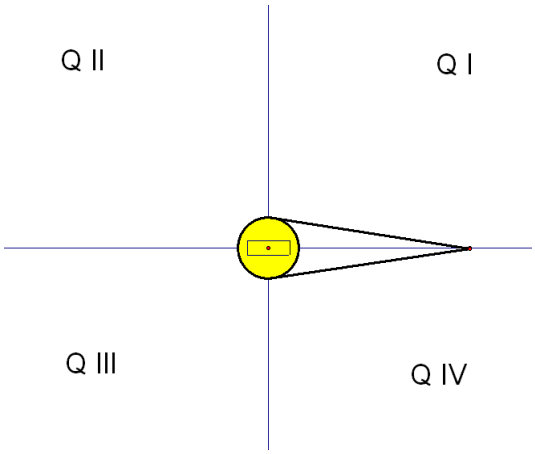
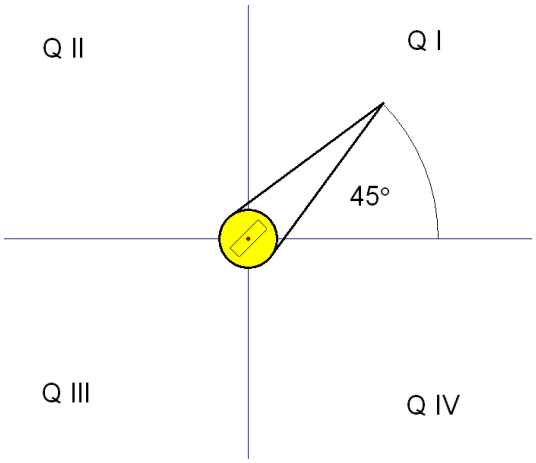
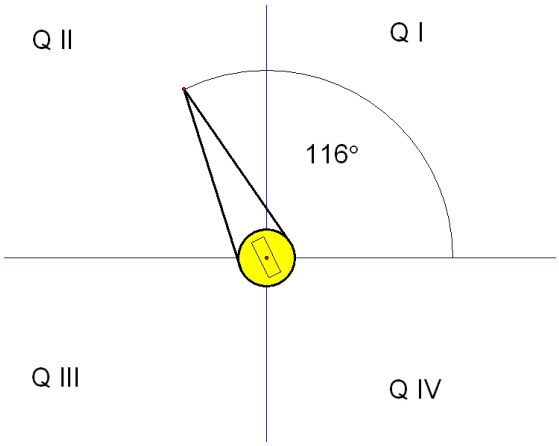
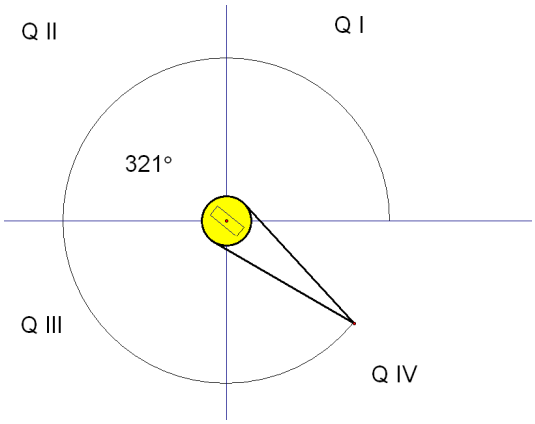
Rotations and Radians NAME_____ HOUR____

Today we are going to deal with angles in the X, Y plane. Let's imagine a dial centered at the origin starting with the pointer along the positive X axis. We are going to measure angles with reference to this starting position. If we twist the dial in the counterclockwise directions the angles are positive as shown.









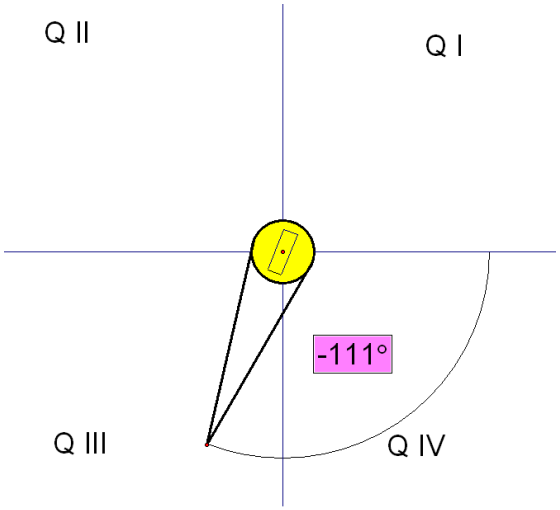
When turning the dial counterclockwise, what angle will place the pointer on:

