PreCalculus
Ch. 4 Application Problems--Review

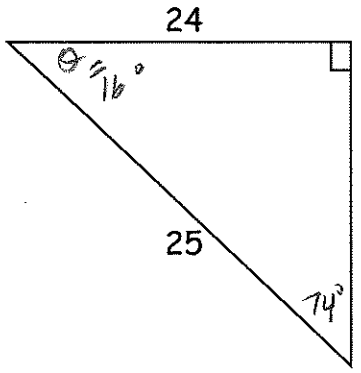
Name KEY
Date_____

USE YOUR CALCULATOR! Round to 2 decimal places! Check your mode!☺

EASY:

*1) Solve the following triangles (for all missing sides and angles):

a)



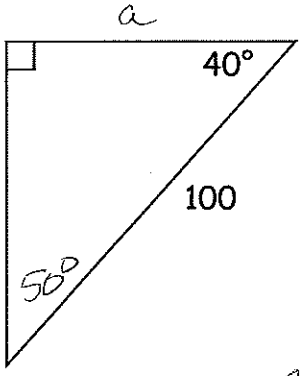
7 (Pythag)

$\cos\theta = \frac{24}{25}$

$\theta = \cos^{-1}\left(\frac{24}{25}\right) = 16.26$

16.26°
73.74°

b)

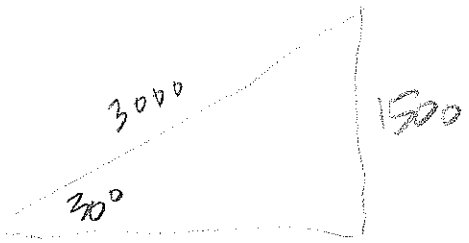


$\cos 40° = \frac{a}{100}$

$a = 76.60$

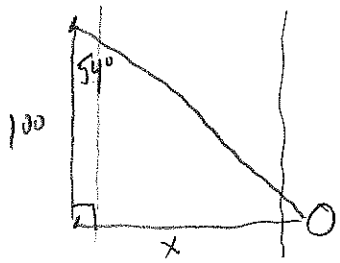
$b = 64.28$ (Pythag)

2) You are skiing down a mountain with a vertical height of 1500 feet. The distance from the top of the mountain to the base is 3000 feet. What is the angle of elevation from the base to the top of the mountain?



30° (30-60-90!)

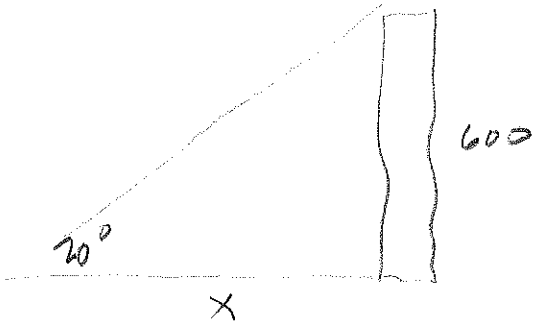
3) A biologist wants to know the width of a river. He spots a special tree directly across from him on the opposite side of the river. He then walks along a path parallel to the river 100 feet. He looks at the tree again and determines that the angle created by the path and his line of sight to the tree is 54°. How wide is the river?



$\tan 54° = \frac{x}{100}$

$x = 100 \tan 54° \approx 137.64 \text{ ft}$

4) The sun is 20° above the horizon. Find the length of a shadow cast by a building that is 600 feet tall.

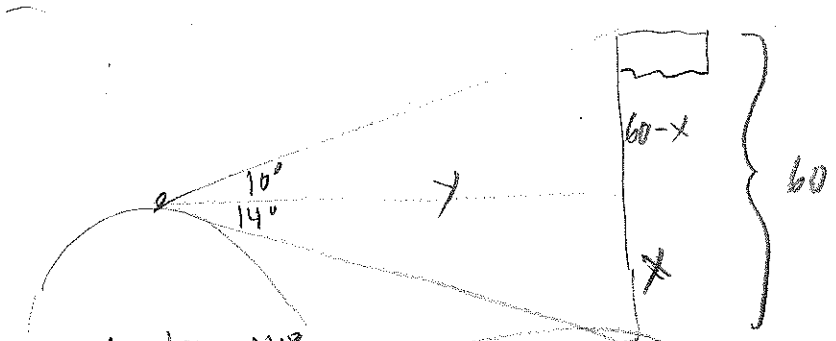


$\tan 20° = \frac{600}{x}$

$x = \frac{600}{\tan 20°} \approx 1648.49 \text{ ft}$

MEDIUM:

5) A woman standing on a hill sees a flagpole. She knows the flagpole is 60 feet tall. The angle of depression to the bottom of the pole is 14°. The angle of elevation to the top of the pole is 10°. Find her distance to the pole.



