Factoring a Difference of Squares: $a^2 - b^2$

Conjugates: Sum of two terms and a difference of two terms.

Learn the pattern that exists for multiplying conjugates.

$(x+2)(x-2) = x^2 - 2x + 2x - 4 = x^2 - 4$ The two middle terms cancel each other out.

We can use this knowledge to quickly factor polynomials that look like $x^2 - 4$.

Eg.1. Factor $x^2 - 9$.

$= (x+3)(x-3)$ Square root each term, place them in 2 brackets with opposite signs (+ and -).

Eg.2. Factor $100a^2 - 81b^2$

$= (10a+9b)(10a-9b)$ Square root each term, place them in 2 brackets with opposite signs (+ and -).

$(a+b)(a+b)$ $(a+b)(a-b)$

Factor the following completely.

239. $a^2 - 25y^2$	240. $x^2 + 144$	241. $1 - c^2$
$(a+5)(a-5)$ $(a+5y)(a-5y)$ $a^2 \cancel{-5ay} \cancel{+5ay} - 25y^2$ $(a^2 - 25y^2)$	$(x-12)(x+12)$ $(\sqrt{x}-12)(\sqrt{x}+12)$ $4a^2b^2c^2d^2 + 9$ $a^6 - 25$ $(a^3+5)(a^3-5)$	$(1+c)(1-c)$ $8a^4 - 18$ $2(4a^4-9)$ $2(2a^2+3)(2a^2-3)$

I recognize a polynomial is a difference of squares because it is a binomial where each/both a^2 and b^2 can be rooted/are perfect squares.

Factor the following completely.

242. $4x^2 - 36$

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

$4(x^2-9)$

$4(x-3)(x+3)$

243. $9x^2 - y^2$

$(3x-y)(3x+y)$

244. $25a^4 - 36$

$(5a^2-6)(5a^2+6)$

245. $49t^2 - 36u^2$

$(7t-6u)(7t+6u)$

246. $7x^2 - 28y^2$

$7(x^2-4y^2)$

$7(x-2y)(x+2y)$

247. $-18a^2 + 2b^2$

$2(-9a^2+b^2)$

$2(-3a+b)(3a+b)$

??

? ★ $2(3a+b)(3a-b)$

248. $-9 + d^4$

$-9+d^4$

$(d^2+3)(d^2-3)$

order?

249. $\frac{a^2}{9} - \frac{b^2}{16}$

$\left(\frac{a}{3}+\frac{b}{4}\right)\left(\frac{a}{3}-\frac{b}{4}\right)$

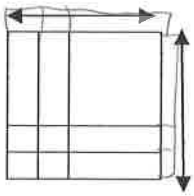
250. $\frac{x^2y^2}{49} - 1$

$\left(\frac{xy}{7}-1\right)\left(\frac{xy}{7}+1\right)$

✓

Factoring a Perfect Square Trinomial

251. Write an expression for the following diagram (do not simplify):



x^2+4x+4

What two binomials are being multiplied above?

$(x+2)(x+2)$

Write an equation using the binomials above and the simplified product.

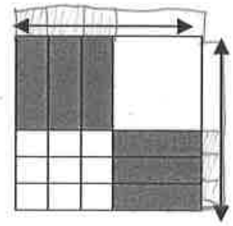
☆ Answer Key ☆

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

☆ $x^2+4x+4=(x+2)^2$ ☆

252. Write an expression for the following diagram (do not simplify):

☆ Answer Key ☆



☆ $x^2-3x-3x+9$ ☆

x^2-6x+9

What two binomials are being multiplied above?

$(x-3)(x-3)$

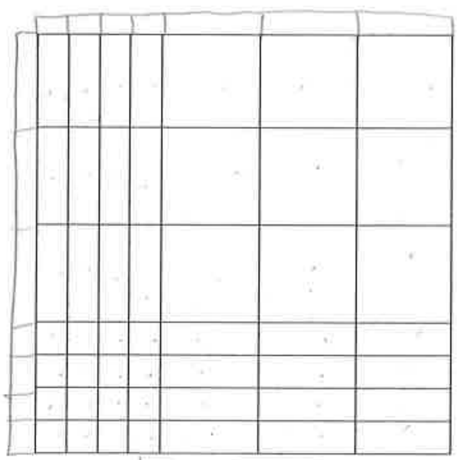
Write an equation using the binomials above and the simplified product.

☆ Answer Key ☆

$x^2-6x+9=(x-3)(x-3)$

$x^2-6x+9=(x-3)^2$

253. Write an expression for the following diagram (do not simplify):



$9x^2+24x+16$

What two binomials are being multiplied above?

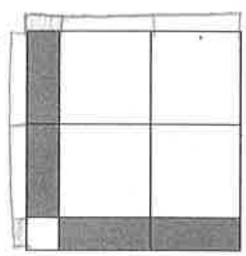
$(3x+4)(3x+4)$

Write an equation using the binomials above and the simplified product.