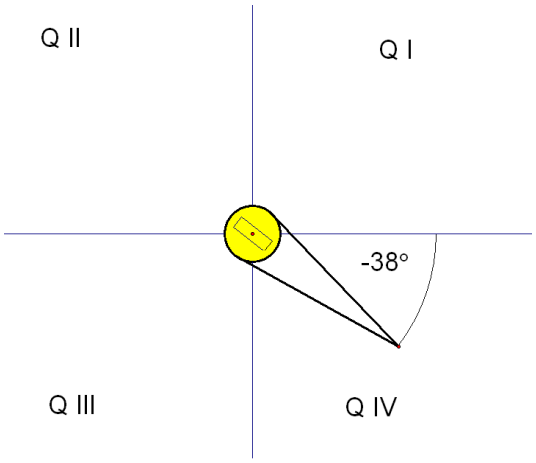
1. the positive Y axis?
2. the negative Y axis?
3. the negative X axis?
4. all the way around?

In what quadrant would the following angle lie in? (Use either the degree or percentage method)

5. 25 degrees?
6. 279 degrees?
7. 89 degrees?
8. 125 degrees?
9. 370 degrees?
10. 720 degrees?

As can be imagined, if we turn the dial clockwise, we will measure the angles as negative numbers. This is represented below.





Answer the following questions.

When turning the dial clockwise, what angle will place the pointer on:

11. the positive Y axis?

12. the negative Y axis?

13. the negative X axis?

14. all the way around?

In what quadrant would the following angle lie in? (Use either the degree or percentage method)

15. -15 degrees?

16. -181 degrees?

17. -91 degrees?

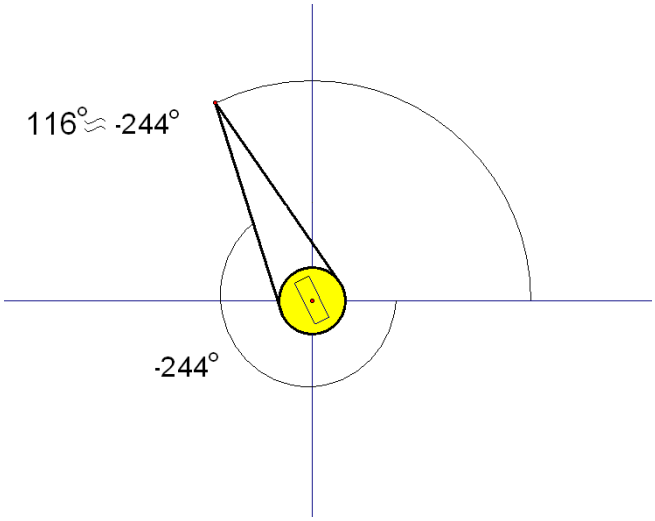
18. -220 degrees?

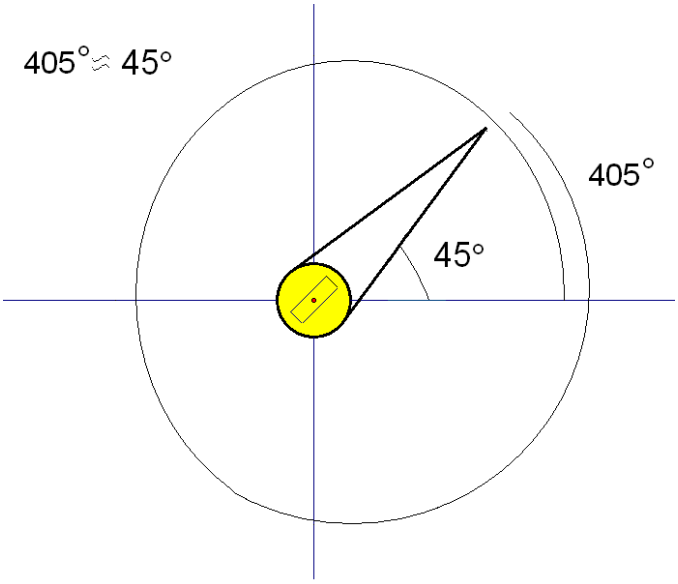
19. -375 degrees?