$\tan 14° = \frac{x}{y}$

$y = \frac{x}{\tan 14°}$

$\tan 10° = \frac{60-x}{y}$

$y = \frac{60-x}{\tan 10°}$

$\frac{x}{\tan 14°} = \frac{60-x}{\tan 10°}$

$x \tan 10° = 60 \tan 14° - x \tan 14°$

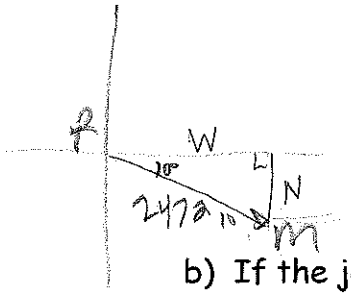
$x = \frac{60 \tan 14°}{(\tan 10° + \tan 14°)} = 35.15 \text{ ft}$

6) A jet leaves Reno, Nevada and is headed toward Miami, Florida at a bearing of 100°. The distance between the two cities is approximately 2472 miles.

a) How far north and how far west is Reno relative to Miami?

$\sin 10° = \frac{N}{2472} \rightarrow N = 2472(\sin 10°) = 429.26 \text{ m}$

$\cos 10° = \frac{W}{2472} \rightarrow W = 2472(\cos 10°) = 2434.44 \text{ m}$

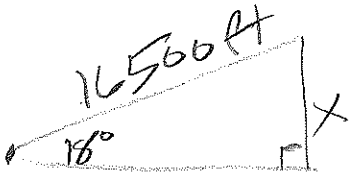


b) If the jet is to return directly to Reno from Miami, at what bearing should it travel?

260°

7) During takeoff, an airplane's angle of ascent is 18° and its speed is 275 feet per second.

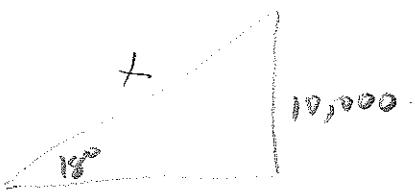
a) Find the plane's altitude after 1 minute.



$\frac{275 \text{ ft}}{1 \text{ s}} \cdot \frac{60 \text{ s}}{1 \text{ min}} = 16500 \text{ ft/min}$

$\sin 18° = \frac{x}{16500} \rightarrow x = 16500(\sin 18°) = 5098.78 \text{ ft}$

b) How long will it take the plane to climb to an altitude of 10,000 feet?

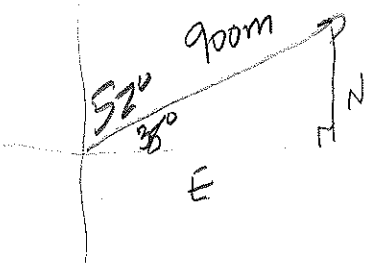


$\sin 18° = \frac{10000}{x}$

$x = \frac{10000}{\sin 18°} = 32360.68 \text{ ft}$

$\frac{32360.68 \text{ ft}}{16500 \text{ ft/min}} = 1.96 \text{ mins}$

8) An airplane flying at 600 mph has a bearing of 52°. After flying for 1.5 hours, how far north and how far east will the plane have traveled from its point of departure?

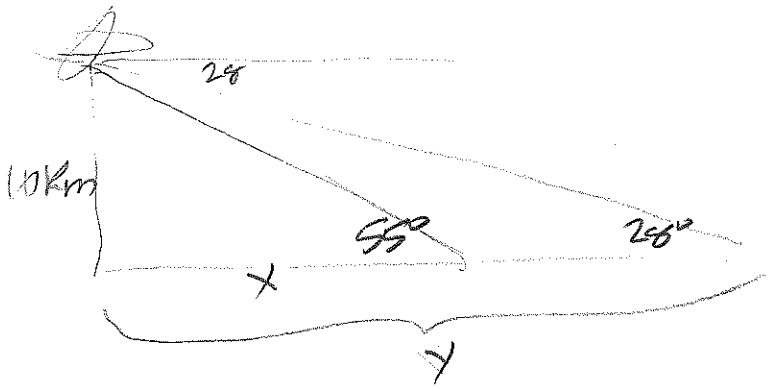


$\sin 38° = \frac{N}{900} \rightarrow N = 900 \sin 38° = 554.10\text{m}$

$\cos 38° = \frac{E}{900} \Rightarrow E = 900 \cos 38° = 709.21\text{m}$

DIFFICULT:

9) A passenger in an airplane at an altitude of 10 kilometers sees two towns directly to the east of the plane. The angles of depression to the towns are 28° and 55°. How far apart are the towns?



