$\tan 2A = \frac{2\tan A}{1-\tan^2 A}$ $\sin 2A = 2\sin A\cos A$

Section 7.5 – Practice Problems

$\cos 2A = \cos^2 A - \sin^2 A$

$2\cos^2 A - 1$

$1 - 2\sin^2 A$

1. Simplify the following expressions

a) $8\sin 5x \cos 5x$

Let $5x = A$

$8\sin A\cos A$

$4 \cdot 2\sin A\cos A$

$4\sin 2A$

$4\sin 2(5x)$

$\boxed{4\sin 10x}$

b) $4\sin\frac{x}{2}\cos\frac{x}{2}$

Let $\frac{x}{2} = A$

$4\sin A\cos A$

$2 \cdot 2\sin A\cos A$

$2\sin 2A$

$2\sin 2\left(\frac{x}{2}\right)$

$\boxed{2\sin x}$

c) $2\sin^2 2x - 2\cos^2 2x$

$-2(-\sin^2 2x + \cos^2 2x)$

$-2(\cos^2 2x - \sin^2 2x)$

$-2\cos 2(2x)$

$\boxed{-2\cos 4x}$

d) $\frac{8\tan 4x}{1-\tan^2 4x}$

$\frac{4 \cdot 2\tan 4x}{1-\tan^2 4x} \rightarrow 4\tan 2(4x)$

$\boxed{4\tan 8x}$

e) $\sec 8x\,(\sin^2 4x - \cos^2 4x)$

$\frac{1}{\cos 8x} \cdot -1(\cos^2 4x - \sin^2 x)$

$\frac{1}{\cos 8x} \cdot -1(\cos 2(4x))$

$\frac{-1}{\cos 8x} \cdot \cos 8x$

$\boxed{-1}$

f) $2\sin 6x(\cos^2 3x - \sin^2 3x)$

$2\sin 6x \cos 2(3x)$

$2\sin 6x \cos 6x$

$\sin 2(6x)$

$\boxed{\sin 12x}$

g) $\frac{1}{2}\cot 4x(1 - \tan^2 4x)$

$\downarrow$

$\frac{1}{2\tan 4x}(1 - \tan^2 4x)$

$\downarrow$

$\frac{1-\tan^2 4x}{2\tan 4x} \rightarrow \frac{1}{\tan 2(4x)}$

$\frac{1}{\tan 8x} \rightarrow \boxed{\cot 8x}$

h) $\frac{1}{4}\sec 6x \csc 6x$

$\frac{1}{4\cos 6x \sin 6x} \rightarrow \frac{1}{2 \cdot 2\sin 6x \cos 6x}$

$\frac{1}{2\sin 2(6x)}$

$\frac{1}{2\sin 12x} \rightarrow \frac{1}{2}\csc 12x$

i) $4\sin^2\frac{x}{2} - 2$

$-2 + 4\sin^2\frac{x}{2}$

$-2(1 - 2\sin^2\frac{x}{2})$

$-2\cos 2(\frac{x}{2})$

$-2\cos x$

j) $2\cos^2 8x - 1$

$2\cos^2 A - 1$

$\cos 2A$

$\cos 2(8x)$

$\boxed{\cos 16x}$

k) $\frac{\sin 6x}{2\sin 3x}$

$\frac{\sin 2(3x)}{2\sin 3x} \rightarrow \frac{2\sin 3x\cos 3x}{2\sin 3x}$

$\boxed{\cos 3x}$

l) $\sin 4x \csc 2x - 2\cos 2x$

$\frac{\sin 2(2x)}{\sin 2x} - 2\cos 2x$

$\frac{2\cancel{\sin 2x}\cos 2x}{\cancel{\sin 2x}} - 2\cos 2x$

$2\cos 2x - 2\cos 2x$

$\boxed{0}$

m) $\sin 4x - (\sin 2x + \cos 2x)^2$

$\sin 4x - [(\sin 2x + \cos 2x)(\sin 2x + \cos 2x)]$

$\sin 4x - [\sin^2 2x + 2\sin 2x\cos 2x + \cos^2 2x]$

$\downarrow$

$2\sin 2x\cos 2x - \sin^2 2x - 2\sin 2x\cos 2x - \cos^2 2x$

$-\sin^2 2x - \cos^2 2x$

