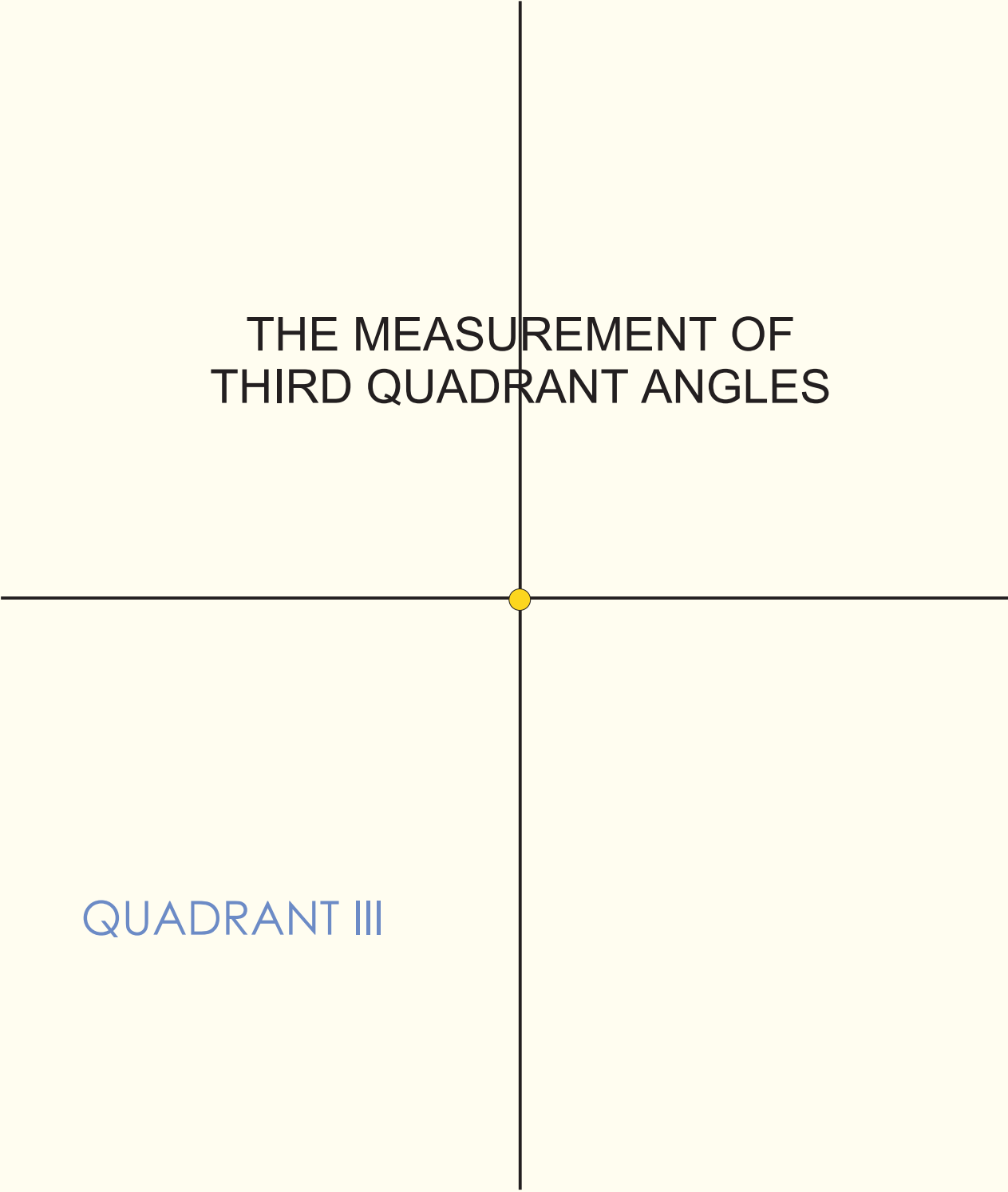


THE TRIGONOMETRIC MEASURE OF ANGLES

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

--> *taking a look at different quadrants
of the Cartesian Plane*

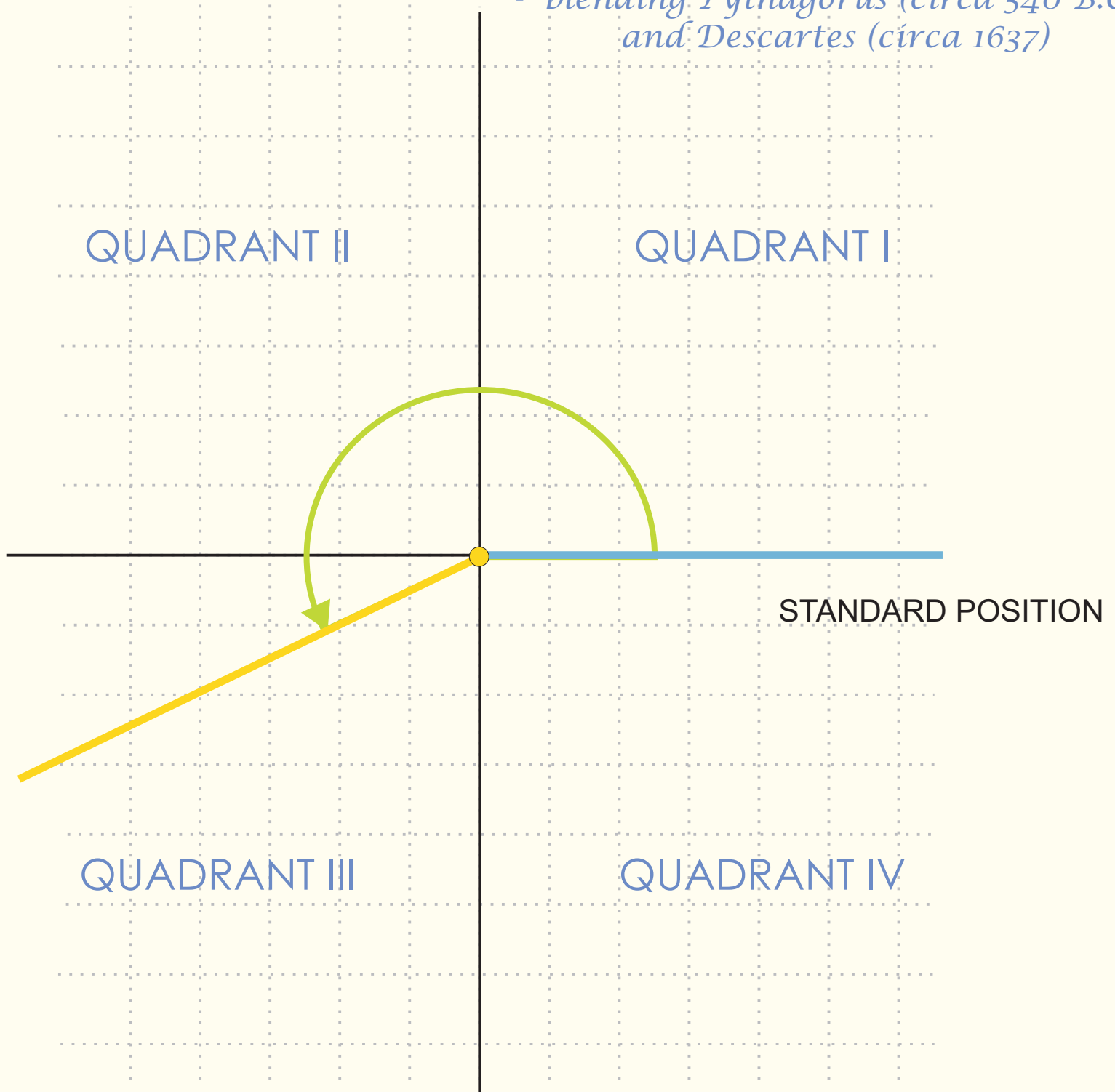


THE MEASUREMENT OF THIRD QUADRANT ANGLES

QUADRANT III

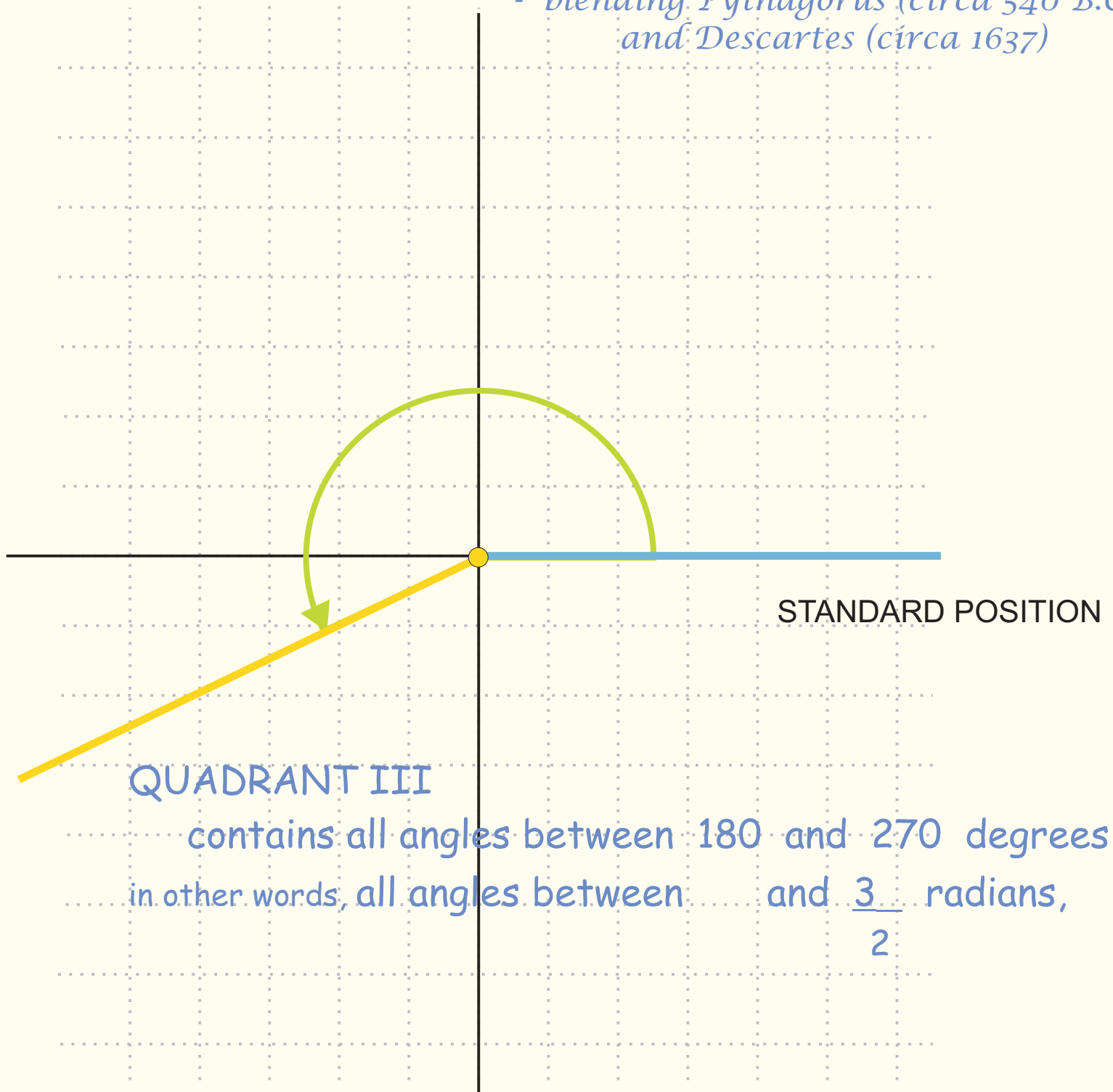
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*