☆ $9x^2+24x+16=(3x+4)(3x+4)$ ☆ Answer Key ☆

$9x^2+24x+16=(3x+4)^2$

254. Write an expression for the following diagram (do not simplify):



$4x^2-2x-2x+1$

$4x^2-4x+1$

What two binomials are being multiplied above?

$(2x-1)(2x-1)$

Write an equation using the binomials above and the simplified product.

☆ Answer Key ☆

☆ $4x^2-4x+1=(2x-1)(2x-1)$ ☆

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

PERFECT SQUARE TRINOMIALS

You may use the methods for factoring trinomials to factor ***trinomial squares*** but recognizing them could make factoring them quicker and easier.

Eg.1. Factor.

$x^2 + 6x + 9$ — Recognize that the first and last terms are both perfect squares.

$(x + 3)^2$ — Guess by taking the square root of the first and last terms and put them in two sets of brackets.

Check: Does $2(x)(3) = 6x$
Yes! Trinomial Square!

In a trinomial square, the middle term will be double the product of the square root of first and last terms. Wow, that's a mouthful!

?

$(x + 3)^2$ — Answer in simplest form.

Eg.2. Factor.

$121m^2 - 22m + 1$

$(11m - 1)^2$ — Guess & Check. $2(11m \times -1) = -22m$.
Since the middle term is negative, binomial answer will be a subtraction.

Factor the following.

255. $x^2 + 14x + 49$

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

$\boxed{(x+7)^2}$

256. $4x^2 - 4x + 1$

$x^2 - 4x + 4$

$(x-\cancel{2})(x-\cancel{2})$

$(2x-1)(2x-1) \to \boxed{(2x-1)^2}$

257. $9b^2 - 24b + 16$

$(3b-4)(3b-4)$

$\boxed{(3b-4)^2}$

258. $64m^2 - 32m + 4$

$4(16m^2 - 8m + 1)$

$\boxed{4(4m-1)^2}$

259. $81n^2 + 90n + 25$

$(9n+5)(9n+5)$

$\boxed{(9n+5)^2}$

260. $81x^2 - 144xy + 64y^2$

$(9x-8y)(9x-8y)$

$\boxed{(9x-8y)^2}$

Create a Factoring Flowchart.

Start with the first thing you should do....collect like terms.

Collect like terms

↓

GCF

$4x^2+28x+48$

$4(x^2+7x+12)$

↓

LOOK FOR SPECIAL PATTERN

Difference of Squares

$\boxed{a^2-b^2=(a+b)(a-b)}$

$36x^2-9x$

$9(4x^2-y^2)$

$9(2x-y)(2x+y)$

$\frac{1}{4}x^2-81y^2=(\frac{1}{2}x-9y)(\frac{1}{2}x+9y)$

$a^2-100b^2=(a+10b)(a-10b)$

Perfect Square Trinomial

$\boxed{(a-b)^2=a^2-2ab+b^2}$

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

$=x^2-xy-xy+y^2$

$=x^2-2xy+y^2$

OR

$\boxed{(a+b)^2=a^2+2ab+b^2}$

$(x+y)^2=(x+y)(x+y)$

$=x^2+xy+xy+y$

$=x^2+2xy+y^2$

$\boxed{ax^2+bx+c}$

$\boxed{a=1}$

$x^2+7x+12$

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

$\boxed{a\neq1}$

Guess & check

$3x^2-10x+8$

$(3x-4)(x-2)$

☆ Decomposition ☆

$3x^2-10x+8$

$3x^2-6x-4x+8$

$3x(x-2)-4(x-2)$

$(3x-4)(x-2)$

✓

Combined Factoring. Factor the following completely.

261. $3a^2 - 3b^2$

$\boxed{3(a-b)(a+b)}$

262. $4x^2 + 28x + 48$

$4(x^2+7x+12)$

$\boxed{4(x+3)(x+4)}$

263. $x^4 - 16$

$\boxed{(x^2-4)(x^2+4)}$

☆ $(x^2+4)(x-2)(x+2)$ ☆

264. $2y^2 - 2y - 24$

$2(y^2-y-12)$

$\boxed{2(y+4)(y-3)}$

☆ +4 or -4 / +3 or -3 ☆

265. $16 - 28x + 20x^2$

$20x^2-28x+16$

$\boxed{4(5x^2-7x+4)}$

☆ why can't you factor anymore? ☆

266. $m^4 - 5m^2 - 36$

$(m^2-9)(m^2+4)$

$\boxed{(m^2+4)(m-3)(m+3)}$

☆ why don't you seperate it? ☆

267. $x^8 - 1$

$(x^4+1)(x^4-1)$

$(x^4+1)(x^2-1)(x^2+1)$

$\boxed{(x^4+1)(x^2+1)(x+1)(x-1)}$

268. $x^3 - xy^2$

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

$\boxed{x(x-y)(x+y)}$

269. $x^4 - 5x^2 + 4$

why don't you

$(x^2-4)(x^2-1)$ why do you seperate it?

