Name: KEY
Date: _____ Period: ____

Quadratic Formula Word Problems

1. Jason jumped off of a cliff into the ocean in Acapulco while vacationing with some friends. His height as a function of time could be modeled by the function $h(t) = -16t^2 + 16t + 480$, where t is the time in seconds and h is the height in feet.

a. How long did it take for Jason to reach his maximum height? .5 SECONDS

$L.o.S. = \frac{-16}{2(-16)} = \frac{1}{2}$ $h(\frac{1}{2}) = -16(\frac{1}{2})^2 + 16(\frac{1}{2}) + 480 = 484$

b. What was the highest point that Jason reached?

c. Jason hit the water after how many seconds?

$0 = -16t^2 + 16t + 480$

$-16(t^2 - t - 30) = 0$

$-16(t-6)(t+5) = 0$

$t = 6$ or $t = -5$ ← Extraneous

2. If a toy rocket is launched vertically upward from ground level with an initial velocity of 128 feet per second, then its height *h* after *t* seconds is given by the equation $h(t) = -16t^2 + 128t$ (if air resistance is neglected).

a. How long will it take for the rocket to return to the ground? Where is $h(t) = 0$?

$0 = -16t^2 + 128t$

$0 = -16t(t-8)$

zero prod: $t = 0$ or $t = 8$

8 seconds after it is launched, the rocket returns to the ground

b. After how many seconds will the rocket be 112 feet above the ground? Where is $h(t) = 112$?

$112 = -16t^2 + 128t$

$-16t^2 + 128t - 112 = 0$

$-16(t^2 + 8t - 7) = 0$

factor: $-16(t-7)(t-1) = 0$

$t = 7$ $t = 1$

The rocket is at 112 ft after 1 second (on the way up) and 7 seconds (on the way down).

c. How long will it take the rocket to hit its maximum height?

$\frac{0+8}{2} \Rightarrow$ 4 seconds

d. What is the maximum height?

$h(4) = -16(4)^2 + 128(4)$

$= 256$ ft.

3. A rocket is launched from atop a 101 – foot cliff with an initial velocity of 116 ft/s.
   a. Substitute the values into the vertical motion formula $h(t) = -16t^2 + vt + h_0$. Let h(t) = 0
   b. Use the quadratic formula to find out how long the rocket will take to hit the ground after it is launched. Round to the nearest tenth of a second.

a) $0 = -16t^2 + 116t + 101$

b) $\dfrac{-116 \pm \sqrt{(116)^2 - 4(-16)(101)}}{2(-16)}$

$\dfrac{-116 \pm \sqrt{19920}}{-32}$

$\dfrac{-116 \pm 141.14}{-32}$

$-.79$ or 8.0 Seconds

↑ Extraneous

4. You and a friend are hiking in the mountains. You want to climb to a ledge that is 20 ft. above you. The height of the grappling hook you throw is given by the function $h(t) = -16t^2 - 32t + 5$. What is the maximum height of the grappling hook? Can you throw it high enough to reach the ledge?

vertex gives max. height.

$L.o.S. = \dfrac{-b}{2a} = \dfrac{-(-32)}{2(-16)} = \dfrac{32}{-32} = -1$

$h(-1) = -16(-1)^2 - 32(-1) + 5$

$-16 + 32 + 5$

$h(-1) = 21$

Max height is 21 feet, so it will reach the ledge.

5. You are trying to dunk a basketball. You need to jump 2.5 ft. in the air to dunk the ball. The height that your feet are above the ground is given by the function $h(t) = -16t^2 + 12t$. What is the maximum height your feet will be above the ground? Will you be able to dunk the basketball?

$L.o.S. = \dfrac{-b}{2a} = \dfrac{-12}{2(-16)} = \dfrac{-12}{-32} = .375$

max height $= h(.375) = -16(.375)^2 + 12(.375)$

$-2.25 + 4.5$

2.25 ft. is NOT high enough to be able to dunk the basketball.

6. A diver is standing on a platform 24 ft. above the pool. He jumps form the platform with an initial upward velocity of 8 ft/s. Use the formula $h(t) = -16t^2 + vt + s$, where h is his height above the water, t is the time, v is his starting upward velocity, and s is his starting height. How long will it take for him to hit the water?