$-1(\sin^2 2x + \cos^2 2x)$

$-1(1)$ $\boxed{-1}$

n) $\sin^4 3x - \cos^4 3x$

$(\sin^2 3x + \cos^2 3x)(\sin^2 3x - \cos^2 3x)$

$\downarrow$

$1(-\cos^2 3x + \sin^2 3x)$

$1(-1(\cos^2 3x - \sin^2 3x)$

$-1(\cos 6x)$

$\boxed{-\cos 6x}$

o) $\frac{2}{1-\cos 8x}$

$\frac{2}{1-\cos 2(4x)}$

$\frac{2}{1-(1-2\sin^2 4x)}$ $\leftarrow$ strategic choice

$\frac{2}{1-1+2\sin^2 4x} \rightarrow \frac{2}{2\sin^2 4x}$

$\frac{1}{\sin^2 4x} \rightarrow \boxed{\csc^2 4x}$

p) $\frac{4}{\tan 3x - \cot 3x}$ shift to sin and cos

$\frac{4}{\frac{\sin 3x}{\cos 3x} - \frac{\cos 3x}{\sin 3x}} \rightarrow \frac{4}{\frac{\sin^2 3x - \cos^2 3x}{\sin 3x\cos 3x}}$

$\frac{4\sin 3x\cos 3x}{\sin^2 3x - \cos^2 3x} \rightarrow \frac{2(2\sin 3x\cos 3x)}{-1(\cos^2 3x - \sin^2 3x)}$

$\frac{2\sin 6x}{-1\cos 6x} \rightarrow \frac{-2\sin 6x}{\cos 6x}$

$\boxed{-2\tan 6x}$

2. Solve, $0 \le x < 2\pi$

a) $\sin 2x + \cos x = 0$

$2\sin x\cos x + \cos x = 0$

$\cos x(2\sin x + 1) = 0$

$\downarrow$ $\frac{\pi}{2}$ and $\frac{3\pi}{2}$

$\searrow$ $\sin x = -\frac{1}{2}$ Ref angle $\frac{\pi}{6}$

Q3 Q4

$\downarrow$ $\frac{7\pi}{6}$ $\downarrow$ $\frac{11\pi}{6}$

$\frac{\pi}{2}, \frac{3\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$

b) $\sin x + \cos 2x = 1$

be strategic get a sin value.

$\sin x + 1 - 2\sin^2 x = 1$

$2\sin^2 x - \sin x = 0$

$\sin x(2\sin x - 1) = 0$

$\downarrow$ 0 and π

$\searrow$ $\sin x = \frac{1}{2}$ $\pi/6$ ba'd

Q1

Q2

$0, \pi, \frac{\pi}{6}, \frac{5\pi}{6}$

c) $3\cos 2x + 2\sin^2 x = 2$

$3(1 - 2\sin^2 x) + 2\sin^2 x - 2 = 0$

$3 - 6\sin^2 x + 2\sin^2 x - 2 = 0$

$2\sin^2 x - 6\sin^2 x + 1 = 0$

$-4\sin^2 x + 1 = 0 \rightarrow 4\sin^2 x - 1 = 0$

$(2\sin x + 1)(2\sin x - 1) = 0$

$\sin x = -\frac{1}{2}$ $\sin x = \frac{1}{2}$ Ref angle $\frac{\pi}{6}$

all Q's

$\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$

d) $\sin 2x = \cot x$

$2\sin x\cos x = \frac{\cos x}{\sin x}$

$2\sin^2 x\cos x - \cos x = 0$

$\cos x(2\sin^2 x - 1) = 0$

$\downarrow$ $\frac{\pi}{2}, \frac{3\pi}{2}$

$\searrow$ $\sin^2 x = \frac{1}{2}$

$\sin x = \pm\frac{1}{\sqrt{2}}$ Ref angle $\frac{\pi}{4}$

$\frac{\pi}{2}, \frac{3\pi}{2}, \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$ all Q's