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

$\boxed{(x-2)(x+2)(x+1)(x-1)}$

HIGHER DIFFICULTY…

For some of the following questions, you may try substituting a variable in the place of the brackets to factor first, and then replace brackets.

270. $(a+b)^2 - c^2$

$a+b = x$

$x^2 - c^2$

$(x-c)(x+c)$

$((a+b)-c)((a+b)+c)$

$\boxed{(a+b-c)(a+b+c)}$

271. $(c-d)^2 - (c+d)^2$

$c-d = x$

$c+d = y$

$x^2 - y^2$

$(x-y)(x+y)$

$((c-d)-(c+d))((c-d)+(c+d))$

$(c-d-c-d)(c-d+c+d)$

$(-2d)(2c)$

$\boxed{-4cd}$

✱ $\boxed{-4dc}$ ✱

272. $(m+7)^2 + 7(m+7) + 12$

$m+7 = x$

$x^2 + 7x + 12$

$x^2 + 3x + 4x + 12$

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

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

$((m+7)+4)((m+7)+3)$

$\boxed{(m+11)(m+10)}$

✓

Answer key wrong?

273. Factor.
$(x+2)^2-(x-3)^2$

$x+2=x$
$x-3=y$
x^2-y^2
$(x-y)(x+y)$
$((x+2)-(x-3))((x+2)+(x-3))$
$(x+2-x+3)(x+2+x-3)$
$5)(2x-1) \rightarrow \boxed{5(2x-1)}$

274. Find all the values of k so that $x^2+kx-12$ can be factored.

$-12: -3,+4=+1$
$-4,+3=-1$
$-12,+1=-11$
$+12,-1=+11$
$-2,+6=+4$
$+2,-6=-4$
$\boxed{\pm 1, \pm 4, \pm 11}$

275. For which integral values of k can $3x^2+kx-3$ be factored.

$3\times -3 = -9 = -3,+3=0$
$-9,+1=-8$
$+9,-1=+8$
$\boxed{0, \pm 8}$

include zero

276. What value of k would make $kx^2+24xy+16y^2$ a perfect square trinomial?

$b=4y$ $12xy+1$ $4y$
$2ab=24xy$
$\frac{\overset{3}{\cancel{24}}x\cancel{x}}{\underset{1}{\cancel{8}}\cancel{x}}=\frac{\cancel{2}a(\cancel{4y})}{\cancel{2}\cancel{\times 4y}}$
$3x=a$
$a^2=kx^2 \rightarrow (3x)^2=kx^2=\frac{9x^2}{x^2}=\frac{kx^2}{x^2} \rightarrow \boxed{k=9}$

277. What value of k would make $2kx^2-24xy+9y^2$ a perfect square trinomial?

$2ab=-24xy \rightarrow b=3y$
$\frac{\overset{-4}{\cancel{-24}}x\cancel{y}}{\underset{1}{\cancel{6}}\cancel{x}}=\frac{\cancel{2}a(\cancel{3y})}{\cancel{2\times 3y}}=-4x=a$
$2kx^2=(-4x)^2=\frac{2kx^2}{2x^2}=\frac{\overset{8}{\cancel{16}}\cancel{x^2}}{\underset{1}{\cancel{2}}\cancel{x^2}}$
$\boxed{k=8}$

278. For which integral values of k can $6x^2+kx+1$ be factored.

a. 5,7

b. $\pm 5, \pm 7$

c. $-5,-7$

d. all integers from 5 to 7.

$6 = -3,-2=-5$
$+3,+2=+5$
$+6,+1=+7$
$-6,-1=-7$
$\boxed{\pm 5, \pm 7}$

279. Expand and simplify.
$-2(3m+4)^2$

$-2(3m+4)(3m+4)$
$-2(9m^2+12m+12m+16)$
$-2(9m^2+24m+16)$
$-18m^2-48m-32$

280. If $a=2x+3$, write a^2-5a+3 in terms of x.

$(2x+3)^2-5(2x+3)+3$
$4x^2+9-10x-15+3$
$4x^2-10x-3$

$2ab=24xy$
$b=4y$
$\frac{\overset{3}{\cancel{24}}x\cancel{x}}{\cancel{8}\cancel{x}}=\frac{\cancel{2}a(\cancel{4}x)}{\cancel{8}\cancel{x}}$
$3x=a$
$(3x)^2=kx^2$
$\frac{9x^2}{x^2}=\frac{kx^2}{x^2} \rightarrow 9=x$

$2ab=-24xy$
$\frac{2a(\cancel{3y})}{\cancel{3y}}=\frac{\overset{8}{\cancel{-24}}x\cancel{x}}{\cancel{3}\cancel{x}}$
$\frac{2a}{2}=\frac{-8x}{2}$
$a=-4x$

$(-4x)^2=2kx^2$
$\frac{16x^2}{2}=\frac{2kx^2}{2}$
$\frac{8x^2}{x^2}=\frac{kx^2}{x^2}$
$8=k$

281. Lindsay was helping Anya with her math homework. She spotted an error in Anya's multiplication below. Find and correct any errors.

