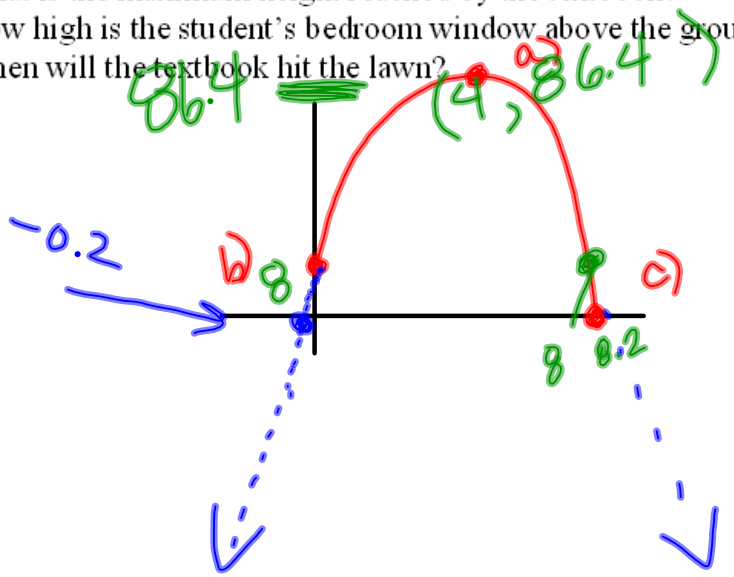
Warm Up

A frustrated Math student opens his second floor bedroom window and throws his textbook and it lands on the lawn below the window. The height h (metres) of the textbook at any tir is falling toward the ground is represented by the equation $h = -4.9t^2 + 39.2t + 8$

(a) What is the maximum height reached by the textbook?

(b) How high is the student's bedroom window above the ground?

(c) When will the textbook hit the lawn?



Warm Up

A frustrated Math student opens his second floor bedroom window and throws his textbook and it lands on the lawn below the window. The height h (metres) of the textbook at any ti is falling toward the ground is represented by the equation $h = -4.9t^2 + 39.2t + 8$

(a) What is the maximum height reached by the textbook?

(b) How high is the student's bedroom window above the ground?

(c) When will the textbook hit the lawn?

86.4m

8m

a) max height

$h = -4.9(t^2 - 8t + 16) - 49(-16) + 8$

$h = -4.9(t-4)^2 + 86.4$

c) TWO WAYS

set $h = 0$

Quadratic formula

$0 = -4.9t^2 + 39.2t + 8$

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

$t = \frac{-39.2 \pm \sqrt{(39.2)^2 - 4(-4.9)(8)}}{2(-4.9)}$

$t = \frac{-39.2 \pm \sqrt{1693.44}}{-9.8}$

$t_1 = -0.199 = -0.2$ inadmissable root

$t_2 = 8.199 = 8.2$

Completing the Square Method

$0 = -4.9(t-4)^2 + 86.4$

$\frac{-86.4}{-4.9} = \frac{-4.9(t-4)^2}{-4.9}$

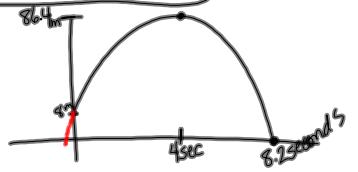
$\sqrt{\frac{86.4}{4.9}} = \sqrt{(t-2)^2}$

$\pm\sqrt{\frac{86.4}{4.9}} = t - 2$

$2 \pm \sqrt{\frac{86.4}{4.9}} = t$

$8.2 = t_1$

$-0.2 = t_2$



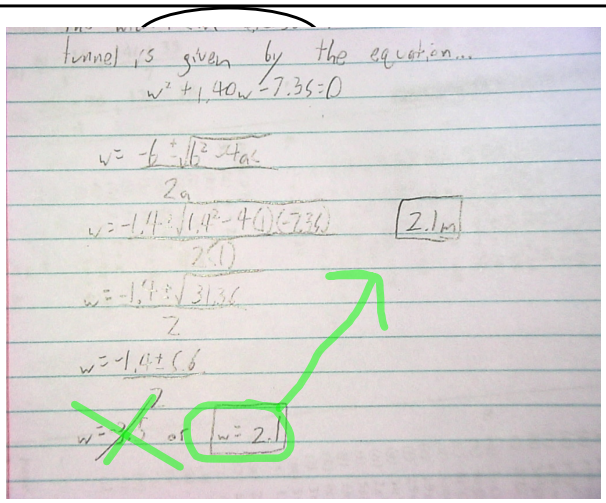
Inadmissable Roots

- one of the roots of a quadratic equation may not lead to a solution that satisfies the original problem.
- may also be called an "extraneous root"

Example #1: The width (in metres) for the most efficient wind tunnel is given by the equation...

$$w^2 + 1.40w - 7.35 = 0$$

Solve the equation to obtain the width.