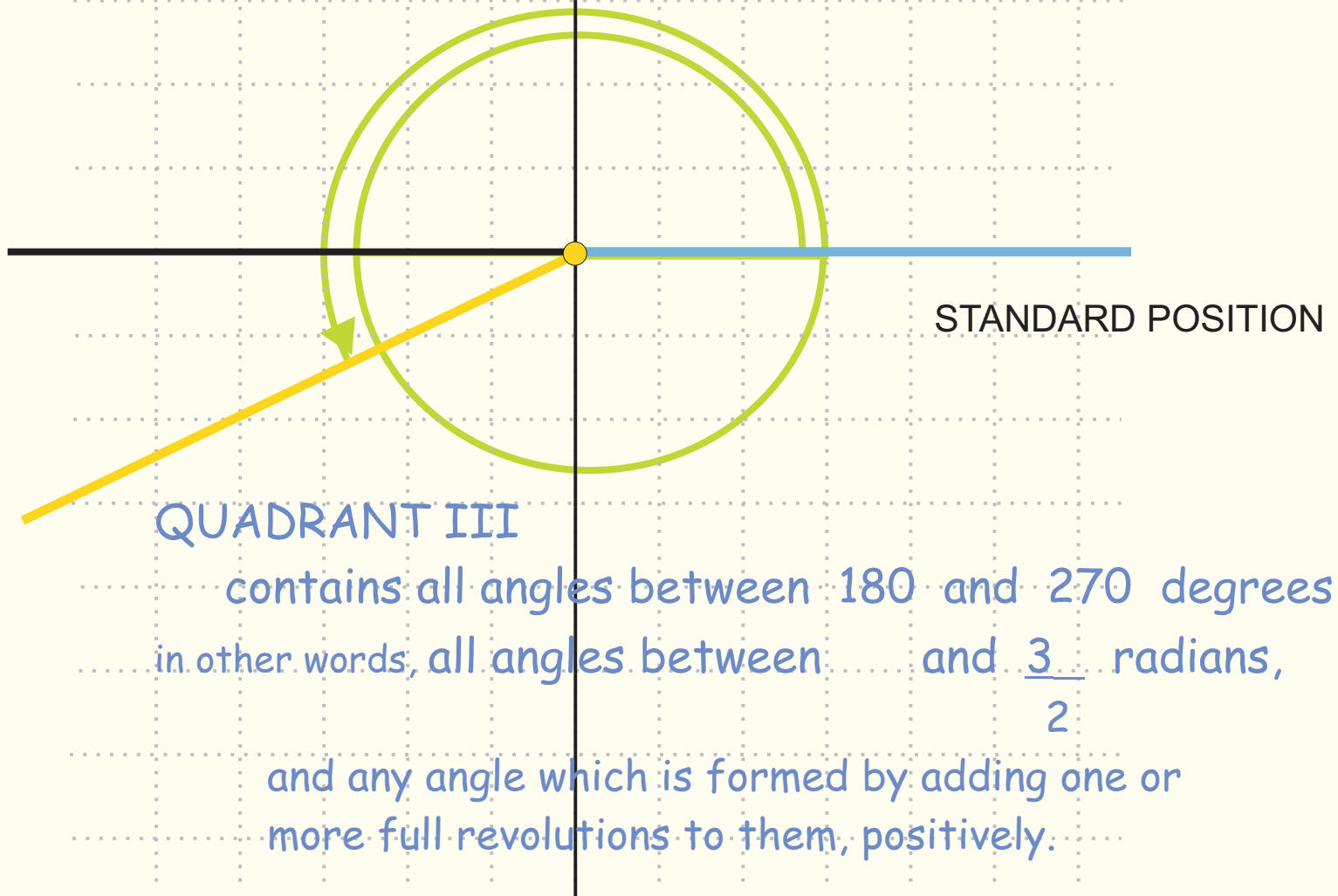
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*



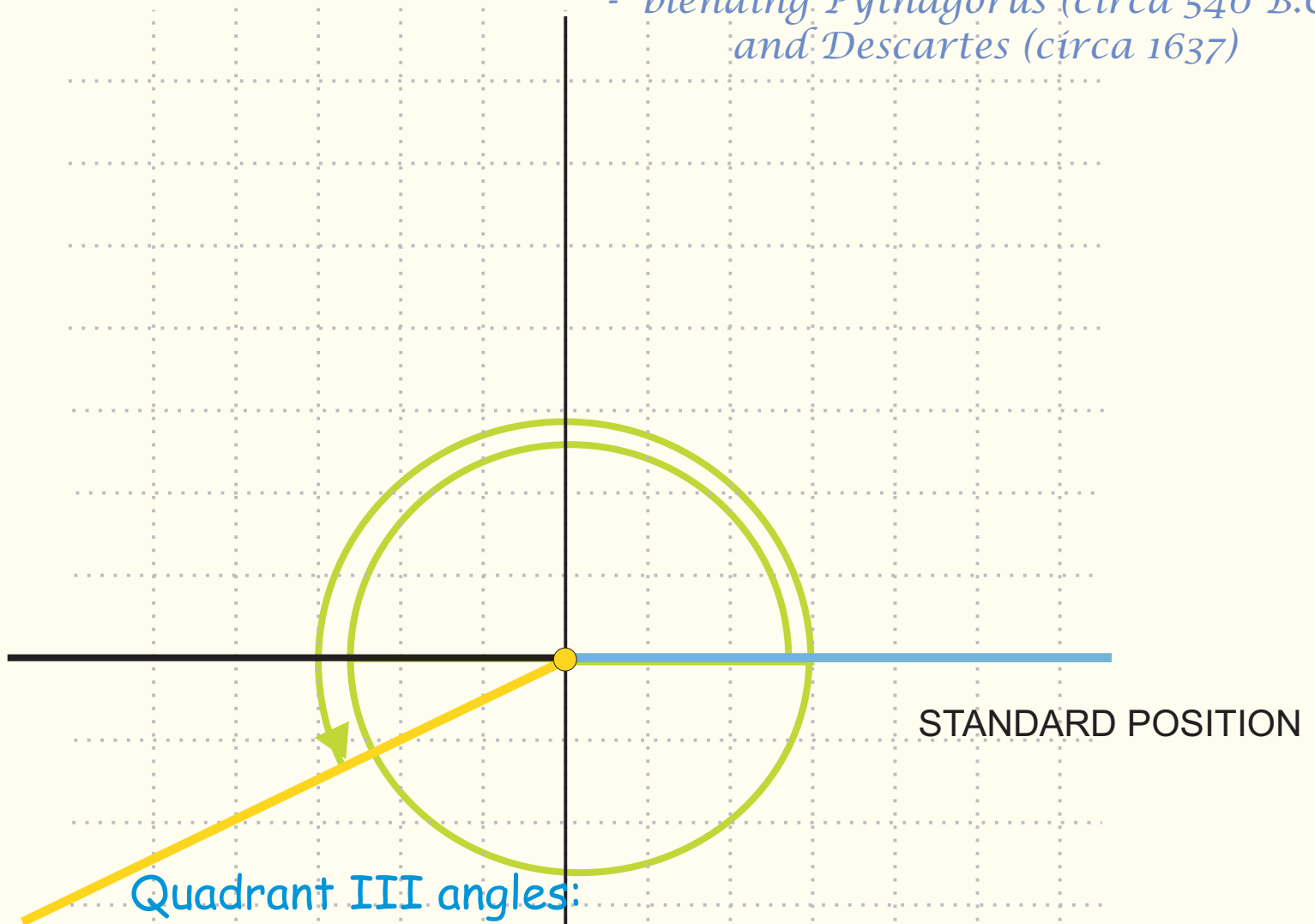
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*



THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*



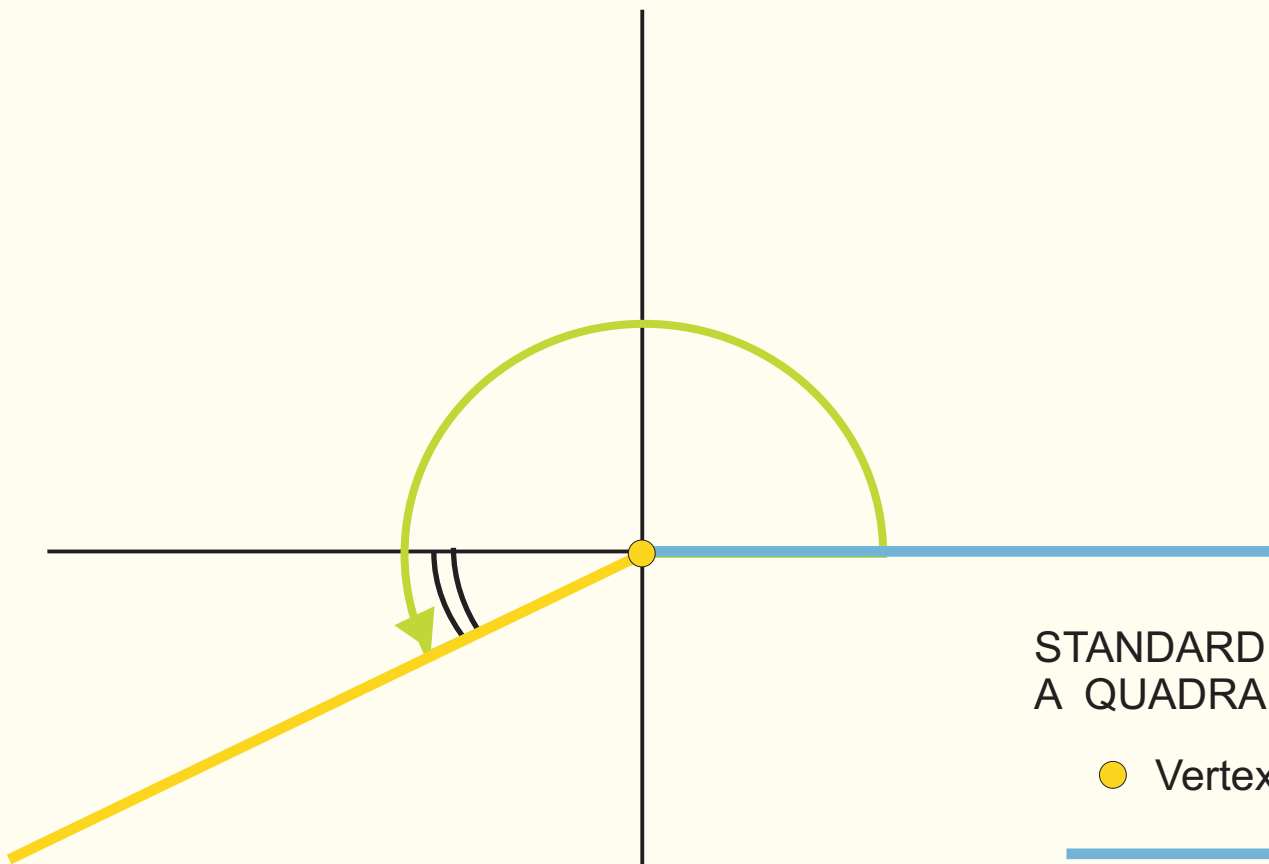
$$210 + 360 = 470 \text{ degrees, or } \frac{7}{6} + 2 = \frac{19}{6} \text{ radians,}$$

$$225 + 360 = 585 \text{ degrees, or } \frac{5}{4} + 2 = \frac{13}{4} \text{ radians,}$$

$$240 + 720 = 960 \text{ degrees, or } \frac{4}{3} + 4 = \frac{16}{3} \text{ radians.}$$

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*



STANDARD POSITION OF
A QUADRANT III ANGLE

● Vertex at origin

Initial arm
along positive x-axis

Terminal arm
lies in quadrant III

// Related angle
to

Definition:

Related angle to
is the acute angle
between its terminal arm
and the nearest extension
of the x-axis.

