DIY: *Solving Quadratic Equations*

To review the methods of solving quadratic equations, click on the following links to watch the following YouTube videos. The videos go over various methods of solving quadratic equations including factoring, square root property, completing the square and quadratic formula. They are followed by several practice problems for you to try, covering all the basic concepts covered in the video, with answers and detailed solutions. Some additional resources are included for more practice at the end.

1. https://www.youtube.com/watch?v=8QHpFfnqJJg Introduction to quadratic equations.

2. Solving Quadratic Equations by Factoring
   a. https://www.youtube.com/watch?v=SDe-1lGeS0U Guess and Check method
   b. https://www.youtube.com/watch?v=HvBiJ9W00Z4 Factoring by grouping. (The presenter says he is factoring "trinomials", but he is only using quadratic expressions. A trinomial can be any 3-term polynomial expression, though if it is not of a quadratic form, the method taught here cannot be used.)

3. https://www.youtube.com/watch?v=Fj-BP7uaWrI Solving quadratic equations by the square root property.

4. Solving Quadratic Equations by Completing the square
   a. https://www.youtube.com/watch?v=sv0L9JpkCv0 Using the method with leading coefficient = 1
   b. https://www.youtube.com/watch?v=_dlbtdsT198 Using the method with leading coefficient ≠ 1

5. Solving Quadratic Equations by Quadratic Formula for equations with:
   a. https://www.youtube.com/watch?v=JSwjmTFMDwg two rational roots
   b. https://www.youtube.com/watch?v=H5AM1bzqCQw two irrational, real roots
   c. https://www.youtube.com/watch?v=rziJBuMI5Ts two complex roots

6. https://www.youtube.com/watch?v=px4MUZVi4Qw Predicting the type of solutions using the discriminant

7. Application of quadratic equations
   a. https://www.youtube.com/watch?v=IGGnn9oa4QY
   b. https://www.youtube.com/watch?v=-q0y2YBlX-U
   c. https://www.youtube.com/watch?v=RdfWo0ae53o
   d. https://www.youtube.com/watch?v=TzRQSD3iQA4

Practice problems: The following problems use the techniques demonstrated in the above video. The answers are given after the problems. Then detailed solutions, if you need them, are provided after the answer section. For further assistance and help please contact ***Math Assistance Area***.

1. State if the following equations are quadratic equations or not and why?
   a) 2x+3y=5 b) $8x^2 + 22 - 5x = 10$ c) $10x^{12} - 15x^2 = 10$ d) $7x^2 + 4x = 0$

2. Solve the following quadratic equations using factoring:
   a) $x^2 + 7x + 15 = 5$ b) $x^2 - 2x - 15 = 0$ c) $8x^2 + 40x - 8x + 32 = 0$ d) $9x^2 - 16 = 0$

3. Solve by using guess and check method for factoring:
   a) $14x^2 - 4x - 15 = -5$ b) $110x^2 + 23x - 3 = 0$
   c) $-x^2 - 27x - 96 = x$ d) $2x^2 + 19x + 35 = 0$

4. Solve the following quadratic equations using square-root property
   a) $x^2 + 2x - 9 =$ 2x b) $4x^2 - 31 = 1$ c) $3x^2 + 27 = -13x^2 + 9$ d) $x^2 + 30 = 5$

5. Solve the following quadratic equations using completing the square
   a) $x^2 + 8x - 9 = 0$ b) $x^2 + 3x + 5 = 100$ c) $2x^2 + 5x - 12 = 0$ d) $3x^2 - x + 3 = 0$

6. Solve the following quadratic equations using quadratic formula
   a) $x^2 + 9x + 20 = 0$ b) $16x^2 + 24x + 29 = 0$ c) $12x^2 + 6x - 1 = 0$ d) $144x^2 + 72x + 4 = 0$
   e) $20x^2 + 24x - 1 = 7x^2 - 3$ f) $-x^2 + 2x + 11 = 0$ g) $-16x^2 + 40x - 25 = 0$

7. Use the discriminant to predict the number and types of solutions of the following quadratic equations
   a) $2x^2 + 8x + 8 = 0$ b) $3x^2 + 5x + 1 = 0$
   c) $7x^2 - 28 = 0$ d) $9x^2 + 11x + 8 = 0$

8. A picture has dimensions of 12in by 30in. Joe wants to frame the picture with a border such that the total covered area is 648 sq. in. How wide is the border?