★ not factoring ★

Multiply:

$5x(2x+1)+2(2x+1)$

$=10x+1+4x+2$

$=14x+3$

$5x(2x+1)+2(2x+1)$

$10x^2+5x+4x+2$

$5x(2x+1)+2(2x+1)$

$\boxed{(5x+2)(2x+1)}$

$* \ 10x^2+9x+2 \ *$

282. When asked to factor the following polynomial, Timmy was a little unsure where to start.

Factor: 10x + 5 + 2xy + y

What type of factoring could you tell him to perform to help him along?

Factor By Grouping

283. Find and correct any errors in the following factoring.

$2x^2 - 5x - 12$

$=2x^2-12x+2x-12$

$=2x(x-6)+2(x-6)$

$=(2x+2)(x-6)$

$2x^2-5x-12$

$2x^2-8x+3x-12$

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

$\boxed{(2x+3)(x-4)}$

284. Explain why
$3x^2 - 17x + 10 \neq (3x+1)(x+10)$

$3x^2-17x+10 \neq 3x^2+30x+x+10$

$3x^2-17x+10 \neq 3x+31x+10$

285. Find and correct any errors in the following multiplication.

$(x^2+2)^2$

$= x^4 + 4$

$+4x$

$(x^2+2)(x^2+2)$

$x^4+2x+2x^2+4$

$\boxed{x^4+4x+4}$

286. Explain why it is uncommon to use algebra tiles to multiply the following

$(x+1)^3$

b/c you are multiplying 3 things (expressions) together.

287. Multiply the expression above.

$(x+1)(x+1)(x+1)$

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

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

$x^3+2x^2+x+x^2+2x+1$

$\boxed{x^3+3x^2+3x+1}$

ADDITIONAL MATERIAL

Solving Quadratic Equations:

One of two methods will be used depending on the equation.

Isolating the variable in one place:

Solve. $x^2 - 25 = 0$
$x^2 = 25$
$x = 5 \text{ or } -5$

Solve. $3x^2 - 12 = 0$
$3x^2 = 12$
$x^2 = 4$
$x = 2 \text{ or } -2$

We can only isolate the variable when there are not x terms as well as x^2 terms.

> ZERO PRODUCT RULE
>
> For two terms to have a product equal to zero, one or both must be equal to zero.

Solve by factoring with the zero product rule:
With quadratic equations like $x^2 + 7x + 12 = 0$, we cannot isolate the variable because x and x^2 cannot be combined.

We must factor the polynomial.

$x^2 + 7x + 12 = 0$	
$(x + 3)(x + 4) = 0$	Factor.
	Think... what would make the left side equal to 0.
	Use the *zero product rule.*
	If $x = -3$ or $x = -4$, the entire left side would equal 0.
$x = -3 \text{ or } -4$	

Solve. $2x^2 + 7x + 6 = 0$

$(2x + 3)(x + 2) = 0$

$x = -2 \text{ or } -\frac{3}{2}$

OMIT

Solve the following quadratic equations.

288. $x^2 = 36$	289. $4x^2 - 64 = 0$	290. $4x^2 = 9$
291. $8x^2 = 49 + x^2$	292. $x^2 + x = 56$	293. $x^2 - 4x - 21 = 0$
294. $4x^2 - 12x + 9 = 0$	295. $3n^2 - 11n + 6 = 0$	296. $a^2 - b^2 = 0$

OMIT

Long Division of Polynomials:

Eg.1 $(x^2 + 8x + 15) \div (x + 3)$

$$\begin{array}{r|l} & \quad x \\ \hline x+3 & x^2 + 8x + 15 \\ & \underline{x^2 + 3x} \end{array}$$

Divide the first term in the polynomial by the first term in the divisor. Write your answer above the polynomial, then expand to get to your next Step.

$$\begin{array}{r|l} & \quad x \\ \hline x+3 & x^2 + 8x + 15 \\ & \underline{x^2 + 3x} \\ & \qquad 5x \;\; + 15 \end{array}$$

Subtract the newly expanded expression from the two terms above it. And bring down the **15** from above.

$$\begin{array}{r|l} & \quad x + 5 \\ \hline x+3 & x^2 + 8x + 15 \\ & \underline{x^2 + 3x} \\ & \qquad 5x + 15 \\ & \qquad \underline{5x + 15} \\ & \qquad\qquad 0 \end{array}$$

Divide the first term in $5x + 15$ by the first term in the divisor $x + 3$. Write your answer (5) above the polynomial, then expand, subtract to get the remainder of 0.

