Answers are at the end of the assignment.

1. Suppose θ is an angle in a right triangle, and that two sides of this triangle are given. Write an equation for x in terms of θ and the other given quantity (your equation should not contain division).

   (a) opposite side is 14, adjacent side is x

   (b) adjacent side is q, hypotenuse is x

   (c) hypotenuse is 10, adjacent side is x

   (d) adjacent side is $3v$, opposite side is x

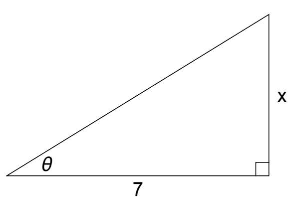
   (e) hypotenuse is $a + 4$, opposite side is x

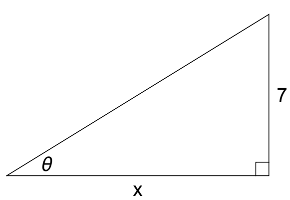
   (f) opposite side is 20, hypotenuse is x

   (g) hypotenuse is 30, adjacent side is $x - 2$

   (h) adjacent side is $2w$, opposite side is $\frac{x}{5}$

2. In each picture, write an equation for x in terms of the other given numbers and/or variables. Your equation should not contain division.

(a)


(b)


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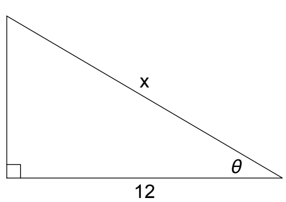

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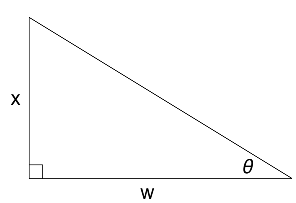
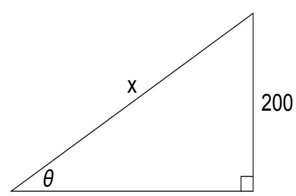


(e)


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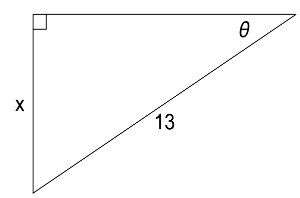
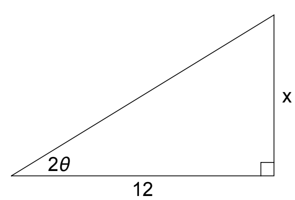
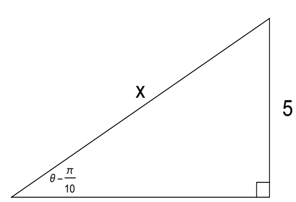
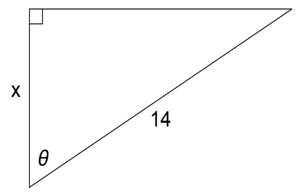
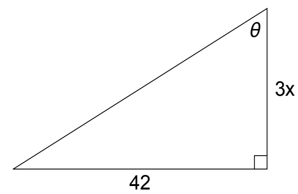
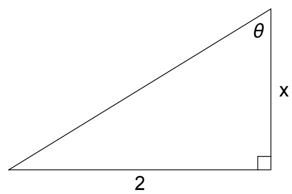


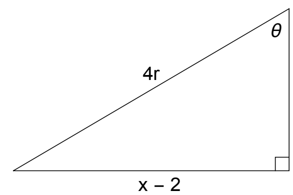
(g)


(h)


(i) 

(k) 

(j) 

(l) 

3. In the given pictures, write an equation for θ in terms of the other given numbers and/or variables. Your equation may contain "$\sin^{-1}$", "$\cos^{-1}$" and/or "$\tan^{-1}$", but not the inverses of the other three trig functions.

   (a) Use the picture from Question 2 (a).

   (b) Use the picture from Question 2 (c).

   (c) Use the picture from Question 2 (e).

   (d) Use the picture from Question 2 (f).

   (e) Use the picture from Question 2 (i).

4. Write an equation for the given quantity in terms of the other given numbers and/or variables (not including x). Your equation should not contain division.

