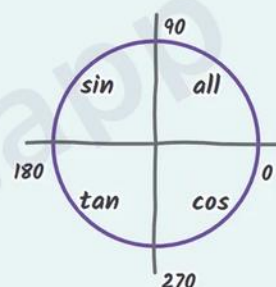


Angles, and the unit that calculus insists on

- one radian is the angle subtended at the centre by an arc equal in length to the radius, and it is a pure number, not a unit of the same kind as a degree
- π radians = 180° , so multiply by $\pi/180$ to go from degrees to radians and by $180/\pi$ to come back
- arc length $s = r\theta$ and area of a sector = $(1/2)r^2\theta$, both valid ONLY with θ in radians
- every derivative and every series in later chapters assumes radians, which is why the unit is not a matter of taste

Signs, and the quadrant they live in

- in the first quadrant all six are positive; in the second only sine and cosecant; in the third only tangent and cotangent; in the fourth only cosine and secant
- $\sin(-\theta) = -\sin \theta$ and $\cos(-\theta) = \cos \theta$, so sine is odd and cosine even, and tangent is odd
- the allied angle rule: for 90° or 270° the function CHANGES to its co function, and for 180° or 360° it does not; the sign comes from the quadrant the result lands in
- so $\sin(90 + \theta) = \cos \theta$, and $\cos(180 - \theta) = -\cos \theta$, both read off that one rule rather than memorised separately



the ratios that are POSITIVE in each quadrant, all in the first and one each after it

The identities everything else is built from *

Pythagorean

$$\sin^2 \theta + \cos^2 \theta = 1$$

divided by $\cos^2$

$$1 + \tan^2 \theta = \sec^2 \theta$$

divided by $\sin^2$

$$1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$$

compound, sine

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

compound, cosine

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

compound, tangent

$$\tan(A \pm B) = (\tan A \pm \tan B) / (1 \mp \tan A \tan B)$$

the cosine formula's sign is the OPPOSITE of the one in the bracket, and that single fact is where most identity errors start