KEY CONCEPT *Square of a Sum*

Words The square of $a + b$ is the square of a plus twice the product of a and b plus the square of b.

Symbols $(a + b)^2 = (a + b)(a + b) = a^2 + 2ab + b^2$

Example $(x + 7)^2 = x^2 + 2(x)(7) + 7^2 = x^2 + 14x + 49$

Example: Square of a Sum

Method 1:

Find $(4y + 5)^2$.

$(a + b)^2 = a^2 + 2ab + b^2$

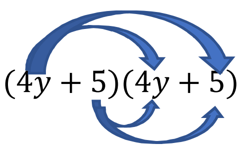
$(4y + 5)^2 = (4y)^2 + 2(4y)(5) + 5^2$ $a = 4y$ and $b = 5$

$= 16y^2 + 40y + 25$ Check by using FOIL.

Method 2:

** To say that $4y + 5$ is squared just means that we are going to multiply it by itself.

$(4y + 5)(4y + 5)$



$16y^2 + 20y + 20y + 25$

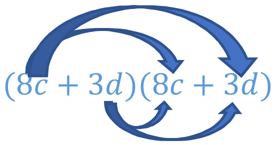
$16y^2 + 40y + 25$ **Don't change exponents when you add like terms!

Check your progress:

1) $(8c + 3d)^2$

** To say that $8c + 3d$ is squared just means that we are going to multiply it by itself.

$(8c + 3d)(8c + 3d)$



$64c^2 + 24cd + 24cd + 9d^2$

**When you are multiplying two unlike variables together, put them in alphabetical order. Remember that it doesn't actually matter which order they go in $cd = dc$. It just makes like terms look more alike if we always put variables in alphabetical order.

$64c^2 + 48cd + 9d^2$

**Don't change exponents when you add like terms!

2) $(3x + 4y)^2$

** To say that $3x + 4y$ is squared just means that we are going to multiply it by itself.

$(3x + 4y)(3x + 4y)$

$(3x + 4y)(3x + 4y)$

$9x^2 + 12xy + 12xy + 16y^2$

**When you are multiplying two unlike variables together, put them in alphabetical order. Remember that it doesn't actually matter which order they go in $xy = yx$. It just makes like terms look more alike if we always put variables in alphabetical order.

$9x^2 + 24xy + 16y^2$

**Don't change exponents when you add like terms!

KEY CONCEPT	*Square of a Difference*
Words	The square of $a - b$ is the square of a minus twice the product of a and b plus the square of b.
Symbols	$(a - b)^2 = (a - b)(a - b) = a^2 - 2ab + b^2$
Example	$(x - 4)^2 = x^2 - 2(x)(4) + 4^2 = x^2 - 8x + 16$

<u>Example: Square of a Difference</u>

Method 1:

Find $(5m^3 - 2n)^2$.

$$(a - b)^2 = a^2 - 2ab + b^2$$

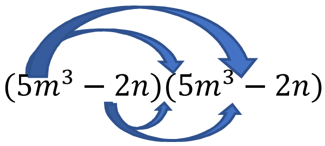
$$(5m^3 - 2n)^2 = (5m^3)^2 - 2(5m^3)(2n) + (2n)^2 \quad a = 5m^3 \text{ and } b = 2n$$

$$= 25m^6 - 20m^3n + 4n^2 \quad \text{Simplify.}$$

Method 2:

** To say that $5m^3 - 2n$ is squared just means that we are going to multiply it by itself.

$(5m^3 - 2n)(5m^3 - 2n)$



$(5m^3 - 2n)(5m^3 - 2n)$

$25m^6 - 10m^3n - 10m^3n + 4n^2$ **Remember that when we multiply $m^3 \cdot m^3$, we add exponents (the same way that $n \cdot n = n^2$). Also, remember that when you are multiplying two unlike variables together, put them in alphabetical order.

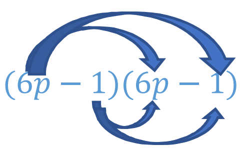
$25m^6 - 20m^3n + 4n^2$ **Don't change exponents when you add like terms!

<u>Check your progress:</u>

1) $(6p - 1)^2$

** To say that $6p - 1$ is squared just means that we are going to multiply it by itself.

$(6p - 1)(6p - 1)$



$(6p - 1)(6p - 1)$

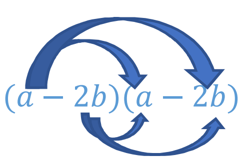
$36p^2 - 6p - 6p + 1$

$36p^2 - 12p + 1$ **Don't change exponents when you add like terms!

2) $(a - 2b)^2$

** To say that $a - 2b$ is squared just means that we are going to multiply it by itself.

$(a - 2b)(a - 2b)$



$(a - 2b)(a - 2b)$

$a^2 - 2ab - 2ab + 4b^2$

**When you are multiplying two unlike variables together, put them in alphabetical order. Remember that it doesn't actually matter which order they go in $ab = ba$. It just makes like terms look more alike if we always put variables in alphabetical order.

