D.O.S.

$a^4 - 81$

$= (\underline{a^2-9})(a^2+9)$

$= (a+3)(a-3)(a^2+9)$

Simple

$x^2 + 11x + 28$

$\underline{7} \cdot \underline{4} = 28$

$\underline{7} + \underline{4} = 11$

$(x+7)(x+4)$

Complex

$\overbrace{2x^2 + x - 6}^{-12}$

$\underline{-3} \cdot \underline{4} = -12$

$\underline{-3} + \underline{4} = 1$

$(2x^2 - 3x) + (4x - 6)$

$= \underline{x}(2x-3) + \underline{2}(2x-3)$

$= (2x-3)(\underline{x+2})$

$(2x^2 + 4x) + (-3x - 6)$

$= \underline{2x}(\underline{x+2}) - \underline{3}(\underline{x+2})$

$= (x+2)(2x-3)$

$\overbrace{4x^2 - 24x + 36}^{144}$

$\underline{-12} \cdot \underline{-12} = 144$

$\underline{-12} + \underline{-12} = -24$

$(2x-6)(2x-6)$

$= (2x-6)^2$

$0 = AB$

$A = 0$ or $B = 0$

$\Longrightarrow$

$(x-5)(x+1) = 0$

$x - 5 = 0$ or $x + 1 = 0$

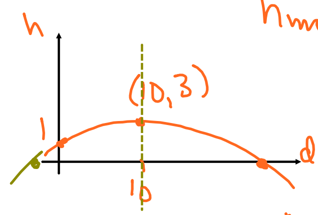
$\boxed{x = 5}$ $\boxed{x = -1}$

#9. $h(d) = -0.02d^2 + 0.4d + 1$

a) $0 = -0.02d^2 + 0.4d + 1$

get vertex form: $x = \frac{-b}{2a} = \frac{-0.4}{2(-0.02)} = \frac{-.4}{-.04} = 10$

$h_{max} = h(10) = -0.02(10)^2 + .4(10) + 1$
$= -2 + 4 + 1$
$= 3$ m



$\therefore h(d) = -0.02(d-10)^2 + 3$

now $0 = -0.02(d-10)^2 + 3$

$\frac{-3}{-0.02} = \frac{-0.02(d-10)^2}{-0.02}$

$\pm\sqrt{150} = \sqrt{(d-10)^2}$

$\pm\sqrt{150} = d - 10$

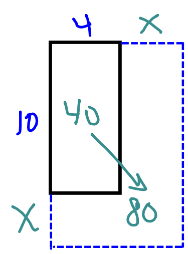
$10 \pm \sqrt{150} = d$

$d = 10 + \sqrt{150}$
$= 22.247$ m
$\boxed{d = 22.2}$

or

$d = 10 - \sqrt{150}$
$\cancel{\boxed{d = -2.2\text{ m}}}$

#8



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

$80 = 40 + 14x + x^2$

$0 = x^2 + 14x - 40$

$x_v = \frac{-b}{2a} = \frac{-14}{2(1)} = -7$

$y_v = (-7)^2 + 14(-7) - 40$
$= 49 - 98 - 40$
$= -89$

$(p,q) = (-7,-89)$

$0 = (x+7)^2 - 89$

$\pm\sqrt{89} = \sqrt{(x+7)^2}$

$\pm\sqrt{89} = x + 7$

$\boxed{-7 \pm \sqrt{89} = x}$

$x = -$ answer doesn't matter

$x = -7 + \sqrt{89} = \boxed{2.434\text{ m}}$

$\therefore$ New dimensions are $\Rightarrow 4 + 2.434 \times 10 + 2.434$

$= \boxed{6.4 \times 12.4}$ m

#15. $ax^2+bx+c=0$

$x=\boxed{\frac{-b}{2a}}$ AOS $\Rightarrow p=\frac{-b}{2a}$

$q=a\left(\frac{-b}{2a}\right)^2+b\left(\frac{-b}{2a}\right)+c$

$q=\cancel{a}\left(\frac{b^2}{4a^{\cancel{2}}}\right)-\frac{b^2}{2a}+c$

$q=\frac{b^2}{4a}-\frac{b^2}{2a}+c$

put into vertex form $\quad 0=a(x-p)^2+q$

$0=a\left(x+\frac{b}{2a}\right)^2+\left(\frac{b^2}{4a}-\frac{b^2}{2a}+c\right)$

$-\frac{b^2}{4a}+\frac{2b^2}{2\cdot 2a}-\frac{c\cdot 4a}{4a}=a\left(x+\frac{b}{2a}\right)^2$

