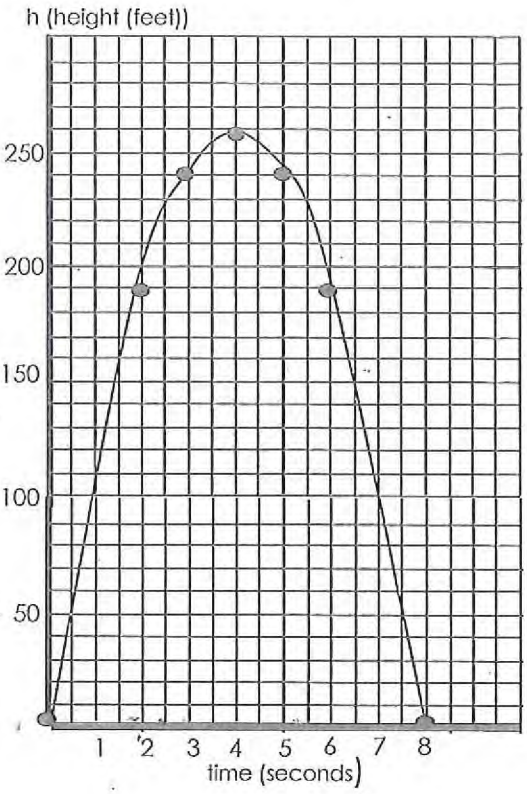
Application Problems

#36

Using the graph at the right, It shows the **height *h*** in feet of a small rocket ***t* seconds** after it is launched. The path of the rocket is given by the equation: $h = -16t^2 + 128t$.



1. How long is the rocket in the air? _____

2. What is the greatest height the rocket reaches? ____

3. About how high is the rocket after 1 second? _____

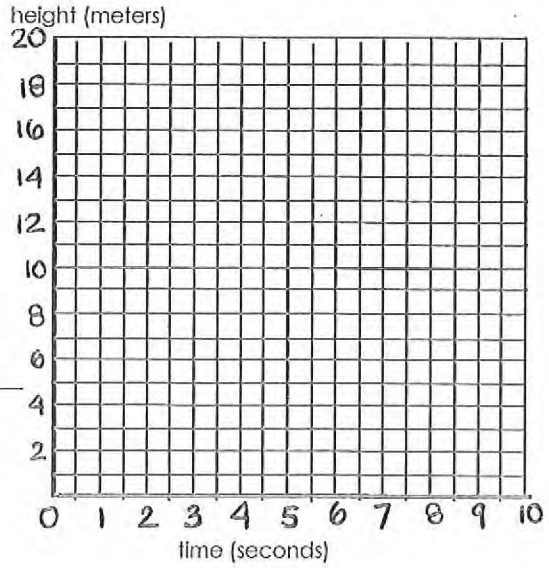
4. After 2 seconds,
   a. about how high is the rocket?_____
   b. is the rocket going up or going down? _____

5. After 6 seconds,
   a. about how high is the rocket? _____
   b. is the rocket going up or going down? _____

6. Do you think the rocket is traveling faster from 0 to 1 second or from 3 to 4 seconds? Explain your answer.

7. Using the equation, find the **exact** value of the height of the rocket at 2 seconds.

8. A ball is thrown in the air. The path of the ball is represented by the equation $h = -t^2 + 8t$. Graph the equation over the interval $0 \le t \le 8$ on the accompanying grid.



What is the maximum height of the ball?_____

How long is the ball above 7 meter? _____

Things to remember when completing quadratic application word problems:

t is_____. It represents x. h or d is _____/distance. It represents y.

When an object hits the **ground** (water), its height = **0**.

1. After *t* seconds, a ball tossed in the air from the ground level reaches a height of *h* feet given by the equation $h = 144t - 16t^2$.

   a. What is the height of the ball after 3 second?

   b. What is the maximum height the ball will reach?

   c. Find the number of seconds the ball is in the air when it reaches a height of 224 feet.

   d. After how many seconds will the ball hit the ground before rebound?

2. A rocket carrying fireworks is launched from a hill 80 feet above a lake. The rocket will fall into lake after exploding at its maximum height. The rocket's height above the surface of the lake is given by $h = -16t^2 + 64t + 80$.

   a. What is the height of the rocket after 1.5 second?

   b. What is the maximum height reached by the rocket?

   c. How long will it take for the rocket to hit 128 feet?

   d. After how many seconds after it is launched will the rocket hit the lake?