Example #2: After experimentation, it was found that the safe stopping distance, d, (in metres) for a heavy aircraft that taxis at a speed, v, (in km/h) is given by...

$$d = 0.003(6v^2 + 400v + 50\,000)$$

---

a) What is the safe stopping distance of the aircraft taxiing at 100 km/h?

d? $\quad v = 100$

$d = 0.003(6(100)^2 + 4(100) + 50000)$

$d =$

b) Determine the speed at which the aircraft is taxiing to take 200 m to stop safely.

$$\frac{200}{0.003} = \frac{0.003(6v^2 + 400v + 50000)}{0.003}$$

Example #2: After experimentation, it was found that the safe stopping distance, d, (in metres) for a heavy aircraft that taxis at a speed, v, (in km/h) is given by...

$$d = 0.003(6v^2 + 400v + 50\,000)$$

a) What is the safe stopping distance of the aircraft taxiing at 100 km/h?

$d = ?$ Know $V = 100$ so sub it into the equation.

$d = 0.003(6(100)^2 + 400(100) + 50\,000)$

$d = 450$ m

b) Determine the speed at which the aircraft is taxiing to take 200 m to stop safely.

$V = ?$ $d = 200$

$200 = 0.003(6v^2 + 400v + 50\,000)$

$200 = 0.018v^2 + 12v + 150$

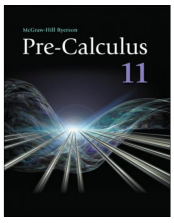
$0 = 0.018v^2 + 12v - 50$

$$v = \frac{-1.2 \pm \sqrt{1.2^2 - 4(0.018)(-50)}}{2(0.018)}$$

$$v = \frac{-1.2 \pm \sqrt{5.04}}{0.036}$$

$v_1 = 29.03$

$v_2 = -95.7$ inadmissable or extraneous ROOTS



Textbook Questions (all equations given)
page 215 #1
page 231 #12,13
page 241 # 9,10
page 255 #11,13a, 14

Page 241 #8, 11 (Equations not given)
page 254 #8, 9,10

11. $h(d) = -0.4(d - 2.5)^2 + 2.5$

$0 = -0.4(d - 2.5)^2 + 2.5$

$\frac{-2.5}{-0.4} = \frac{-0.4(d - 2.5)^2}{-0.4}$

$\sqrt{6.25} = \sqrt{(d - 2.5)^2}$

$\pm 2.5 = d - 2.5$

$2.5 \pm 2.5 = d$

0 OR $5 = d$

diameter 5 m

Solving Word Problems: Building Quadratic Equations

STRATEGIES:-
- declare variable(s).
- draw a sketch if needed
- build a quadratic equation.
- solve

EXAMPLE #1...

Two positive numbers differ by 4 and the sum of their squares is 136. Find the numbers.

Solution?

$b - s = 4$

$b = s + 4$

$b = 6 + 4$

$b = 10$

$b^2 + s^2 = 136$

$(s+4)^2 + s^2 = 136$

$s^2 + 8s + 16 + s^2 = 136$

$2s^2 + 8s - 120 = 0$

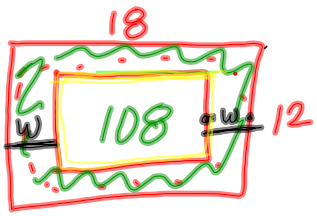
$s^2 + 4s - 60 = 0$

$(s-6)(s+10) = 0$

$s = 6$ $s = -10$

EXAMPLE #2:

For Curran Park, a landscaper wishes to plant a boundary of tulips within a rectangular garden with dimensions 18 m by 12m. The tulip border should be half the area of the garden. How wide should the border be? (1 decimal place)



