Warm Up

If a pistol bullet is fired vertically at an initial speed of 100 m/s, the height in metres after t seconds is given by the quadratic function... $h(t) = -5t^2 + 100t + 2$

(a) Determine the height of the bullet after 2 seconds.
(b) When will the bullet reach a height of 457 m?
(c) What is the maximum height that the bullet will reach?

(a) $h(2) = -5(2)^2 + 100(2) + 2$

$= -20 + 200 + 2$

$= 182 \, m$

(c) $h(t) = -5t^2 + 100t + 2$

$h(t) = -5(t^2 - 20t + 100) + 2 + 500$

$h(t) = -5(t-10)^2 + 502$

$V(10, 502)$

(t, h)

Max. Height $= 502 \, m$

(b) $457 = -5t^2 + 100t + 2$

$\dfrac{0}{-5} = \dfrac{-5t^2}{-5} + \dfrac{100t}{-5} - \dfrac{455}{-5}$

$0 = t^2 - 20t + 91$

$t = \dfrac{20 \pm \sqrt{(-20)^2 - 4(1)(91)}}{2(1)}$

$t = \dfrac{20 \pm \sqrt{36}}{2}$

$t = \dfrac{20 \pm 6}{2}$

$t = 13 \sec \, \text{OR} \, 7 \sec$

Example - Building a Quadratic Equation

Determine a quadratic that will have the following roots...

a) 3i & -5i

$$(x-3i)(x+5i)=0$$

$$x^2+5xi-3xi-15i^2=0 \qquad \overset{i^2=-1}{\bigcirc}$$

$$\boxed{x^2+2ix+15=0}$$

b) $\dfrac{4 \overset{+}{-} 2i\sqrt{3}}{5}$

Remember... $x=-2$ & $x=\dfrac{3}{4}$

$$(x+2)(4x-3)=0$$

$$4x^2-3x+8x-6=0$$

$$\boxed{4x^2+5x-6=0}$$

$$x = \frac{4 \pm 2i\sqrt{3}\,\sqrt{-12}}{5}$$

$$ax^2 + bx + c = 0$$

$$x = -\frac{b \pm \sqrt{b^2 - 4ac}}{2a}$$

$2a = 5$ $-b = 4$

$a = \frac{5}{2}$ $b = -4$

$$2i\sqrt{3}$$
$$= \sqrt{(2i)^2 \cdot 3}$$
$$= \sqrt{-12}$$

$$-12 = b^2 - 4ac$$
$$-12 = (-4)^2 - \overset{2}{\cancel{4}}\left(\frac{5}{\cancel{2}}\right) c$$

$$-12 = 16 - 10c$$
$$-28 = -10c$$
$$\frac{28}{10} = c$$
$$\frac{14}{5} = c$$

$$\boxed{\frac{5}{2}x^2 - 4x + \frac{14}{5} = 0}$$

$\times 10$

$$25x^2 - 40x + 28 = 0$$

$$5x = \frac{4 \pm 2i\sqrt{3}}{5} \, (\cancel{5})$$

$$5x = 4 \pm 2i\sqrt{3}$$

$$(5x - 4)^2 = (\pm 2i\sqrt{3})^2$$

$$25x^2 - 40x + 16 = 4i^2(3)$$

$$25x^2 - 40x + 16 = -12$$

$$\underline{25x^2 - 40x + 28 = 0}$$