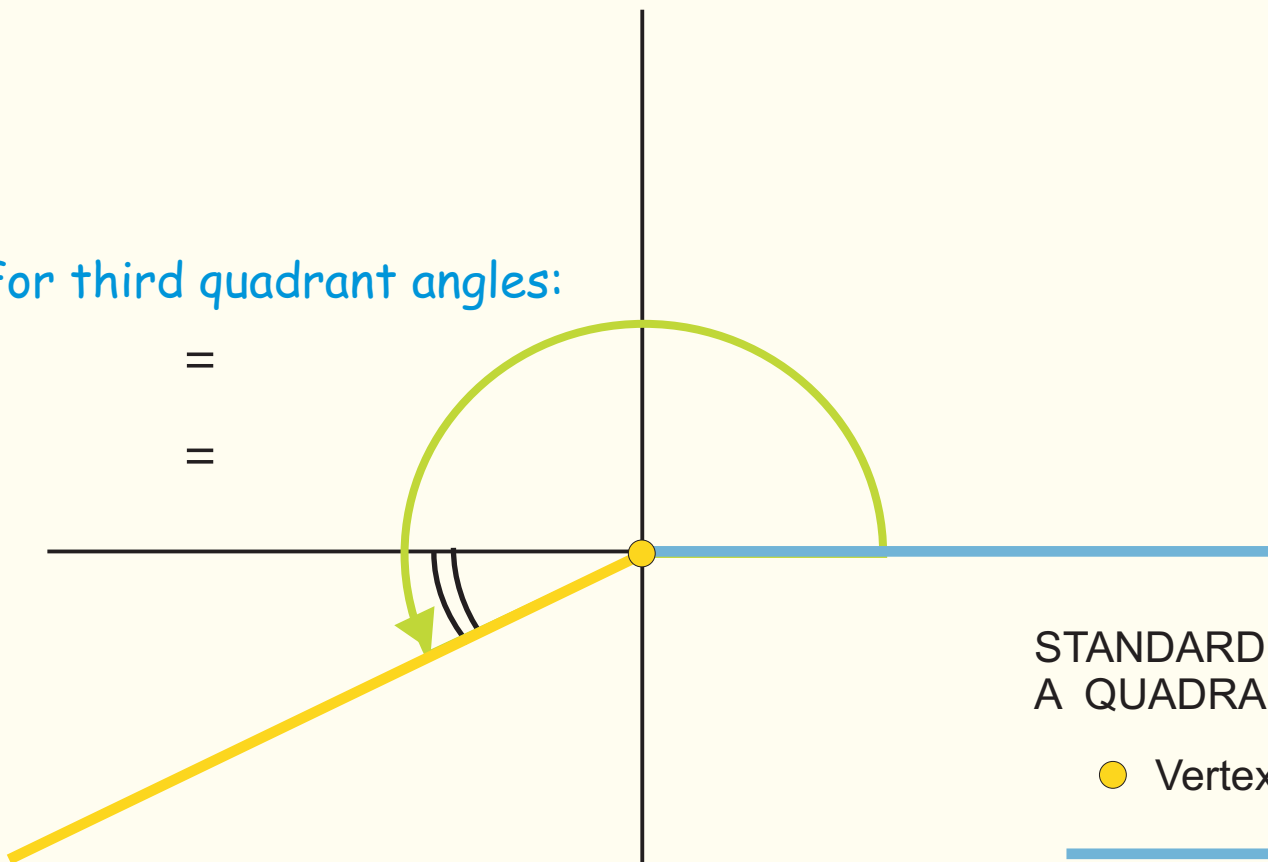
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

For third quadrant angles:

=

=



STANDARD POSITION OF
A QUADRANT III ANGLE

● Vertex at origin

Initial arm
along positive x-axis

Terminal arm
lies in quadrant III

// Related angle
to

Definition:

Related angle to
is the acute angle
between its terminal arm
and the nearest extension
of the x-axis.

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

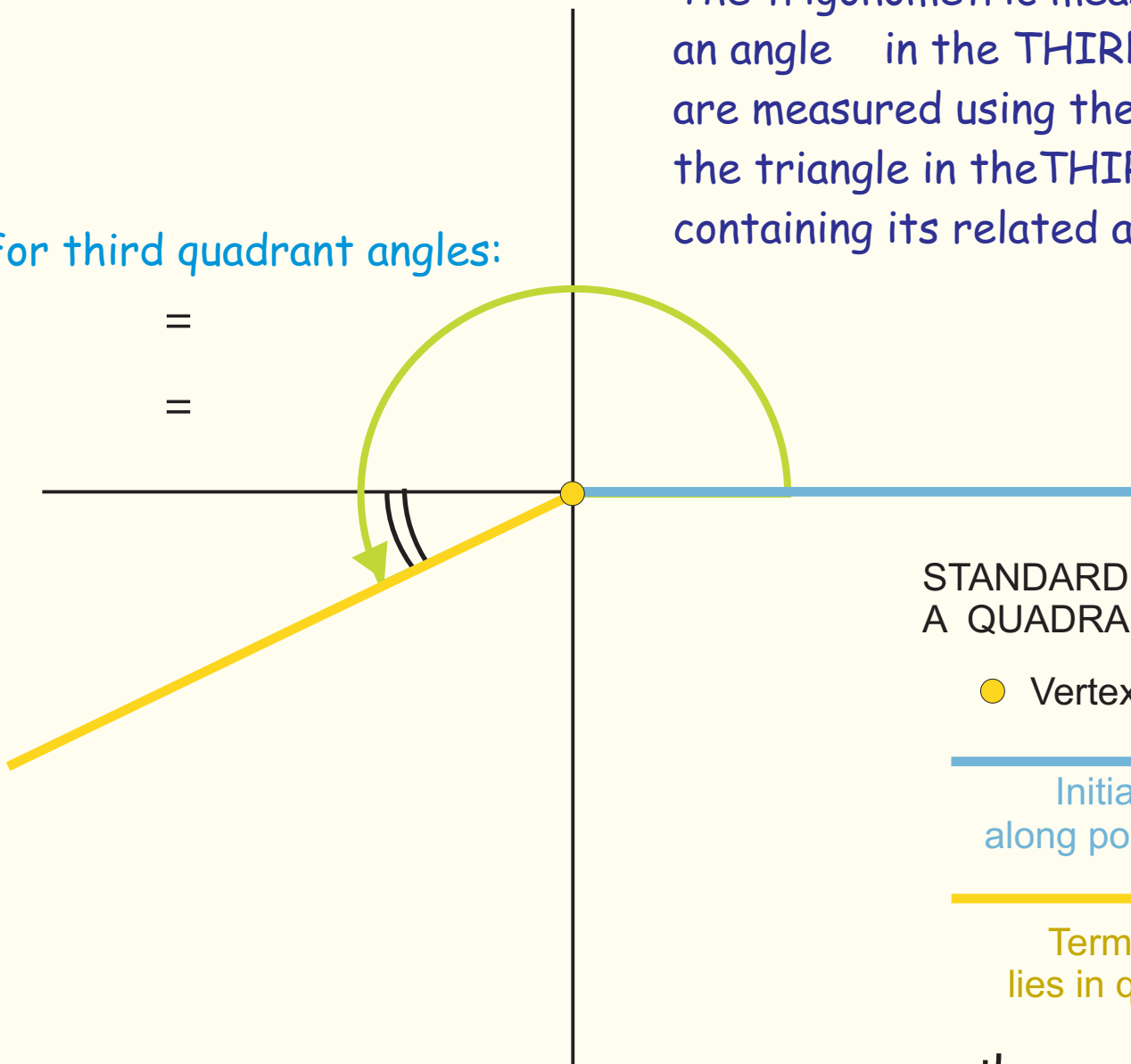
- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

The trigonometric measures of
an angle in the THIRD quadrant
are measured using the sides of
the triangle in the THIRD quadrant
containing its related angle.

For third quadrant angles:

=

=



STANDARD POSITION OF
A QUADRANT III ANGLE

● Vertex at origin

Initial arm
along positive x-axis

Terminal arm
lies in quadrant III

// Related angle
to

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

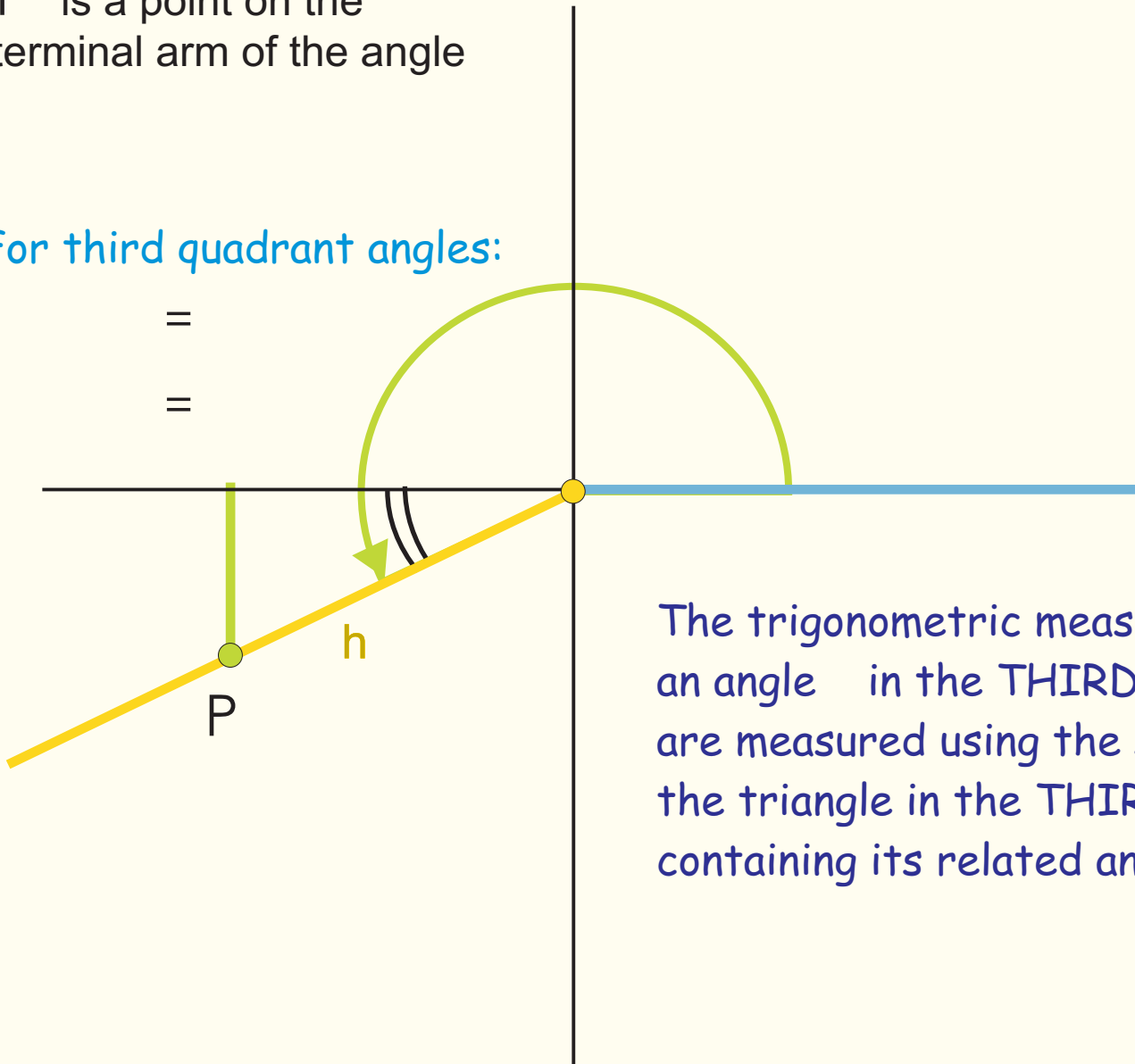
h = distance from P to the origin

P is a point on the
terminal arm of the angle

For third quadrant angles:

=

=



The trigonometric measures of
an angle in the THIRD quadrant
are measured using the sides of
the triangle in the THIRD quadrant
containing its related angle .

