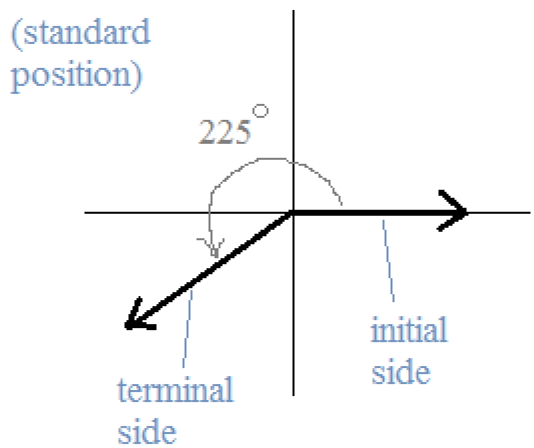
Trigonometry:

Angle Measurement

Notes, Examples, Practice Quiz, and Puzzle (with Solutions)



Includes coterminal and reference angles, Degrees/Minutes/Seconds, angle vs. linear speed, radians, and more.

Mathplane.com

Degrees/Minutes/Seconds Measurement of Angles

Circle: 360° (360 degrees)

1 degree = 60' (60 minutes)

1 minute = 60'' (60 seconds)

Angle measurements are not always whole numbers.

For example: when you bisect a 45° angle, what is the measure of the resulting angles?

$$\frac{45^\circ}{2} = ?$$

The solution contains a 'fractional degree'..

It can be expressed in 'decimal form' 22.5°
Or,
It can be expressed in 'DMS form' $22^\circ\ 30'$

Degrees/Minutes/Seconds (DMS) Form

Angle measurements can be expressed using standard divisions of a degree.

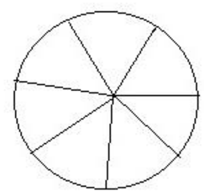
1 degree = 60 minutes $1^\circ = 60'$

1 minute = 60 seconds $1' = 60''$

Then, 1 degree = 3600 seconds $1^\circ = 3600''$

Example: Suppose you divide a circle into 7 equal parts. What is the measure of each angle?

$$\frac{360^\circ}{7} = \boxed{51.429^\circ}$$ Decimal Form (rounded to 3 decimal places)



$$51.429^\circ = 51^\circ + .429^\circ \times \frac{60'}{1^\circ}$$

$$= 51^\circ + 25.74'$$

$$= 51^\circ + 25' + .74' \times \frac{60''}{1'}$$

$$= \boxed{51^\circ + 25' + 44.4''}$$ DMS Form

Example: Write $72^\circ 15' 23''$ in Decimal Form (rounded to 3 places)

$72^\circ 15' 23''$

$$72^\circ + \frac{15^\circ}{60} + \frac{23^\circ}{3600}$$

$$72^\circ + .25^\circ + .006^\circ$$

approximately 72.256°

$72^\circ = 72^\circ$

$15' \cdot \frac{1^\circ}{60'} = .25^\circ$

$23'' \cdot \frac{1^\circ}{3600} = .006^\circ$

72.256° total

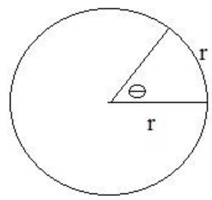
Radian Measurement of Angles

What is a Radian?

Formal Definition: Measure on an angle with vertex at the center of a circle that subtends an arc equal to the radius of the circle.

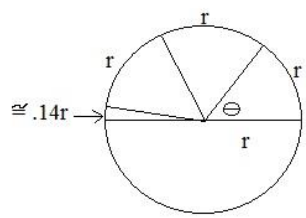
What does that mean?

If you take the radius of the circle and lay it on the circle, the angle formed by that arc is ONE RADIAN.



$180^\circ = \pi$ radians

(In other words, if you laid the radius around the circle, it would take approx. 3.14 radii to cover half of the circle..)



It follows that the degree measure of an angle that is 1 radian would be

$$\frac{180^\circ}{\pi} \cong 57.3^\circ$$

Converting Radians/Degrees

$$180^\circ = \pi \text{ radians} \Longrightarrow \frac{180^\circ}{\pi \text{ radians}} = 1 = \frac{\pi \text{ radians}}{180^\circ}$$

Examples:

Degrees ---> Radians

$$60^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{\pi}{3} \text{ radians (rad)}$$

$$360^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = 2\pi \text{ radians}$$

$$147^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} \cong 0.817\,\pi \text{ radians}$$

$$\cong 0.817 \cdot (3.14) \text{ radians}$$

approximately 2.56 radians

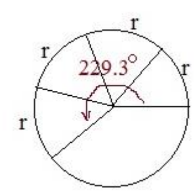
Radians ---> Degrees

$$\frac{\pi}{2} \text{ radians} \cdot \frac{180^\circ}{\pi \text{ radians}} = 90^\circ$$

$$\frac{7\pi}{3} \text{ rad} \cdot \frac{180^\circ}{\pi \text{ radians}} = 420^\circ$$

$$4 \text{ radians} \cdot \frac{180^\circ}{\pi \text{ radians}} = \frac{720^\circ}{\pi} = \frac{720^\circ}{3.14}$$

$$\cong 229.3^\circ$$



(r = length of radius)

Angular vs. Linear Speed

Example: A bicycle wheel spins at a rate of 400 rotations/minute.
If the diameter of the wheel is 26",

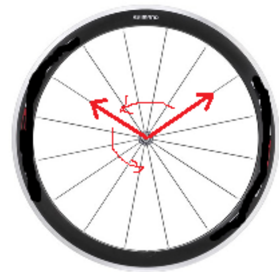
a) what is the *angular* speed?

b) what is the *linear* speed?

a) Angular speed describes the amount of distance covered in terms of *angles* and time.