9. Find the legs and hypotenuse of a right triangle if one of the legs is 14 inches less than the longer leg and the hypotenuse is 2 inches longer than the longer leg. (Hint: use the Pythagorean Theorem. If the lengths of the legs of a right triangle are a and b and the length of the hypotenuse is c, then the relation between these lengths is always $a^2 + b^2 = c^2$.)

10. The height of a projectile is given by $h = -16t^2 + v_0 t + h_0$ where v_0 is the initial velocity and h_0 is the initial height of the projectile.

    a. Calculate the time it takes the projectile to reach a height of 60ft when it is projected with a velocity of 120ft/sec from a height of 10ft above the ground.

    b. At what time does the projectile touch the ground?
    *(**Note**: Round your answer(s) to the nearest hundredth.)*

Answers:

1.
a) No b) Yes c) No d) Yes

2.
a) {-2,-5} b) {-3,5} c) {-2} d) $\{\frac{4}{3}, -\frac{4}{3}\}$

3.
a) $\{-\frac{5}{7}, 1\}$ b) $\{\frac{1}{11}, -\frac{3}{10}\}$ c) $\{-24, -4\}$ d) $\{-\frac{5}{2}, -7\}$

4.
a) {3,-3} b) $\{2\sqrt{2}, -2\sqrt{2}\}$ c) $\{\frac{3\sqrt{2}}{4}i, -\frac{3\sqrt{2}}{4}i\}$ d) $\{5i, -5i\}$

5.
a) {1,-9} b) $\{\frac{-3+\sqrt{389}}{2}, \frac{-3-\sqrt{389}}{2}\}$ c) $\{-4, \frac{3}{2}\}$ d) $\{\frac{1+i\sqrt{35}}{6}, \frac{1-i\sqrt{35}}{6}\}$

6.
a) {-4,-5} b) $\{\frac{-3 \pm 2i\sqrt{5}}{4}\}$ c) $\{\frac{-3 \pm \sqrt{21}}{12}\}$ d) $\{\frac{-3 \pm \sqrt{5}}{12}\}$
e) $\{\frac{-12 \pm \sqrt{118}}{13}\}$ f) $\{1 \pm 2\sqrt{3}\}$ g) $\{\frac{5}{4}\}$

7.
a) One Real Solution b) Two real, irrational Solutions c) Two real, rational solutions d) Two Complex Solutions

8. The width of the picture frame is 3 in.

9. The lengths of the legs are 10 and 24 in. and the hypotenuse is 26 in.

10.
a) t=7.06 sec and t=0.44 sec b) t=7.58 sec

Detailed Solution

1 a) $2x + 3y = 5$ **NO**, this is not a quadratic equation because the degree (the highest power) is not 2

b) $8x^2 + 22 - 5x = 10$ **Yes**, this is a quadratic equation because the degree of this equation is 2

c) $10x^{12} - 5x^2 = 10$ **NO**, this is not a quadratic equation as the degree of this equation is 12