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

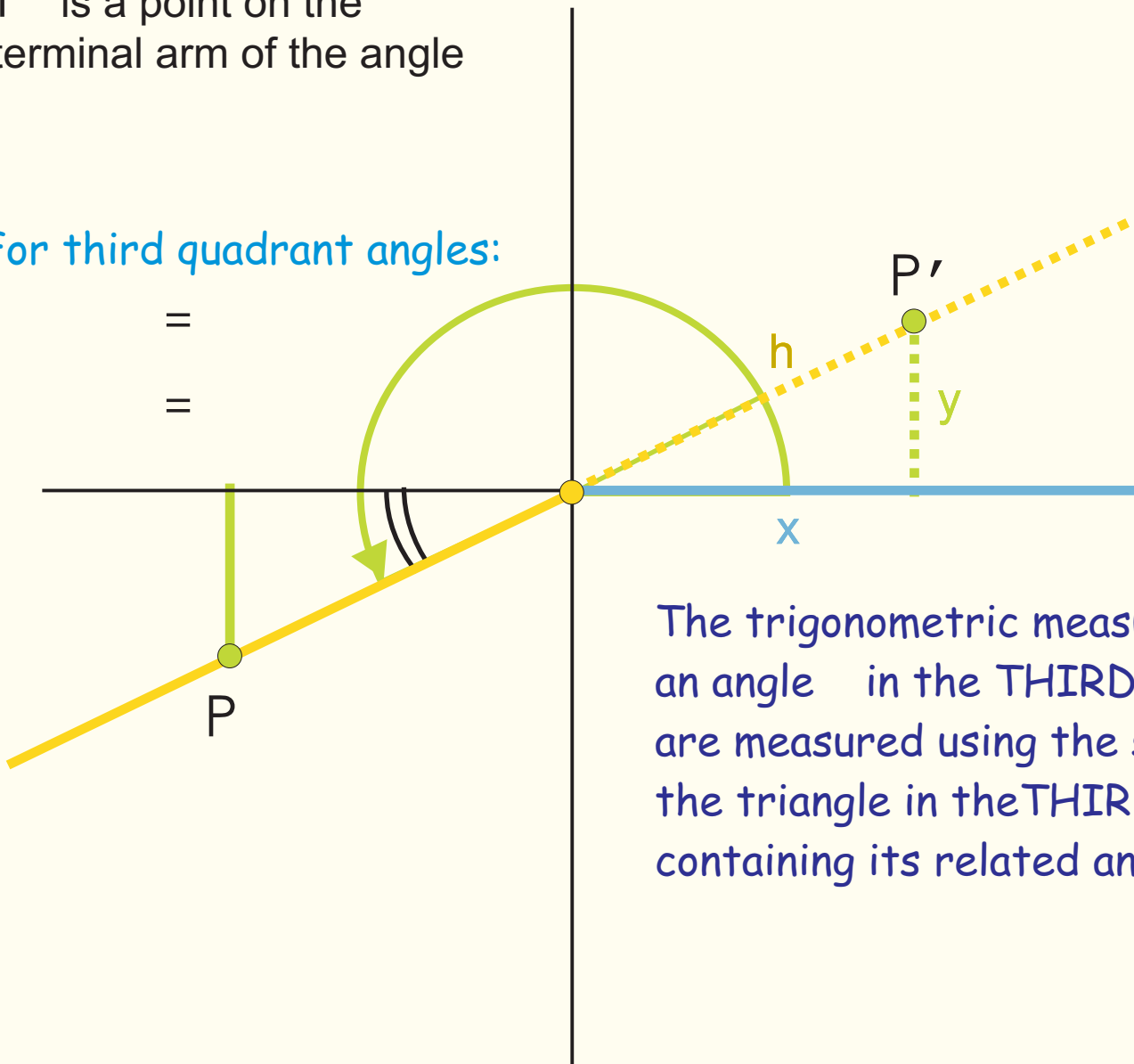
h = distance from P to the origin

P is a point on the
terminal arm of the angle

For third quadrant angles:

=

=



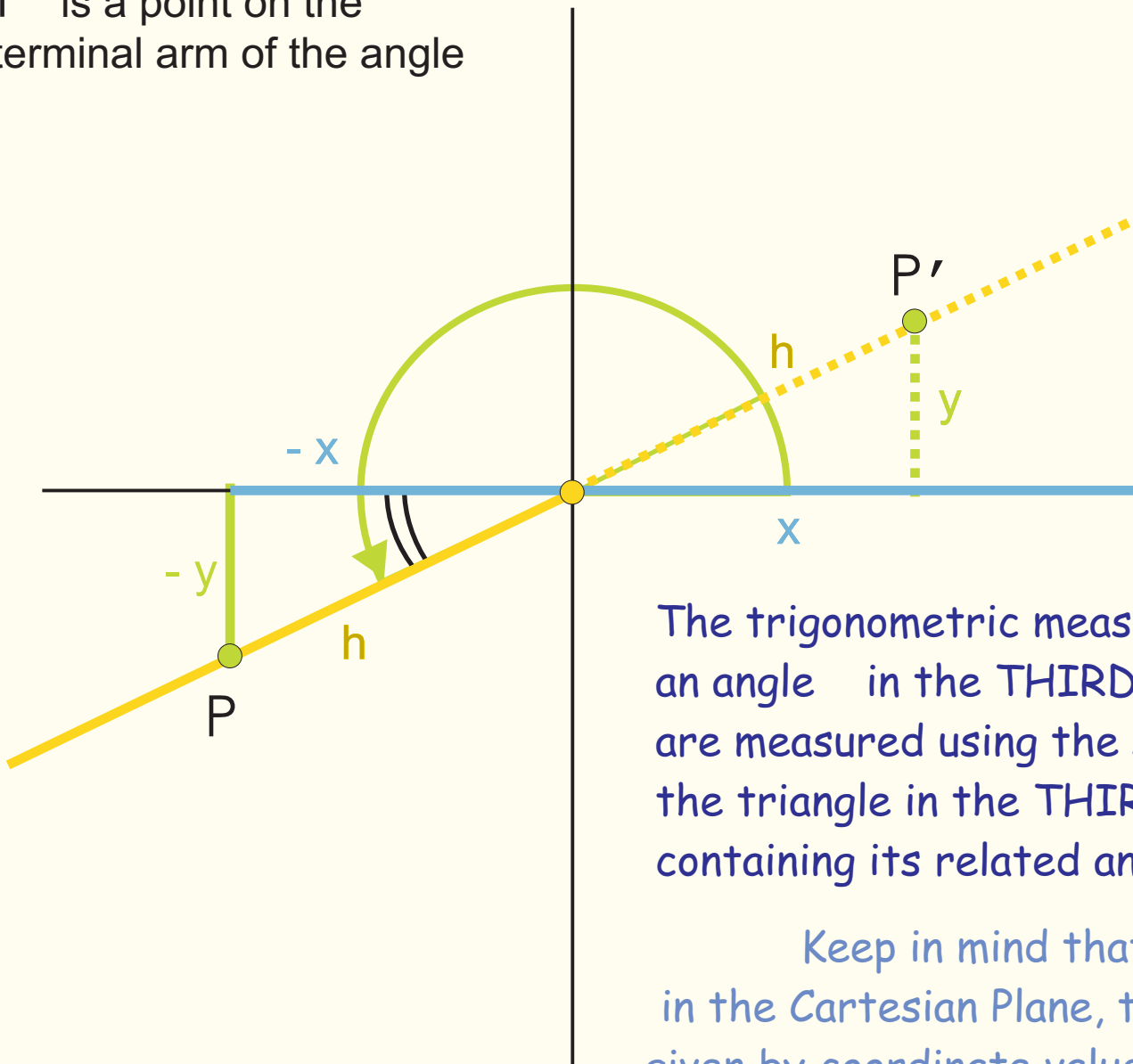
The trigonometric measures of
an angle in the THIRD quadrant
are measured using the sides of
the triangle in the THIRD quadrant
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THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
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h = distance from P to the origin

P is a point on the
terminal arm of the angle



The trigonometric measures of
an angle in the THIRD quadrant
are measured using the sides of
the triangle in the THIRD quadrant
containing its related angle .

Keep in mind that,
in the Cartesian Plane, the sides
given by coordinate values may be
either positive or negative.

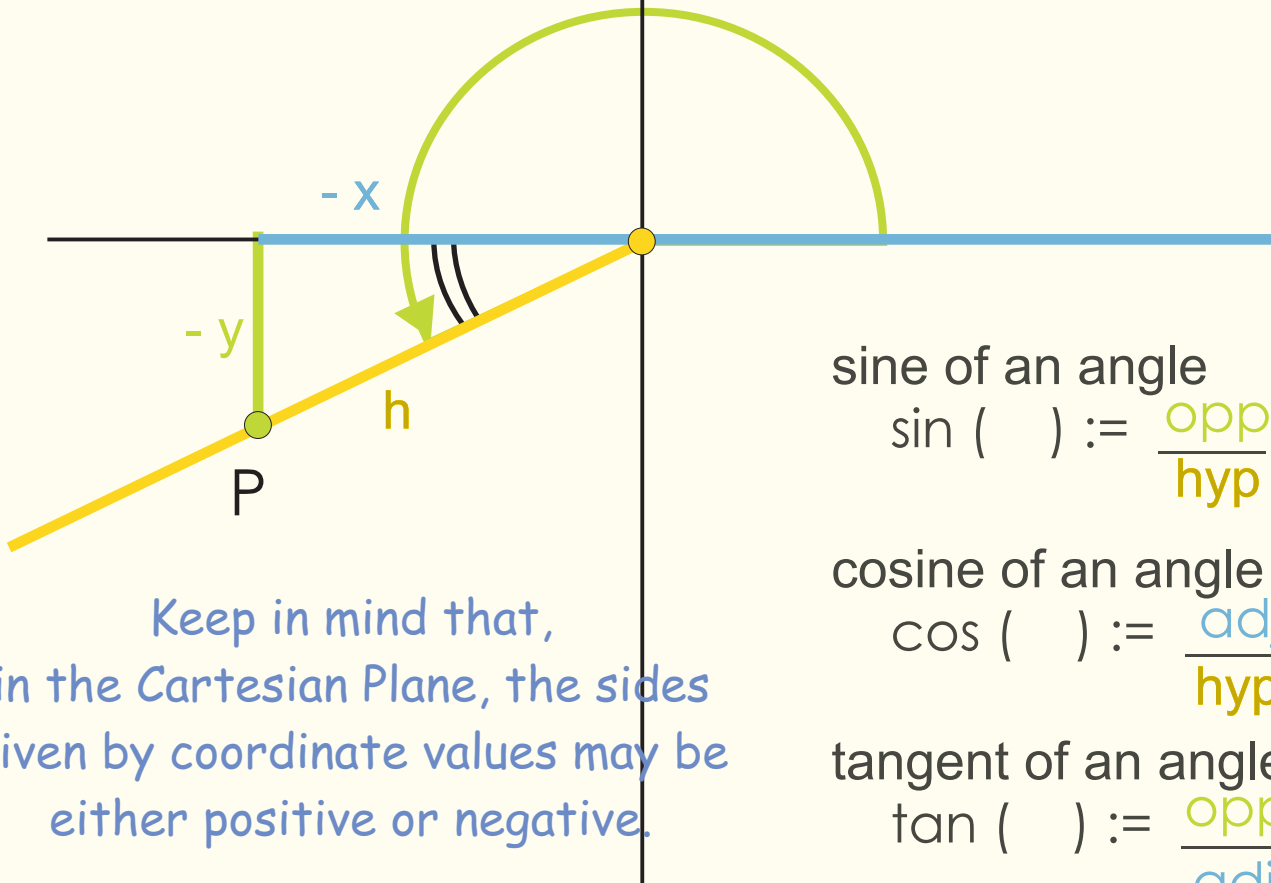
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

h = distance from P to the origin

P is a point on the
terminal arm of the angle

The trigonometric measures of
an angle in the THIRD quadrant
are measured using the sides of
the triangle in the THIRD quadrant
containing its related angle.