If a bicycle wheel (or any circle) goes around once, the angular distance is 360° or 2π radians

So, if the bicycle wheel rotates 400 times, the angular distance is $400 \cdot 360^\circ$



$= 144{,}000$ degrees/minute
or
$= 800\pi$ radians/minute
approx. 2513 radians/minute

b) Linear speed describes the distance covered by a point on the circumference path of the rotating item.

Suppose a little person went around the bicycle wheel one time. He would travel the circumference of the wheel:

circumference = 2π radius or π diameter

Since the wheel's circumference is $\pi \times 26$ inches = 81.68 inches,

the linear distance of 400 trips around would be $400(\pi \times 26 \text{ inches})$ = 32,672 inches

Therefore, the linear speed of the wheel is approximately 32,672 inches/minute
or 2723 feet/minute

Now, suppose we measure the angular and linear speed of the bicycle rim.
Again, the wheel spins at a rate of 400 rotations/minute.
If the radius of the rim is 11 inches (diameter is 22 inches), then

a) what is the angular speed?

b) what is the linear speed?

a) Since the number of rotations/minute is the same, the angular speed is the same!

$$360 \frac{\text{degrees}}{\text{rotation}} \times 400 \frac{\text{rotations}}{\text{minute}} = 144{,}000 \frac{\text{degrees}}{\text{minute}}$$

b) $$\text{linear speed} = \frac{\text{distance traveled}}{\text{time}}$$

$$= \frac{400 \text{ rotations} \cdot 22\pi \text{ inches/rotation}}{1 \text{ minute}} = 27{,}645 \text{ inches/minute} \quad \text{or } 2304 \text{ feet/minute}$$

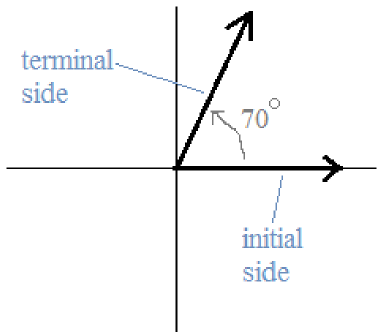
(approximately)

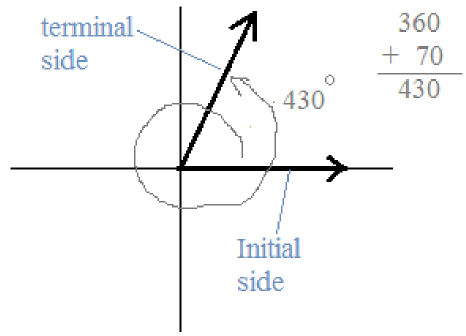
Coterminal vs. Reference Angles

Coterminal Angles: Angles that share the same terminal side (when drawn in standard position)

Examples:

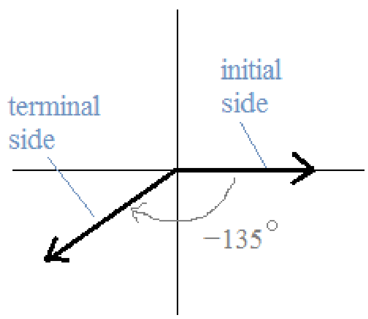
70 degree and 430 degree angles are coterminal

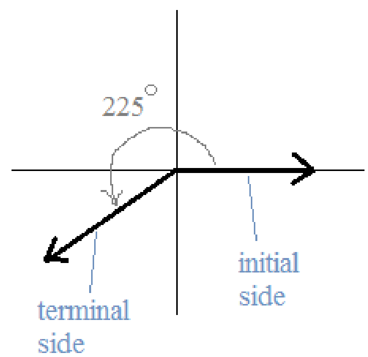




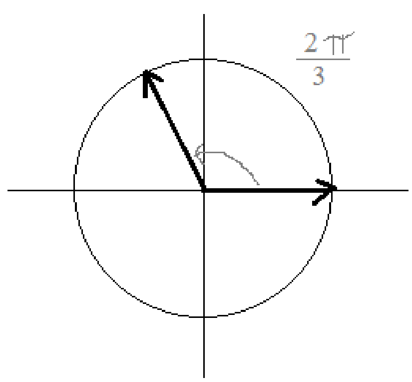
-135 degree and 225 degree angles are coterminal

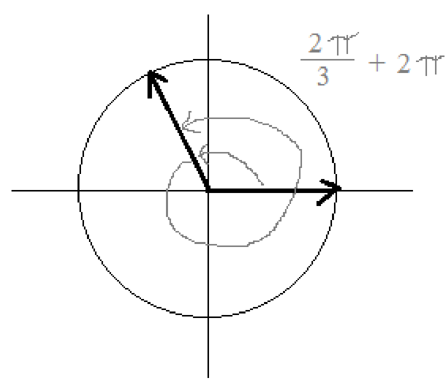
note: $-135^{\circ} + 360^{\circ} = 225^{\circ}$





If the angle is measured in radians, adding or subtracting 2π will reveal coterminal angles

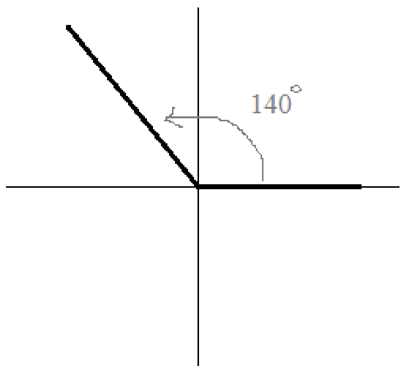




Coterminal vs. Reference Angles

Question: Can you identify one *positive* and one *negative* coterminal angle to 140 degrees?