d) $7x^2 + 4x = 0$ **Yes**, this is a quadratic equation

2 a) $x^2 + 7x + 15 = 5$

$-5 \quad -5$

$x^2 + 7x + 10 = 0$

$2 + 5 = 7$

$(x+2)(x+5) = 0$

Hence

$(x+2) = 0$ or $(x+5) = 0$

$-2 \quad -2 \qquad -5 \quad -5$

$x = -2 \qquad x = -5$

Hence the solutions are $\{-2, -5\}$

2 b) $x^2 - 2x - 15 = 0$

$+3 \quad -5 = -2$

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

Hence

$x + 3 = 0$ $\qquad x - 5 = 0$

$-3 \quad -3 \qquad +5 \quad +5$

$x = -3 \qquad x = 5$

Hence the solutions are $\{-3, 5\}$

2 c) $\frac{8x^2 + 40x - 8x + 32}{8} = \frac{0}{8}$

$x^2 + 5x - x + 4 = 0$

$x^2 + 4x + 4 = 0$

$2 + 2 = 4$

$(x+2)(x+2) = 0$

$x + 2 = 0$

$x = -2$

solution $\{-2\}$

2 d) $9x^2 - 16 = 0$

This is a difference of square

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

Hence

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

$3x + 4 = 0$ or $3x - 4 = 0$

$-4 \quad -4 \qquad +4 \quad +4$

$\frac{3x}{3} = \frac{-4}{3} \qquad \frac{3x}{3} = \frac{4}{3}$

$x = -4/3 \qquad x = 4/3$

solutions $\{\frac{4}{3}, -\frac{4}{3}\}$

3a) $14x^2 - 4x - 15 = -5$

$+5 \quad +5$

$14x^2 - 4x - 10 = 0$

$(7x + 5)(2x - 2) = 0$

Hence

$7x + 5 = 0$ or $2x - 2 = 0$

$-5 \quad -5$ $\qquad$ $+2 \quad +2$

$\frac{7x}{7} = \frac{-5}{7}$ $\qquad$ $\frac{2x}{2} = \frac{2}{2}$

$x = -\frac{5}{7}$ $\qquad$ $x = 1$

Solution $\{-\frac{5}{7}, 1\}$

3b) $110x^2 + 23x - 3 = 0$

$(11x - 1)(10x + 3) = 0$

Hence

$11x - 1 = 0$ or $10x + 3 = 0$

$+1 \quad +1$ $\qquad$ $-3 \quad -3$

$\frac{11x}{11} = \frac{1}{11}$ $\qquad$ $\frac{10x}{10} = \frac{-3}{10}$

$x = \frac{1}{11}$ $\qquad$ $x = -\frac{3}{10}$

Solution $\{\frac{1}{11}, -\frac{3}{10}\}$

3c) $-x^2 - 27x - 96 = x$

$-x \quad -x$

$-1(-x^2 - 28x - 96) = (0)(-1)$

$x^2 + 28 + 96 = 0$

$(x + 24)(x + 4) = 0$

Hence

$x + 24 = 0$ or $(x + 4) = 0$

$-24 \quad -24$ $\qquad$ $-4 \quad -4$

$x = -24$ $\qquad$ $x = -4$

Solution $\{-24, -4\}$

3d) $2x^2 + 19x + 35 = 0$

$(2x + 5)(x + 7) = 0$

Hence

$2x + 5 = 0$ or $x + 7 = 0$

$-5 \quad -5$ $\qquad$ $-7 \quad -7$

$\frac{2x}{2} = \frac{-5}{2}$ $\qquad$ $x = -7$

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

Solution $\{-\frac{5}{2}, -7\}$

4a) $x^2 + 2x - 9 = 2x$

$-2x \quad -2x$

$x^2 - 9 = 0$

$+9 \quad +9$

$\sqrt{x^2} = \sqrt{9}$

$x = \pm 3$

Solution $\{3, -3\}$

4b) $4x^2 - 31 = +1$

$+31 \quad +31$

$\frac{4x^2}{4} = \frac{32}{4}$

$\sqrt{x^2} = \sqrt{8}$

$x = \pm 2\sqrt{2}$

$8 = 2 \cdot 2 \cdot 2 = 4 \cdot 2$

$\sqrt{8} = \sqrt{4} \cdot \sqrt{2} = 2\sqrt{2}$

Solution $\{2\sqrt{2}, -2\sqrt{2}\}$

4c) $3x^2 + 27 = -13x^2 + 9$

$+13x^2 - 27 \quad +13x^2 - 27$

$\frac{16x^2}{16} = -\frac{18}{16}\ 9\ 8$

$\sqrt{x^2} = \sqrt{-\frac{9}{8}}$ [no real roots]