sine of an angle

$$\sin (\quad) := \frac{\text{opp}}{\text{hyp}}$$

cosine of an angle

$$\cos (\quad) := \frac{\text{adj}}{\text{hyp}}$$

tangent of an angle

$$\tan (\quad) := \frac{\text{opp}}{\text{adj}}$$

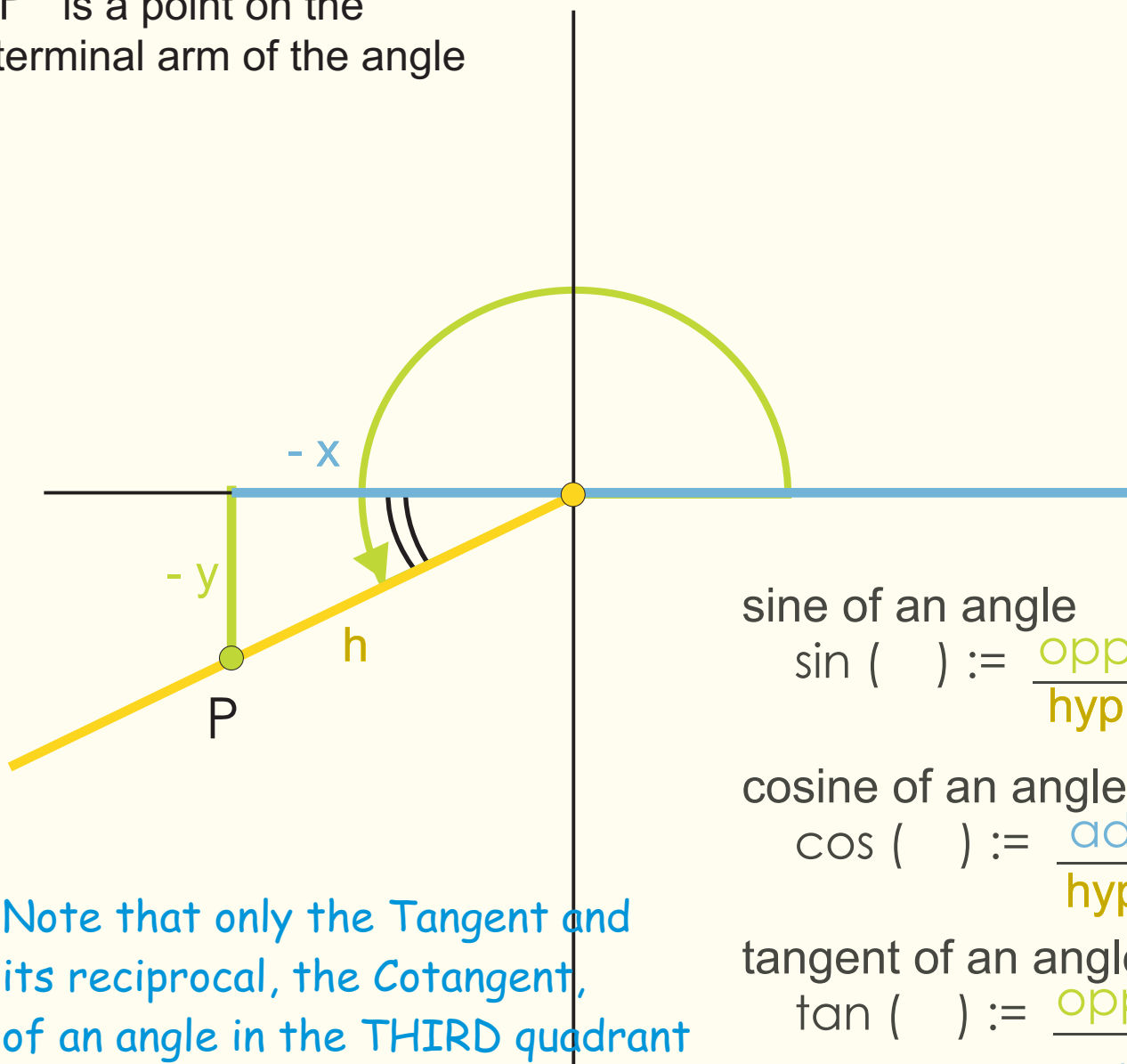
Keep in mind that,
in the Cartesian Plane, the sides
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THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

h = distance from P to the origin

P is a point on the
terminal arm of the angle



sine of an angle

$$\sin (\quad) := \frac{\text{opp}}{\text{hyp}} = \frac{-y}{h}$$

cosine of an angle

$$\cos (\quad) := \frac{\text{adj}}{\text{hyp}} = \frac{-x}{h}$$

tangent of an angle

$$\tan (\quad) := \frac{\text{opp}}{\text{adj}} = \frac{-y}{-x}$$

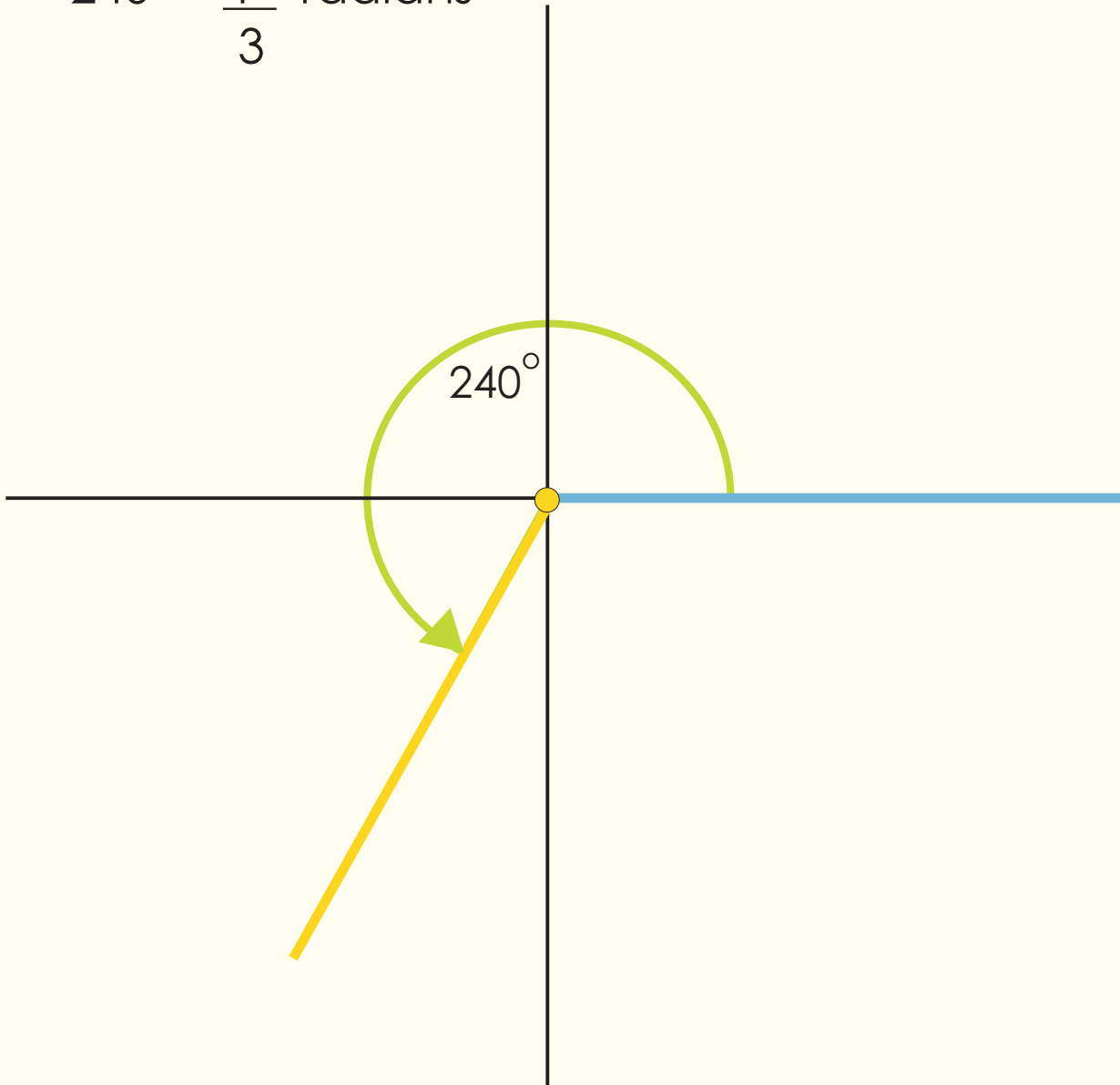
Note that only the Tangent and
its reciprocal, the Cotangent,
of an angle in the THIRD quadrant
have positive measures.

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

$$= 240^\circ = \frac{4}{3} \text{ radians}$$



Find the sine, cosine and tangent values of $\frac{4}{3}$ radians .

