The product of two consecutive even integers is 168. Find the integers.

Let even integer $= n$

next consecutive even integer $= n+2$

previous consecutive even integer $= n-2$

$n(n+2) = 168$

integer · next

$n(n-2) = 168$

integer · previous

$n(n+2) = 168$

$n^2 + 2n = 168$

$n^2 + 2n - 168 = 0$ ← quadratic equation

- complete the square / square root property
- quadratic formula
- factor (if possible)

$(n+14)(n-12) = 0$

$n+14=0$ or $n-12=0$

$n=-14$ $\quad$ $n=12$

$n+2=-12$ $\quad$ $n+2=14$

next even

$-14, -12$ or $12, 14$

* $a=1$

$b=2$

$c=-168$

$\underline{14} + \underline{-12}$

$(14)(-12)$

$n(n-2) = 168$

integer · previous

$n(n-2) = 168$

$n^2 - 2n = 168$

$n^2 - 2n - 168 = 0$

$(n-14)(n+12) = 0$

$n - 14 = 0$ or $n + 12 = 0$

$n = 14$ $\qquad$ $n = -12$

$n - 2 = 12$ $\qquad$ $n - 2 = -14$ previous even

12, 14 or -14, -12

The product of two consecutive odd integers is 195. Find the integers.

Let x = odd

Let $x+2$ = next odd

$x(x+2) = 195$

$x^2 + 2x = 195$

$x^2 + 2x - 195 = 0$

$(x+15)(x-13) = 0$

$x + 15 = 0$ $\qquad$ $x - 13 = 0$

$x = -15$ $\qquad$ $x = 13$

$x + 2 = -13$ $\qquad$ $x + 2 = 15$

-15, -13 $\qquad$ 13, 15

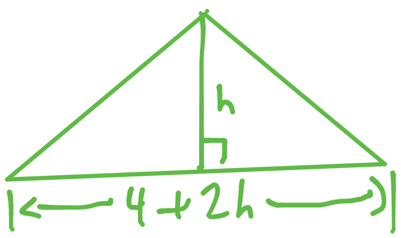
An architect is designing the entryway of a restaurant. She wants to put a triangular window above the doorway. Due to energy restrictions, the window can only have an area of 120 square feet and the architect wants the base to be 4 feet more than twice the height. Find the base and height of the window.

$A = 120 ft^2$

* Formula $A_\Delta = \frac{1}{2} bh = \frac{bh}{2}$

Not mentioned but inferred

$b = 4 + 2h$



$$\frac{bh}{2} = A$$

$$\frac{(4+2h)h}{2} = 120 ft^2$$

$$\frac{4h + 2h^2}{2} = 120 ft^2$$

$$\frac{4h}{2} + \frac{2h^2}{2} = 120 ft^2$$

$$2h + h^2 = 120 \quad ft^2$$

$$h^2 + 2h - 120 = 0$$

*a = 1
$b = 12 + {-10}$
$c = (12)(-10)$

$$(h+12)(h-10) = 0$$

$h + 12 = 0$ or $h - 10 = 0$

$h = -12$

reject we cannot have negative length.

$h = 10 ft$

$b = 4 + 2h$

base

$= 4 + 2(10) = 24 ft$

Mike wants to put 150 square feet of artificial turf in his front yard. This is the maximum area of artificial turf allowed by his homeowners association. He wants to have a rectangular area of turf with length one foot less than 3 times the width. Find the length and width. Round to the nearest tenth of a foot.

Shape: $\boxed{A = 150 ft^2}$ $3w-1$

w

$$A = lw$$

$$150 = (3w-1)w$$

$$150 = 3w^2 - w$$

$$0 = 3w^2 - w - 150$$

a lot to factor

complete the square

quadratic formula

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

$$w = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(3)(-150)}}{2(3)}$$

$$w = \frac{1 \pm \sqrt{1801}}{6}$$

$$w = \frac{1 - \sqrt{1801}}{6}$$

reject negative or

$$w = \frac{1+\sqrt{1801}}{6} \text{ ft}$$

$$l = 3w - 1$$

$$= 3\left(\frac{1+\sqrt{1801}}{6}\right) - 1$$

$$L = \frac{1+\sqrt{1801}}{2} - 1 \text{ ft}$$

Projectile Motion

y is a function of t

General Formula: $y = \frac{1}{2}at^2 + v_0 t + y_0$

y = height
t = time in seconds
a = acceleration due to gravity
v_0 = initial (starting) velocity
y_0 = initial (starting) height

Looks like $y = ax^2 + bx + c$

- **Objects that are dropped:** If an object is **dropped**, it is simply released, and not thrown. There is no initial velocity other than the pull of gravity. This means that the middle term of the formula (seen above) is not needed, since $v_0 = 0$. We will now be using "h" to represent *the height* (as it is easier to remember its meaning) and h_0 to represent the initial (starting) height.