$x = \pm i\sqrt{\frac{9}{8}}$ [taking Square root]

$x = \pm i \frac{3}{2\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$ [rationalizing the denominator]

$= \pm \frac{3\sqrt{2}}{2 \cdot 2} i$

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

Solution $\left\{\frac{3\sqrt{2}}{4} i, -\frac{3\sqrt{2}}{4} i\right\}$

4d) $x^2 + 30 = 5$

$-30 \quad -30$

$\sqrt{x^2} = \sqrt{-25}$ [no real roots]

$x = \pm i\sqrt{25}$

$x = \pm 5i$

Solution $\{5i, -5i\}$

5a) $x^2 + 8x - 9 = 0$

$+9 \quad +9$

$x^2 + 8x + 16 = 9 + 16$ $\left[\frac{8}{2} = 4;\ 4^2 = 16\right]$

$\sqrt{(x+4)^2} = \sqrt{25}$

$x + 4 = \pm 5$

$x + 4 = 5$ or $x + 4 = -5$

$-4 \quad -4 \qquad -4 \quad -4$

$x = 1$ or $x = -9$

Solution $\{1, -9\}$

5b) $x^2 + 3x + 5 = 100$

$-5 \quad -5$

$x^2 + 3x + \frac{9}{4} = 95 + \frac{9}{4}$ $\left[\frac{3}{2} \times \frac{1}{2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}\right]$

$\left(x + \frac{3}{2}\right)^2 = \frac{95 \cdot 4}{4} + \frac{9}{4} = \frac{380 + 9}{4}$

$\sqrt{\left(x + \frac{3}{2}\right)^2} = \sqrt{\frac{389}{4}}$

$x + \frac{3}{2} = \pm \frac{\sqrt{389}}{2}$

$x + \frac{3}{2} = \frac{\sqrt{389}}{2}$ or $x + \frac{3}{2} = -\frac{\sqrt{389}}{2}$

$-\frac{3}{2} \quad -\frac{3}{2} \qquad -\frac{3}{2} \quad -\frac{3}{2}$

$x = \frac{-3 + \sqrt{389}}{2}$ or $x = \frac{-3 - \sqrt{389}}{2}$

Solution $\left\{\frac{-3 + \sqrt{389}}{2}, \frac{-3 - \sqrt{389}}{2}\right\}$

5c) $2x^2+5x-12=0$

$2x^2+5x=12$ (divide both sides by 2)

$x^2+\frac{5}{2}x=6$ $\quad \frac{1}{2}\left(\frac{5}{2}\right)=\frac{5}{4}$ $\quad \left(\frac{5}{4}\right)^2=\frac{25}{16}$

$x^2+\frac{5}{2}x+\frac{25}{16}=6+\frac{25}{16}=6\cdot\frac{16}{16}+\frac{25}{16}$

$=\frac{96}{16}+\frac{25}{16}=\frac{121}{16}$

$\sqrt{\left(x+\frac{5}{4}\right)^2}=\pm\sqrt{\frac{121}{16}}$

$x+\frac{5}{4}=\pm\frac{11}{4}$

$x=-\frac{5}{4}\pm\frac{11}{4}=\frac{-5+11}{4},\ \frac{-5-11}{4}$

$x=\left\{\frac{6}{4},\frac{-16}{4}\right\}=\boxed{\left\{\frac{3}{2},-4\right\}}$

5d) $3x^2-x+3=0$

$\frac{3x^2-x}{3}=\frac{-3}{3}$

$x^2-\frac{1}{3}x=-1$ $\quad \frac{1}{2}\left(\frac{-1}{3}\right)=\frac{-1}{6}$ $\quad \left(\frac{-1}{6}\right)^2=\frac{1}{36}$

