B5 Find all sol'ns $x \in [0, 2\pi]$ (should be $[0, 2\pi)$)

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

$0 \le x \le 2\pi \Rightarrow$

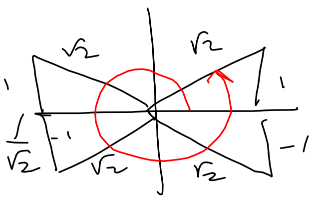
$0 \le 3x \le 6\pi$

$2\sin^2(3x) = 1$

$\sin^2(3x) = \frac{1}{2}$

$\sin(3x) = \pm\sqrt{\frac{1}{2}} = \pm\frac{1}{\sqrt{2}}$

$\sin(3x) = \frac{\pm 1}{\sqrt{2}} \Rightarrow 3x = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}, \frac{9\pi}{4}, \frac{11\pi}{4}, \frac{13\pi}{4}, \frac{15\pi}{4}, \frac{17\pi}{4}, \frac{19\pi}{4}, \frac{21\pi}{4}, \frac{23\pi}{4}$



3 TIMES : $3 \cdot 2\pi = 6\pi = \frac{24\pi}{4}$

$\Rightarrow x = \frac{\pi}{12}, \frac{3\pi}{12} = \frac{\pi}{4}, \frac{5\pi}{12}, \frac{7\pi}{12}, \frac{9\pi}{12} = \frac{3\pi}{4}, \frac{11\pi}{12}, \frac{13\pi}{12}, \frac{15\pi}{12} = \frac{5\pi}{4}, \frac{17\pi}{12}, \frac{19\pi}{12}, \frac{21\pi}{12} = \frac{7\pi}{4}, \frac{23\pi}{12}$

$2 \cdot \sin\left(\frac{3 \cdot 23 \cdot Pi}{12}\right)^2 - 1 = 0$ is a random check and it checks.

B2 A gun with a muzzle velocity of 370 meters per second is fired, at ground level, with an angle of 15^0 from the horizontal.

a. (5 pts) Find the horizontal and vertical components of the bullet, as it leaves the muzzle, accurate to 4 decimal places.

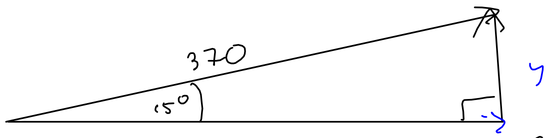
b. (5 pts) Use a half-angle formula to find the *exact* value for the answer to the previous.

c. (5 pts) Using $-9.8\ \frac{m}{s^2}$ for the acceleration due to gravity, and neglecting air friction, predict where and when the bullet will hit the ground, in the gun question.

IMO, IMHO

ISWYDT

FAIK > FAIC



(a) $x = 370\cos(15^\circ) \approx 357.3925557 \approx \boxed{357.3926\ \frac{m}{s}}$

$y = 370\sin(15^\circ) \approx 95.76304669 \approx \boxed{95.7630\ \frac{m}{s}}$

$\dfrac{1+\frac{\sqrt3}{2}}{2} = \dfrac{\frac{2+\sqrt3}{2}}{2} = \dfrac{2+\sqrt3}{4}$

(b) $x = 370\sqrt{\dfrac{1+\cos 30^\circ}{2}} = 370\sqrt{\dfrac{1+\frac{\sqrt3}{2}}{2}} = \sqrt{\dfrac{2+\sqrt3}{4}}\cdot 370 = \dfrac{\sqrt{2+\sqrt3}}{2}\cdot 370$

$= \boxed{185\sqrt{2+\sqrt3} = x}$

$y = 370\sqrt{\dfrac{1-\cos 30^\circ}{2}}$

$= \boxed{185\sqrt{2-\sqrt3} = y}$

(c) $y = \frac{1}{2}gt^2 + v_0 t + y_0$ $\quad v_0 =$ y-component of the muzzle velocity.

