Quadratic Applications Practice Worksheet

Name_____ Date_____

1. Suppose you launch a model rocket with an upward starting velocity of v ft/s. You can use the equation $h = -16t^2 + vt + h_0$ to find the rocket's altitude, h represents height in feet, t seconds after launch and h_0 represents initial height. Suppose the upward starting velocity is 315 ft/s and the initial height is 3 ft. When will the rocket hit the ground? → find x intercepts

$h(t) = -16t^2 + 315t + 3$

$b^2 - 4ac$

$(315)^2 - 4(-16)(3)$

99417

$\pm R$

$$x = \frac{-315 \pm \sqrt{99417}}{2(-16)}$$

(+) -0.010 sec

* Not the answer. Time cannot be negative

(−) 19.70 sec

2. The height of a projectile can be described by the **Vertical motion model**: $h = -16t^2 + vt + s$, where **t** is the time (in seconds) the object has been in the air, **v** is the initial vertical velocity (in feet per second), and **s** is the initial height (in feet). To catch a frisbee, a dog leaps into the air with an initial vertical velocity of 28 feet per second.

a. Write a model for the height of the dog above the ground.

fancy word for equation ←

$h(t) = -16t^2 + 28t$

b. After how many seconds does the dog land on the ground? find the x intercepts

FACTOR

$0 = -16t^2 + 28t$

$0 = -4t(4t - 7)$

$t = 0 \quad t = \frac{7}{4}$

$t \approx 1.75$ sec

Quad. Formula

$b^2 - 4ac$

$(28)^2 - 4(-16)(0)$

784

$\pm R$

$$x = \frac{-28 \pm \sqrt{784}}{2(-16)}$$

$\frac{-28 + 28}{-32} = \frac{0}{-32} = 0$

$\frac{-28 - 28}{-32} = \frac{-56}{-32}$

$t = 1.75$ sec

3. Henry launched a model rocket with an initial speed of 88 feet per second. After how many seconds will the rocket be 40 feet high? $h = -16t^2 + vt$.

time — height

$h(t) = -16t^2 + 88t$

height @ a specific time.

$40 = -16t^2 + 88t$

$0 = -16t^2 + 88t - 40$

Set equal to zero → solve.

$b^2 - 4ac$

$(+88)^2 - 4(-16)(-40)$

5184

$\sqrt{}$

$x = \frac{-88 \pm \sqrt{5184}}{2(-16)}$

(+) 1/2 sec going up

(−) 5 sec coming down

4. Suppose you launch a firecracker with an upward starting velocity of v ft/s. You can use the equation $h = -16t^2 + vt + h_0$ to find the firecracker's altitude h feet t seconds after launch. Suppose the upward starting velocity is 185 ft/s and the initial height is 2 feet. At what time will the firecracker be at its maximum height? What is the maximum height?

find vertex. use $x = \frac{-b}{2a}$

$h(t) = -16t^2 + 185t + 2$

$x = \frac{-b}{2a} = \frac{-185}{2(-16)} = \frac{-185}{-32}$

$x = 5.8$ sec

time the firecracker reaches the max

$h(5.8) = -16(5.8)^2 + 185(5.8) + 2$

$h(5.8) = 536.76$ feet

↑ maximum height

5. Each of the "golden arches" at a McDonald's is in the shape of a parabola. Each arch is modeled by: $h(x) = -x^2 + 6x$, where $h(x)$ is the height of the arch(in feet) at a distance x (in feet) from one side.

a. Find the equation of the axis of symmetry. → x value of vertex: $x = \frac{-b}{2a}$

$x = \frac{-b}{2a} = \frac{-6}{2(-1)} = \frac{-6}{-2} = 3$ feet

b. How high is the arch at the axis of symmetry?

finding the maximum height aka y value of the vertex

$h(3) = -(3)^2 + 6(3)$

$= -9 + 18$

$= 9$ ft

6. The tallest building in the USA is in Chicago, Illinois. It is 1450ft. tall. How long would it take a penny to drop from the top of the building to the ground? Use the formula $h = -16t^2 + h_0$.

Solve for X intercept. ←

$h(t) = -16t^2 + 1450$ ← missing a middle term solve using SQRT or Quad. Form

SQ RT

$0 = -16t^2 + 1450$

$-1450 = -16t^2$

$90.625 = t^2$

$9.5 \approx t$ sec

Quad. Formula

$b^2 - 4ac$

$(0)^2 - 4(-16)(1450)$

92 800

2R

$x = \frac{-0 \pm \sqrt{92\,800}}{2(-16)}$

$= \frac{-\sqrt{92\,800}}{-32}$

$x \approx 9.5$ sec

7. A study of air quality in a particular city by an environmental group suggest that t years from now the level of carbon monoxide, in parts per million, in the air will be $A = 0.2t^2 + .01t + 5.1$.

a. What is the level, in part per million, now? → original year → time zero → y intercept

5.1 part per million

b. How many years from now will the level of carbon monoxide be at 8 parts per million? Round to the nearest tenth.

$8 = 0.2t^2 + .01t + 5.1$

$0 = 0.2t^2 + .01t - 2.9$

$b^2 - 4ac$

$(.01)^2 - 4(0.2)(-2.9)$

.2321

2R

$\frac{-.01 \pm \sqrt{.2321}}{2(.2)}$

→ 1.2 years

→ −1.2 years

8. A rocket is shot upward with an initial velocity of 125 feet per second from a platform 3 feet above the ground. Use the model $h = -16t^2 + v_0t + h_0$ to find the maximum height of the rocket.

find the vertex
use $x = \frac{-b}{2a}$

$h(t) = -16t^2 + 125t + 3$

$x = \frac{-125}{2(-16)} = \frac{-125}{-32}$

$x = 3.9$ sec

time it takes to reach max height

$h(3.9) = -16(3.9)^2 + 125(3.9) + 3$

$= 247.14$ ft

9. If an object is thrown vertically upward, its height h, above the ground in feet after t seconds is given by $h = h_0 + v_0t - 16t^2$, where h_0 is the initial height from which the object is thrown and v_0 is the initial velocity of the object. Using this formula solve the problem.

$h(t) = -16t^2 + 32t + 48$

A ball thrown vertically into the air has the equation of motion $h = 48 + 32t - 16t^2$.

a. How high is the ball at t = 0? y int

48 ft

b. How high is the ball at t = 1?

$h(1) = -16(1)^2 + 32(1) + 48$

$= 64$ ft

c. When does the ball hit the ground again? solve for x intercept

$b^2 - 4ac$

$(32)^2 - 4(-16)(48)$

4096

OR

$x = \frac{-32 \pm \sqrt{4096}}{2(-16)}$

-1

3 sec