$\tan 28° = \frac{10}{y}$

$y = \frac{10}{\tan 28°}$

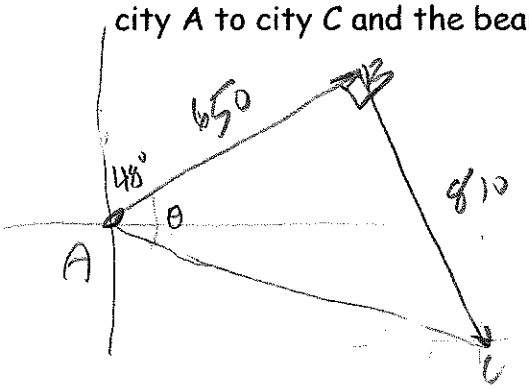
$\tan 55° = \frac{10}{x}$

$x = \frac{10}{\tan 55°}$

$y - x = \frac{10}{\tan 28°} - \frac{10}{\tan 55°}$

$= 11.81\text{ km}$

10) From city A to city B, a plane flies 650 miles at a bearing of 48 degrees. From city B to city C, the plane flies 810 miles at a bearing of 138 degrees. Find the distance from city A to city C and the bearing from city A to city C.



$138 - 48 = 90°$

$AC = \sqrt{650^2 + 810^2} = 1038.56\text{m}$

Bearing from A $\Rightarrow$ C $= 48° + \theta$

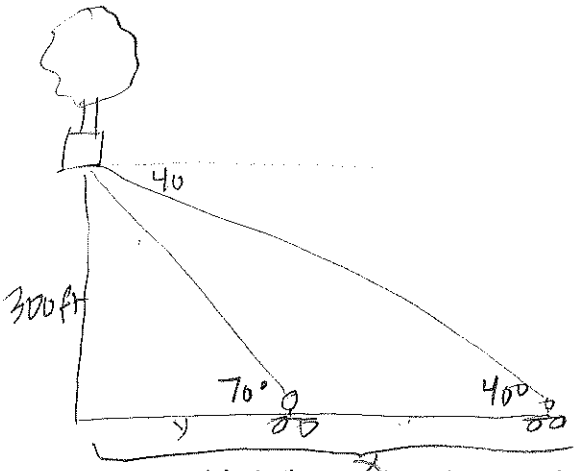
$\tan\theta = \frac{810}{650}$

$\theta = \tan^{-1}\left(\frac{810}{650}\right) = 51.25°$

Bearing $= 48 + 51.25 = 99.25°$

11) Jimbo is in a hot air balloon floating at a height of 300 feet. He sees Kurt riding his moped below him on a straight road that goes directly beneath his balloon. The first time he notices Kurt, he is at an angle of depression of 40°. Two minutes later he sees Kurt again at an angle of depression of 70°.

a) How far has Kurt traveled in the two minutes.



$\tan 40° = \frac{300}{x}$

$x = \frac{300}{\tan 40°}$

$\tan 70° = \frac{300}{y}$

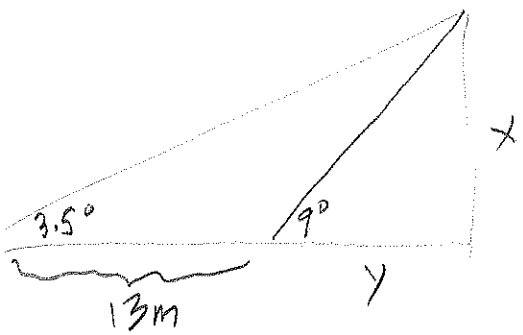
$y = \frac{300}{\tan 70°}$

$x - y = 248.34 \text{ ft}$

b) What is Kurt's speed in MPH?

$\frac{248.34 \text{ ft}}{2 \text{ mins}} \cdot \frac{1 \text{ m}}{5280 \text{ ft}} \cdot \frac{60 \text{ mins}}{1 \text{ hr}} = 1.41 \text{ m/hr}$

12) In traveling across flat land, you notice a mountain in front of you. Its angle of elevation to the peak is 3.5°. After you drive 13 miles closer to the mountain, the angle of elevation is 9°. Approximate the height of the mountain.



$\tan 9° = \frac{x}{y}$

$x = y \tan 9°$

$\tan 3.5° = \frac{x}{13+y}$

$x = 13 \tan 3.5° + y \tan 3.5°$

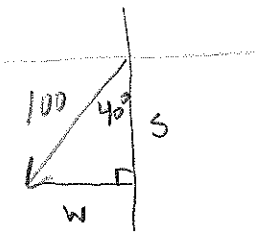
$y \tan 9° = 13 \tan 3.5° + y \tan 3.5°$

$y = \frac{13 \tan 3.5°}{(\tan 9° - \tan 3.5°)} = 8.18$

But... $x = 8.18(\tan 9°) = 1.30 \text{ miles}$

13) A ship leaves port at 3 pm and sails at a bearing of S 40° W. The ship sails at 25 miles per hour. At 7 pm, the ship puts down anchor.

a) How many miles south of the port is the ship at 7 pm?



