

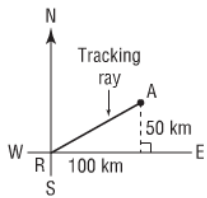
## Math 20-1 Lesson 2.1 Angles in Standard Position in Quadrant 1

**FOCUS** Relate the primary trigonometric ratios to angles in standard position.

### Get Started

Air traffic controllers use radar to track aircraft. A tracking ray rotates about the centre of the radar display and shows a “blip” as it identifies an aircraft’s position. The blip indicates the distance and direction of the aircraft from the radar antenna.

One aircraft, A, is 100 km due east and 50 km due north of a radar antenna, R.



To the nearest kilometre, what is the distance between the aircraft and the radar antenna?

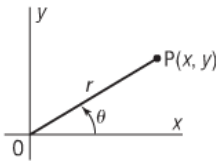
What is the angle between the tracking ray to the aircraft and due east?

## Construct Understanding

Use this diagram.

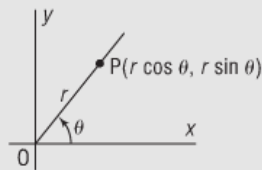
Write an expression for:

- $r$  in terms of  $x$  and  $y$
- the value of  $\theta$  in terms of  $x$  and  $y$
- the  $x$ -coordinate of  $P$  in terms of  $r$  and  $\theta$
- the  $y$ -coordinate of  $P$  in terms of  $r$  and  $\theta$

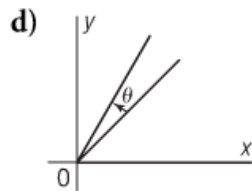
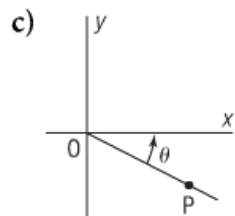
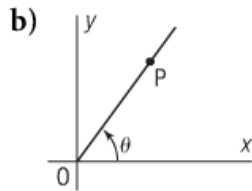
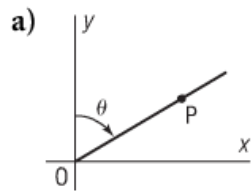


The coordinates of a point  $P$  on the coordinate plane can be described by its distance  $r$  from the origin,  $O$ , and the angle  $\theta$  that  $OP$  makes with the positive  $x$ -axis. When the angle  $\theta$ , between  $0^\circ$  and  $360^\circ$ , is measured counterclockwise from the positive  $x$ -axis, the angle is in **standard position**. The ray  $OP$  is the **terminal arm** of the angle and the point  $P$  is a **terminal point** for the angle.

### Angle in Standard Position in Quadrant 1



3. State whether each diagram represents an angle in standard position. Explain your thinking.



4. Point  $P(5, 8)$  is on the terminal arm of an angle  $\theta$  in standard position.

a) Sketch the angle.

b) Determine the distance from the origin to P.

c) Write the primary trigonometric ratios of  $\theta$ .

d) What is the measure of  $\theta$  to the nearest degree?

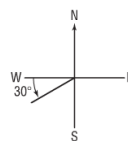
### Example 1 Determining the Trigonometric Ratios of an Angle Given a Terminal Point

The point  $P(4, 7)$  is on the terminal arm of an angle  $\theta$  in standard position.

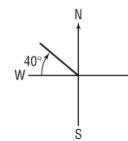
- Determine the distance  $r$  from the origin to  $P$ .
- Determine the primary trigonometric ratios of  $\theta$ .
- Determine the measure of  $\theta$  to the nearest degree.

Trigonometry is essential to navigation. A direction can be described by relating it to two of the compass points: north, south, west, and east

For example, a heading of  $W30^\circ S$  means from a direction due west, rotate  $30^\circ$  counterclockwise; that is, toward south.



Similarly, a heading of  $W40^\circ N$  means from a direction due west, rotate  $40^\circ$  clockwise; that is, toward north.



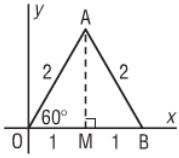
### Example 2 Solving a Problem Using Trigonometric Ratios

An aircraft made an emergency landing 200 km from an airport. Its heading from the airport was  $E50^\circ N$ . The land-based rescue team has to travel east then north to get to the aircraft. To the nearest kilometre, how far should the team travel in each direction?

- The point  $P(3, 4)$  is on the terminal arm of an angle in standard position.
  - Determine the distance  $r$  from the origin to  $P$ .
  - Determine the primary trigonometric ratios of  $\theta$ .
  - Determine the measure of  $\theta$  to the nearest degree.

- A forest ranger sees smoke rising from a point that lies in a direction  $E40^\circ N$ . She estimates that the distance from the ranger station is about 30 km. The firefighters at the ranger station have to travel east then north to get to the fire. To the nearest kilometre, how far should the firefighters travel in each direction?

5. a) Use this diagram to determine the exact primary trigonometric ratios of  $60^\circ$ .



You will need the results of question 5 in Lesson 6.2.

- b) Use the diagram in part a to determine the exact primary trigonometric ratios of  $30^\circ$ .
- c) How are the values of the primary trigonometric ratios of  $30^\circ$  and  $60^\circ$  related? How can you predict the relationship by inspecting the triangles?
6. For each angle below, determine the exact coordinates of a point on the terminal arm of the angle in standard position.
- a)  $30^\circ$
- b)  $45^\circ$
- c)  $60^\circ$

- 7.** A support cable is anchored 15 m from the base of a pole and is attached to the pole 10 m above the ground.
- a) Determine the length of the cable to the nearest tenth of a metre.

b) To the nearest degree, what angle does the cable make with the ground?

- 8. a)** Determine the distance of each point from the origin.

i) A(4, 6)

ii) B(7, 3)

b) Each point in part a is on the terminal arm of an angle  $\theta$  in standard position. For each angle, determine  $\cos \theta$ ,  $\sin \theta$ ,  $\tan \theta$ , and the measure of  $\theta$  to the nearest degree.

i) A(4, 6)

ii) B(7, 3)

- 9.** Point P( $x, y$ ) is on the terminal arm of each angle below in standard position. The distance  $r$  between P and the origin is given. To the nearest tenth, determine the coordinates of P.

a)  $20^\circ$ ;  $r = 10$

b)  $80^\circ$ ;  $r = 5$