Here is a 140° angle in *standard position:*



**To find coterminal angles, add/subtract 360°

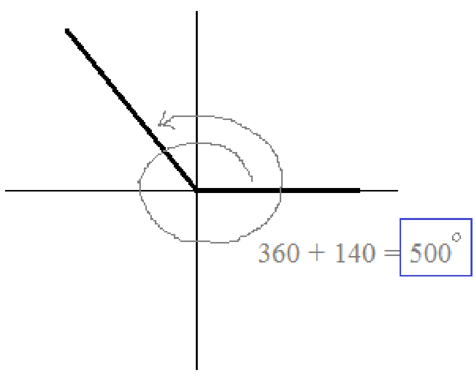
$140^\circ, 500^\circ, 860^\circ, \ldots$

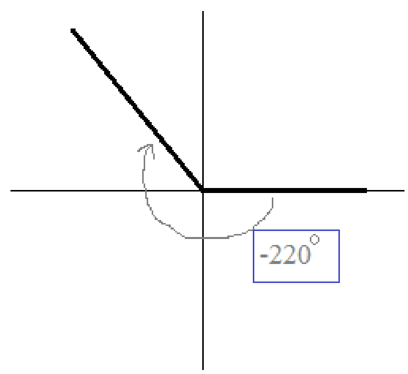
360 360

$\ldots -580^\circ, -220^\circ, 140^\circ$

360 360

So, one positive coterminal angle to 140° is 500° and one negative coterminal angle to 140° is -220°





Question: Are 217° and -143° coterminal angles?

Since -143 + 360 = 217, these are coterminal angles..

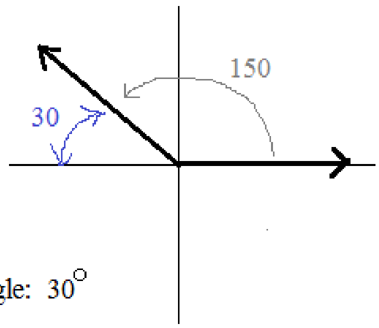
Question: What are all the coterminal angles to -20° ?

One way to express the answer: $340^\circ + 360^\circ n$, where n is any integer...

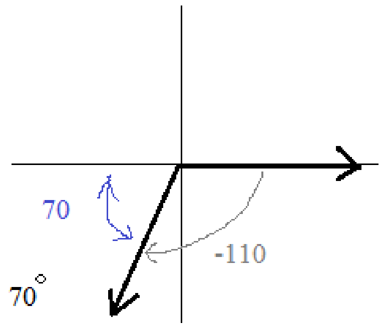
Coterminal vs. Reference Angles

Reference angle: the *acute* angle between the x-axis and the terminal side of an angle (in standard position)
("an acute angle version of an angle")

Examples:

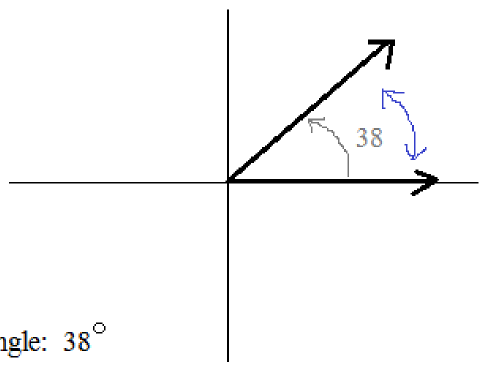


150° angle
reference angle: 30°

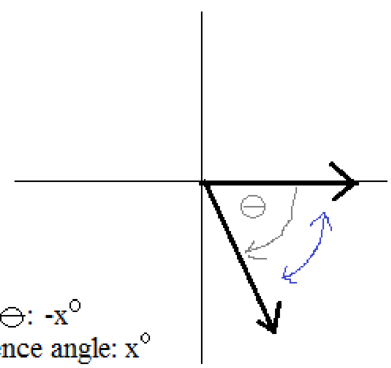


-110° angle
reference angle: 70°

Observations: 1) since reference angles are measures, they have a positive value
2) any acute angle in quadrant I has an identical reference angle

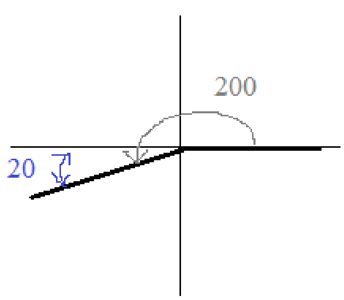


38° angle
reference angle: 38°



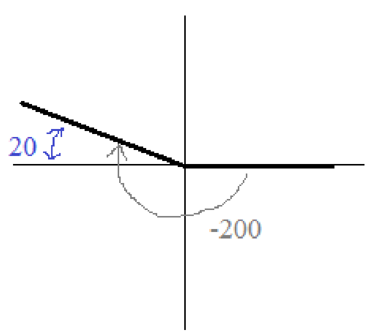
angle θ: -x°
reference angle: x°

Questions: Find the reference angles for 200° and -200°



The reference angles for 200 and -200 are the same!

It's 20°



Study Break: Math Snacks

LanceAF #35 6-3-12
www.mathplane.com

Preferable to ordinary computer cookies...

Essential part of a well-rounded, academic diet.

Try with (t), or any beverage...

Also, look for Honey Graham Squares
in the geometry section of your local store...

PRACTICE TEST (w/SOLUTIONS)-→

Measuring Angles Quiz
(Decimal Form, DMS, Radians, Degrees)

1) Write $21^\circ 18' 49''$ using decimal degrees.

2) Write 88.297° using DMS (Degrees, Minutes, & Seconds)

3) $\angle A$ and $\angle B$ are complementary angles.

$\angle A = 62^\circ 15' 23''$ What is the measure of $\angle B$?

4) At 2:30pm, what is the angle measure between the hour and minute hands?
Express your answer in decimal degree form and DMS form.

