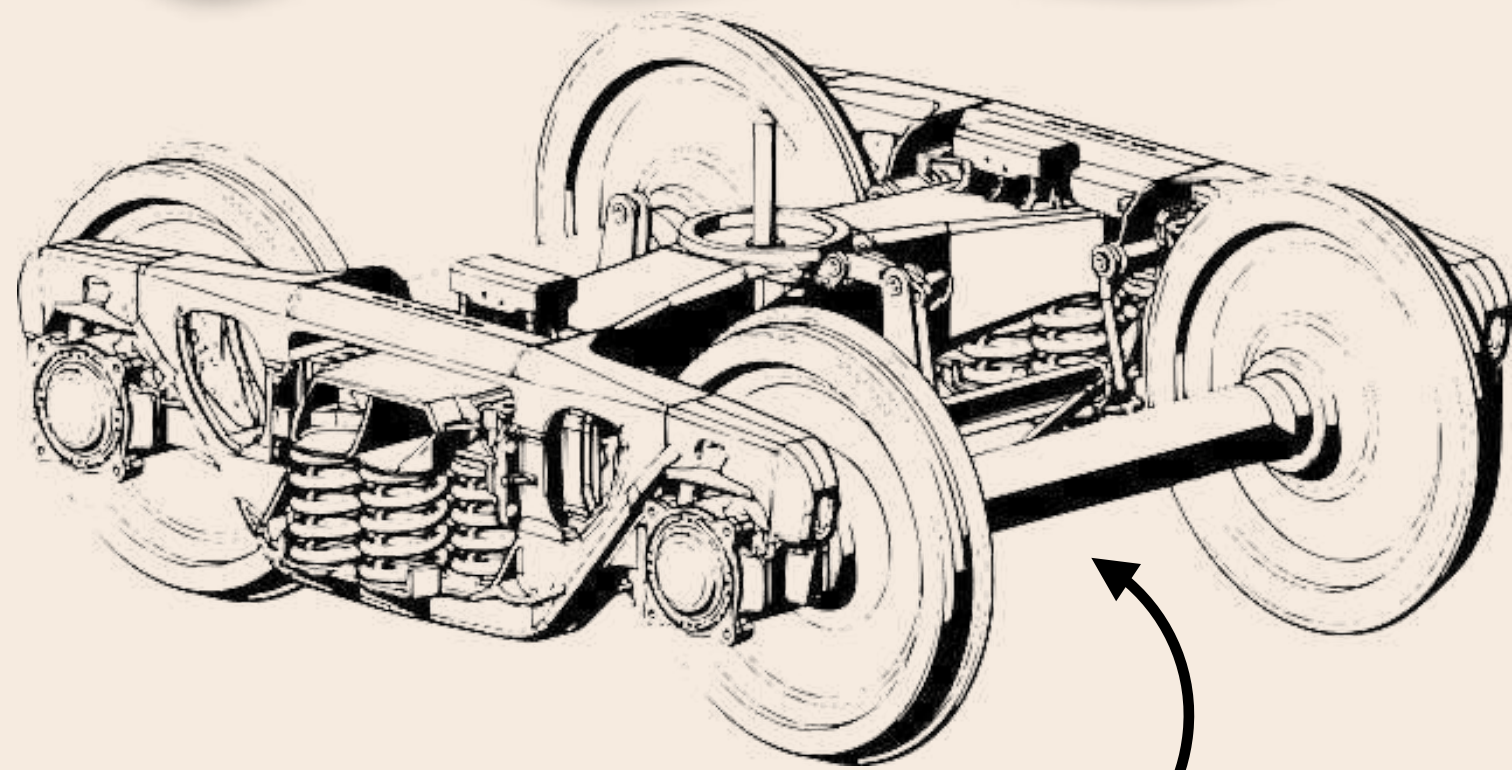
1. Severe or intense (often in an unpleasant sense)
e.g. he experienced an acute abdominal pain;
e.g. there was an acute housing shortage.
2. Perceptive, shrewd, or sharp of mind.
3. Of an angle, less than 90°.