$4 \times 25 = 100$

$\cos 40° = \frac{S}{100}$

$S = 100 \cos 40° = 76.60$ miles

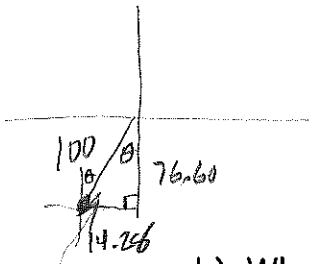
b) How many miles west of the port is the ship at 7 pm?

$\sin 40° = \frac{W}{100}$

$W = 100 \sin 40° = 64.28$ miles

14) The ship in problem #13 picks up anchor at 8 pm and sails due west at 25 mph until 10 pm when it runs ashore on a sand-bar.

a) How far is the ship from the original port at 10 pm?



$\sqrt{76.60^2 + 14.28^2} = 77.92$ miles

b) What is the bearing from the sand bar to the original port?

$\sin \theta = \frac{14.28}{100}$

$\theta = \sin^{-1}\left(\frac{14.28}{100}\right) = 8.21°$

$90 - 8.21 = 81.79°$

8.21°

FOR THE NEXT FEW PROBLEMS, YOU NEED TO USE THESE TWO FORMULAS:

$$w = \frac{\theta}{t} \qquad v = \frac{s}{t} = \frac{\theta \bullet r}{t}$$

15) A wheel with a diameter of 28 inches is traveling at 49 mph. Find the angular velocity in degrees per minute.

14)

$$v = \frac{\theta r}{t} = \frac{49 \text{ mi}}{\text{hr}}$$

$$w = \frac{\theta}{t} = \frac{49 \text{ mi}}{\text{hr}} \cdot \frac{1}{14 \text{ in}} \cdot \frac{12 \text{ in}}{1 \text{ ft}} \cdot \frac{5280 \text{ ft}}{1 \text{ mi}} \cdot \frac{1 \text{ hr}}{60 \text{ min}}$$

$$= \frac{310460}{840 \text{ min}} \cdot 360^\circ = \frac{3696 \cdot 360^\circ}{1 \text{ min}}$$

$$= \frac{1330560^\circ}{\text{min}}$$

16) A truck tire has a diameter of 34 inches. It is spinning at a rate of 450 rpm. What is the speed of the truck in mph?

$$v = \frac{\theta r}{t} = \frac{450 \text{ rev}}{\text{min}} \cdot \frac{2\pi \text{ rad}}{\text{rev}} \cdot 17 \text{ in} \cdot \frac{1 \text{ ft}}{12 \text{ in}} \cdot \frac{1 \text{ mi}}{5280 \text{ ft}}$$

$$= \frac{15300\pi}{63360} = \frac{85\pi}{352} \frac{\text{mi}}{\text{hr}}$$

16) A wheel has a diameter of 35 inches. It is spinning at a rate of 150 revolutions per minute.

a) What is the angular velocity of the wheel in degrees per minute? (do not round)

$$w = \frac{\theta}{t} = \frac{150 \text{ revs}}{1 \text{ min}} \cdot \frac{360^\circ}{1 \text{ rev}} = \frac{5400^\circ}{\text{min}}$$

b) What is the angular velocity of the wheel in radians per hour? (do not round)

$$w = \frac{\theta}{t} = \frac{150 \text{ rev}}{\text{min}} \cdot \frac{2\pi \text{ rad}}{1 \text{ rev}} \cdot \frac{60 \text{ min}}{1 \text{ hr}} = \frac{18000\pi \text{ rad}}{\text{min}}$$

c) What is the linear velocity of the wheel in inches per hour? (leave in terms of pi)

$$V = \frac{\theta r}{t} = \frac{1800\pi \text{ rad}}{\text{min}} \cdot 17.5 \text{ in} = \frac{31500\pi \text{ in}}{1 \text{ hr}}$$

d) What is the linear velocity of the wheel in miles per hour? (leave in terms of pi)

$$V = \frac{\theta r}{t} = \frac{31500\pi \text{ in}}{1 \text{ hr}} \cdot \frac{1 \text{ ft}}{12 \text{ in}} \cdot \frac{1 \text{ mi}}{5280 \text{ ft}} = \frac{875\pi \text{ mi}}{\text{hr}}$$