Hwa Chong Institution 华侨中学
Mathematics (SMTP)

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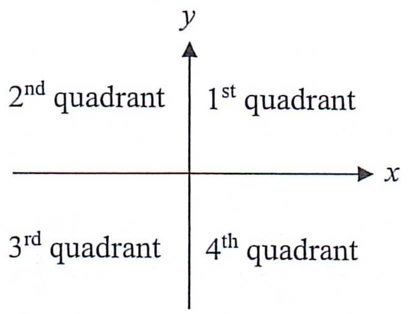
MA304.2.1 – The Four Quadrants

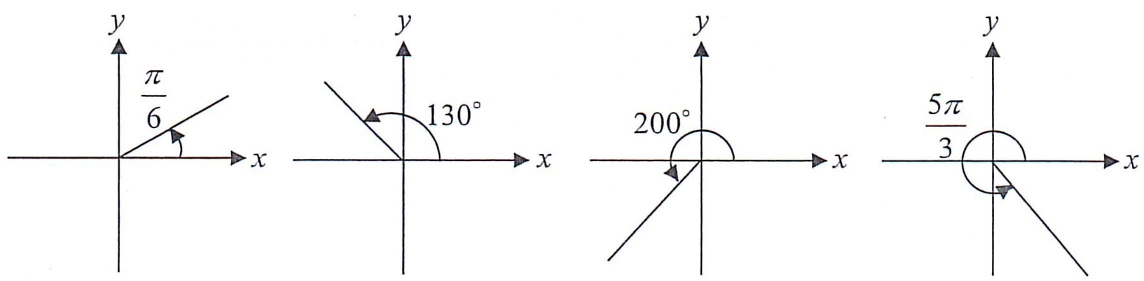
At the end of this unit, you should be able to

- **understand how angles are measured in trigonometry**
- **understand and find basic angles**

If we look at the standard x-y plane, the plane is divided into four regions, and we call them **quadrants**.

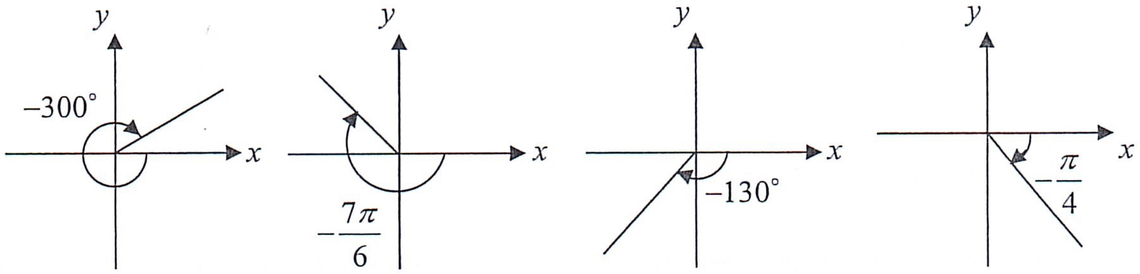


For a given coordinate of a point in the plane, we can assign an angle from the origin to the point to denote the directional position of this point. This angle is always measured from the <u>positive</u> x-axis, in an <u>anticlockwise</u> sense:

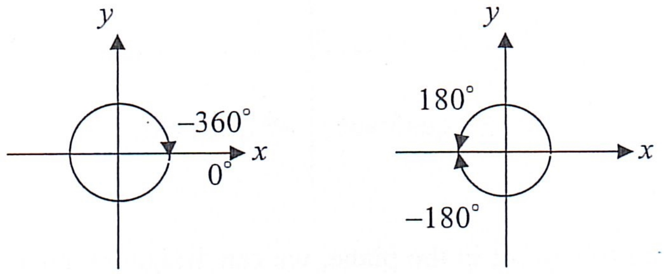


Notice this is different from bearings, which we will encounter later.

We can also measure angles in the opposite directions as follows, but they would be negative:



All the angles are **modulo** 360° (or 2π). In other words, we can go around the origin as many rounds as we like, but eventually we can always write the angle as one of a 'simpler' angle within the range $0^\circ \le \theta < 360^\circ$ (notice that $360^\circ = 0^\circ \bmod 360^\circ$). Alternatively, we can choose to describe the quadrant with angles such as $-360^\circ < \theta \le 0^\circ$, or even $-180^\circ < \theta \le 180^\circ$.