5) What is the radian measure of 120°? 75°?

6) Convert a) $\frac{\pi}{6}$ radians to degrees. b) 3.6 radians to degrees

Coterminal and Reference Angles

I. Coterminal Angles

1) Determine if the following pairs are coterminal:

a) 57° 357°

b) -20° 160°

c) -80° 280°

d) $-40^\circ 30'$ $319^\circ 30'$

2) Identify one *positive* and one *negative* coterminal angle to -30 degrees

3) Identify one *positive* and one *negative* coterminal angle to $\frac{\pi}{3}$ (use radian measures)

4) Write an expression that describes *all* coterminal angles to 100 degrees

II. Reference Angles

Identify the reference angle for each angle:

1) 110°

2) 42°

3) -72°

4) 210°

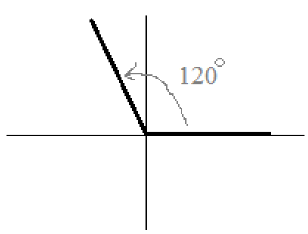
5) -150°

**6) 180°

III. Coterminal vs Reference Angles

For each of the following, identify *the reference* angle and *any coterminal* angle:

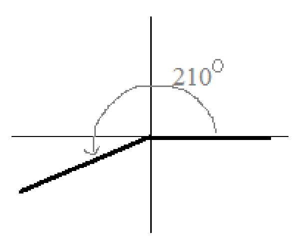
A)



Reference Angle:

Coterminal Angle:

B)



Reference Angle:

Coterminal Angle:

Trigonometry angle measurements and terms

1) 30°

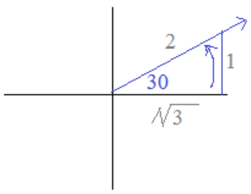
reference angle? 30°

coterminal angle? ex: 390, -330

sine? $\frac{1}{2}$

cosine? $\frac{\sqrt{3}}{2}$

convert to radians: $30 \cdot \frac{\pi}{180} = \frac{\pi}{6}$ radians



2) -60°

reference angle?

coterminal angle?

sine?

cosine?

convert to radians:

3) -120°

reference angle?

2 coterminal angles?

tangent?

cosine?

convert to radians:

4) $\frac{3\pi}{4}$ radians

reference angle?

coterminal angle?

sine?

tangent?

convert to degrees:

5) $\frac{-\pi}{6}$ radians

reference angle?

2 coterminal angles?

sine?

cosine?

convert to degrees:

6) $\frac{9\pi}{4}$ radians

reference angle?

coterminal angle?

sine?

tangent?

convert to degrees:

7) 90°

coterminal angle?

tangent?

sine?

cosine?

convert to radians:

8) π radians

negative coterminal angle?

positive coterminal angle?

sine?

cosine?

convert to degrees:

9) 480°

reference angle?

coterminal angle?

sine?

cosine?

convert to radians:

Measuring Angles Quiz
(Decimal Form, DMS, Radians, Degrees)

SOLUTIONS

1) Write $21^\circ 18' 49''$ using decimal degrees.

$$21^\circ + 18' \frac{1^\circ}{60'} + 49'' \frac{1^\circ}{3600''}$$

$$21^\circ + .3^\circ + .014^\circ = \boxed{21.314^\circ}$$

2) Write 88.297° using DMS (Degrees, Minutes, & Seconds)

$$88^\circ + .297^\circ \frac{60'}{1^\circ}$$

$$17.82' \longrightarrow 17' + .82' \frac{60''}{1'}$$

$$49.2''$$

$$\boxed{88^\circ 17' 49.2''}$$

3) $\angle A$ and $\angle B$ are complementary angles.

$\angle A = 62^\circ 15' 23''$ What is the measure of $\angle B$?

Complementary -- therefore,
A + B = 90

$$90^\circ - 62^\circ 15' 23'' = \boxed{27^\circ 44' 37''}$$

$$90^\circ - 62.26^\circ = 27.74^\circ$$

4) At 2:30pm, what is the angle measure between the hour and minute hands?
Express your answer in decimal degree form <u>and</u> DMS form.

3:00 would obviously be 90°

2:30 takes a little bit of thought...
1) There are 360 degrees in a circle.. Since there are 12 hours -- 30° between each hour
2) At 2:30, the hour hand is HALFWAY between the 2 and the 3..

Degrees from 3 to 6 = 90°

Degrees from 3 to the middle of 2 and 3 = 15°

Angle is 90 + 15 = $\boxed{105^\circ}$

5) What is the radian measure of 120°? 75°?

$$120^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{2}{3}\pi \text{ radians}$$

$$75^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{5}{12}\pi \text{ radians}$$

$$\cong .417\ (3.14) \text{ rad}$$

$$\boxed{\text{approximately } 1.308 \text{ rad}}$$

6) Convert a) $\frac{\pi}{6}$ radians to degrees. b) 3.6 radians to degrees

$$\frac{\pi}{6} \text{ radians} \cdot \frac{180^\circ}{\pi \text{ radians}} = 30^\circ$$

$$3.6 \text{ radians} \cdot \frac{180^\circ}{\pi \text{ radians}} = \frac{3.6\ (180^\circ)}{\pi}$$

$$\cong \frac{3.6\ (180^\circ)}{3.14}$$

$$\boxed{\text{approximately } 206.369^\circ}$$

Coterminal and Reference Angles

SOLUTIONS

I. Coterminal Angles

1) Determine if the following pairs are coterminal:

a) 57° 357° **NO** $357 - 57 = 300$

b) -20° 160° **NO** $160 - (-20) = 180$

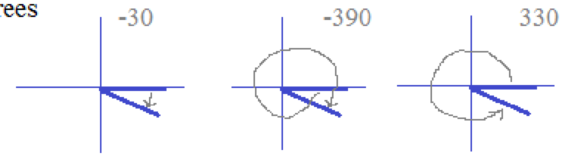
c) -80° 280° **YES** $280 - (-80) = 360^\circ$

d) $-40^\circ 30'$ $319^\circ 30'$ **YES** $-40^\circ 30' - (319^\circ 30') = -360^\circ$

