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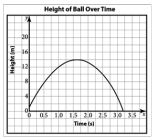
Worksheet 8-4: Applications of Quadratic Relations

1. The table and the graph show a soccer ball's height above the ground over time after it was kicked in the air.

Time (s)	Height (m)
0	0.10
0.5	7.80
1.0	12.00
1.5	13.80
2.0	13.00
2.5	9.75
3.0	4.00



(a) Describe the shape of the graph.

(b) What was the ball's maximum height?

(c) For about how many seconds was the ball in the air?

(d) How long did it take the ball to hit a height of 12 m?

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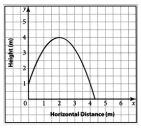
2. A cascading fountain forms a stream of water that can be modelled by the quadratic relation shown in the graph.



(a) Use the graph to find the maximum height reached by the stream of water.

(b) How far from the fountain did the stream of water reach this maximum height?

(c) What horizontal distance from the centre of the fountain did the water reach?

(d) Assume this stream of water does not leave any drops of water in its path. How far from the centre of the fountain could a person 1.8 m tall stand, under the water stream, and not get wet?

(e) How tall is the base that the fountain rests upon?

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3. A textbook falls from the top shelf of a shaky bookcase. The path of the book can be modelled by the relation $h = -9t^2 + 144$, where h represents the height of the book above the floor, in centimetres, and t represents time in seconds.

(a) What is the height of the top shelf?

144 cm

(b) How long does it take the book to reach the floor?

$h = -9(t^2 - 16)$

$= -9(t+4)(t-4)$

$t+4=0$ or $t-4=0$

$t=-4$ (not possible) $t=4$

It takes 4 s.

4. Two identical rubber balls are dropped from the roof of the school. The path of the first ball can be modelled by the relation $h = -4t^2 + 36$, where h represents the height of the ball above the ground, in metres, and t represents time in seconds. The path of the second ball can be modelled by the relation $h = -5t^2 + 20$.

(a) From what height are the two balls dropped?

(b) Which ball reaches the ground first?

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5. Rory is a competitive diver. One of Rory's dives can be modelled by the relation $h = -2t^2 + 8$, where h represents Rory's height above the water, in metres, and t represents time in seconds.

(a) From what height does Rory dive?

8m

(b) How long does it take Rory to reach the water?

$h = -2(t^2 - 4)$

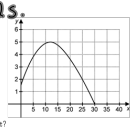
$h = -2(t+2)(t-2)$

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

$t=-2$ (not possible) $t=2$

It takes 2 s.

6. The path of a basketball, h, in metres, over time, in seconds, after it was thrown.



(a) What was the maximum height reached by the basketball?

(b) How long did it take for the ball to reach this maximum height?

(c) Suppose the basketball was originally thrown from a player's hands that were level with the top of his head. How tall is the player?

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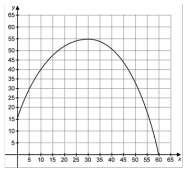
7. A sprinkler system sprays a stream of water onto the grass. The path of the water can be modelled by the quadratic relation shown below. The height reached by the water stream nd the horizontal distance from the sprinkler are measured in centimetres.



(a) What is the maximum height reached by the stream of water?

(b) How far from the sprinkler does the stream of water reach this maximum height?

(c) Suppose a dog stands 20 cm away from the sprinkler and does not get wet. What is the maximum height of the dog?

(d) How high above the ground is the sprinkler head?

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8. A model rocket is launched from a platform. The trajectory (flight path) of the rocket can be modelled by the relation $h = -5t^2 + 10t + 15$, where h represents the height of the rocket in metres and t represents time in seconds.

(a) What is the height of the platform?

15m

(b) What is the height of the model rocket after 1 s?

$h=?$ $t=1$

$h = -5(1)^2 + 10(1) + 15$

$= 20$

It is 20 m in the air after 1 s.

(c) How long does the model rocket stays in the air?

$h = -5(t^2 - 2t - 3)$

$= -5(t+1)(t-3)$

$t+1=0$ or $t-3=0$

$t=-1$ (not possible) $t=3$

It takes 3 s.

Answers: **1.** (a) Parabola, (b) 13.8 m, (c) 3 s, (d) 1 s and 2 s, **2.** (a) 7 m, (b) 2 m, (c) 4.25 m, (d) more than 4.25 m, (e) 1 m, **3.** (a) 144 cm, (b) 4 s, **4.** (a) 36 m and 20 m, (b) second book, **5.** (a) 8 m, (b) 2 s, **6.** (a) 5 m, (b) 12 s, (c) 1.6 m, **7.** (a) 55 cm, (b) 30 cm, (c) 51 cm, (d) 15 cm, **8.** (a) 15 m, (b) 20 m, (c) 3s

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