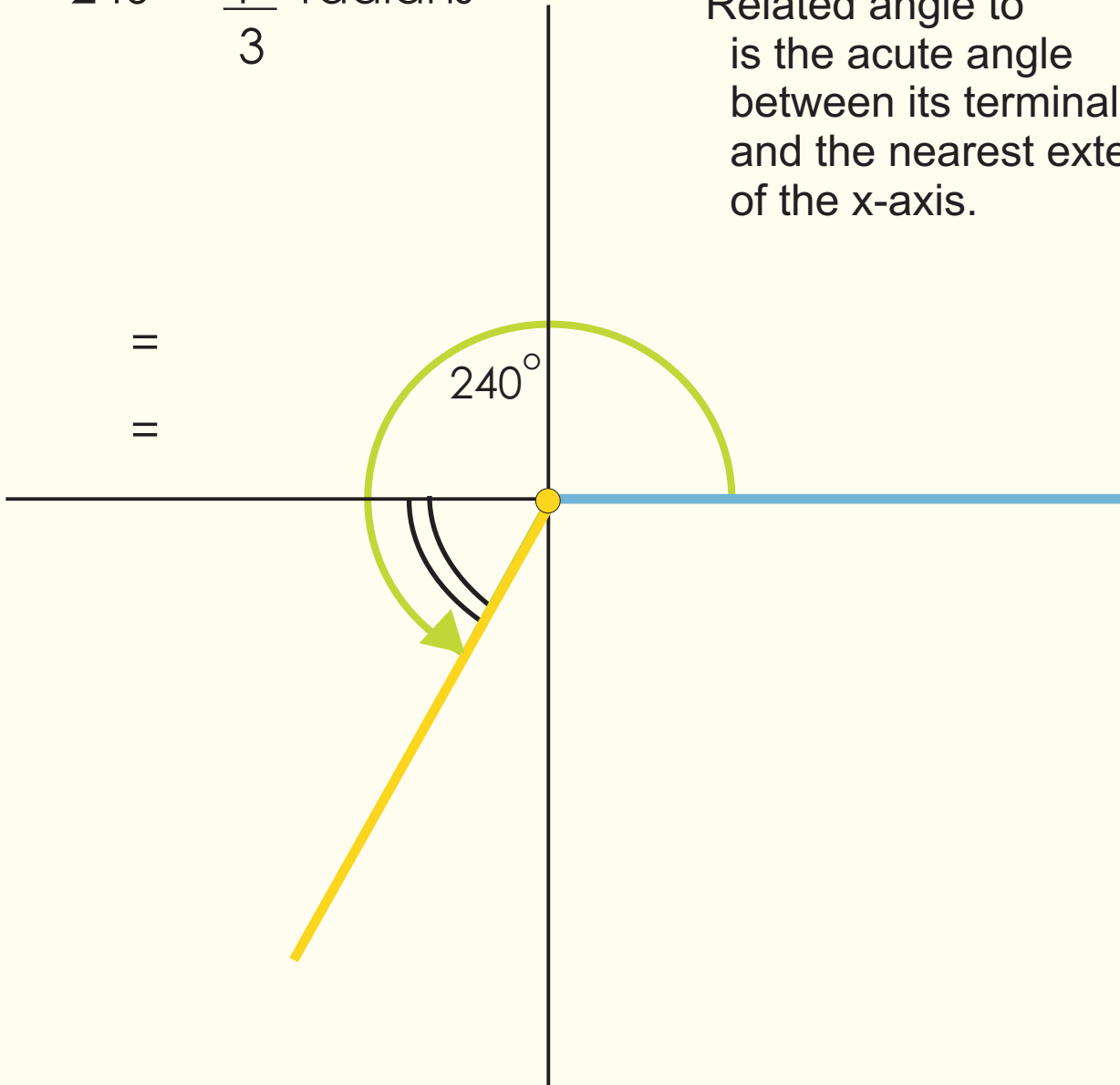
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

$$= 240^\circ = \frac{4}{3} \text{ radians}$$

Related angle to
is the acute angle
between its terminal arm
and the nearest extension
of the x-axis.



Find the sine, cosine and tangent values of $\frac{4}{3}$ radians .

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

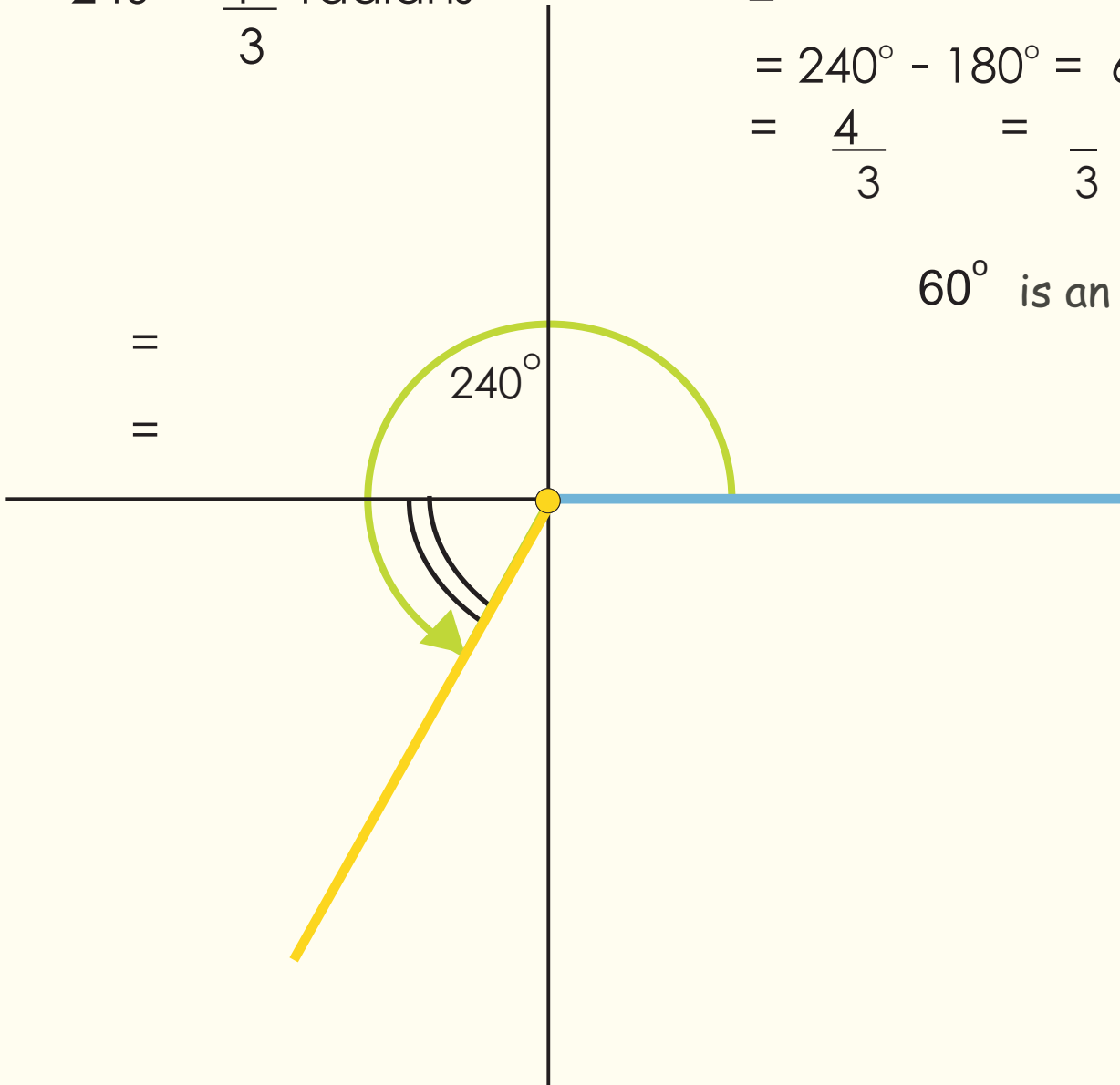
$$= 240^\circ = \frac{4}{3} \text{ radians}$$

=

$$= 240^\circ - 180^\circ = 60^\circ$$

$$= \frac{4}{3} = \frac{2}{3} \text{ radians}$$

60° is an acute angle.



Find the sine, cosine and tangent values of $\frac{4}{3}$ radians .

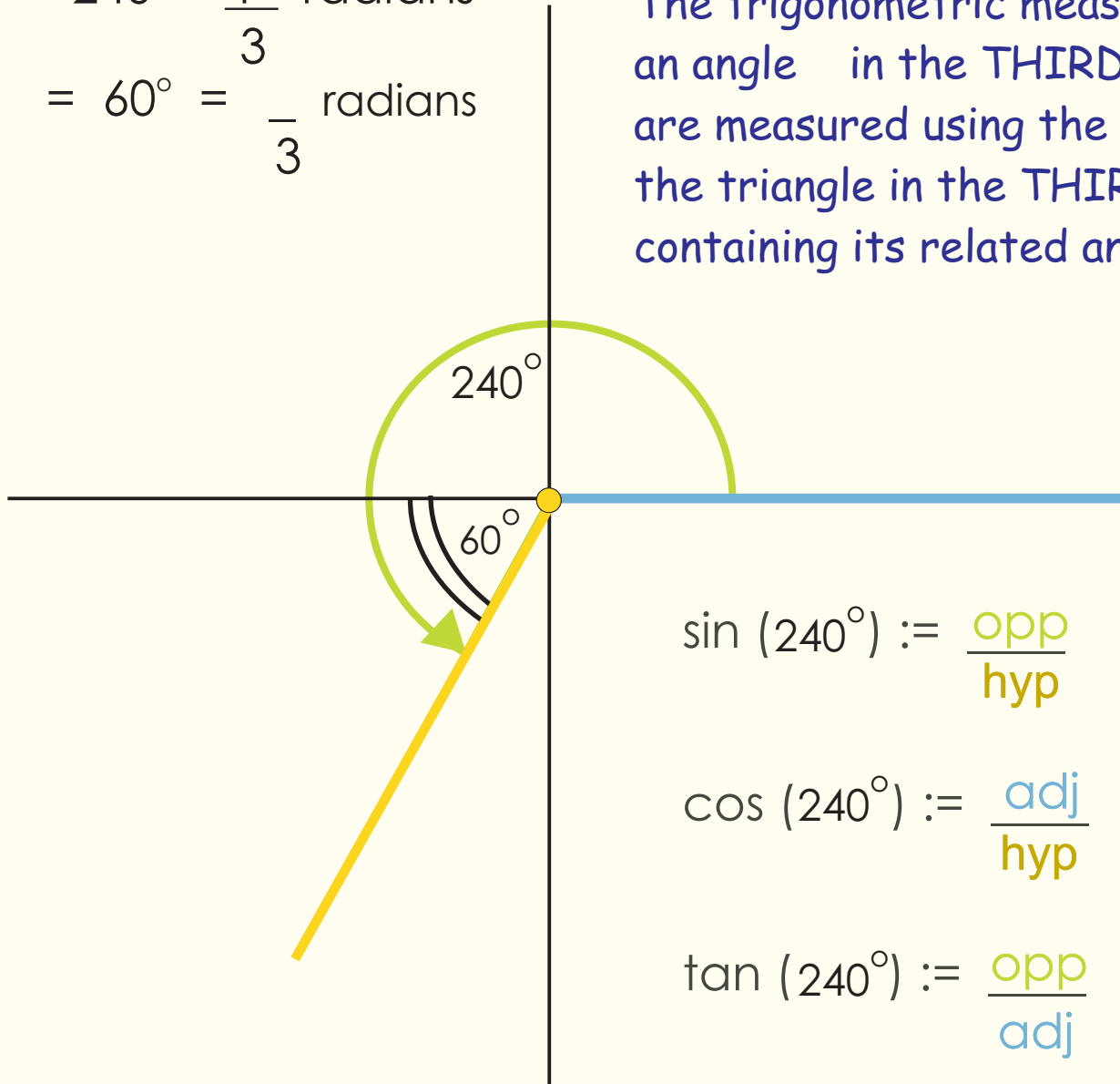
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

$$\begin{aligned} &= 240^\circ = \frac{4}{3} \text{ radians} \\ &= 60^\circ = \frac{\pi}{3} \text{ radians} \end{aligned}$$

The trigonometric measures of an angle in the THIRD quadrant are measured using the sides of the triangle in the THIRD quadrant containing its related angle.