Remainder is 0.

This means that $(x^2 + 8x + 15) = (x + 3)(x + 5)$ In the form $\boxed{P = DQ + R}$

Or $\frac{(x^2+8x+15)}{(x+3)} = (x + 5) + \frac{0}{x+3}$ In the form $\frac{P}{D} = Q + \frac{R}{D}$

Eg.2 $(2x^2 + 7x + 5) \div (x + 1)$

$$\begin{array}{r|l} & \quad 2x + 5 \\ \hline x+1 & 2x^2 + 7x + 5 \\ & \underline{2x^2 + 2x} \\ & \qquad 5x + 5 \\ & \qquad \underline{5x + 5} \\ & \qquad\qquad 0 \end{array}$$

Eg.3 $(6x^3 - x^2 - 11x + 9) \div (2x - 1)$

$$\begin{array}{r|l} & \qquad 3x^2 + x \; - 5 \\ \hline 2x-1 & 6x^3 - x^2 - 11x + 9 \\ & \underline{6x^3 - 3x^2} \\ & \qquad 2x^2 - 11x \\ & \qquad \underline{2x^2 - 1x} \\ & \qquad\quad -10x + 9 \\ & \qquad\quad \underline{-10x + 5} \\ & \qquad\qquad\qquad 4 \end{array}$$

Solution: $(6x^3 - x^2 - 11x + 9) = (2x - 1)(3x^2 + x - 5) + 4$

OMIT

Perform the following divisions. Answer in $P = DQ + R$ or $\frac{P}{D} = Q + \frac{R}{D}$ form.

297. $(x^3 + 2x^2 + 3x + 2) \div (x + 1)$

298. $(t^3 + 3t^2 - 5t - 4) \div (t + 4)$

299. $(m^3 + 2m^2 - m - 4) \div (m + 1)$

300. $(x^3 - 4x^2 - 2x + 8) \div (x - 4)$

301. $(m^3 + 3m^2 - 4) \div (m + 2)$

You will need to insert "0*m*" into this polynomial before you divide!

302. $(a^3 - 3a + 6) \div (a + 1)$

OMIT

303. $(n^3 + 2n^2 - n - 2) \div (n^2 - 1)$

304. $(6r^2 - 25r + 14) \div (3r - 2)$

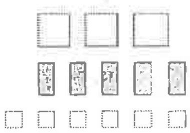
305. $(12s^3 + 3s^2 - 20s - 5) \div (3s^2 - 5)$

306. $(4y^2 - 29) \div (2y - 5)$

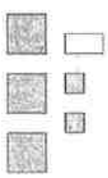
OMIT

Answers:

1. 5,-7
2. 13
3. x, y
4. no, negative exponent
5. yes
6. no, negative exponent
7. no, exponent not a whole number
8. yes
9. no, exponent not a whole number
10. 1, binomial
11. 3, trinomial
12. 7, polynomial
13. 0, monomial
14. Many possibilities
15. Many possibilities
16. $5x$
17. $-3x^2$
18. $x^2 + 3x + 4$
19. $-4x^2 - 2x - 3$
20. $3x^2 + 3x + 4$
21.

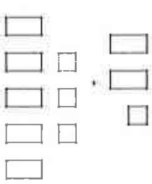


22.

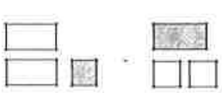


23. The two terms cancel each other, resulting in a sum of 0.
24. The two expressions cancel each other, resulting in a sum of 0.
25. 0
26. $-x^2 + x - 1$
27.

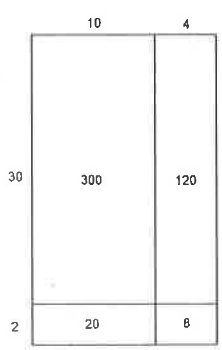
28.



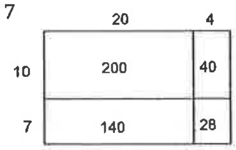
29. $-3x + 4$
30. $-x^2 + 5x + 2$
31. 0
32. 0
33.



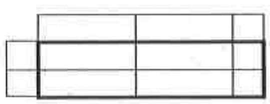
34. You cannot subtract / take away, or cancel the "negative-x" tile from the first expression because there was not one there. The same problem arises with the "+2".
35. Raj added "zero" in the form of opposite tiles so that he could then subtract the $(-x + 2)$ from the first expression.
36. $7x - 6$
37. $5x^2 + 5x - 8$
38. $x^2 - 4x - 8$
39. Same shape.
40. Same letter, same exponent (degree).
41. $-9x + 9y,\ -45$
42. $3x^3 - 5x^2 - 6,\ 30$
43. $11x^2y^3 - 5, -797$
44. $6x + 17$
45. $12a + 4b$
46. $4x + 4$
47. $7a$
48. $12x - 5y$
49. $19a - 3b$
50. $13x^2 - x - 5$
51. $-2m^2n - 2mn + n$
52. $-y^2 + 2y - 4$
53. $10x^2 - 6xy + 3x + 6$
54. A rectangle that is 3 by 3 has an area of 9 square units.
55. A rectangle that is 3 by 4 has an area of 12 square units.
56. 20
57. Colour one side differently. The (-2) could be shaded.
58. -12
59. -20
60. Both edges would be shaded to represent negatives.
61. 12
62. 20
63. 252
64. $(30 + 2)(10 + 4)$
    $300 + 120 + 20 + 8$
    448
65. 408
66. 252
67. =448