Then the width MU

$A_{big} = 18 \times 12 = 216\ m^2$

$A_{tulips} = 108$

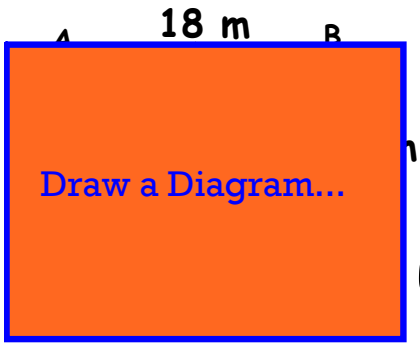
$A_{small} = (18-2w)(12-2w)$

$108 = (18-2w)(12-2w)$

$108 = 216 - 36w - 24w + 4w^2$

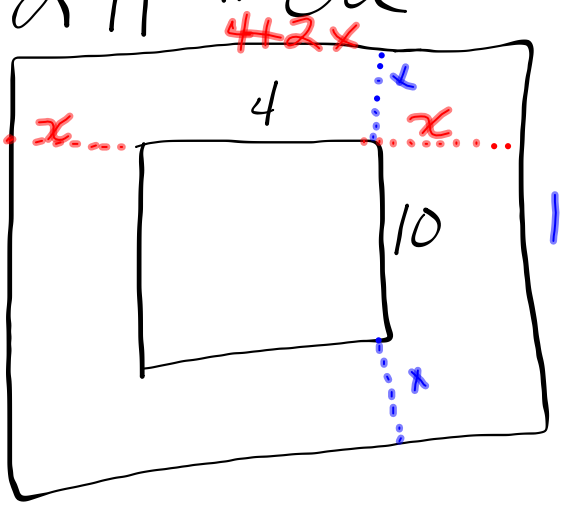
$0 = 4w^2 - 60w + 108$

$0 = 4(w^2 - 15w + 27)$



SOLUTION???

241 #8a

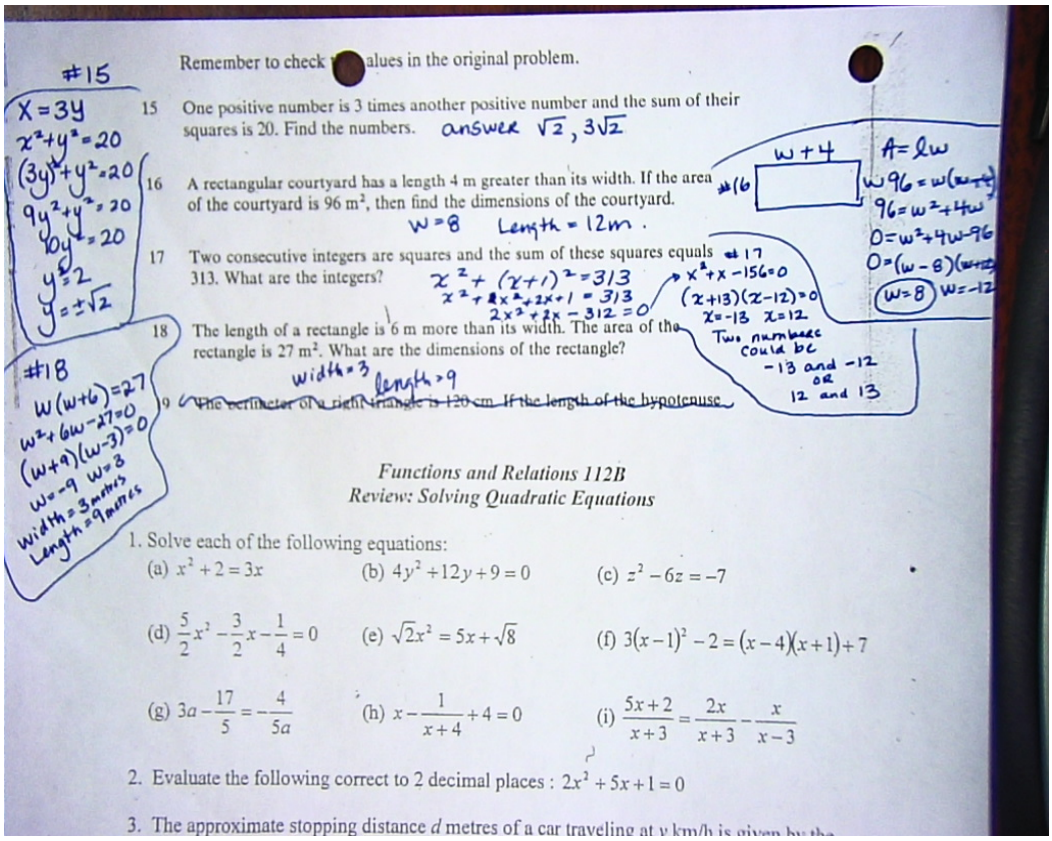


$A_{original} = 4 \times 10 = 40$

$10+2x$

$A_{new} = (4+2x)(10+2x)$

$80 = (4+2x)(10+2x)$



#15

$x = 3y$

$x^2+y^2=20$

$(3y)^2+y^2=20$

$9y^2+y^2=20$

$10y^2=20$

$y^2=2$

$y=\pm\sqrt{2}$

Remember to check values in the original problem.