2) Identify one *positive* and one *negative* coterminal angle to -30 degrees

$-30 + 360 =$ **330 degrees**

$-30 - 360 =$ **−390 degrees**



3) Identify one *positive* and one *negative* coterminal angle to $\frac{\pi}{3}$ (use radian measures)

add 2π **$\frac{7\pi}{3}$** subtract 2π **$\frac{-5\pi}{3}$**

4) Write an expression that describes *all* coterminal angles to 100 degrees

$100^\circ + 360^\circ n$ where n is any integer....

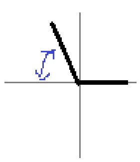
II. Reference Angles

Identify the reference angle for each angle:

(reference angle is measured from the *terminal side to the x-axis*)

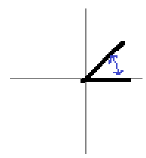
1) 110°

70 degrees



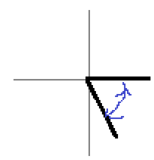
2) 42°

42 degrees



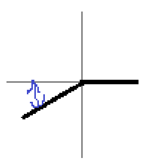
3) -72°

72 degrees



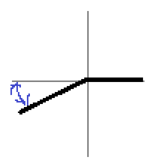
4) 210°

30 degrees



5) -150°

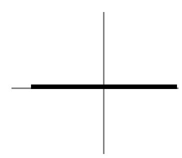
30 degrees



**6) 180°

NONE

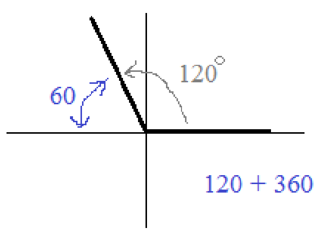
(zero degrees)



III. Coterminal vs Reference Angles

For each of the following, identify *the reference* angle and *any coterminal* angle:

A)

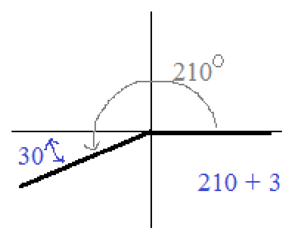


$120 + 360 = 480$

Reference Angle: 60 degrees

Coterminal Angle: 480 degrees

B)



$210 + 360 = 570$

Reference Angle: 30 degrees

Coterminal Angle: 570 degrees

Trigonometry angle measurements and terms

SOLUTIONS

1) 30°

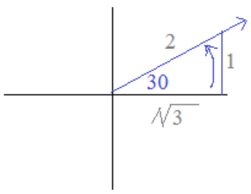
reference angle? 30°

coterminal angle? ex: 390, -330

sine? $\frac{1}{2}$

cosine? $\frac{\sqrt{3}}{2}$

convert to radians: $30 \cdot \frac{\pi}{180} = \frac{\pi}{6}$ radians



2) -60°

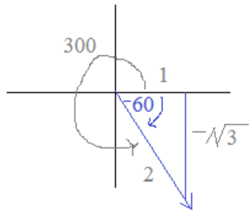
reference angle? 60°

coterminal angle? ex: 300, 660

sine? $\frac{-\sqrt{3}}{2}$

cosine? $\frac{1}{2}$

convert to radians: $-60^\circ \cdot \frac{\pi \text{ rad}}{180^\circ} = \frac{-\pi}{3}$ radians



3) -120°

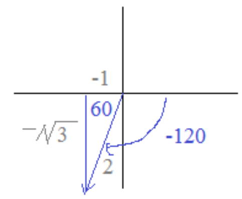
reference angle? 60°

2 coterminal angles? examples: $-120 + 360 = 240^\circ$; $-120 - 360 = -480^\circ$

tangent? $\sqrt{3}$

cosine? $-\frac{1}{2}$

convert to radians: $-120 \cdot \frac{\pi \text{ rad}}{180^\circ} = \frac{-2\pi}{3}$ rad



4) $\frac{3\pi}{4}$ radians

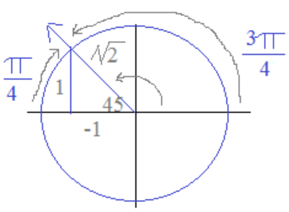
reference angle? $\frac{\pi}{4}$ or 45 degrees

coterminal angle? ex: $\frac{11\pi}{4}$, $\frac{-5\pi}{4}$

sine? $\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$

tangent? -1

convert to degrees: $\frac{3\pi}{4}$ 135°



5) $\frac{-\pi}{6}$ radians

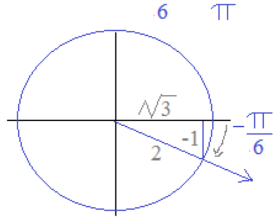
reference angle? $\frac{\pi}{6}$ or 30 degrees