$$\sin (240^\circ) := \frac{\text{opp}}{\text{hyp}}$$

$$\cos (240^\circ) := \frac{\text{adj}}{\text{hyp}}$$

$$\tan (240^\circ) := \frac{\text{opp}}{\text{adj}}$$

THE TRIGONOMETRIC MEASURES OF 240°

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

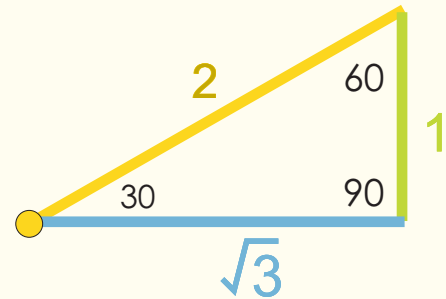
- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

$$= 240^\circ = \frac{4}{3} \text{ radians}$$

h = distance from P to the origin

P is a point on the
terminal arm of the angle

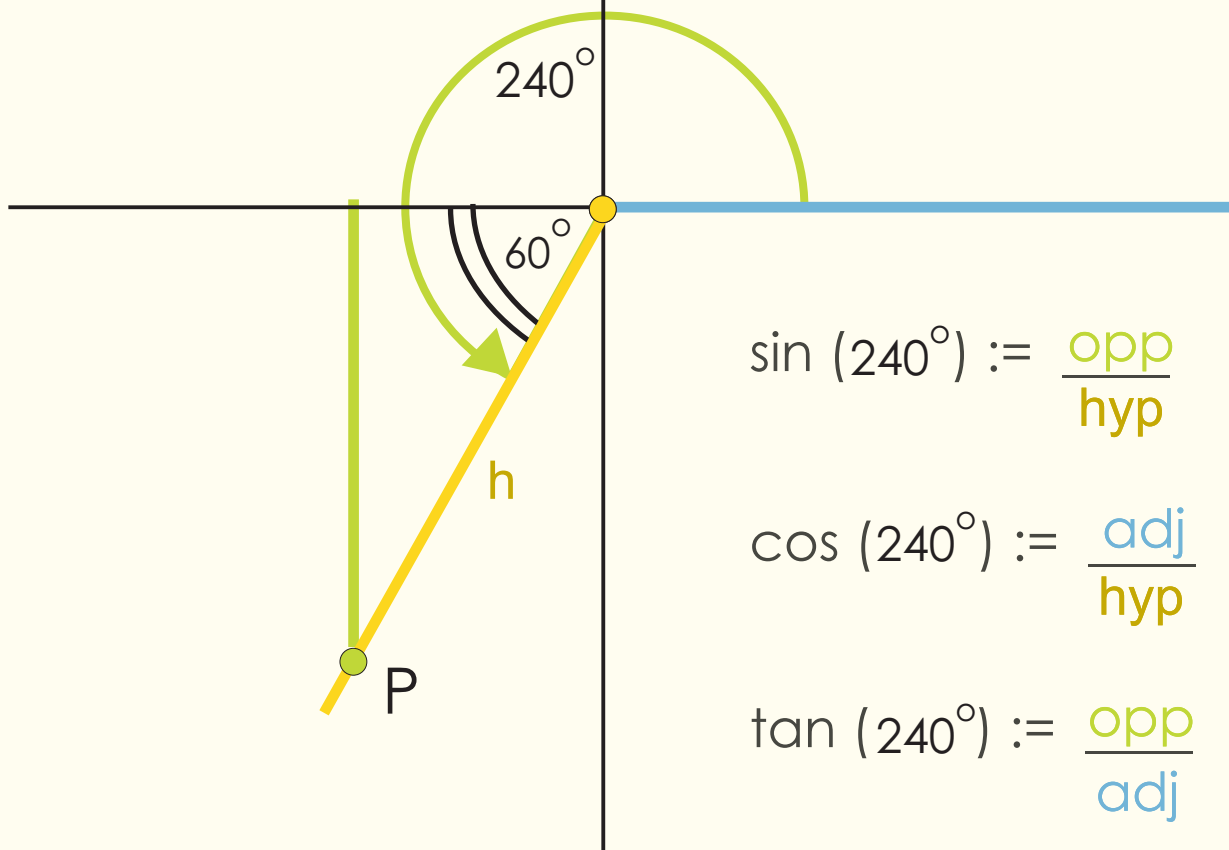


60°

hyp = 2

opp = $\sqrt{3}$

adj = 1



$$\sin (240^\circ) := \frac{\text{opp}}{\text{hyp}}$$

$$\cos (240^\circ) := \frac{\text{adj}}{\text{hyp}}$$

$$\tan (240^\circ) := \frac{\text{opp}}{\text{adj}}$$

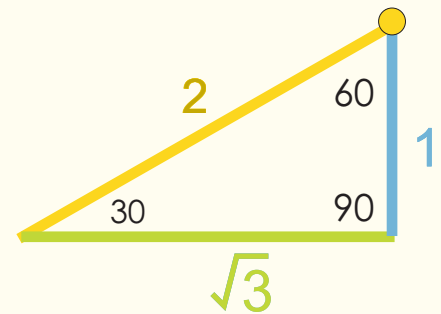
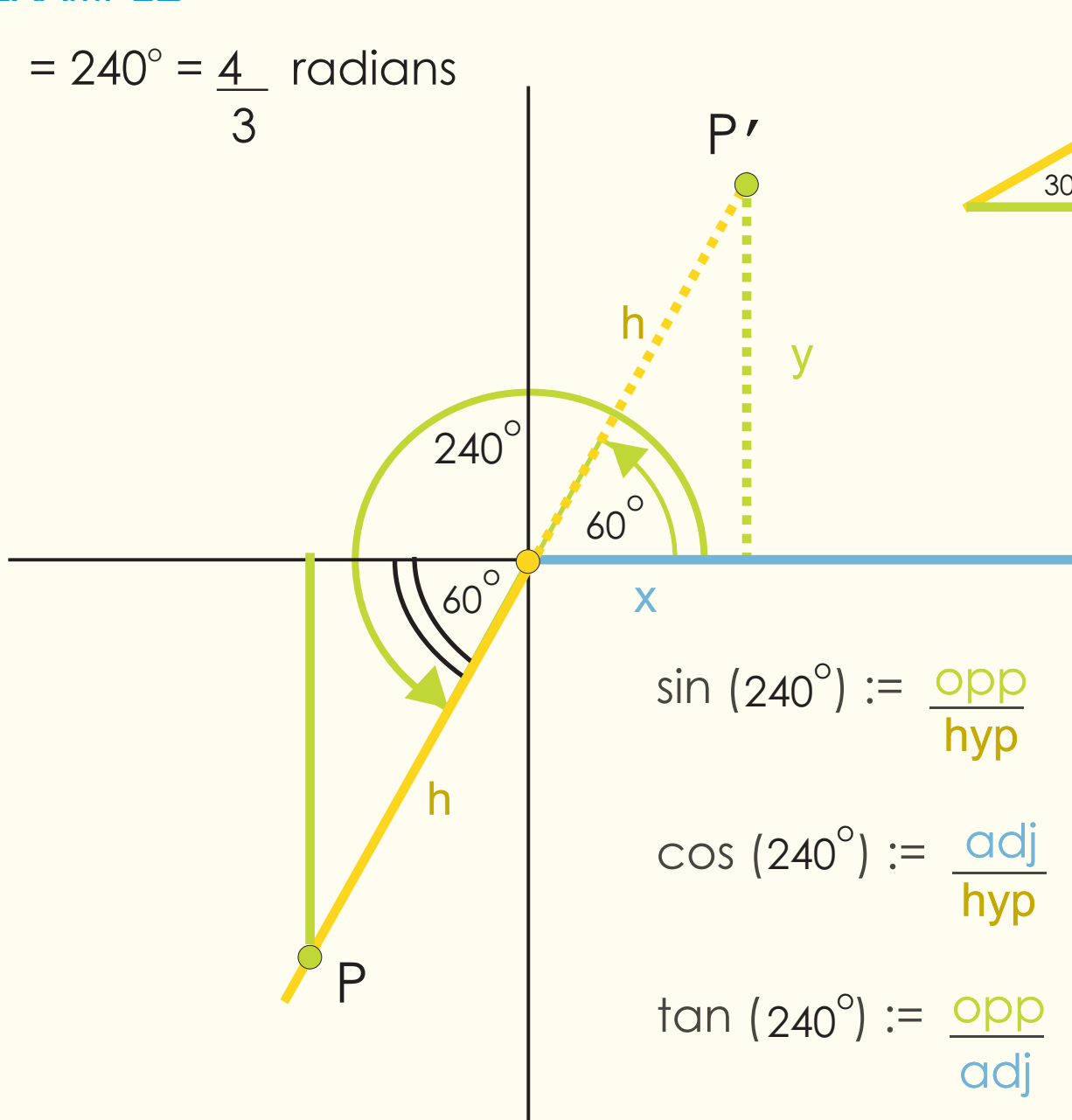
THE TRIGONOMETRIC MEASURES OF 240°

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

$$= 240^\circ = \frac{4}{3} \text{ radians}$$



$$\begin{aligned} 60^\circ \\ \text{hyp} &= 2 \\ \text{opp} &= \sqrt{3} \\ \text{adj} &= 1 \end{aligned}$$

$$\sin (240^\circ) := \frac{\text{opp}}{\text{hyp}}$$

$$\cos (240^\circ) := \frac{\text{adj}}{\text{hyp}}$$

$$\tan (240^\circ) := \frac{\text{opp}}{\text{adj}}$$

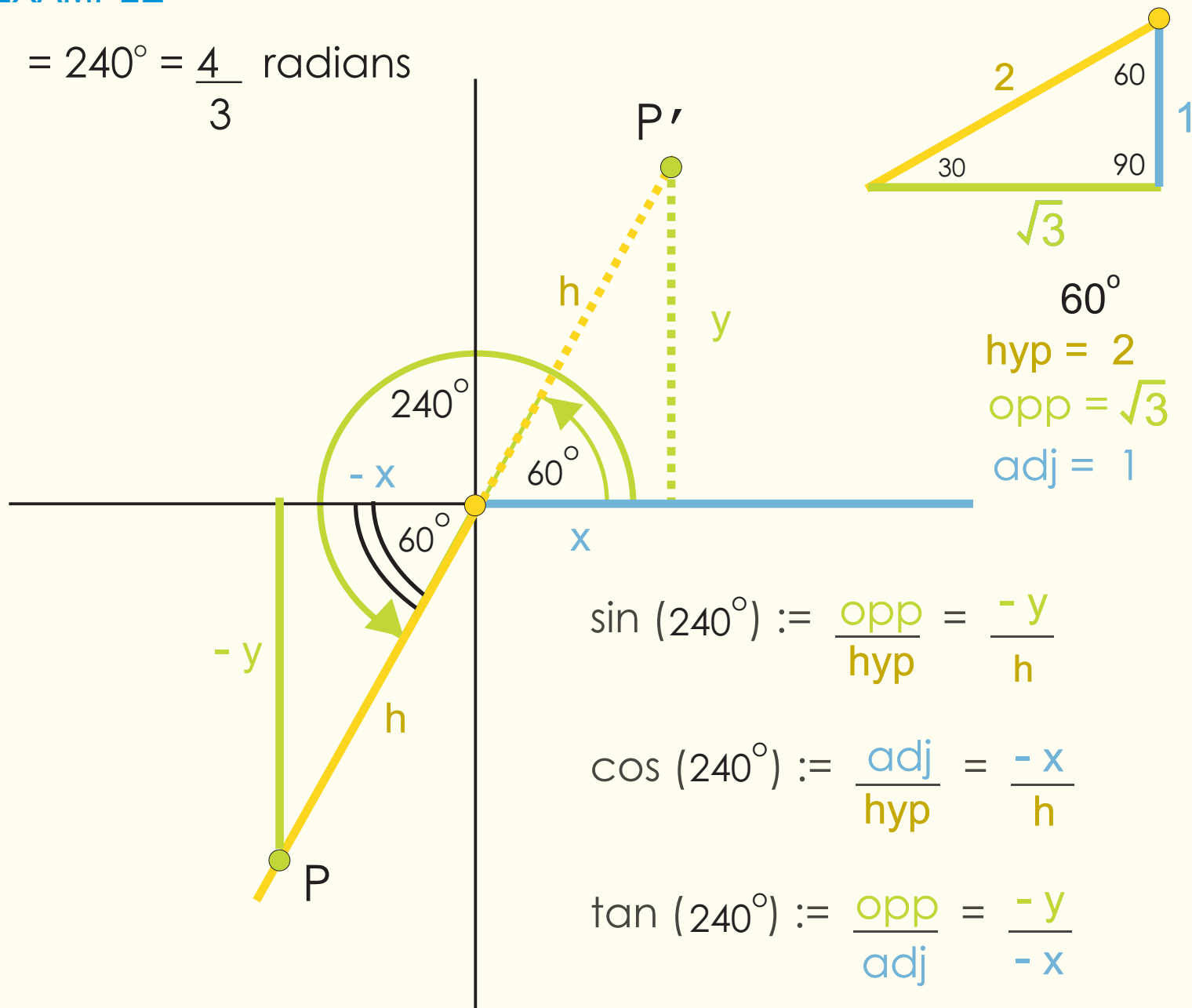
THE TRIGONOMETRIC MEASURES OF 240°

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
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EXAMPLE