15 One positive number is 3 times another positive number and the sum of their squares is 20. Find the numbers. answer $\sqrt{2}, 3\sqrt{2}$

16 A rectangular courtyard has a length 4 m greater than its width. If the area of the courtyard is 96 m², then find the dimensions of the courtyard.

#16 $w+4$ $A = lw$

$w = 8$ Length = 12m.

$96 = w(w+4)$

$96 = w^2+4w$

$0 = w^2+4w-96$

$0 = (w-8)(w+12)$

$w=8$ $w=-12$

17 Two consecutive integers are squares and the sum of these squares equals 313. What are the integers?

#17 $x^2+(x+1)^2=313$

$x^2+x^2+2x+1=313$

$2x^2+2x-312=0$

$x^2+x-156=0$

$(x+13)(x-12)=0$

$x=-13$ $x=12$

Two numbers could be -13 and -12 or 12 and 13

18 The length of a rectangle is 6 m more than its width. The area of the rectangle is 27 m². What are the dimensions of the rectangle?

#18

$w(w+6)=27$

$w^2+6w-27=0$

$(w+9)(w-3)=0$

$w=-9$ $w=3$

Width = 3 metres

Length = 9 metres

width = 3 length = 9

9 ~~The perimeter of a right triangle is 120 cm. If the length of the hypotenuse~~

Functions and Relations 112B
Review: Solving Quadratic Equations

1. Solve each of the following equations:

(a) $x^2+2=3x$ (b) $4y^2+12y+9=0$ (c) $z^2-6z=-7$

(d) $\frac{5}{2}x^2-\frac{3}{2}x-\frac{1}{4}=0$ (e) $\sqrt{2}x^2=5x+\sqrt{8}$ (f) $3(x-1)^2-2=(x-4)(x+1)+7$

(g) $3a-\frac{17}{5}=-\frac{4}{5a}$ (h) $x-\frac{1}{x+4}+4=0$ (i) $\frac{5x+2}{x+3}=\frac{2x}{x+3}-\frac{x}{x-3}$

2. Evaluate the following correct to 2 decimal places : $2x^2+5x+1=0$

3. The approximate stopping distance d metres of a car traveling at v km/h is given by the

3. The approximate stopping distance d metres of a car traveling at v km/h is given by the quadratic function $d = 0.0066v^2 + 0.14v$
   (a) What is the stopping distance for a car traveling 80 km/h?
   (b) Find the highest speed that could be traveled in which a car could be stopped in 35 m.

4. Sylvia somersaults from a 3 m springboard. Her height h metres above the water t seconds after she leaves the board is given by $h = -4.9t^2 + 9.8t + 3$.
   (a) What is the maximum height that she reaches above the water?
   (b) How long will it take her to end up 1 m above the water?
   (c) How high above the water is Sylvia 1.5 seconds after leaving the board?

5. A rectangle, 3 cm longer than it is wide, has a diagonal 15 cm long. Find the dimensions of the rectangle.

6. Three pieces of metal rods measure 20 cm, 41 cm, and 44 cm. If the same amount is cut off of each piece, the remaining lengths can be used to form a right triangle. What length is cut off of each rod?

7. The height h metres of an infield fly ball t seconds after being hit is given by the function $h(t) = 30t - 5t^2$.
   (a) How long is the ball in the air?
   (b) What is the maximum height reached by the ball?
   (c) How high will the ball be 5 seconds after being hit?
   (d) When will the ball be located 40m above the ground?

$5\sqrt{2} \pm \sqrt{82}$

Answers

1. (a) 1 , 2	(g) $\frac{4}{5}, \frac{1}{3}$	4. (a) 7.9 m	7. (a) 6 s
(b) $\frac{-3}{2}$	(h) −3 , −5	(b) 2.19 s	(b) 45 m
(c) $3 \pm \sqrt{2}$	(i) $\frac{1 \pm \sqrt{7}}{2}$	(c) 6.67 s	(c) 25 m
(d) $\frac{3 \pm \sqrt{19}}{10}$	2. −0.22 , -2.28	5. *9 cm by 12 cm*	(d) 2 s & 4 s