2 coterminal angles? $\frac{-\pi}{6} + 2\pi = \frac{11\pi}{6}$; $\frac{-\pi}{6} - 2\pi = \frac{-13\pi}{6}$

sine? -1/2

cosine? $\sqrt{3}/2$

convert to degrees: $-\frac{\pi}{6} \cdot \frac{180}{\pi} =$ -30 degrees



6) $\frac{9\pi}{4}$ radians

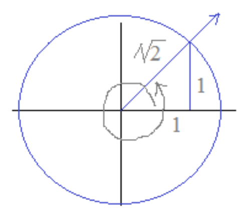
reference angle? $\frac{\pi}{4}$ or 45 degrees

coterminal angle? ex: $\frac{\pi}{4}$

sine? $\frac{\sqrt{2}}{2}$

tangent? 1

convert to degrees: $\frac{9\pi}{4} \cdot \frac{180^\circ}{\pi} = 405^\circ$



7) 90°

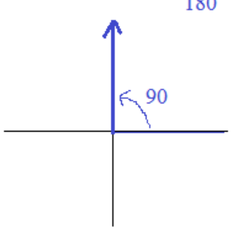
coterminal angle? ex: 90 + 360 = 450; 90 - 360 = -270

tangent? undefined

sine? 1

cosine? 0

convert to radians: $90 \cdot \frac{\pi}{180} = \frac{\pi}{2}$ radians



8) π radians

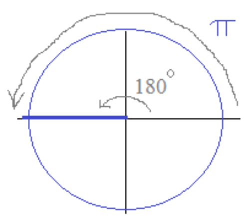
negative coterminal angle? ex: $-\pi$ or -3π

positive coterminal angle? ex: 3π or 5π

sine? 0

cosine? −1

convert to degrees: 180 degrees



9) 480°

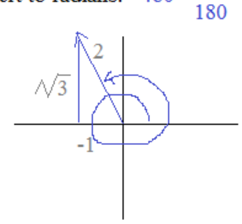
reference angle? 60°

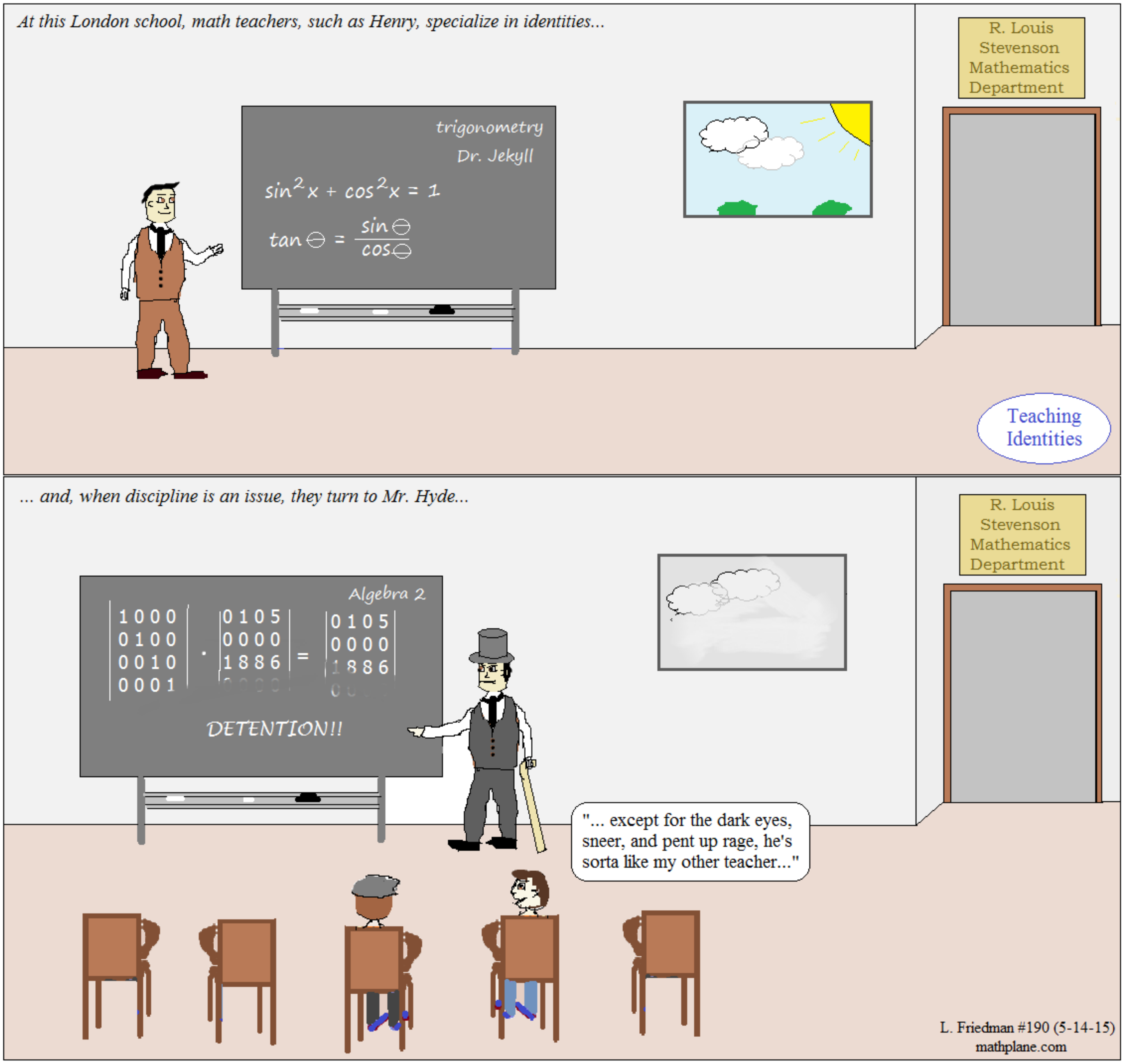
coterminal angle? $480 - 360 = 120^\circ$

sine? $\frac{\sqrt{3}}{2}$

cosine? $-\frac{1}{2}$

convert to radians: $480 \cdot \frac{\pi}{180} = \frac{8\pi}{3}$ radians





Hidden Message Puzzle-→

Hidden Message

Hint: The ultimate clue is in the puzzle

Answer the 12 questions below. Then, convert the numbers into letters to reveal the hidden term!