   (a) The perimeter of the triangle in Question 2 (a).

   (b) The perimeter of the triangle in Question 2 (f).

   (c) The perimeter of the triangle in Question 2 (i).

   (d) The area of the triangle in Question 2 (c).

   (e) The area of the triangle in Question 2 (i).

5. A 16-foot long ladder leans up against a building.

   (a) Write an equation for the distance from the bottom of the ladder to the building, in terms of the angle the ladder makes with the ground.

   (b) Write an equation for the distance from the bottom of the ladder to the building, in terms of the angle the ladder makes with the side of the building.

   (c) Write an equation for the distance from the top of the ladder straight down to the ground, in terms of the angle the ladder makes with the ground.

   (d) Write an equation for the distance from the top of the ladder straight down to the ground, in terms of the angle the ladder makes with the side of the building.

6. A deer is 150 feet east of a hunter. The deer takes off running, at 40 feet per second, due north.

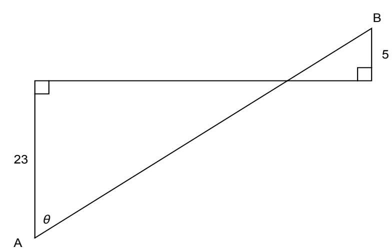
(a) How far north has the deer run t seconds after it starts running? Your answer should be in terms of t. (*Hint:* distance = rate · time.)

(b) Find the distance from the hunter to the deer t seconds after the deer starts running. Your answer should be in terms of t. (*Hint:* Pythagorean theorem.)

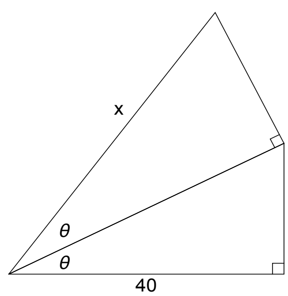
(c) Suppose the angle at which the hunter views the deer is θ, measured north of east. How far north (in terms of θ) has the deer run?

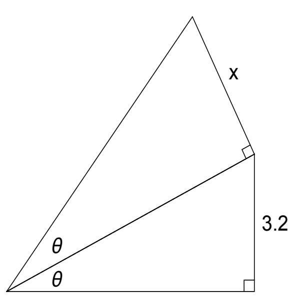
(d) Suppose the angle at which the hunter views the deer is θ, measured north of east. How long (in terms of θ) has the deer been running?

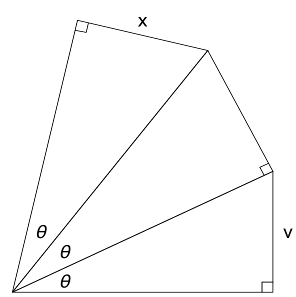
7. Let x be the distance from A to B in the picture below. Write an equation for x, in terms of the other numbers and/or variables. (your equation should not contain division).

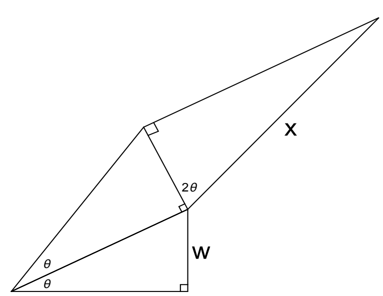


8. In each picture, write an equation for x in terms of the other given numbers and/or variables. Your equation should not contain division.

(a)


(b)


(c)


(d)


9. There is a 5 foot high wall 2 feet away from a house, running parallel to the house. Find the length of a ladder that leans up against the house, in terms of the angle the ladder makes with the side of the house, assuming that the ladder just brushes up against the top of the wall.

10. A person is on a road that runs due north-south through a desert. He can drive a four-wheeler along the road at a speed of 50 mph, and can drive the four-wheeler off the road (in the desert) at 30 mph. He wants to get to a point that is 170 miles north and 100 miles east of his current location. To get there, he will drive some number of miles north on the road, then turn at angle θ (measured east of north) and drive directly toward his final destination. In terms of θ, compute these quantities:

    (a) What distance will he drive on the road?

