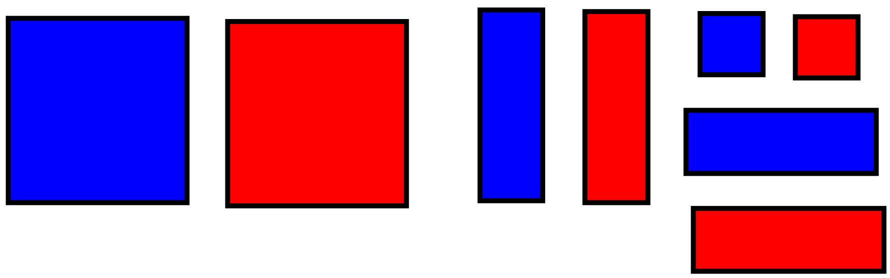
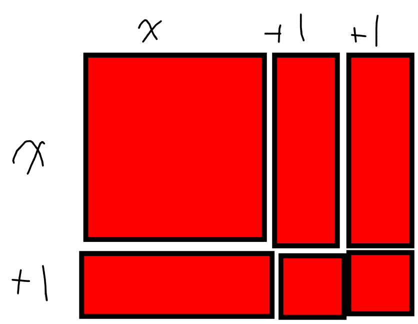
Completing the Square with Alge-tiles

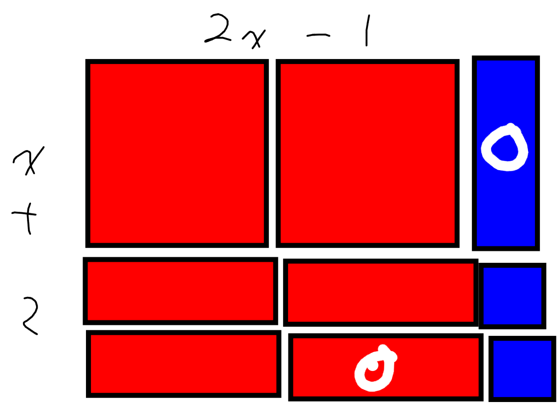


FACTOR

$x^2 + 3x + 2 = (x+2)(x+1)$

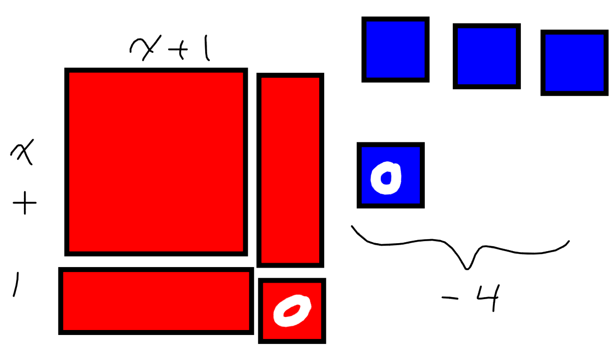


$2x^2+3x-2 = (2x-1)(x+2)$



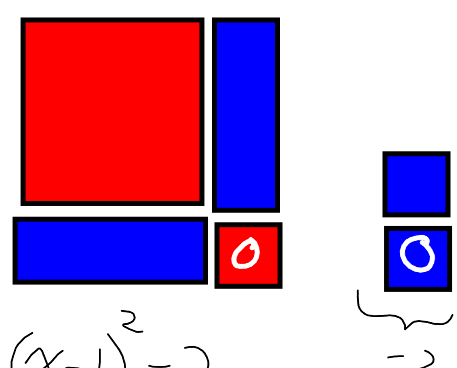
Complete the square

x^2+2x-3



$(x+1)^2 - 4$

x^2-2x-1



$(x-1)^2 - 2$

2.3 - Completing the Square

Why do we complete the square?

to change a quardatic equation from standard form

to vertex form

What can you tell from this form?

$y = a(x-h)^2 + k$

- direction of opening and stretch a
- the vertex (h,k)
- max/min & when it occurs

Ex. 1

Find the value of c that makes the following expression a perfect square trinomial.

a) $x^2 + 8x + c$

$c = \left(\frac{8}{2}\right)^2$

$= 4^2$

$= 16$

$(x+4)^2$

b) $x^2 - 10x + c$

$c = \left(\frac{-10}{2}\right)^2$

$= (-5)^2$

$= 25$

$(x-5)^2$

c) $x^2 + 3x + c$

$c = \left(\frac{3}{2}\right)^2$

$= \frac{9}{4}$

Ex 2: Change to vertex form by Completing the square.