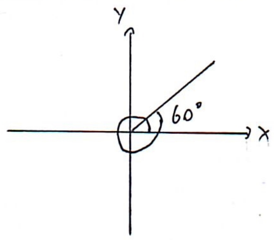


E1. Rewrite the following angles into the respective domain indicated in the square brackets:

(a) 420° $[0^\circ \le \theta < 360^\circ]$

$420^\circ - 360^\circ = 60^\circ$

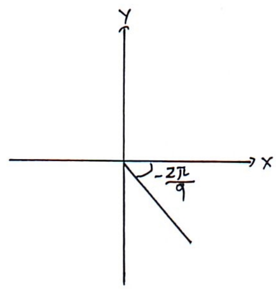
$420^\circ = 60^\circ \pmod{360^\circ}$



(b) $-\frac{2\pi}{9}$ $[0 \le \theta < 2\pi]$

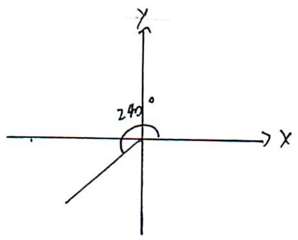
$\frac{2\pi}{1} - \frac{2\pi}{9} = \frac{16\pi}{9}$

$-\frac{2\pi}{9} = \frac{16\pi}{9} \pmod{2\pi}$



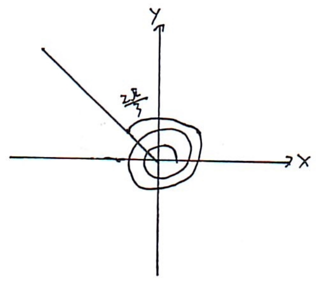
(c) 240° $[-180^\circ < \theta \le 180^\circ]$

$240^\circ = -120^\circ \pmod{360^\circ}$



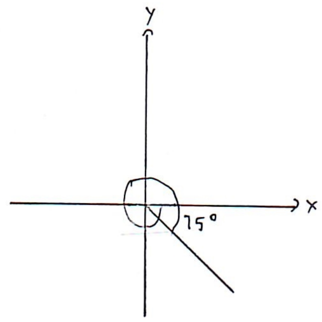
(d) $\dfrac{14\pi}{3}$ $[-\pi < \theta \le \pi]$ and $[0 \le \theta < 2\pi]$

$\dfrac{14\pi}{3} = \dfrac{2\pi}{3} \pmod{2\pi}$

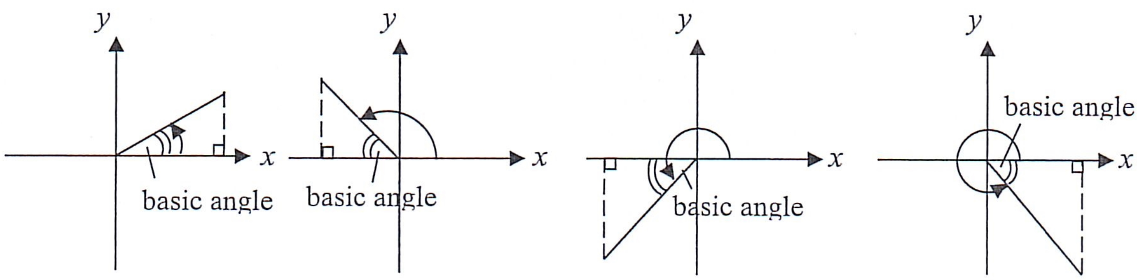


(e) -435° $[-360^\circ < \theta \le 0^\circ]$ and $[0^\circ \le \theta < 360^\circ]$

$-435^\circ = 285^\circ \pmod{360^\circ}$



For any angle in any of the four quadrants, whether positive or negative, there is a **basic angle** for it. From the basic angle, we can then form a basic right-angled triangle. This angle is always made between the hypotenuse and the **horizontal** axis.



Now, understanding trigonometric ratios of angles in all the four quadrants can then be reduced to understanding trigonometric ratios of acute angles, since all the basic angles are acute.