Math 120 Exam #2 **NAME**_____

No books or notes allowed. Do not talk to, give help to, or receive help from others. Check your work. Please show as much work as possible. It may help with partial credit.

1-3 **[20 points]** Suppose the height *h* (in feet) of a yoyo above the ground exactly *t* seconds after it is released is given by $h(t) = 2 - 0.75\sin(7t + 4)$

1 What is the highest that the yoyo ever gets above the ground (in feet)?

Answer: _____ feet.

2 Give a formula (involving $n = 0, \pm 1, \pm 2, \ldots$) for all of the times *t* that the yoyo is exactly 2 feet above the ground. Give exact numbers in your formula; don't convert to decimals. Show your work.

Answer:

3 When is the **first** time (in seconds) after $t = 0$ that the yoyo is exactly 2 feet above the ground? Give a decimal answer accurate to two places after the decimal point.

Answer: $t =$_____

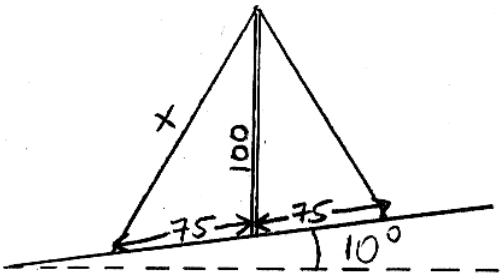
4 **[10 points]** Find the exact value of $\cos\left(\frac{13\pi}{12}\right)$. (Note: $\frac{13\pi}{12} = \frac{\frac{13\pi}{6}}{2}$)

Answer: $\cos\left(\frac{13\pi}{12}\right) =$ _____

5 **[19 points]** Find all solutions of $\sin(2x) = \cos x$. Your answer should be a set of formulas involving n where $n = 0, \pm 1, \pm 2, \ldots$ Give exact numbers in your formulas; don't convert to decimals.

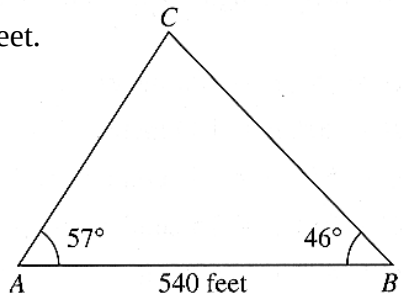
Answer:

6 **[18 points]** A 100-foot tall radio antenna is to be set up exactly vertically on a slope that makes a 10° angle with the horizontal (see the figure). It will be anchored by two wires that are located 75 feet directly uphill and downhill from the antenna, as shown. Find the length of the wire that is downhill from the antenna, labeled as x in the figure.



Answer: $x =$ _____ feet

7 **[18 points]** Find the distance from point *A* to point *C* in feet.



Answer: The distance *AC* =

8 **[15 points]** Simplify the trigonometric expression $\cos x + \sin x \tan x$. You should find that your answer is much simpler than the original expression. Show all of your work as you simplify.

Answer: $\cos x + \sin x \tan x =$ _____

Sum and Difference Formulas

$$\sin(u + v) = \sin u \cos v + \cos u \sin v$$

$$\sin(u - v) = \sin u \cos v - \cos u \sin v$$

$$\cos(u + v) = \cos u \cos v - \sin u \sin v$$

$$\cos(u - v) = \cos u \cos v + \sin u \sin v$$

$$\tan(u + v) = \frac{\tan u + \tan v}{1 - \tan u \tan v}$$

$$\tan(u - v) = \frac{\tan u - \tan v}{1 + \tan u \tan v}$$

Double-Angle Formulas

$$\sin 2u = 2 \sin u \cos u$$

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

$$\cos 2u = \cos^2 u - \sin^2 u$$
$$= 2 \cos^2 u - 1$$
$$= 1 - 2 \sin^2 u$$

Power-Reducing Formulas

$$\sin^2 u = \frac{1 - \cos 2u}{2} \qquad \cos^2 u = \frac{1 + \cos 2u}{2} \qquad \tan^2 u = \frac{1 - \cos 2u}{1 + \cos 2u}$$

Half-Angle Formulas

$$\sin \frac{u}{2} = \pm \sqrt{\frac{1 - \cos u}{2}}$$

$$\cos \frac{u}{2} = \pm \sqrt{\frac{1 + \cos u}{2}}$$

$$\tan \frac{u}{2} = \frac{1 - \cos u}{\sin u} = \frac{\sin u}{1 + \cos u}$$

The signs of $\sin \frac{u}{2}$ and $\cos \frac{u}{2}$ depend on the quadrant in which $\frac{u}{2}$ lies.

Sum-to-Product Formulas

$$\sin u + \sin v = 2 \sin\left(\frac{u + v}{2}\right) \cos\left(\frac{u - v}{2}\right)$$

$$\sin u - \sin v = 2 \cos\left(\frac{u + v}{2}\right) \sin\left(\frac{u - v}{2}\right)$$

$$\cos u + \cos v = 2 \cos\left(\frac{u + v}{2}\right) \cos\left(\frac{u - v}{2}\right)$$

$$\cos u - \cos v = -2 \sin\left(\frac{u + v}{2}\right) \sin\left(\frac{u - v}{2}\right)$$

Product-to-Sum Formulas

$$\sin u \sin v = \frac{1}{2}[\cos(u - v) - \cos(u + v)]$$

$$\cos u \cos v = \frac{1}{2}[\cos(u - v) + \cos(u + v)]$$

$$\sin u \cos v = \frac{1}{2}[\sin(u + v) + \sin(u - v)]$$

$$\cos u \sin v = \frac{1}{2}[\sin(u + v) - \sin(u - v)]$$