68. =408
    7

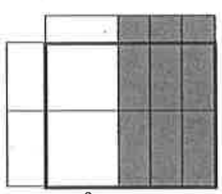


69. 345
70. 2496
71. 5329
72. $(4)(5) = 20$
73. $(-3)(6) = -18$
74. $(x)(5) = 5x$
75. $(x)(x) = x^2$
76. $(x)(-x) = -x^2$
77. $(x)(2x) = 2x^2$
78. $(3)(2x) = 6x$
79. $(-3)(2x) = -6x$
80. $(2)(-3x) = -6x$
81. $\frac{6x}{x} = 6$, length is 6 units.
82. $\frac{6x^2}{3x} = 2x$,
    length is 2x units.
83. $\frac{-6x^2}{3x} = -2x$,
    length is $-2x$ units.
84. $(2x)(x + 1) = 2x^2 + 2x$
85. $(2x)(-x + 1) = -2x^2 + 2x$
86. $(2x)(x - 2) = 2x^2 - 4x$
87. $(-2x)(x - 3) = -2x^2 + 6x$
88.



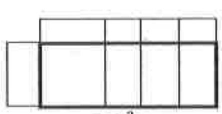
$= 4x + 2$

89.



$= 2x^2 - 6x$

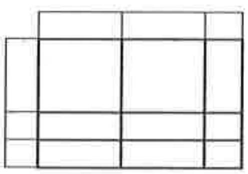
90.



$= x^2 + 3x$

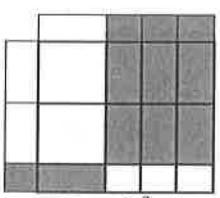
91. $-x^2 - 3x$
92. $-6x^2 - 9x$
93. $\frac{x^2+3x}{x}$ or $(x^2 + 3x) \div (x)$
    length is $x + 3$
94. $\frac{-x^2-3x}{x}$ or $(-x^2 - 3x) \div (x)$
    length is $-x - 3$

95. $\frac{2x^2-8x}{2x}$ or $(2x^2 - 8x) \div (2x)$
length is $x - 4$
96. $2x^2 + 6x$
$x + 3$
$2x$
97. $6x + 18$
6
$x + 3$
98. $2x^2 + 3x$
$2x + 3$
x
99. $6a^2b^8$
100. $-10x^5y^8$
101. $-12x^4$
102. $\frac{3}{8}a^4b^3$ or $\frac{3a^4b^3}{8}$
103. $-5t^3$
104. $5xz^2$
105. $\frac{4x^2}{3y}$
106. $-20c^4d^4$
107. $6x^2y^2$
108. a
109. $2x^2 - 9x - 5$
110. $2x(x + 1) = 2x^2 + 2x$
111. $2x(2x + 1) = 4x^2 + 2x$
112. $2x(x - 2) = 2x^2 - 4x$
113. $-2x(x - 3) = -2x^2 + 6x$
114.



$= 2x^2 + 5x + 2$

115.



$= 2x^2 - 7x + 3$

116. $4 - x^2$
See solutions guide for area model.
117. $-x^2 + 4x - 3$
See solutions guide for area model.
118. $6x^2 + 5x + 1$
See solutions guide for area model.
119. $A = lw$

$$l = \frac{A}{w}$$

$$\frac{x^2 + 3x + 2}{x + 1}$$

length: $x + 2$

120. $\frac{2x^2+5x+2}{2x+1}$

length: $x + 2$

121. $\frac{4x^2-8x+3}{2x-1}$

length: $2x - 3$

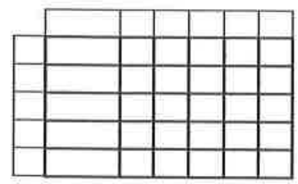
122. Area: $x^2 + 5x + 6$
Length: $x + 3$
Width: $x + 2$