20. -1060 degrees?

Co-terminal Angles.

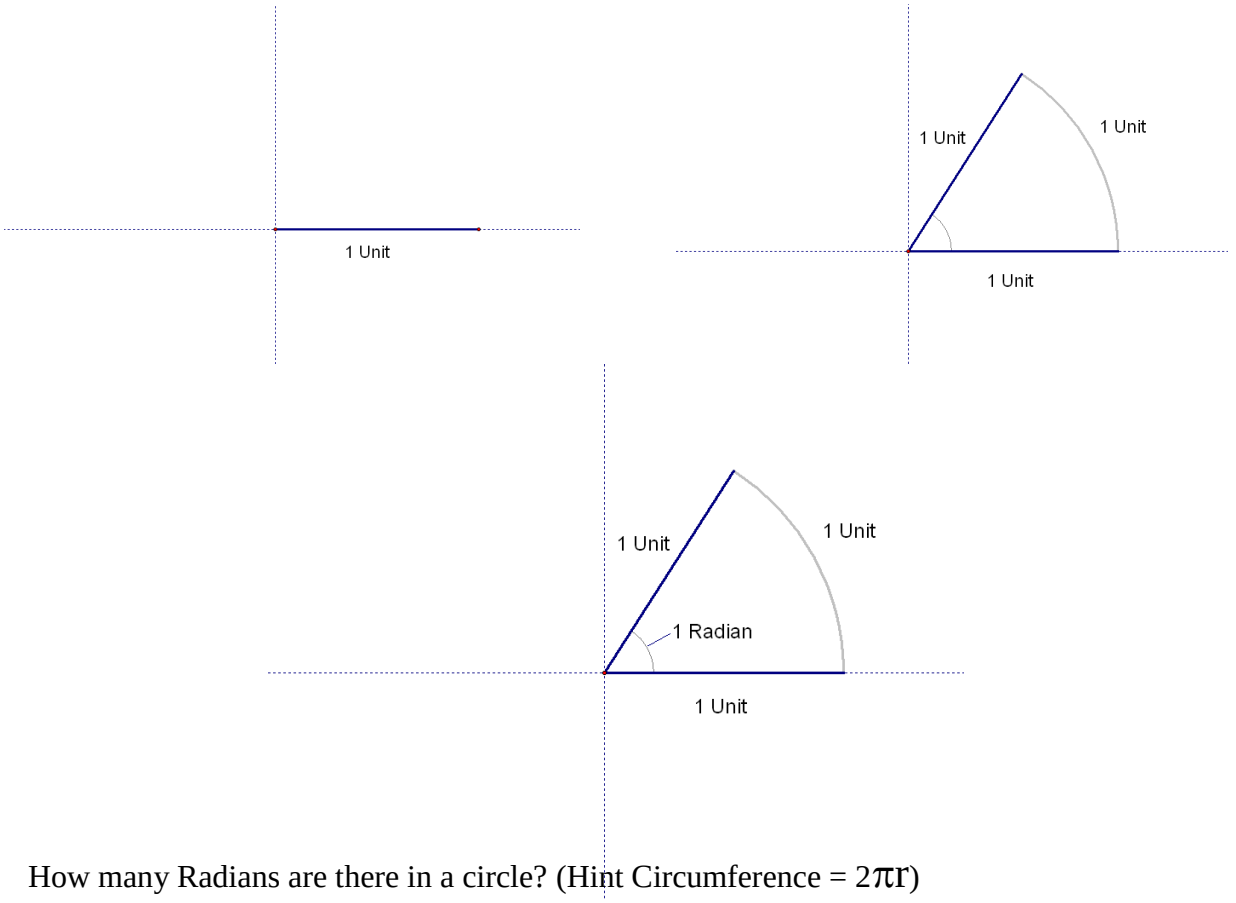
After turning the dial in both directions it is obvious that turning the dial 90° is the same as turning the dial -270°. The angles are called COTERMINAL, meaning they terminate in the same position. In the following diagrams, 116° and -244° are co-terminal because the end in the same position; 405° and 45° are co-terminal also.





