

# 11.4 Double and Half Angle Identities

Write your  
questions here!



$\sin 2\theta$

$\cos 2\theta$

$\tan 2\theta$

Ex 1: If  $\cos \theta = \frac{\sqrt{5}}{5}$  and  $0^\circ < \theta < 90^\circ$ , find the exact value of each function.

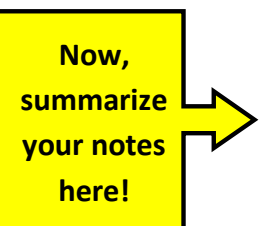
Ex 2: Find the exact value of each!

Ex 3: If  $\sin \theta = \frac{5}{7}$  and  $90^\circ < \theta < 180^\circ$ , find the exact value of each function.

Ex 4: Verify the following:

Ex 5: Verify the following:

**SUMMARY:**



## 11.4 Double and Half Angle Identities

## PRACTICE

Directions: Tell whether each statement is true.

1)  $\cos 2(20^\circ) = 2\cos^2 40^\circ - 1$

2)  $\cos(70^\circ) = \cos^2 35^\circ - \sin^2 35^\circ$

3)  $\tan \frac{140^\circ}{2} = -\sqrt{\frac{1-\cos 140^\circ}{1+\cos 140^\circ}}$

Directions: Find the exact value of the given function.

4)  $\cos 75^\circ$

5)  $\sin \frac{5\pi}{8}$

Directions: For #6-9: If  $\sin x = \frac{3}{5}$  and  $x$  is in Quadrant II, find each value. Draw the reference triangle.

6)  $\cos 2x$

7)  $\tan 2x$

8)  $\sin \frac{x}{2}$

9)  $\cos \frac{x}{2}$

Directions: For #10-13: If  $\cos \theta = -\frac{1}{3}$  and  $\theta$  is in Quadrant II, find each value. Draw the reference triangle.

10)  $\cos 2\theta$

11)  $\sin 2\theta$

12)  $\tan \frac{\theta}{2}$

13)  $\sin \frac{\theta}{2}$

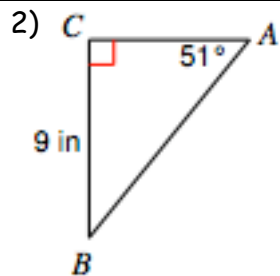
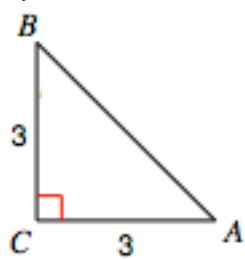
Directions: Verify the following identities.

14)  $1 + \sin 2x = (\sin x + \cos x)^2$

15)  $\tan \frac{x}{2} = \frac{\sin x}{1 + \cos x}$

REVIEW SKILLZ: Directions: Solve the triangle.

1)



### 11.4 Application and Extension

If  $\tan \theta = -\frac{1}{3}$  and  $x$  is in Quadrant II, find each value. Draw the reference triangle.

1)  $\cos 2x$

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

3) Mr. Bean is a tremendous golfer. He can hit the ball with an initial velocity of 50 feet per second. The distance that a golf ball travels is found by the formula  $d = \frac{v_0^2}{g} \sin 2\theta$ , where  $v_0$  is the initial velocity,  $g$  is the acceleration due to gravity and  $\theta$  is the measure of the angle that the initial path of the ball makes with the ground. The acceleration due to gravity is  $32 \text{ ft/s}^2$ .

a. Write an expression for the distance the ball travels in terms of  $\theta$ .

b. Use a calculator to find the distance Mr. Bean's ball traveled if the angle between the initial path of the ball and the ground measured  $60^\circ$ .

4) For each equation try the following values  $\left(x = 0, \pi, \frac{\pi}{2}, \frac{\pi}{4}, \frac{\pi}{6}\right)$  and calculate both the left and right sides of the equation. If the equation is an identity, VERIFY IT! If it is not an identity, find a value of  $x$  for which both sides are defined but not equal.

a)  $\sin 4x = 4 \sin x \cos x$

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

**BRING THE PAIN!** Use your graphing calculator and determine which of the following three equations is a trig identity. Then verify it!

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

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

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