Number Key:									
0	1	2	3	4	5	6	7	8	9
A	C	D	E	G	H	K	N	R	T

1) Seconds between $24^\circ\ 12'$ and $24^\circ\ 11'\ 41''$

2) $\frac{3\pi}{4}$ Radians = x degrees. What is x?

3) Minutes in 1/2 degree

4) $63^\circ\ 41'\ 45''$: convert to decimal form (round to nearest tenth)

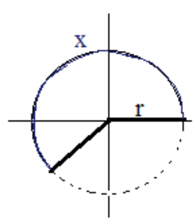
5) $71.15^\circ = 71^\circ\ x'\ y''$ What is x?

6) $36^\circ = \frac{\pi}{z}$ Radians What is z?

7) Angles A and B are complementary. $m\angle A = 43^\circ\ 32'\ 30''$ $m\angle B = 46^\circ\ x'\ 30''$ What is x?

8) At 1:00, what is the degree measure between the hour hand and minute hand?

9) Approximate arc length of x (measured in radians - rounded to nearest integer)



10) Degrees in 5 Radians

11) Seconds in 1 degree

12) Convert to degrees (decimal form): $144^\circ 18'$

1 [ ] → ____

13 [ ] → ____

[ ] 0 → ____

63.[ ] → ____

[ ] → ____

[ ] → ____

[ ] 7 → ____

[ ] 0 → ____

[ ] → ____

2 [ ] 6.5° → ____

[ ] 600 → ____

144.[ ] → ____

Hidden Message

Hint: The ultimate clue is in the puzzle

Answer the 12 questions below. Then, convert the numbers into letters to reveal the hidden term!

Number Key:

0	1	2	3	4	5	6	7	8	9
A	C	D	E	G	H	K	N	R	T

SOLUTIONS

1) Seconds between 24° 12' and 24° 11' 41"

$$\begin{array}{r} 24\ \ 11'\ 60'' \\ -\ 24\ \ 11'\ 41'' \\ \hline 19'' \end{array}$$

2) $\frac{3\pi}{4}$ Radians = x degrees. What is x?

$\frac{3 \text{ pi radians}}{4} \cdot \frac{180 \text{ degrees}}{\text{pi radians}} = 135$ degrees

3) Minutes in 1/2 degree

60 minutes = 1 degree... therefore, 30 minutes = 1/2 degree

4) 63° 41' 45" : convert to decimal form (round to nearest tenth)

$63^\circ + 41' \frac{1^\circ}{60'} + 45'' \frac{1^\circ}{3600''} \cong 63 + .6833 + .0125$

$\cong 63.6958$

5) $71.15^\circ = 71^\circ$ x' y" What is x?

$.15 \text{ degrees} \times \frac{60 \text{ minutes}}{1 \text{ degree}} = 9$ minutes

x = 9 y = 0

6) $36^\circ = \frac{\pi}{z}$ Radians What is z?

$\frac{\pi \text{ Rad}}{z}\left(\frac{180^\circ}{\pi \text{Rad}}\right) = \frac{180^\circ}{z} = 36$ degrees z = 5

7) Angles A and B are complementary.
m∠A = 43° 32' 30" m∠B = 46°x' 30"
What is x?

43° 32' 30" + 46° x' 30" = 90°

89° (32 + x)' + 60" = 90°

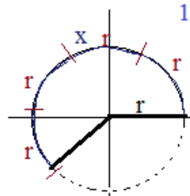
x = 27

8) At 1:00, what is the degree measure between the hour hand and minute hand?

clock is 360 degrees
12 hours; 30
degrees between
each hour!

9) Approximate arc length of x (measured in radians - rounded to nearest integer)

approx: 4 radians



10) Degrees in 5 Radians

$5 \text{ Radians}\left(\frac{180^\circ}{\pi \text{ radians}}\right)$ $900^\circ/3.1415 \cong 286.5^\circ$

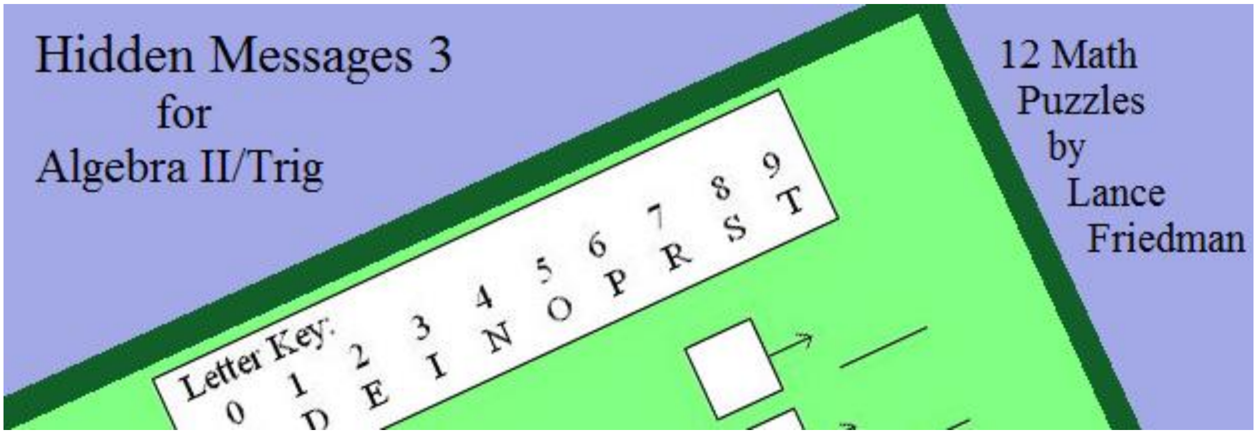
11) Seconds in 1 degree

$\left(\frac{60 \text{ seconds}}{1 \text{ minute}}\right) \cdot \left(\frac{60 \text{ minutes}}{1 \text{ degree}}\right) = 3600$ secondes/degree