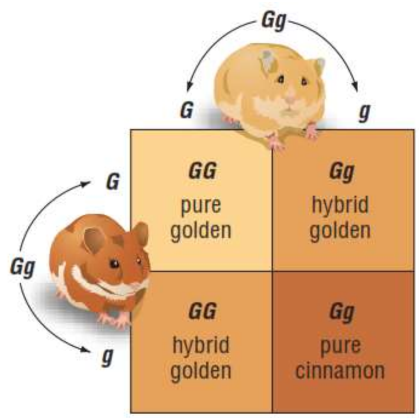
$a^2 - 4ab + 4b^2$

**Don't change exponents when you add like terms!

Example: Genetics

GENETICS **The Punnett square shows the possible gene combinations between two hamsters. Each hamster passes on one *dominant* gene *G* for golden coloring and one *recessive* gene *g* for cinnamon coloring.**

Show how combinations can be modeled by the square of a binomial. Then determine what percent of the offspring will be pure golden, hybrid golden, and pure cinnamon.



Each parent has half the genes necessary for golden coloring and half the genes necessary for cinnamon coloring. The makeup of each parent can be modeled by $0.5G + 0.5g$. Their offspring can be modeled by the product of $0.5G + 0.5g$ and $0.5G + 0.5g$ or $(0.5G + 0.5g)^2$.

Use this product to determine possible colors of the offspring.

$$(a + b)^2 = a^2 + 2ab + b^2 \quad \text{Square of a Sum}$$

$$(0.5G + 0.5g)^2 = (0.5G)^2 + 2(0.5G)(0.5g) + (0.5g)^2 \quad a = 0.5G \text{ and } b = 0.5g$$

$$= 0.25G^2 + 0.5Gg + 0.25g^2 \quad \text{Simplify.}$$

$$= 0.25GG + 0.5Gg + 0.25gg \quad G^2 = GG \text{ and } g^2 = gg$$

Thus, 25% of the offspring are *GG* or pure golden, 50% are *Gg* or hybrid golden, and 25% are *gg* or pure cinnamon.

KEY CONCEPT ***Product of a Sum and a Difference***

Words The product of $a + b$ and $a - b$ is the square of a minus the square of b.

Symbols $(a + b)(a - b) = (a - b)(a + b) = a^2 - b^2$

Example $(x + 9)(x - 9) = x^2 - 9^2 = x^2 - 81$

<u>Example: Product of a Sum and a Difference</u>

Method 1:

Find $(11v - 8w^2)(11v + 8w^2)$

$$(a - b)(a + b) = a^2 - b^2$$

$$(11v - 8w^2)(11v + 8w^2) = (11v)^2 - (8w^2)^2 \quad a = 11v \text{ and } b = 8w^2$$

$$= 121v^2 - 64w^4 \quad \text{Simplify.}$$

Method 2:

$(11v - 8w^2)(11v + 8w^2)$

$121v^2 + 88vw^2 - 88vw^2 - 64w^4$

$121v^2 - 64w^4$ **The $+88vw^2 - 88vw^2$ cancels out, so that term just disappears.

<u>Check your progress:</u>

1) $(3n + 2)(3n - 2)$

$(3n + 2)(3n - 2)$

$9n^2 - 6n + 6n - 4$

$9n^2 - 4$ **The $+6n - 6n$ cancels out, so that term just disappears.

2) $(4c - 7d)(4c + 7d)$

$(4c - 7d)(4c + 7d)$

$16c^2 + 28cd - 28cd - 49d^2$

$16c^2 - 49d^2$ **The $+28cd - 28cd$ cancels out, so that term just disappears.

Practice

Find each product.

1) $(a+6)^2$

$(a+6)(a+6)$

$a^2+6a+6a+36$

$a^2+12a+36$

2) $(2a+7b)^2$

$(2a+7b)(2a+7b)$

$4a^2+14ab+14ab+49b^2$

$4a^2+28ab+49b^2$

3) $(3x+9y)^2$

$(3x+9y)(3x+9y)$

$9x^2+27xy+27xy+81y^2$

$9x^2+54xy+81y^2$

4) $(4n-3)(4n-3)$

$16n^2-12n-12n+9$

$16n^2-24n+9$

5) $(x^2-6y)^2$

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

$x^4-6x^2y-6x^2y+36y$

x^4-12x^2y+36y

6) $(9-p)^2$

$(9-p)(9-p)$

$81-9p-9p+p^2$

$81-18p+p^2$

7) Dalila has brown eyes and Bob has blue eyes. Brown genes B are dominant over blue genes b. A person with genes BB or Bb has brown eyes. Someone with genes bb has blue eyes. Suppose Dalila's genes for eye color are Bb.
   a. Write an expression for the possible eye coloring of Dalila and Bob's children.

   $(0.5B+0.5b)(0.5b+0.5b)$

   $0.25Bb+0.25Bb+0.25bb+0.25bb$

   $0.5Bb+0.5bb$

   b. What is the probability that a child of Dalila and Bob would have blue eyes?

   $0.5=50\%$

Find each product.

8) $(8x-5)(8x+5)$

$64x^2+40x-40x-25$

$64x^2-25$

9) $(3a+7b)(3a-7b)$

$9x^2-21ab+21ab-49b^2$

$9x^2-49^2$

10) $(4y^2+3z)(4y^2-3z)$

$16y^4-12y^2z+12y^2z-9z^2$

$16y^4-9z^2$