Working in FEET:	Working in METERS:
The acceleration due to gravity is -32 ft/sec/sec. (gravity pulls objects toward the Earth making the value negative). The formula to model the height of an object t seconds after it has been dropped is: $h = -16t^2 + h_0$	The acceleration due to gravity is -9.8 meters/sec/sec. The formula to model the height of an object t seconds after it has been dropped is: $h = -4.9t^2 + h_0$.

- **Objects that are thrown:** If an object is **thrown**, a certain amount of initial velocity accompanies its launch. Now, we have a reason to use that middle term from the General Formula (seen above). We will continue to use "h" to represent *the height* and h_0 to represent the initial (starting) height.

Working in FEET:	Working in METERS:
The acceleration due to gravity is -32 ft/sec/sec. The formula to model the height of an object t seconds after it has been dropped is: $h = -16t^2 + v_0 t + h_0$	The acceleration due to gravity is -9.8 meters/sec/sec. The formula to model the height of an object t seconds after it has been dropped is: $h = -4.9t^2 + v_0 t + h_0$

$\frac{1}{2}$ acceleration

velocity

initial height

$\frac{1}{2}$ acceleration

based on gravity

$g = -9.8 m/s^2 \quad -32 ft/s^2$

A model rocket is launched straight upward. The solid fuel propellant pushes the rocket off the ground at an initial velocity of 200 feet per second. $v_0 = 200 \text{ ft/s}$

$a = -32$

$\frac{1}{2}a = -16$

a. When will the rocket reach a height of 336 feet?

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

c. You forgot to put the parachute in the rocket. When will the rocket hit the ground?

$h_0 = 0$

$$h(t) = -16t^2 + 200t + 0$$

a.) $h(t) = 336 \text{ ft}$

$$336 = -16t^2 + 200t$$

$$0 = -16t^2 + 200t - 336$$

$$16t^2 - 200t + 336 = 0$$

$a = 16$

$b = -200$

$c = 336$

$$t = \frac{-(-200) \pm \sqrt{(-200)^2 - 4(16)(336)}}{2(16)}$$

$$t = \frac{200 \pm \sqrt{18496}}{32}$$

$$t = \frac{200 \pm 136}{32}$$

$t = \frac{200 - 136}{32}$ or $t = \frac{200 + 136}{32}$

$t = \frac{64}{32}$ $t = \frac{336}{32}$

$t = 2$ sec $t = 10.5$ sec

b.) max height? vertex

$h(t) = -16t^2 + 200t$

vertex $\to$ CTS

vertex $\to$ vertex formula $\to$ vertex (h, k) $(t,$ max height$)$

$t = -\frac{b}{2a} = -\frac{(200)}{2(-16)} = -\frac{200}{-32} = 6.25$ s

time when it reaches max height

max height

$h(6.25) = -16(6.25)^2 + 200(6.25)$

$= 625$ ft

max height by CTS

$$h = -16t^2 + 200t$$

$$h = -16\left(t^2 - \frac{25}{2}t\right)$$

$$\frac{h}{-16} = t^2 - \frac{25}{2}t$$

$$\frac{h}{-16} + \left(-\frac{25}{4}\right)^2 = t^2 - \frac{25}{2}t + \left(-\frac{25}{4}\right)^2$$

$$\frac{h}{-16} + \frac{625}{16}\left(\frac{-1}{-1}\right) = \left(t - \frac{25}{4}\right)^2$$

$$\frac{h}{-16} - \frac{625}{-16} = \left(t - \frac{25}{4}\right)^2$$

$$\frac{h - 625}{-16} = \left(t - \frac{25}{4}\right)^2$$

$$h - 625 = -16\left(t - \frac{25}{4}\right)^2$$

$$h = -16\left(t - \frac{25}{4}\right)^2 + 625$$

vertex $\left(\frac{25}{4}, 625\right)$

$$\frac{-\frac{25}{2}}{2/1}$$

$$\frac{25}{2} \cdot \frac{1}{2}$$

$$6.25 = \frac{25}{4}$$

c.) height when rocket hits ground

$h(t)=0$

$0=-16t^2+200t$

$0=-8t\left(2t-25\right)$

$-8t=0$ or $2t-25=0$

$\frac{-8t}{-8}=\frac{0}{-8}$

$+25 \quad +25$

$\frac{2t}{2}=\frac{25}{2}$

$\cancel{t=0s}$

rocket left ground @ $t=0$ reject

$t=\frac{25}{2}$

$\boxed{t=12.5\text{ s}}$

time when rocket hits ground