axis *n.* axle (Latin)

axle *n.*

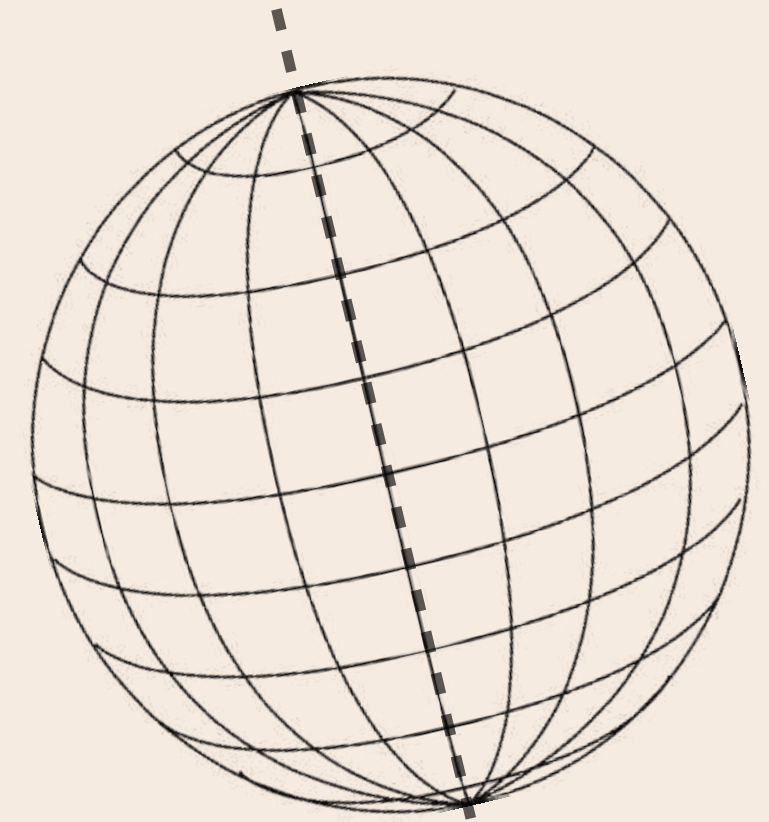
1. A transverse (sideways) bar connecting the opposite wheels of a car or other wheeled vehicle.



An axle of a rail bogie.
(A train coach typically rests on two bogies like this one, each with two axles.)

axis *n.* (*pl.* axes)

1. An imaginary line around which an object spins e.g. the earth rotates around its axis.
2. A one-dimensional figure (often a line) with an origin, orientation, and a scale. A set of axes can be used to position and locate points in a given space.



Why were Germany, Italy, Japan, and their supporters in World War II known as the Axis powers?

The name perhaps arose from a speech by Mussolini in 1936 in which he stated that all other European countries would start to rotate around what he called the *Rome-Berlin axis*.

commutare *v.* to modify, decay, exchange (Latin)

commute *v.*

1. To cut short or reduce e.g. his death sentence was commuted to life imprisonment.
2. To pay a lump sum instead of instalments or parts.
3. To travel regularly from home to work or vice versa. This sense of the word comes from a shortening of what was known as a *commutation ticket*, i.e. a ticket that allows multiple rides in a time period for a single, commuted, payment.

commutative *adj.*

1. In mathematics, of a binary operation, such that the order of the quantities involved does not matter i.e. they can be swapped or exchanged.
e.g. addition is commutative because
 $7 + 12 = 12 + 7$, but subtraction is *not* commutative because
 $7 - 12 \neq 12 - 7$.

A word that can mean lots of things: range

range *n.*

1. A line or series e.g. of mountains.
2. A fireplace or large cooking stove.
3. A selection e.g. we sell a range of books.
4. An area for practising shooting at targets.
5. An area where military equipment is tested.
6. The maximum distance capability of a vehicle or weapon e.g. the car has a range of 420 miles on a full tank.

7. In maths, the set of values which a function can take.
8. In statistics, the difference between the largest and smallest values in a sample.
9. In music, the scale of all the tones a voice or instrument can produce e.g. opera singers have an incredible vocal range.
10. Of species, the geographical area in which they are naturally found

range *v.*

1. To travel over or roam.
2. To arrange into a line or row.