$x^2-\frac{1}{3}x+\frac{1}{36}=-1+\frac{1}{36}$

$\left(x-\frac{1}{6}\right)^2=\frac{-36}{36}+\frac{1}{36}=\frac{-35}{36}$

$x-\frac{1}{6}=\pm\frac{\sqrt{-35}}{6}=\pm\frac{i\sqrt{35}}{6}$

$x=\frac{1}{6}\pm\frac{i\sqrt{35}}{6}$

$\text{or}\ \boxed{\left\{\frac{1+i\sqrt{35}}{6},\frac{1-i\sqrt{35}}{6}\right\}}$

6a) $x^2+9x+20=0$ $\quad x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ where $a=1,\ b=9,\ c=20$

$x=\frac{-9\pm\sqrt{9^2-4(1)(20)}}{2(1)}=\frac{-9\pm\sqrt{81-80}}{2}=\frac{-9\pm\sqrt{1}}{2}=\frac{-9\pm1}{2}$

$=\left\{\frac{-9+1}{2},\frac{-9-1}{2}\right\}=\boxed{\{-4,-5\}}$

6b) $16x^2+24x+29=0$

$a=16 \quad b=24 \quad c=29$

$x=\frac{-24\pm\sqrt{24^2-4(16)(29)}}{2(16)}$

$=\frac{-24\pm\sqrt{576-1856}}{32}=\frac{-24\pm\sqrt{-1280}}{32}$

to simplify $\sqrt{1280}$, break 1280 down to its prime factors: $1280=2\cdot2\cdot2\cdot2\cdot2\cdot2\cdot2\cdot5$

$=2^8\cdot5$

$\sqrt{1280}=\sqrt{2^8}\cdot\sqrt{5}=2^4\sqrt{5}=16\sqrt{5}$

$x=\frac{-24\pm16i\sqrt{5}}{32}=\frac{8(-3\pm2i\sqrt{5})}{8\cdot4}=\boxed{\frac{-3\pm2i\sqrt{5}}{4}}$

6c) $12x^2+6x-1=0$ $\quad a=12 \quad b=6 \quad c=-1$

$$x=\frac{-6\pm\sqrt{6^2-4(12)(-1)}}{2(12)}$$

$$=\frac{-6\pm\sqrt{36+48}}{24}=\frac{-6\pm\sqrt{84}}{24}$$

$$x=\frac{-6\pm\sqrt{4\cdot 21}}{24}=\frac{-6\pm 2\sqrt{21}}{24}=\frac{2(-3\pm\sqrt{21})}{2\cdot 12}$$

$$\boxed{x=\frac{-3\pm\sqrt{21}}{12}}$$

6d) $144x^2+72x+4=0$ (all coefficients can be divided by 4).

$36x^2+18x+1=0 \quad a=36 \quad b=18 \quad c=1$

$$x=\frac{-18\pm\sqrt{18^2-4(36)(1)}}{2(36)}=\frac{-18\pm\sqrt{324-144}}{72}=\frac{-18\pm\sqrt{180}}{72}$$

$$=\frac{-18\pm\sqrt{9\cdot 4\cdot 5}}{72}=\frac{-18\pm 3\cdot 2\sqrt{5}}{72}=\frac{-18\pm 6\sqrt{5}}{72}$$

$$x=\frac{6(-3\pm\sqrt{5})}{6\cdot 12} \qquad \boxed{x=\frac{-3\pm\sqrt{5}}{12}}$$

6e) $20x^2+24x-1=7x^2-3$

$-7x^2 \quad +3 \quad -7x^2+3$

$13x^2+24x+2=0 \quad a=13 \quad b=24 \quad c=2$

$$x=\frac{-24\pm\sqrt{24^2-4(13)(2)}}{2(13)}=\frac{-24\pm\sqrt{472}}{26}=\frac{-24\pm 2\sqrt{118}}{26}$$

$$=\frac{2(-12\pm\sqrt{118})}{2\cdot 13} \qquad x=\boxed{\frac{-12\pm\sqrt{118}}{13}}$$