$-\frac{b^2}{4a}+\frac{2b^2}{4a}-\frac{4ac}{4a}$

$\pm\sqrt{\frac{b^2-4ac}{4a\cdot a}}=\sqrt{\frac{\cancel{a}}{\cancel{a}}\left(x+\frac{b}{2a}\right)^2}$

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

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

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

Journal Quest: Vertex Finding

Using the example: $y = 4x^2 - 4x - 3$, explain how to find the vertex by

a) factoring

b) graphing using technology

c) converting to vertex form

In all cases, explain the details of every step of your solution.

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4.4 The Quadratic Formula

homefun: page 254 #2, 3, 5, 7,9-15,17-20, 21, 22

What's it for?	What is required?	How does it work?
finding roots of a quadratic eqn (zeroes of a quadratic function)	$\boxed{a, b, c}$ coefficients ax^2+bx+c	plug in values (in brackets) and follow BEDMAS.

So what is the formula?

To solve quadratic relations ($y = ax^2 + bx + c$) that are not easily factored, use the quadratic formula

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

From standard form, you can use the quadratic formula to determine the number of zeros.

Ex. How many zeros are there for the following functions:

a. $f(x) = 2x^2 - 3x - 5$

$a = 2$
$b = -3$
$c = -5$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(2)(-5)}}{2(2)}$$

$$= \frac{3 \pm \sqrt{9+40}}{4} = \frac{3 \pm \sqrt{49}}{4}$$

$\boxed{\frac{3+7}{4}} = \frac{10}{4}$

$\boxed{\frac{3-7}{4}} = -1$

2 sol'ns

b. $g(x) = 4x^2 + 4x + 1$

$$x = \frac{-(4) \pm \sqrt{(4)^2 - 4(4)(1)}}{2(4)} = \frac{-4 \pm 0}{8} = \frac{-4}{8} = -\frac{1}{2} \rightarrow 1 \text{ sol}^n$$

c. $h(x) = -5x^2 + x - 2$

$$x = \frac{-(1) \pm \sqrt{(1)^2 - 4(-5)(-2)}}{2(-5)} = \frac{-1 \pm \sqrt{1-40}}{-10} = \frac{-1 \pm \sqrt{-39}}{-10}$$

imaginary → no real roots

The value of the discriminant, $b^2 - 4ac$, is enough to tell you the number of zeros for a quadratic equation.

Value of the discriminant	Number of zeros/solutions
$b^2 - 4ac > 0$ positive	2 sol'ns
$b^2 - 4ac = 0$	1 sol'n
$b^2 - 4ac < 0$ negative	0 sol'ns or

discriminant: $\Delta = b^2 - 4ac$

$$\boxed{x = \frac{-b \pm \sqrt{\Delta}}{2a}}$$

Ex. For what value(s) of k will the function $f(x) = kx^2 - 4x + 1$ have no real roots, and one root, and two roots?

check the discriminant

$$\Delta = b^2 - 4ac$$
$$= (-4)^2 - 4(k)(1)$$
$$\Delta = 16 - 4k$$

a) if $\Delta = 0$, one double root (1 sol^{n})

$\therefore 0 = 16 - 4k$

$\frac{4k}{4} = \frac{16}{4} \Rightarrow \boxed{k = 4}$

b) if $\Delta < 0$, no real sol^{ns}

$0 > 16 - 4k$

$\frac{4k}{4} > \frac{16}{4} \Rightarrow \boxed{k > 4}$

$0 > 16 - 4k$

$\frac{-16}{-4} > \frac{-4k}{-4}$

$4 < k$

switch the sign when $\times$ or $\div$ by $\ominus$

c) $\therefore$ if $k < 4$, we get 2 sol^{ns} all the time