$= -4.9t^2 + v_0 t + 0 \Rightarrow -t(4.9t - v_0) = 0$

$t = 0$ OR $t = \dfrac{v_0}{4.9}$

$\Rightarrow t = \dfrac{185\sqrt{2-\sqrt3}}{4.9} \approx 19.54347893 \approx \boxed{19.5435\ \text{sec}} \approx t$

How far downrange when it hits?

HORIZONTAL COMPONEN TIMES THE TIME

So $\left(185\sqrt{2+\sqrt3}\right)\left(\dfrac{185\sqrt{2-\sqrt3}}{4.9}\right) = x \approx 6984.693892 \approx \boxed{6984.6939\ m}$ $\quad x \approx$

Calculations

$$evalf\left(370\cdot\cos\left(\frac{15\cdot Pi}{180}\right)\right) \qquad 357.3925557$$

$$evalf\left(370\cdot\sin\left(\frac{15\cdot Pi}{180}\right)\right) \qquad 95.76304669$$

$$185\cdot\mathrm{sqrt}(2-\mathrm{sqrt}(3)) \qquad \frac{185\sqrt{6}}{2}-\frac{185\sqrt{2}}{2}$$

$$evalf(\%) \qquad 95.7630467$$

$$\frac{185\cdot\mathrm{sqrt}(2-\mathrm{sqrt}(3))}{4.9} \qquad 18.87755102\sqrt{6}-18.87755102\sqrt{2}$$

$$evalf(\%) \qquad 19.54347893$$

$$185\cdot\mathrm{sqrt}(2-\mathrm{sqrt}(3))\cdot\frac{185\cdot\mathrm{sqrt}(2+\mathrm{sqrt}(3))}{4.9}$$

$$6984.693878\left(\frac{\sqrt{6}}{2}-\frac{\sqrt{2}}{2}\right)\left(\frac{\sqrt{6}}{2}+\frac{\sqrt{2}}{2}\right)$$

6984.693892

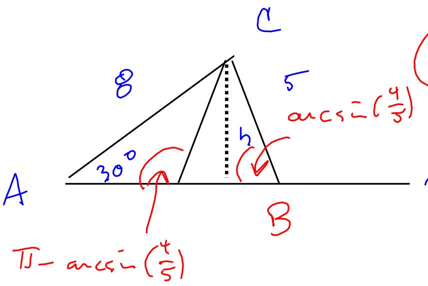
B7 The triangle described has 2 possible solutions:

Angle $A = 30^0$, side $b = 8$ and side $a = 5$.

a. (5 pts) Prove there are 2 possible triangles from this ambiguous information.

b. (5 pts) Find both triangles.

c. (5 pts) Use your work to find the area of both triangles. NOT a good investment of time.



(a) $\frac{h}{8} = \sin 30^0$

$h = 8 \sin 30^0 = 4$

$5 > h = 4 \Rightarrow$ long enough for a sol'n.

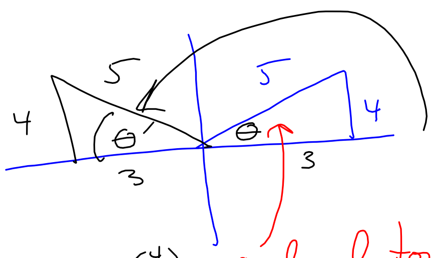
AND $5 < b = 8 \Rightarrow$ short enough for 2 sol'ns.

(b) $\frac{\sin 30^0}{5} = \frac{\sin B}{8}$

$\Rightarrow \sin B = \frac{8 \sin 30^0}{5} = \frac{4}{5}$

$\sin^{-1}(\sin B) = \sin^{-1}(\frac{4}{5})$

$\pi - \arcsin(\frac{4}{5})$ OR $\text{Arcsin}(\frac{4}{5})$



$\pi - \arcsin(\frac{4}{5})$

Calculator finds THIS one.

OR $180^0 - \arcsin(\frac{4}{5})$, $\text{Arcsin}(\frac{4}{5})$