$$= 240^\circ = \frac{4}{3} \text{ radians}$$



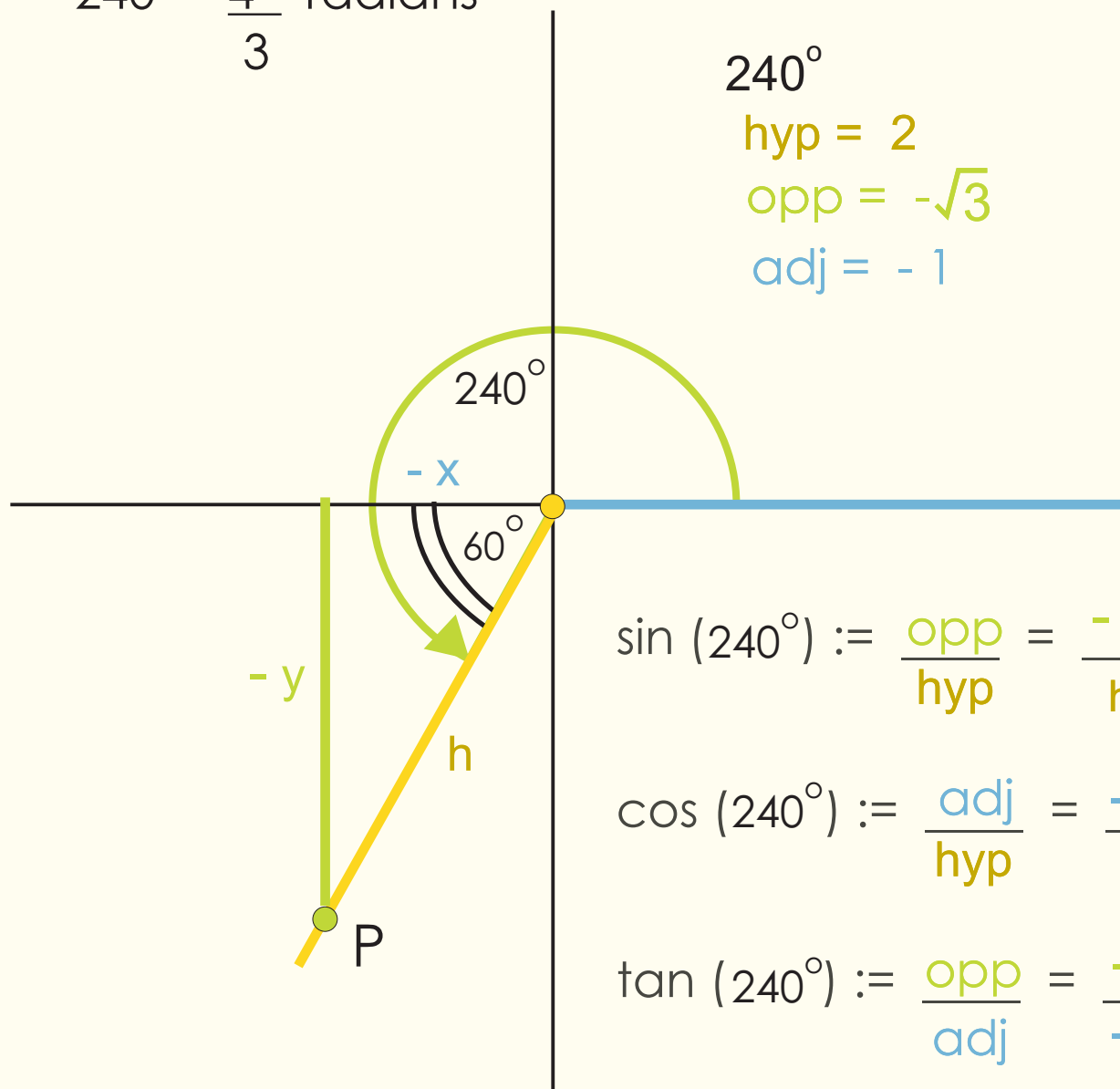
THE TRIGONOMETRIC MEASURES OF 240°

THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

$$= 240^\circ = \frac{4}{3} \text{ radians}$$



$$240^\circ$$

$$\text{hyp} = 2$$

$$\text{opp} = -\sqrt{3}$$

$$\text{adj} = -1$$

$$60^\circ$$

$$\text{hyp} = 2$$

$$\text{opp} = \sqrt{3}$$

$$\text{adj} = 1$$

$$\sin (240^\circ) := \frac{\text{opp}}{\text{hyp}} = \frac{-y}{h} = \frac{-\sqrt{3}}{2}$$

$$\cos (240^\circ) := \frac{\text{adj}}{\text{hyp}} = \frac{-x}{h} = \frac{-1}{2}$$

$$\tan (240^\circ) := \frac{\text{opp}}{\text{adj}} = \frac{-y}{-x} = \frac{-\sqrt{3}}{-1}$$

THE TRIGONOMETRIC MEASURES OF 240°

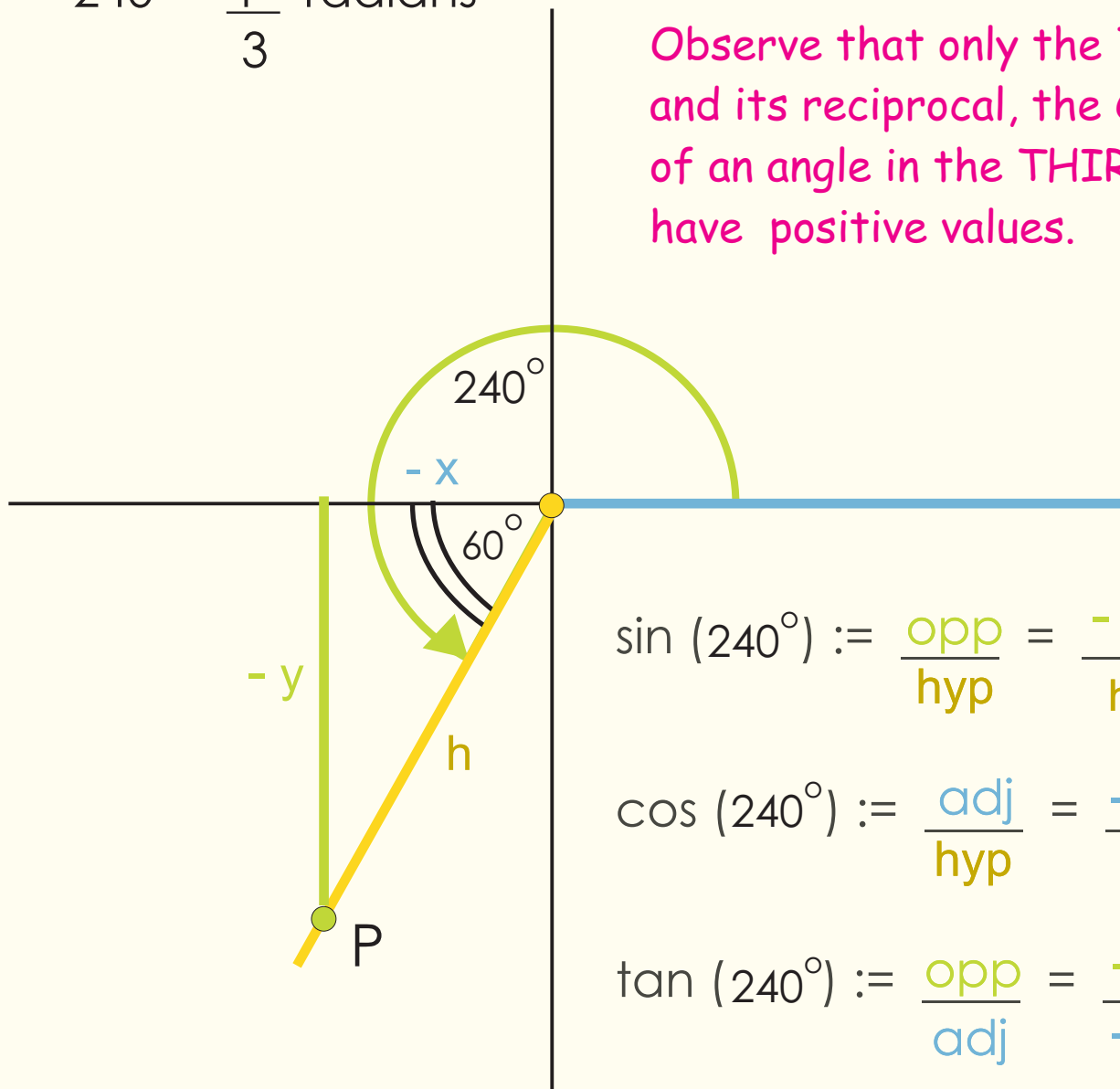
THE TRIGONOMETRY OF ANGLES IN QUADRANT III

- *blending Pythagorus (circa 540 B.C.)
and Descartes (circa 1637)*

EXAMPLE

$$= 240^\circ = \frac{4}{3} \text{ radians}$$

Observe that only the Tangent, and its reciprocal, the Cotangent, of an angle in the THIRD quadrant have positive values.



$$\sin (240^\circ) := \frac{\text{opp}}{\text{hyp}} = \frac{-y}{h} = \frac{-\sqrt{3}}{2}$$

$$\cos (240^\circ) := \frac{\text{adj}}{\text{hyp}} = \frac{-x}{h} = \frac{-1}{2}$$

$$\tan (240^\circ) := \frac{\text{opp}}{\text{adj}} = \frac{-y}{-x} = \frac{-\sqrt{3}}{-1}$$

THE TRIGONOMETRIC MEASURES OF 240°

QUADRANT II

$\sin (\)$ positive
 $\cos (\)$ negative
 $\tan (\)$ negative

QUADRANT I

$\sin (\)$ positive
 $\cos (\)$ positive
 $\tan (\)$ positive

$\sin (\)$ negative
 $\cos (\)$ negative
 $\tan (\)$ positive

QUADRANT III

QUADRANT IV