e) $\csc^2 x = 2\sec 2x$

$$\frac{1}{\sin^2 x} = \frac{2}{\cos 2x}$$

$$\frac{1}{\sin^2 x} = \frac{2}{1-2\sin^2 x}$$

$$1-2\sin^2 x = 2\sin^2 x$$

$$1 = 4\sin^2 x \rightarrow 4\sin^2 x - 1 = 0$$

$$(2\sin x+1)(2\sin x-1) = 0$$

all Q's ref ang $\frac{\pi}{6}$

$\sin x = -\frac{1}{2}$ $\quad \sin x = \frac{1}{2}$

$$\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$$

f) $\tan x - \cot x = 2$

$$\tan x - \frac{1}{\tan x} = 2$$

$$\frac{\tan^2 x - 1}{\tan x} = 2 \rightarrow \tan^2 x - 1 = 2\tan x$$

$$\tan^2 x - 2\tan x - 1 = 0$$

$$\tan^2 x - 1 = 2\tan x$$

$$-1(1-\tan^2 x) = 2\tan x$$

$$-1 = \frac{2\tan x}{1-\tan^2 x}$$

$$-1 = \tan 2x$$

$2x = -1$ at ref angle $\frac{\pi}{4}$

Q2 Q4

$2x = \frac{3\pi}{4} \rightarrow \boxed{x = \frac{3\pi}{8} \text{ and } \frac{11\pi}{8}}$

$2x = \frac{7\pi}{4} \quad \boxed{x = \frac{7\pi}{8} \text{ and } \frac{15\pi}{8}}$

g) $\tan 2x + \tan x = 0$

$$\frac{2\tan x}{1-\tan^2 x} + \tan x = 0$$

$$2\tan x + \tan x(1-\tan^2 x) = 0$$

$$2\tan x + \tan x - \tan^3 x = 0$$

$$\tan^3 x - 3\tan x = 0$$

$$\tan x(\tan^2 x - 3) = 0$$

$0, \pi$

$$\tan^2 x = 3$$

$$\tan x = \pm\sqrt{3}$$

Ref angle $\frac{\pi}{3}$

Q1 Q2 Q3 Q4

$$0, \pi, \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$$

h) $4\sin^2 x = 2 - \cos^2 2x$

$$\cos^2 2x = 2 - 4\sin^2 x$$

$$\cos^2 2x = 2(1-2\sin^2 x)$$

$$\cos^2 2x = 2\cos 2x$$

$$\cos^2 2x - 2\cos 2x = 0$$

undefined

$$\cos 2x(\cos 2x - 2) = 0$$

$$\cos 2x = 0$$

$2x = \frac{\pi}{2}$ and $\frac{3\pi}{2}$

$$x = \frac{\pi}{4} \quad \frac{3\pi}{4} \quad \frac{5\pi}{4} \quad \frac{7\pi}{4}$$

$$2x = \frac{\pi}{2} + 2\pi$$

$$2x = \frac{5\pi}{2}$$

$$2x = \frac{3\pi}{2} + 2\pi \rightarrow 2x = \frac{7\pi}{2}$$

$2\cos^2 A - 1 = \cos 2A$

i) $\cos 4x + 2\cos^2 2x = 2$

Let $A = 2x$

was the 2

$\cos 2A + \underbrace{2\cos^2 A - 1}_{} - 1 = 0$

$\cos 2A + \cos 2A - 1 = 0$

$2\cos 2A - 1 = 0$

$\cos 2A = \frac{1}{2} \rightarrow \cos 4x = \frac{1}{2}$

ref angle $\frac{\pi}{3}$

$\frac{2\pi}{4} = \frac{\pi}{2}$

this is Period means we have 8 sol'n over 2π

$4x = \frac{\pi}{3} + 2\pi n$

$4x = \frac{5\pi}{3} + 2\pi n$

$x = \frac{\pi}{12} + \frac{\pi n}{2}$

$\frac{5\pi}{12} + \frac{\pi n}{2}$

$\frac{\pi}{12}, \frac{7\pi}{12}, \frac{13\pi}{12}, \frac{19\pi}{12}, \frac{5\pi}{12}, \frac{11\pi}{12}, \frac{17\pi}{12}, \frac{23\pi}{12}$