6f) $-x^2 + 2x + 11 = 0$ $\quad a = -1 \quad b = 2 \quad c = 11$

$$x = \frac{-2 \pm \sqrt{2^2 - 4(-1)(11)}}{2(-1)} = \frac{-2 \pm \sqrt{4 + 44}}{-2}$$

$$= \frac{-2 \pm \sqrt{48}}{-2} = \frac{-2 \pm 4\sqrt{3}}{-2} = \frac{-2(1 \pm 2\sqrt{3})}{-2} *$$

$$x = \boxed{1 \pm 2\sqrt{3}}$$

* when factoring out the (-2), since we are using both $+4\sqrt{3}$ and $-4\sqrt{3}$, our result will be $-2\sqrt{3}, 2\sqrt{3}$, which is the same result as factoring out (+2).

6g) $-16x^2 + 40x - 25 = 0$ (multiply both sides by -1 if you want)

$16x^2 - 40x + 25 = 0$

$a = 16 \quad b = 40 \quad c = -25$

$$x = \frac{-40 \pm \sqrt{40^2 - 4(16)(25)}}{2(16)} = \frac{-40 \pm \sqrt{1600 - 1600}}{32}$$

$$= \frac{-40 \pm 0}{32} = \frac{-40}{32} = \boxed{\frac{5}{4}}$$

(only 1 solution).

7a) $2x^2+8x+8=0$

Discriminant

$D = b^2-4ac$

$a=2,\ b=8,\ c=8$

Therefore

$D = 8^2-4(2)(8)$

$= 64-64$

$D = 0$

There is one real solution

7b) $3x^2+5x+1=0$

Discriminant

$D = b^2-4ac$

$a=3,\ b=5,\ c=1$

$D = 5^2-4(3)(1)$

$= 25-12 = 13$

since $D>0$ and not a perfect square we have two irrational solutions

7c) $7x^2-28=0$

Notice the equation is missing the x term. Hence

$7x^2+0x-28=0$

Now $D = b^2-4ac$

$a=7,\ b=0,\ c=-28$

$D = 0^2-4(7)(-28)$

$= (-28)(-28) = (28)^2$

$= 784$

Now $D>0$ and is a perfect square hence we have two rational solution

7d) $9x^2+11x+8=0$

$D = b^2-4ac$

$a=9,\ b=11,\ c=8$

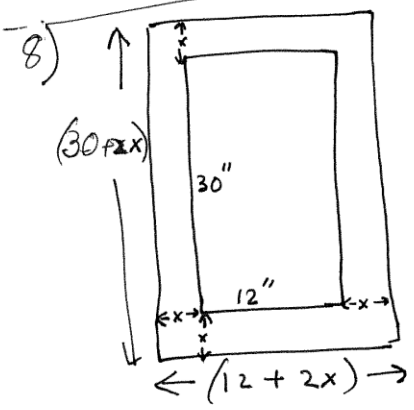
$D = 11^2-4(9)(8)$

$= 121-288$

$= -167$

Since $D<0$ therefore we have two complex solutions.

8)



Let the width of the frame be x inches hence the total area of the picture is given by

$(30+2x)(12+2x) = 648$

$360+60x+24x+4x^2 = 648$

$\frac{4x^2+84x+360}{4} = \frac{648}{4}$

$x^2+21x+90 = 162$

$-162 \quad -162$

$x^2+21-72 = 0$

$(x-3)(x+24) = 0$

8 (cont.) $(x-3)(x+24)=0$ $x-3=0$ or $x+24=0$

$\boxed{x=3}$ or $x=-24$ (this answer makes no sense).

The border should be 3" wide.

9)

let x = length of longer leg.
$x-14$ = length of shorter leg.
$x+2$ = length of hypotenuse.