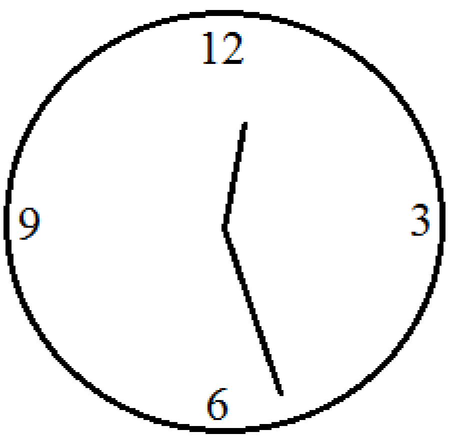
12) Convert to degrees (decimal form): 144°18'

$144 \text{ degrees} + 18 \text{ minutes} \times \frac{1 \text{ degree}}{60 \text{ minutes}} = 144.3$ degrees

Question	Answer (boxed digit)	Letter
1	1 [9]	T
2	13 [5]	H
3	[3] 0	E
4	63.[7]	N
5	[9]	T
6	[5]	H
7	[2] 7	D
8	[3] 0	E
9	[4]	G
10	2 [8] 6.5°	R
11	[3] 600	E
12	144.[3]	E



Clock Question:



12:26:35

When will the minute hand cross the hour hand?

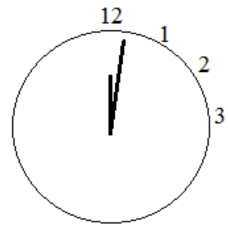
Express the answer to the nearest second.

(Answer and Explanation on the next page)

Question:

A clock sits at exactly 12:02...

What time will the minute hand cross the hour hand?
Express the answer to the nearest second...



Measurements to remember:

60 minutes = 1 hour

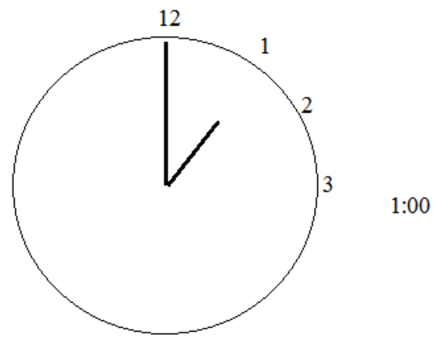
60 seconds = 1 minute

3600 seconds = 1 hour

Solution:

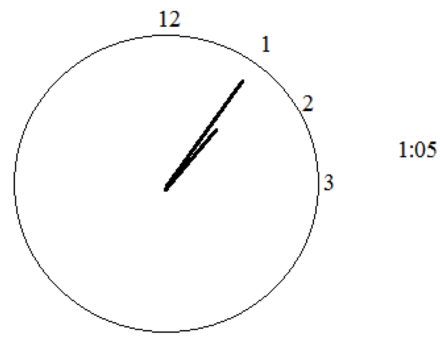
The hour hand will move from one number to the next every 60 minutes (or 3600 seconds)

The minute hand will move from one number to the next every 5 minutes (or 300 seconds)



The minute hand goes around the clock and returns to the top. (1:00)... The minute hand is on the 12, and the hour hand is on the 1....

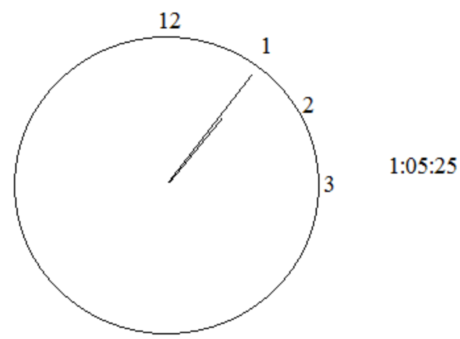
Then, the minute hand reaches the 1 five minutes later (1:05)...



***But, during those 5 minutes, the hour hand moved!!

How far?

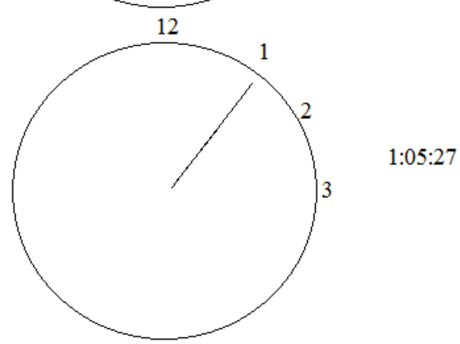
The hour hand moves from 1 to 2 in 60 minutes...
So, during the 5 minutes, the hour hand moved 5/60 or 1/12 of the way to 2...
So, how long would it take for the minute hand to travel 1/12 of the way to 2?
Well, it takes 300 seconds for the minute hand to travel from 1 to 2...
Therefore, it takes 25 seconds to travel 1/12 of the way!!



But, wait.... During those 25 seconds, the hour hand is still moving...
So, during the 25 seconds, how far did the hour hand move?

Well, it takes 3600 seconds for the hour hand to move from 1 to 2...
Therefore, in 25 seconds, the hour hand moved 25/3600 of the distance.. This is approx. .007

Again, it takes 300 seconds for the minute hand to travel from 1 to 2.
Therefore, it would take approx. 2 seconds to travel .007 of the way between 1 and 2.



So, the minute hand has moved
63 minutes to get to 1:05...
Then, 25 seconds to close in on the hour hand... 1:05:25...
And, finally, 2 more seconds to reach the hour hand... 1:05:27

Thanks for visiting. (Hope it helped!)

If you have questions, suggestions, or requests, let us know.

Cheers

Also, at Facebook, Google+, TeachersPayTeachers, and Pinterest