j) $\csc^2 x = 2\sec 2x$

$\csc^2 x = \frac{2}{\cos 2x}$

$\frac{1}{\sin^2 x} = \frac{2}{\cos 2x}$

common denominator

$\cos 2x = 2\sin^2 x$

$1 - 2\sin^2 x = 2\sin^2 x$

$4\sin^2 x - 1 = 0$

$(2\sin x - 1)(2\sin x + 1) = 0$

$\sin x = \pm\frac{1}{2}$ Ref angle $\pi/6$

All Q's

$\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$

3. Prove the following identities

a) $\cot x - \tan x = \frac{4\cos^2 x - 2}{\sin 2x}$

$\frac{\cos x}{\sin x} - \frac{\sin x}{\cos x}$

$\frac{\cos^2 x - \sin^2 x}{\sin x \cos x}$

$\frac{\cos 2x}{\sin x \cos x}$

$\frac{2(2\cos^2 x - 1)}{\sin 2x}$

$\frac{2\cos 2x}{\sin 2x}$

$\frac{2\cos 2x}{2\sin x \cos x}$

$\frac{\cos 2x}{\sin x \cos x}$

LHS = RHS

b) $\frac{\sin 4x - \sin 2x}{\cos 4x + \cos 2x} = \tan x$

$\frac{2\sin 2x \cos 2x - \sin 2x}{2\cos^2 2x - 1 + \cos 2x}$

$\frac{\sin 2x(2\cos 2x - 1)}{2\cos^2 2x + \cos 2x - 1}$

$\frac{\sin 2x(\cancel{2\cos 2x - 1})}{(\cancel{2\cos 2x - 1})(\cos 2x + 1)}$

$\frac{\sin 2x}{\cos 2x + 1}$

LHS = RHS

$\frac{2\sin x \cos x}{2\cos^2 x - 1 + 1}$

$\frac{2\sin x \cos x}{2\cos^2 x} \rightarrow \frac{\cancel{2}\sin x \cancel{\cos x}}{\cancel{2}\cos^{\cancel{2}} x} \rightarrow \frac{\sin x}{\cos x} \rightarrow \tan x$

c) $\tan 2x = \dfrac{2}{\cot x - \tan x}$

$$\frac{2}{\frac{1}{\tan x} - \tan x}$$

$$\frac{2}{\frac{1-\tan^2 x}{\tan x}}$$

$$\frac{2\tan x}{1-\tan^2 x}$$

$$\tan 2x$$

d) $\dfrac{\cot x - \cos x}{1-\sin x} = \dfrac{\sin 2x}{1-\cos 2x}$

$$\frac{\frac{\cos x}{\sin x} - \cos x}{1-\sin x}$$

$$\frac{\frac{\cos x - \cos x \sin x}{\sin x}}{1-\sin x}$$

$$\frac{\cos x(1-\sin x)}{\sin x} \cdot \frac{1}{1-\sin x}$$

$$\frac{\cos x}{\sin x}$$

$$\cot x$$

$$\frac{2\sin x\cos x}{1-(1-2\sin^2 x)}$$

$$\frac{2\sin x\cos x}{1-1+2\sin^2 x}$$

$$\frac{\cancel{2}\cancel{\sin x}\cos x}{\cancel{2}\sin^{\cancel{2}} x}$$

$$\frac{\cos x}{\sin x}$$

$$\cot x$$

e) $\cot 2x = \dfrac{\cot^2 x - 1}{2\cot x}$

$$\frac{\frac{1}{\tan^2 x} - 1}{\frac{2}{\tan x}}$$

$$\frac{\frac{1-\tan^2 x}{\tan^2 x}}{\frac{2}{\tan x}}$$

$$\frac{1-\tan^2 x}{\tan^2 x} \cdot \frac{\tan x}{2}$$

$$\frac{1-\tan^2 x}{2\tan x}$$

$$\frac{1}{\tan 2x}$$

$$\frac{1-\tan^2 x}{2\tan x}$$

f) $\dfrac{\cos 2x}{1-\sin 2x} = \dfrac{1+\tan x}{1-\tan x}$

$$\frac{1+\frac{\sin x}{\cos x}}{1-\frac{\sin x}{\cos x}} \rightarrow \frac{\frac{\cos x+\sin x}{\cos x}}{\frac{\cos x-\sin x}{\cos x}}$$

$$\frac{\cos x+\sin x}{\cos x-\sin x} \cdot \frac{(\cos x-\sin x)}{(\cos x-\sin x)}$$