Using the Pythagorean Theorem,

$$(x-14)^2 + x^2 = (x+2)^2$$
$$(x-14)(x-14) + x^2 = (x+2)(x+2)$$
$$x^2-28x+196+x^2 = x^2+4x+4$$
$$-4x \quad -4 \quad -x^2 \quad -x^2-4x-4$$

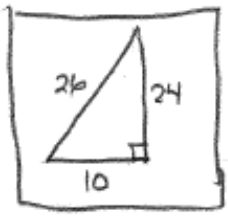
$$x^2-32x+192=0$$

Using completing the square: $x^2-32x=-192$ $\frac{1}{2}(-32)=-16$, $(-16)^2=256$

$$x^2-32x+256=-192+256$$
$$(x-16)^2=64$$
$$\sqrt{(x-16)^2}=\pm\sqrt{64}$$
$$x-16=\pm 8$$
$$x=16\pm 8 = 24 \text{ or } 8$$

if $x=8$ then $x-14=-6$ (not physically possible)

if $x=24$
$x-14=10$
$x+2=26$



10) $h = -16t^2 + v_0 t + h_0$

a) $v_0 = 120$ ft/sec
$h_0 = 10$ ft
$h = 60$ ft
$t = ?$

$60 = -16t^2 + 120t + 10$ — (1)
$-60 \qquad\qquad -60$

or $\frac{-16t^2 + 120t - 50}{2} = \frac{0}{2}$

or $-8t^2 + 60t - 25 = 0$

using quadratic formula

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

$a = -8, \quad b = 60, \quad c = -25$

$t = \frac{-60 \pm \sqrt{60^2 - 4(-8)(-25)}}{2(-8)}$

$= \frac{-60 \pm \sqrt{3600 - 800}}{-16}$

$= \frac{-60 \pm \sqrt{2800}}{-16}$

$= \frac{(-60 \pm 20\sqrt{7})}{-16} = \frac{-4(15 \mp 5\sqrt{7})}{-4(4)}$

$= \frac{15 \pm 5\sqrt{7}}{4}$

$t = \frac{15 + 5\sqrt{7}}{4}, \frac{15 - 5\sqrt{7}}{4}$

$t \approx 7.06$ sec, 0.44 sec (using calculator)

b) on the ground $h = 0$
Hence from (1)

$0 = -16t^2 + 120t + 10$

or $\frac{16t^2 - 120t - 10}{2} = 0$

or $8t^2 - 60t - 5 = 0$

using quadratic formula

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

$a = 8, \quad b = -60, \quad c = -5$

$t = \frac{-(-60) \pm \sqrt{(-60)^2 - 4(8)(-5)}}{2(8)}$

$= \frac{60 \pm \sqrt{3600 + 160}}{16}$

$= \frac{60 \pm \sqrt{3760}}{16}$

$= \frac{60 \pm \sqrt{16 \cdot 235}}{16}$

$= \frac{60 \pm 4\sqrt{235}}{16}$

$= \frac{4(15 \pm \sqrt{235})}{16}$

$= \frac{15 \pm \sqrt{235}}{4}$

$t = \frac{15 + \sqrt{235}}{4}, \frac{15 - \sqrt{235}}{4}$

using calculator
$t \approx 7.58$ sec, -0.08 sec

$t = 7.58$ sec

negative value for time is discarded

Additional Resources

Click on the links below to download worksheets under "Basics" for more practice:

1. Completing the square
2. Solving quadratic equations
    - by taking square roots
    - by factoring
    - with the quadratic formula
    - by completing the square

Alternatively;

1. Go To http://www.kutasoftware.com/free.html
2. Under "**Quadratic Functions**" click on:
3. Completing the square
4. Solving quadratic equations
    - by taking square roots
    - by factoring
    - with the quadratic formula
    - by completing the square

    You can print out the worksheets and work on them. The solutions are provided at the end of the worksheets

3. For help please contact the ***Math Assistance Area*.**