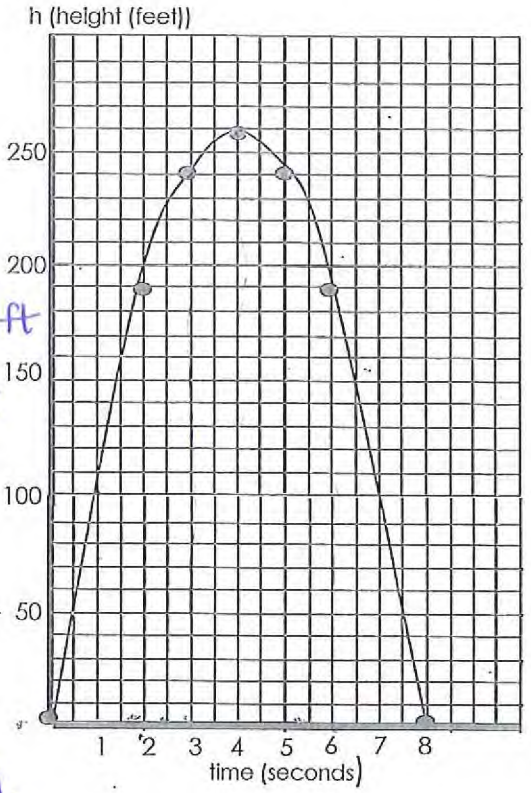
3. A rock is thrown from the top of a tall building. The distance, in feet, between the rock and the ground t seconds after it is thrown is given by $d = -16t^2 - 4t + 382$. How long after the rock is thrown is it 370 feet from the ground?

Application Problems

※36

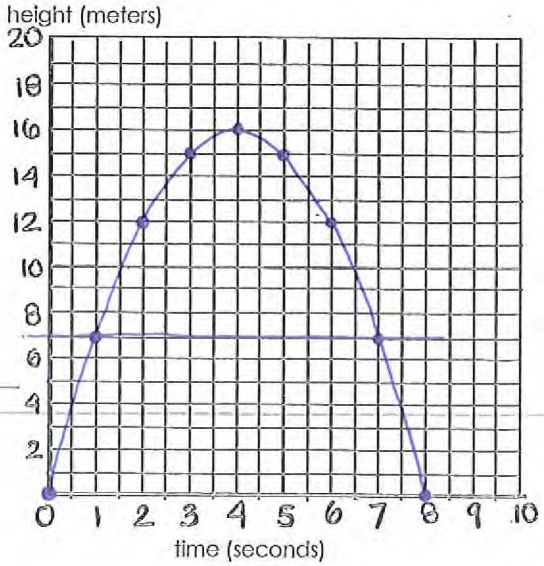
2nd pd: 1, 4b, 7
5th pd: 2, 5b, 7
6th pd: 1, 5b, 7
7th pd: 2, 4b, 7

Using the graph at the right, It shows the **height *h*** in feet of a small rocket ***t* seconds** after it is launched. The path of the rocket is given by the equation: $h = -16t^2 + 128t$.



1. How long is the rocket in the air? 8 sec
2. What is the greatest height the rocket reaches? 260 ft
3. About how high is the rocket after 1 second? 110 ft
4. After 2 seconds,
   a. about how high is the rocket? 190 ft
   b. is the rocket going up or going down? up
5. After 6 seconds,
   a. about how high is the rocket? 190 ft
   b. is the rocket going up or going down? "down"
6. Do you think the rocket is traveling faster from 0 to 1 second or from 3 to 4 seconds? Explain your answer.
   from 0-1 sec: traveled from 0 ft to 110 ft (110 ft)
   from 3-4 sec: traveled from 240 ft to 260 ft (20 ft)
   Traveling faster from 0 to 1 sec.
7. Using the equation, find the **exact** value of the height of the rocket at 2 seconds. $h = -16(2)^2 + 128(2)$
   $= -64 + 256 =$ 192 ft
8. A ball is thrown in the air. The path of the ball is represented by the equation $h = -t^2 + 8t$. Graph the equation over the interval $0 \le t \le 8$ on the accompanying grid.

$t=0$ $h=-0^2+8(0)=0$
$t=1$ $h=-1^2+8(1)=7$
$t=2$ $h=-2^2+8(2)=12$
$t=3$ $h=-3^2+8(3)=15$
$t=4$ $h=-4^2+8(4)=16$
$t=5$ $h=-5^2+8(5)=15$
$t=6$ $h=-6^2+8(6)=12$
$t=7$ $h=-7^2+8(7)=7$
$t=8$ $h=-8^2+8(8)=0$



What is the maximum height of the ball? 16 m

How long is the ball above 7 meter? 6 sec from 1-7 sec

Things to remember when completing quadratic application word problems:

t is time. It represents x. h or d is height /distance. It represents y.