$h(t) = 0$, so $0 = -16t^2 + 8t + 24$

$0 = -4(4t^2 - 2t - 6)$

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

$2t + 2 = 0$ or $2t - 3 = 0$

$2t = -2$ $\quad$ $2t = 3$

$t = -1$ $\quad$ $t = 1.5$

↑ Extraneous

The diver hits the water in 1.5 seconds

7. A ball is thrown upward from a height of 15 ft. with an initial upward velocity of 5 ft/s. Use the formula $h(t) = -16t^2 + vt + s$ to find how long it will take for the ball to hit the ground.

$h(t) = 0$ so $0 = -16t^2 + 5t + 15$

$$\frac{-5 \pm \sqrt{25 + 960}}{-32}$$

$$\frac{-5 \pm 31.38}{-32}$$

1.14 seconds

8. One of the games at a carnival involves trying to ring a bell with a ball by hitting a lever that propels the ball into the air. The height of the ball is modeled by the equation $h(t) = -16t^2 + 39t$. If the bell is 25 ft. above the ground, will it be hit by the ball?

max height → vertex

L.o.s. $= \frac{-39}{2(-16)} = \frac{-39}{-32} = 1.21875$

$h(1.21875) = -16(1.21875)^2 + 39(1.21875)$

$= 23.8$ ft.

The max height of the ball is 23.8 ft, so it will not reach the bell.

9. A ship drops anchor in a harbor. The anchor is 49 ft. above the surface of the water when it is released. Use the vertical motion formula $h = -16t^2 + vt + s$ to answer the following questions.

a. What is the value of s, the starting height? 49

b. What is the value of h when the anchor hits the water? 0

c. The starting velocity is zero. After how many seconds will the anchor hit the water?

$0 = -16t^2 + 49$

$16t^2 = 49$

$t^2 = \frac{49}{16}$

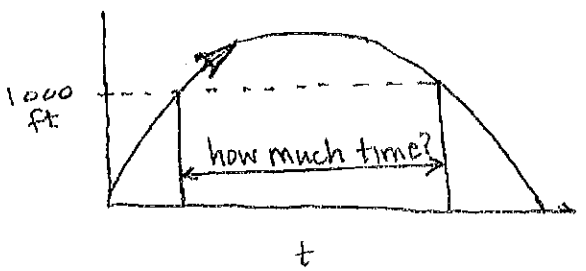
$t = \pm\sqrt{\frac{49}{16}}$

$t = \pm\frac{7}{4}$

t = 1.75 seconds

10. An amateur rocketry club is holding a competition. There is cloud cover at 1000 ft. If a rocket is launched with a velocity of 315 ft/s, use the function $h(t) = -16t + vt + h_0$ to determine how long the rocket is out of sight.

Find the times when the rocket is at 1000 ft.



$1000 = -16t + 315t$

$-16t + 315t - 1000 = 0$

$$\frac{-315 \pm \sqrt{(315)^2 - 4(-16)(-1000)}}{2(-16)}$$

$$\frac{-315 \pm \sqrt{35225}}{-32}$$

$$\frac{-315 \pm 188}{-32}$$

3.97 15.72

The rocket is out of sight between 3.97 & 15.72 seconds.

15.72 − 3.97 = 11.75 sec.

11. A trebuchet launches a projectile on a parabolic arc at a velocity of 35 ft/s. Using the function $h(t) = -16t^2 + vt + h_0$, determine when the projectile will first reach a height of 80 ft., and how many seconds later will it again be 80 feet.

Imaginary solutions - never reaches 80ft.

12. During World War I, mortars were fired from trenches 3 feet down. The mortars had a velocity of 150 ft/s. Determine how long it will take for the mortar shell to strike its target.

$$0 = -16t^2 + 150t - 3$$

$$0 = \frac{-150 \pm \sqrt{(150)^2 - 4(-16)(-3)}}{-32}$$

$$\frac{-150 \pm \sqrt{22308}}{-32}$$

$$\frac{-150 \pm 149.4}{-32}$$

9.35 seconds