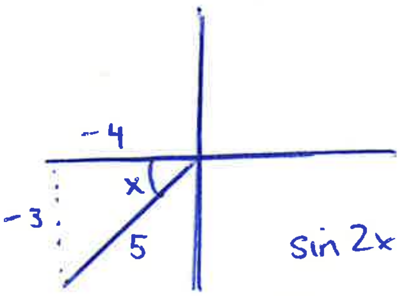
$$\frac{\cos^2 x-\sin^2 x}{\cos^2 - 2\sin x\cos x+\sin^2 x}$$

$$\frac{\cos 2x}{\sin^2 x+\cos^2 x - 2\sin x\cos x}$$

$$\frac{\cos 2x}{1-\sin 2x}$$

4. If $\sin x = -\frac{3}{5}$ in $Q3$, find:

a) $\sin 2x$



$\sin 2x$

$2\sin x\cos x$

$2\left(-\frac{3}{5}\right)\left(-\frac{4}{5}\right)$

$\boxed{\frac{24}{25}}$

b) $\cos 2x$

$\cos 2x$

$\cos^2 x - \sin^2 x$

$\left(\frac{-4}{5}\right)^2 - \left(-\frac{3}{5}\right)^2$

$\frac{16}{25} - \frac{9}{25}$

$\boxed{\frac{7}{25}}$

c) $\tan 2x$

$\tan 2x$

$\frac{2\tan x}{1-\tan^2 x}$

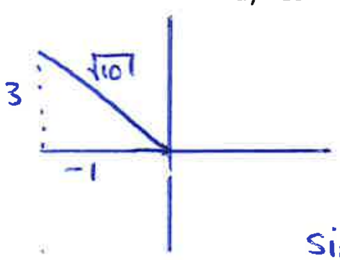
$\frac{2\left(3/4\right)}{1-\left(3/4\right)^2}$

$\frac{\frac{3}{2}}{1-9/16} \rightarrow \frac{\frac{3}{2}}{\frac{7}{16}} \rightarrow \frac{3}{2}\cdot\frac{16}{7}$

$\boxed{\frac{24}{7}}$

5. If $\tan x = -3$, in $Q2$, find:

a) $\sin 2x$



$\sin 2x$

$2\sin x\cos x$

$2\left(\frac{3}{\sqrt{10}}\right)\left(\frac{-1}{\sqrt{10}}\right)$

$\frac{-6}{10} = \boxed{\frac{-3}{5}}$

b) $\tan 2x$

$\tan 2x$

$\frac{2\tan x}{1-\tan^2 x}$

$\frac{2(-3)}{1-(-3)^2}$

$\frac{-6}{-8} = \boxed{3/4}$

c) $\sec 2x$

$\sec 2x \rightarrow \frac{1}{\cos 2x}$

$\frac{1}{\cos^2 x - \sin^2 x}$

$\frac{1}{\left(\frac{-1}{\sqrt{10}}\right)^2 - \left(\frac{3}{\sqrt{10}}\right)^2}$

$\frac{1}{\frac{1}{10} - \frac{9}{10}}$

$\frac{1}{-8/10}$

$\frac{-10}{8} = \boxed{\frac{-5}{4}}$

6. Write $\cos 3x$ in terms of $\cos x$

$\cos 3x \rightarrow \cos(2x+x) \rightarrow \cos 2x \cos x - \sin 2x \sin x$

$(1-2\sin^2 x)\cos x - 2\sin x\cos x \cdot \sin x \rightarrow \cos x - 2\sin^2 x\cos x - 2\sin^2 x\cos x$

$\cos x - 4\sin^2 \cos x \rightarrow \cos x(1-4\sin^2 x) \rightarrow \cos x(1-4(1-\cos^2 x))$