    (b) What distance will he drive off the road?

    (c) What amount of time will he spend driving on the road?

    (d) What amount of time will he spend driving off the road?

    (e) What is the total amount of time he will spend reaching his destination?

Answers

(I did these by hand; it is possible that they contain errors)

1. (a) $x = 14 \cot \theta$
   (b) $x = q \sec \theta$
   (c) $x = 10 \cos \theta$
   (d) $x = 3v \tan \theta$
   (e) $x = (a + 4) \sin \theta$
   (the parentheses in (e) are important)
   (f) $x = 20 \csc \theta$
   (g) $x = 2 + 30 \sin \theta$ (or $x = 30 \sin \theta + 2$)
   (h) $x = 10w \tan \theta$

2. (a) $x = 7 \tan \theta$
   (b) $x = 7 \cot \theta$
   (c) $x = 12 \sec \theta$
   (d) $x = w \tan \theta$
   (e) $x = 200 \csc \theta$
   (f) $x = 13 \sin \theta$
   (g) $x = 12 \tan 2\theta$
   (h) $x = 5 \csc \left(\theta - \frac{\pi}{10}\right)$
   (the parentheses in (h) are important)
   (i) $x = 14 \cos \theta$
   (j) $x = 2 \cot \theta$
   (k) $x = 14 \cot \theta$
   (l) $x = 2 + 4r \sin \theta$ (or $x = 4r \sin \theta + 2$)

3. (a) $\theta = \tan^{-1} \frac{x}{7}$
   (b) $\theta = \cos^{-1} \frac{12}{x}$
   (c) $\theta = \sin^{-1} \frac{200}{x}$
   (d) $\theta = \sin^{-1} \frac{x}{13}$.
   (e) $\theta = \cos^{-1} \frac{x}{14}$.

4. (a) $P = 7 + 7 \tan \theta + 7 \sec \theta$
   (b) $P = 13 + 13 \sin \theta + 13 \cos \theta$.
   (c) $P = 14 + 14 \cos \theta + 14 \sin \theta$.
   (d) $A = \frac{1}{2} \cdot 12 \cdot 12 \tan \theta = 72 \tan \theta$.
   (e) $A = \frac{1}{2}(14 \sin \theta)(14 \cos \theta) = 98 \sin \theta \cos \theta$.

5. Throughout this problem, I called x the distance from the bottom of the ladder to the building, I called y the distance from the top of the ladder straight down to the ground, I called θ the angle between the bottom of the ladder and the ground, and I called ϕ the angle between the top of the ladder and the side of the building. But it doesn't matter what letters you choose.
   (a) $x = 16 \cos \theta$
   (b) $x = 16 \sin \phi$.
   (c) $y = 16 \sin \theta$.
   (d) $y = 16 \cos \phi$.

6. (a) $40t$ feet.
   (b) $\sqrt{150^2 + (40t)^2} = \sqrt{1600t + 22500}$.
   (c) $150 \tan \theta$ feet.
   (d) $\frac{150}{40} \tan \theta = 3.5 \tan \theta$ seconds.

7. $x = 23 \sec \theta + 5 \sec \theta = 28 \sec \theta$.

8. (a) $x = 40 \sec^2 \theta$.
   (b) $x = 3.2 \csc \theta \tan \theta$ (this simplifies to $3.2 \sec \theta$, but you don't need to know that yet).
   (c) $x = v \csc \theta \sec \theta \sin \theta$ (this simplifies to $x = v \sec \theta$, but you don't need to know that yet).

(d) $x = w \csc\theta \tan\theta \cos 2\theta$.

9. $L = 5\csc\theta + 2\sec\theta$.

10. (a) $170 - 100\cot\theta$ miles.
    (b) $100\csc\theta$ miles.
    (c) $\frac{170-100\cot\theta}{50} = 3.2 - 2\cot\theta$ hours.
    (d) $\frac{100\csc\theta}{30} = 3.333\csc\theta$ hours.
    (e) $3.2 - 2\cot\theta + 3.333\csc\theta$ hours.