When an object hits the ground (water), its height = 0.

1. After t seconds, a ball tossed in the air from the ground level reaches a height of h feet given by the equation $h = 144t - 16t^2$.

a. What is the height of the ball after 3 second?

$h = 144(3) - 16(3)^2$
$= 432 - 144$
$= 288$ ft

b. What is the maximum height the ball will reach? (extrema / y-coordinate of vertex.)

$x = \frac{-b}{2a} = \frac{-(144)}{2(-16)} = \frac{-144}{-32} = 4.5$

$y = 144(4.5) - 16(4.5)^2 = 648 - 324 = 324$ ft

* c. Find the number of seconds the ball is in the air when it reaches a height of 224 feet. (Let $h = 224$) Find t!

$224 = 144t - 16t^2$
$0 = -16t^2 + 144t - 224$

$t = \frac{-144 \pm \sqrt{(144)^2 - 4(-16)(-224)}}{2(-16)} = \frac{-144 \pm \sqrt{20736 - 14336}}{-32} = \frac{-144 \pm \sqrt{6400}}{-32}$

$= \frac{-144 \pm 80}{-32} \rightarrow \frac{-144+80}{-32} = 2 \quad \frac{-144-80}{-32} = 7$

The ball is in the air 2 sec when it reaches 224 feet.

d. After how many seconds will the ball hit the ground before rebound? (when will the height be 0 ft?) (Let $h = 0$) Find t.

$0 = 144t - 16t^2$

x or $t = \frac{-144 \pm \sqrt{144^2 - 4(-16)(0)}}{2(-16)} = \frac{-144 \pm \sqrt{20736}}{-32} = \frac{-144 \pm 144}{-32}$

$\rightarrow \frac{-144+144}{-32} = \frac{0}{-32} = 0 \quad \frac{-144-144}{-32} = \frac{-288}{-32} = 9$

after 9 secs the ball will hit the ground

2. A rocket carrying fireworks is launched from a hill 80 feet above a lake. The rocket will fall into lake after exploding at its maximum height. The rocket's height above the surface of the lake is given by $h = -16t^2 + 64t + 80$.

a. What is the height of the rocket after 1.5 second?

$h = -16(1.5)^2 + 64(1.5) + 80$
$= -36 + 96 + 80$
$=$ 140 ft

b. What is the maximum height reached by the rocket? (extrema/vertex)

$t = \frac{-b}{2a} = \frac{-64}{2(-16)} = \frac{-64}{-32} = 2$

$h = -16(2)^2 + 64(2) + 80$
$= -64 + 128 + 80$
$=$ 144 ft

c. How long will it take for the rocket to hit 128 feet? let h=128, find t

$128 = -16t^2 + 64t + 80 \rightarrow 0 = -16t^2 + 64t - 48$
$-128 \qquad\qquad -128$

$t = \frac{-64 \pm \sqrt{64^2 - 4(-16)(-48)}}{2(-16)} = \frac{-64 \pm \sqrt{1024}}{-32} = \frac{-64 \pm 32}{-32}$

$\frac{-64+32}{-32} = 1 \qquad \frac{-64-32}{-32} = 3$

It will take the rocket 1 sec to hit 128 feet.

d. After how many seconds after it is launched will the rocket hit the lake? Find t, when h=0.

$0 = -16t^2 + 64t + 80$

$t = \frac{-64 \pm \sqrt{64^2 - 4(-16)(80)}}{2(-16)} = \frac{-64 \pm \sqrt{9216}}{-32} = \frac{-64 \pm 96}{-32}$

$\frac{-64+96}{-32} = -1$ ↗ ↘ $\frac{-64-96}{-32} = 5$

5 secs after it is launched the rocket will hit the lake

4pt 3. A rock is thrown from the top of a tall building. The distance, in feet, between the rock and the ground t seconds after it is thrown is given by $d = -16t^2 - 4t + 382$. How long after the rock is thrown is it 370 feet from the ground?

$370 = -16t^2 - 4t + 382$
$-370 \qquad\qquad -370$

$0 = -16t^2 - 4t + 12$ ← 1pt

$t = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(-16)(12)}}{2(-16)} = \frac{4 \pm \sqrt{16 + 768}}{-32} = \frac{4 \pm \sqrt{784}}{-32} = \frac{4 \pm 28}{-32}$

1pt → 1pt ↓

$\frac{4+28}{-32} = -1 \qquad \frac{4-28}{-32} = 0.75$

1pt

0.75 seconds after the rock is thrown it is 370 ft from the ground.