$\cos x(1-4+4\cos^2 x) \rightarrow \cos x(-3+4\cos^2 x)$

$-3\cos x + 4\cos^3 x$

$\boxed{4\cos^3 x - 3\cos x}$

7. Write $\cos 4x$ in terms of $\cos x$

$\cos 4x \rightarrow \cos(2x+2x) \rightarrow \cos 2x \cos 2x - \sin 2x \sin 2x$

$(2\cos^2 x - 1)(2\cos^2 x - 1) - [2\sin x\cos x \cdot 2\sin x\cos x]$

$4\cos^4 x - 4\cos^2 x + 1 - [4\sin^2 x\cos^2 x]$

$4\cos^4 x - 4\cos^2 x + 1 - [4(1-\cos^2 x)\cos^2 x]$

$4\cos^4 x - 4\cos^2 x + 1 - [4 - 4\cos^2 x)\cos^2 x]$

$4\cos^4 x - 4\cos^2 x + 1 - (4\cos^2 x - 4\cos^4 x)$

$4\cos^4 x - 4\cos^2 x + 1 - 4\cos^2 x + 4\cos^4 x$

$\boxed{8\cos^4 x - 8\cos^2 x + 1}$

8. Write $\tan^4 x$ in terms of a first power.

$$\tan^4 x \to \tan^2 x \cdot \tan^2 x \to (\tan^2 x)^2$$

use power reducing formulas (PRF's)

$$\left(\frac{1-\cos 2x}{1+\cos 2x}\right)^2 \to \frac{1-\cos 2x}{1+\cos 2x} \cdot \frac{1-\cos 2x}{1+\cos 2x} \to \frac{1-2\cos 2x+\cos^2 2x}{1+2\cos 2x+\cos^2 2x}$$

$$\frac{1-2\cos 2x+\frac{1+\cos 4x}{2}}{1+2\cos 2x+\frac{1+\cos 4x}{2}} \to \frac{\frac{2-4\cos 2x+1+\cos 4x}{\cancel{2}}}{\frac{2+4\cos 2x+1+\cos 4x}{\cancel{2}}}$$

$$\boxed{\frac{3-4\cos 2x+\cos 4x}{3+4\cos 2x+\cos 4x}}$$

9. Write $\sin^2 x\cos^4 x$ in terms of the first power of Cosine.

Diff of Squares

PRF's

$$\sin^2 x\cos^4 x \to (1-\cos^2 x)\cos^4 x \to (1-\cos^2 x)(\cos^2 x)(\cos^2 x)$$

$$(1-\cos x)(1+\cos x)\left(\frac{1+\cos 2x}{2}\right)\left(\frac{1+\cos 2x}{2}\right)$$

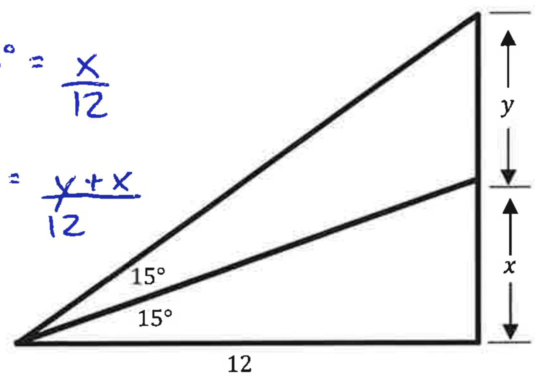
$$\frac{(1-\cos x)(1+\cos x)(1+\cos 2x)(1+\cos 2x)}{4} \to \frac{(1-\cos x)(1+\cos x)(1+2\cos 2x+\cos^2 2x)}{4}$$

$$\frac{(1-\cos x)(1+\cos x)\left(1+2\cos 2x+\frac{1+\cos 4x}{2}\right)}{4} \to \frac{(1-\cos x)(1+\cos x)\left(\frac{2+4\cos 2x+1+\cos 4x}{2}\right)}{4}$$