Find a positive co-terminal angle to the given angle.	Find a negative co-terminal angle to the given angle.
21. 50°	30. 570°
22. 360°	31. 136°
23. 71°	32. 261°
24. 90°	33. 390°
25. 180°	34. 188°
26. -28°	35. -287°
27. -159°	36. -15°
28. -323°	37. -33°
29. -870°	38. -470°

We have now looked at the angles associated with turning the dial. Now let's look at the distance traveled by the tip of the dial. It will help us to consider the length of the dial as one unit. To make things simple, we want to measure the distance traveled by the tip of the dial in terms of the length of the dial. We will call the length of the dial 1 RADIAN. When we turn the dial counterclockwise so that the tip of the dial travels one radian, we will call the associated angle one radian also.



How many Radians are there in a circle? (Hint Circumference = $2\pi r$)

How do we convert from Radians to degrees and vice versa?

Convert to Radians	Convert to Degrees
39. 50°	46. $\pi/4$
40. 360°	47. $\pi/6$
41. 71°	48. $3\pi/2$
42. 90°	49. 3π
43. 180°	50. $\pi/8$
44. 275°	51. $\pi/12$
45. 369°	52. $5\pi/8$

Find a positive co-terminal angle to the given angle (use radians).	Find a negative co-terminal angle to the given angle(use radians).
53. $3\pi/4$	62. $\pi/4$
54. $-5\pi/6$	63. $-\pi/6$
55. $3\pi/2$	64. $3\pi/2$
56. -3π	65. $3\pi/4$
57. $8\pi/3$	66. $-\pi/8$
58. $\pi/12$	67. $\pi/12$
59. $-\pi/8$	68. $-5\pi/8$
60. $15\pi/6$	69. $17\pi/8$
61. $-\pi/12$	70. $-5\pi/12$

Determine which quadrant each of the angles lies in (Use either the fraction or the percentage method).

71. $\frac{\pi}{4}$	72. $-\frac{\pi}{4}$
73. $\frac{3\pi}{4}$	74. $-\frac{5\pi}{4}$
75. $\frac{7\pi}{3}$	76. $-\frac{7\pi}{2}$
77. $\frac{\pi}{6}$	78. -5π
79. 3π	80. $-\frac{8\pi}{5}$
81. $\frac{7\pi}{4}$	82. $-\frac{12\pi}{5}$
83. $\frac{9\pi}{4}$	84. $-\frac{9\pi}{4}$
85. $\frac{10\pi}{3}$	86. $-\frac{3\pi}{4}$
87. $\frac{2\pi}{5}$	88. $-\frac{10\pi}{7}$
89. $\frac{8\pi}{3}$	90. $-\frac{9\pi}{7}$

1. 90°	2. 270°	3. 180°	4. 360°	5. Q I
6. Q IV	7. Q I	8. Q II	9. Q IV	10. Pos X Axis
11. -270°	12. -90°	13. -180°	14. -360°	15. Q IV
16. Q II	17. Q IV	18. Q II	19. Q IV	20. Q I
21. 410°	22. 0°	23. 431°	24. 450°	25. 540°
26. 332°	27. 201°	28. 37°	29. 210°	30. -150°
31. -224°	32. -99°	33. -330°	34. -172°	35. -647°
36. -375°	37. -393°	38. -830°	39. 5π/18	40. 2π
41. 71 π/180	42. π/2	43. π	44. 55 π/36	45. 41 π/20
46. 45°	47. 30°	48. 270°	49. 540°	50. 22.5°
51. 15°	52. 112.5°	53. 11 π/4	54. 7 π/6	55. 7 π/2
56. Π	57. 14 π/3	58. 25 π/12	59. 15 π/8	60. 27 π/6
61. 23 π/12	62. -7 π/4	63. -13 π/6	64. – π/2	65. -5 π /4
66. -17 π/8	67. -23 π/12	68. -21 π/8	69. -15 π/8	70. -29 π/12
71. Q I	72. Q IV	73. Q II	74. Q II	75. Q I
76. POS Y	77. Q I	78. NEG X	79. NEG X	80. Q I
81. Q IV	82. Q IV	83. Q I	84. Q IV	85. Q III
86. Q III	87. Q I	88. Q II	89. Q II	90. Q II