123. a: $x^2 + 6x + 9$
Length: $x + 3$
Width: $x + 3$
124. Area: $2x^2 + 7x + 6$
Length: $2x + 3$
Width: $x + 2$
125. $x^2 - 2x - 3$
126. $4x^2 + 4x + 1$
127. $x^2 - 16$
128. $x^2 - 3x - 10$
129. $2x^2 - 5x - 3$
130. $x^2 - 6x + 9$
131. $x^2 + 4x + 4$
132. $6x^2 - 3x - 3$
133. $4x^2 - 1$
134. $x^2 + 4x + 4$
135. $4x^2 + 20x + 25$
136. $x^3 + 2x^2 - 7x + 4$
137. $x^3 - 10x^2 + 26x - 5$
138. $6x^3 - 5x^2 - 4x - 3$
139. $x^3 + 6x^2 + 12x + 8$
140. $x^2 + 2x - 2x - 4$
$(x + 2)(x - 2)$
$(x + 2)(x - 2) = x^2 - 4$
141. $x^2 + 3x - 3x - 9$
$(x + 3)(x - 3)$
$(x + 3)(x - 3) = x^2 - 9$
142. $4x^2 + 4x - 4x - 4$
$(2x + 2)(2x - 2)$
$(2x + 2)(2x - 2) = 4x^2 - 4$
143. $9x^2 + 12x - 12x - 16$
$(3x + 4)(3x - 4)$
$(3x + 4)(3x - 4) = 9x^2 - 16$
144. $x^2 - 9$
145. $4x^2 - 9$
146. $9x^2 - 1$
147. $x^2 - 2y$
148. $3b^2 - 147$
149. $-2c^2 + 50$
150. $2x^2 + 15x + 30$
151. $3x^2 - 11x - 38$
152. $30t^2 - 61t + 25$
153. $-12y^2 - 20y - 1$
154. $3^2 \times 2$
155. $3^2 \times 2^4$
156. 2^6
157. $2^3 \times 3 = 24$
158. $2^4 = 16$
159. $2 \times 3^2 = 18$
160. $5\times2\times a\times a\times b$
161. $2\times3\times3\times a\times b\times b\times c\times c\times c$
162. $2\times2\times3\times b\times b\times b\times c\times c$
163. $2ab$
164. $6b^2c^2$
165. $2b$
Challenge: $5(x+2)$

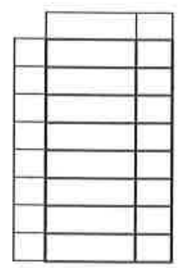
Challenge: $3x(x^2+2x-4)$

166. $5(x+5)$
167. Not factorable.
168. $8(x+1)$

169.



170. Cannot be represented as a rectangle using the tiles we have established, therefore it is not factorable.
171.



172. $2a(2x + 4y - 3z)$
173. $6w^3(2w - 1)(2w + 1)$
174. $wxy(3w^2 + 12y - 1)$
175. $9a^2b^2(3b + 1 - 2a)$
176. $6mn^2(m^2 + 3mn - 2 + 4n)$
177. $(5x + 3)(a + b)$
178. $(3m + 5)(x - 1)$
179. Not factorable
180. $(4t + 1)(m + 7)$
181. $(3t - 1)(x - y)$
182. $(4y - x)(p + q)$
Challenge: $(a + b)(c + d)$

183. $(w + z)(x + y)$
184. $(x + 1)(x - y)$
185. $(x + 3)(y + 4)$
186. $(2x + 3y)(x + 2)$
187. $(m + 4)(m - n)$
188. $(3a - 2b^2)(a - 3)$
Refer to solutions guide to see algebra tiles for questions 189-192.

189. $(x + 4)(x + 2)$
190. $(x + 7)(x + 2)$
191. $(x - 6)(x - 1)$
192. $(x - 1)(x + 10)$

193. $(a+5)(a+1)$
194. $(n+5)(n+2)$
195. $(x-6)(x+5)$
196. $(q+5)(q-3)$
197. $(k-7)(k+8)$
198. $(t+8)(t+3)$
199. $(y-10)(y+3)$
200. $(g-10)(g-1)$
201. $(s-10)(s+8)$
202. $(m-3)(m-9)$
203. $(x-9)(x+3)$
204. $(p+9)(p-6)$
205. $2(y-4)^2$
206. $(a-9)(a-5)$
207. $2(x+5)(x-2)$
208. $(x^2-5)(x^2+2)$
209. $(w^3+4)(w^3+3)$
210. $(p^4-7)(p^4+3)$
211. $x(8-x)(7+x)$
212. $(x^2+16)(x^2-5)$
213. Not factorable.
214. $(x-5y)(x-y)$
215. $(x+9y)(x-4y)$
216. $(ab-3)(ab-2)$

Challenge: $(2x+3)(x+2)$

217. $(a+4)(2a+3)$
218. $(5a-2)(a-1)$
219. $(3x-2)(x-3)$
220. $(2y+3)(y+3)$
221. $(5y+1)(y-3)$
222. $(2x-3)(5x-1)$
223. $(2x+1)(x+1)$
224. $(3k-4)(2k+1)$
225. $(2y+3)(3y+1$
226. $(3x+2)(x-6)$
227. $x(3x+1)(x-2)$
228. $(3x+1)(3x+4)$
229. $(7x+3)(3x+4)$
230. $x(3x-5)(2x+3)$
231. $2(5t-3)(t+1)$
232. $(3x-y)(x-7y)$
233. $(2c-d)(2c-d)$
234. $(x^2+2)(2x^2+3)$