$$\frac{(1-\cos x)(1+\cos x)(\cos 4x+4\cos 2x+3)}{8}$$

DEGREE MODE

10. Find y



$\tan 15° = \frac{x}{12}$

$\tan 30° = \frac{y+x}{12}$

$12\tan 15 = x$

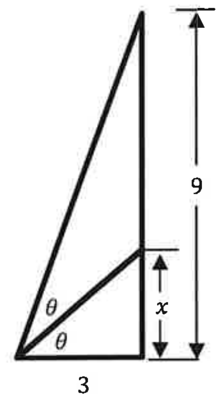
$12\tan 30 - y = x$

$12\tan 15 = 12\tan 30 - y$

$y = 12\tan 30 - 12\tan 15$

$\boxed{y = 3.71}$

11. Find x



$\tan 2\theta = \frac{9}{3}$

$\tan 2\theta = 3$

$2\theta = \tan^{-1} 3$

$2\theta = 71.57°$

$\theta = 35.78°$

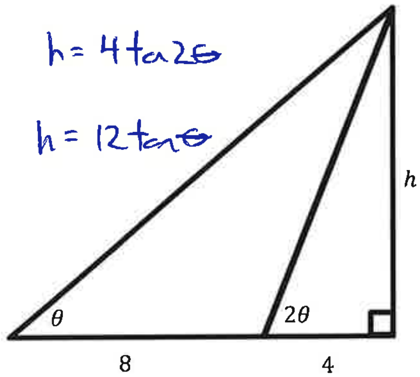
$\tan \theta = \frac{x}{3}$

$\tan 35.78 = \frac{x}{3}$

$x = 3\tan 35.78$

$x = 2.16$

12. Find h



$\tan 2\theta = \frac{h}{4}$

$\tan\theta = \frac{h}{12}$

$h = 4\tan 2\theta$

$h = 12\tan\theta$

$4\tan 2\theta = 12\tan\theta$

$4\left(\frac{2\tan\theta}{1-\tan^2\theta}\right) = 12\tan\theta$

$\frac{8\tan\theta}{4} = \frac{12\tan\theta(1-\tan^2\theta)}{4}$

$2\tan\theta = 3\tan\theta(1-\tan^2\theta)$

$2\tan\theta = 3\tan\theta - 3\tan^3\theta$

$3\tan^3\theta - \tan\theta = 0$

$\tan\theta(3\tan^2\theta - 1) = 0$

$\tan\theta = 0$ give $h=0$ so reject

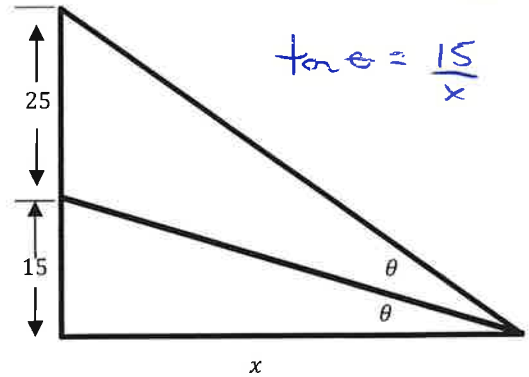
$3\tan^2\theta - 1 = 0$

$\tan^2\theta = \frac{1}{3}$ $\quad \tan\theta = \pm\frac{1}{\sqrt{3}}$ reject negative

$\tan\theta = \frac{h}{12} \rightarrow 12\left(\frac{1}{\sqrt{3}}\right) = h$

$\boxed{h = 6.93}$

13. Find x



$\tan 2\theta = \frac{40}{x}$

$\tan\theta = \frac{15}{x}$

$x = \frac{40}{\tan 2\theta}$ $\quad x = \frac{15}{\tan\theta}$

solve for $\tan\theta$

$\frac{40}{\tan 2\theta} = \frac{15}{\tan\theta} \rightarrow 40\tan\theta = 15\tan 2\theta$

$8\tan\theta = 3\tan 2\theta$

$8\tan\theta = 3\left[\frac{2\tan\theta}{1-\tan^2\theta}\right]$

$8\tan\theta = \frac{6\tan\theta}{1-\tan^2\theta} \rightarrow 8\tan\theta - 8\tan^3\theta = 6\tan\theta$

$8\tan^3\theta - 2\tan\theta = 0$

$2\tan\theta(4\tan^2\theta - 1) = 0$

undefined as h would $= 0$

$\tan^2\theta = \frac{1}{4}$

$\tan\theta = \pm\frac{1}{2}$ Reject negative

$\theta = \tan^{-1}\left(\frac{1}{2}\right)$

$\theta = 26.57^\circ$

$\boxed{x = \frac{15}{\tan 26.57^\circ} = 30}$

See Website for Detailed Answer Key

Extra Work Space