a) $y = x^2 - 12x + 8$

$y = \boxed{x^2 - 12x + 36} - 36 + 8$

$y = (x-6)^2 - 28$

Rough

$\frac{-12}{2} = -6$

$(-6)^2 = 36$

b) $y = 2x^2 - 12x + 23$

$y = 2x^2 - 12x \quad + 23$

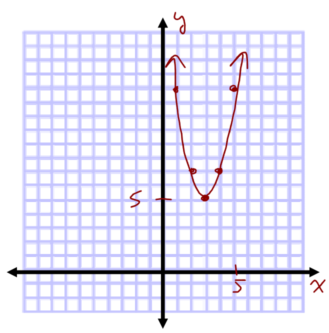
$= 2(x^2 - 6x + 9 - 9) + 23$

$= 2(x^2 - 6x + 9) - 18 + 23$

$= 2(x-3)^2 + 5$

$\frac{-6}{2} = -3$

$(-3)^2 = 9$



Graph

- plot vertex (3,5)
- count using stretch (x2)

1, 4, 9

x 2

2, 8, 18

Ex.3 - Determine the max/min and when it occurs. ← Put in vertex form

a) $y = 3x^2 + 6x + 7$

$y = 3(x^2 + 2x + 1 - 1) + 7$

$y = 3(x^2 + 2x + 1) - 3 + 7$

$= 3(x+1)^2 + 4$

MIN @ $y = 4$ when $x = -1$

b) $y = -2x^2 + 8x - 13$

$y = -2(x^2 - 4x + 4 - 4) - 13$

$= -2(x^2 - 4x + 4) + 8 - 13$

$= -2(x-2)^2 - 5$

MAX @ $y = -5$ when $x = 2$

c) $y = 3x^2 - 9x + 2$

$y = 3(x^2 - 3x \quad) + 2$

$= 3\left(x^2 - 3x + \frac{9}{4} - \frac{9}{4}\right) + 2$

$= 3\left(x^2 - 3x + \frac{9}{4}\right) - \frac{27}{4} + 2$

$= 3\left(x - \frac{3}{2}\right)^2 - \frac{19}{4}$

MIN @ $y = -\frac{19}{4}$ when $x = \frac{3}{2}$

d) $y = -4x^2 - 5x - 3$

$y = -4\left(x^2 + \frac{5}{4}x + \frac{25}{64} - \frac{25}{64}\right) - 3$

$y = -4\left(x^2 + \frac{5}{4}x + \frac{25}{64}\right) + \frac{25}{16} - 3$

$y = -4\left(x + \frac{5}{8}\right)^2 - \frac{23}{16}$

MAX OF $-\frac{23}{16}$ WHEN $x = -\frac{5}{8}$

$-\cancel{4}\left(-\frac{25}{\cancel{64}}\right)$

$+\frac{25}{16}$

e) $y = 3x^2 - 4x + 2$

$y = 3(x^2 - \frac{4}{3}x + \frac{4}{9} - \frac{4}{9}) + 2$

$y = 3(x^2 - \frac{4}{3}x + \frac{4}{9}) - \frac{4}{3} + 2$

$y = 3(x - \frac{2}{3})^2 + \frac{2}{3}$

Min of $\frac{2}{3}$

When $x = \frac{2}{3}$

f) $y = \frac{2}{3}x^2 + 7x - \frac{1}{2}$

$y = \frac{2}{3}(x^2 + \frac{21}{2} + \frac{441}{16} - \frac{441}{16}) - \frac{1}{2}$

$y = \frac{2}{3}(x^2 + \frac{21}{2} + \frac{441}{16}) - \frac{147}{8} - \frac{1}{2}$

$y = \frac{2}{3}(x + \frac{21}{4})^2 - \frac{151}{8}$

MIN of $-\frac{151}{8}$

When $x = -\frac{21}{4}$

Rough

$7 \div \frac{2}{3}$

$= 7 \times \frac{3}{2}$

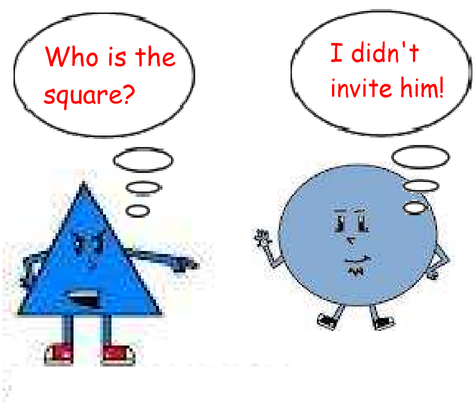
$= \frac{21}{2}$

$-\frac{\cancel{441}^{147}}{\cancel{16}_{8}}\left(\frac{\cancel{2}^{1}}{\cancel{3}}\right)$

$= -\frac{147}{8}$

$-\frac{147}{8} - \frac{4}{8}$

$= -\frac{151}{8}$



Homework
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Sep 24-9:00 AM