Challenge:

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

235. Answered on page.
236. x^2-9
   $(x+3)(x-3)$
   $x^2-9=(x+3)(x-3)$
237. $4x^2-4$
   $(2x+2)(2x-2)$
   $4x^2-4=(2x+2)(2x-2)$
238. $9x^2-16$
   $(3x+4)(3x-4)$
   $9x^2-16=(3x+4)(3x-4)$
239. $(a+5)(a-5)$
240. $(x+12)(x-12)$
241. $(1+c)(1-c)$
242. $4(x+3)(x-3)$
   Note:
   $(2x+6)(2x-6)$ is not fully factored because there is GCF that can be removed.
243. $(3x+y)(3x-y)$
244. $(5a^2+6)(5a^2-6)$
245. $(7t+6u)(7t-6u)$
246. $7(x+2y)(x-2y)$
247. $-2(3a+b)(3a-b)$
248. $(d^2+3)(d^2-3)$
249. $(\frac{a}{3}+\frac{b}{4})(\frac{a}{3}-\frac{b}{4})$
250. $(\frac{xy}{7}+1)(\frac{xy}{7}-1)$
251. x^2+4x+4
   $(x+2)(x+2)$
   $x^2+4x+4=(x+2)(x+2)$

   Factored Form: $(x+2)^2$
252. $x^2-3x-3x+9$
   $(x-3)(x-3)$
   $x^2-6x+9=(x-3)(x-3)$

   Factored Form: $(x-3)^2$
253. $9x^2+12x+12x+16$
   $(3x+4)(3x+4)$
   $9x^2+24x+16=(3x+4)(3x+4)$

   Factored Form: $(3x+4)^2$
254. $4x^2-2x-2x+1$
   $(2x-1)(2x-1)$
   $4x^2-4x+1=(2x-1)(2x-1)$

   Factored Form: $(2x-1)^2$
255. $(x+7)^2$
256. $(2x-1)^2$
257. $(3b-4)^2$
258. $4(4m-1)^2$
   Careful. Look for the GCF first.
259. $(9n+5)^2$
260. $(9x-8y)^2$
261. $3(a+b)(a-b)$
262. $4(x+4)(x+3)$
263. $(x^2+4)(x+2)(x-2)$
264. $2(y-4)(y+3)$
265. $4(5x^2-7x+4)$
266. $(m+3)(m-3)(m^2+4)$
267. $(x+1)(x-1)(x^2+1)(x^4+1)$
268. $x(x+y)(x-y)$
269. $(x+2)(x-2)(x+1)(x-1)$
270. $(a+b+c)(a+b-c)$
271. $-4dc$
272. $(m+11)(m+10)$
273. $5(2x-1)$
274. $\pm 1, \pm 4, \pm 11$
275. $\pm 8, 0, 3$
276. $k=9$
277. $k=8$
278. b
279. $-18m^2-48m-32$
280. $4x^2+2x$
281. The second line should read $10x^2+5x+4x+2$. The simplified answer would then be $10x^2+9x+2$.
282. Factor by grouping.
283. The first step in decomposition should have read
   $2x^2-8x+3x-12$
   $2x(x-4)+3(x-4)$
   $(2x+3)(x-4)$
284. If we expand the two binomials, the middle term will not equal -17.
285. $(x^2+2)(x^2+2)$
   $x^4+2x^2+2x^2+4$
   x^4+4x^2+4
286. We would need to describe the tiles in 3-dimensions.
287. x^3+3x^2+3x+1

Additional Material:

288. $x=\pm 6$
289. $x=\pm 4$
290. $x=\pm\frac{3}{2}$
291. $x=\pm\sqrt{7}$
292. $x=-8$ *or* 7
293. $x=-3$ *or* 7
294. $x=\frac{3}{2}$
295. $n=3$ *or* $\frac{2}{3}$
296. $a=b$ *or* $a=-b$
297. $x^3+2x^2+3x+2=(x+1)(x^2+x+2)$
298. $t^3+3t^2-5t-4=(t+4)(t^2-t-1)$
299. $m^3+2m^2-m-4=(m+1)(m^2+m-2)-2$
300. $x^3-4x^2-2x+8=(x-4)(x^2-2)$
301. $m^3+3m^2-4=(m+2)(m^2+m-2)$
302. $a^3-3a+6=(a+1)(a^2-a+2)+8$
303. $n^3+2n^2-n-2=(n^2-1)(n+2)$
304. $6r^2-25r+14=(3r-2)(2r-7)$
305. $12s^3+3s^2-20s-5=(3s^2-5)(4s+1)$
306. $4y^2-29=(2y-5)(2y+5)-4$