

MTH-4106 Factoring and Algebraic Fractions: Worksheet #9

Reduce the following algebraic fractions to their lowest terms.
Show all the steps in the solutions.

$$1. \frac{h^2 - h^2k^2}{h^3 - h^3k^2} = \frac{h^2(1-k^2)}{h^3(1-k^2)} = \frac{\cancel{h^2}(1-\cancel{k^2})}{h^{\cancel{3}}(1-\cancel{k^2})} = \boxed{\frac{1}{h}}$$

$$2. \frac{4x^2 - 26x + 40}{-2x^2 + 13x - 20} = \frac{2(2x^2 - 13x + 20)}{(-2x^2 + 13x - 20)} = \frac{2(-1)(-2x^2 + 13x - 20)}{(-2x^2 + 13x - 20)} = \boxed{-2}$$

$$3. \frac{ab - bc}{-b} = \frac{b(a-c)}{-b} = \frac{\cancel{b}(a-c)}{-\cancel{b}} = \frac{a-c}{-1}$$

OR $\boxed{-1(a-c)}$

OR $-a + c$

OR $c - a$

$$4. \quad \frac{\textcircled{1} x^2 - 8xy + 7y^2}{\textcircled{2} x^2 - 3xy - 28y^2} = \frac{(x-y)(x-7y)}{(x+4y)(x-7y)} = \boxed{\frac{x-y}{x+4y}}$$

$$\textcircled{1} x^2 - 8xy + 7y^2$$

$$p=7 \\ s=-8 \\ -7, -1$$

$$(x^2 - 7xy) + (-1xy + 7y^2)$$

$$x(x-7y) - y(x-7y)$$

$$(x-y)(x-7y)$$

$$\textcircled{2} x^2 - 3xy - 28y^2$$

$$p=-28 \\ s=-3$$

$$-7, +4$$

$$(x^2 - 7xy) + (4xy - 28y^2)$$

$$x(x-7y) + 4y(x-7y)$$

$$(x+4y)(x-7y)$$

$$5. \quad \frac{4-j}{j^2-16} = \frac{4-j}{(j-4)(j+4)} = \frac{-1(-4+j)}{(j-4)(j+4)} = \frac{-1(-4+j)}{(j-4)(j+4)}$$

$$= \boxed{\frac{-1}{j+4}}$$

$$6. \quad \frac{xy+5y^2}{x^2+6xy+5y^2} = \frac{y(x+5y)}{(x+y)(x+5y)} = \boxed{\frac{y}{x+y}}$$

$$x^2 + 6xy + 5y^2$$

$$p=5 \\ s=6$$

$$5, 1$$

$$(x^2 + 5xy) + (xy + 5y^2)$$

$$x(x+5y) + y(x+5y)$$

$$(x+y)(x+5y)$$

$$7. \quad \frac{4x^2 - 8xy - 12y^2}{3y - x} = \frac{4(x+y)(x-3y)}{(3y-x)} = \frac{4(x+y)(-1)(-x+3y)}{(3y-x)}$$

$$\textcircled{1} 4x^2 - 8xy - 12y^2$$

$$4(x^2 - 2xy - 3y^2)$$

$$p = -3 \\ s = -2 \\ -3, +1$$

$$(x^2 - 3xy) + (xy - 3y^2)$$

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

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

$$= \frac{4(x+y)(-1)(-x+3y)}{(3y-x)}$$

$$= \boxed{-4(x+y)}$$

$$8. \quad \frac{\textcircled{1} 2x^2 - 2y^2}{\textcircled{2} 2x^2 - xy - y^2} = \frac{2(x-y)(x+y)}{(2x+y)(x-y)} = \frac{2(x-y)(x+y)}{(2x+y)(x-y)}$$

$$\textcircled{1} 2x^2 - 2y^2$$

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

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

$$\textcircled{2} 2x^2 - xy - y^2$$

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

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

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

$$p = -2 \\ s = -1 \\ -2, +1$$

$$= \boxed{\frac{2(x+y)}{2x+y}}$$

$$9. \quad \frac{21m - 3n}{n^2 - 49m^2} = \frac{3(7m - n)}{(n-7m)(n+7m)} = \frac{3(-1)(-7m+n)}{(n-7m)(n+7m)}$$

$$= \frac{3(-1)(-7m+n)}{(n-7m)(n+7m)}$$

$$= \boxed{\frac{-3}{n+7m}}$$

$$10. \frac{\textcircled{1} x^2 + 2xy + y^2}{\textcircled{2} x^4 - y^4} = \frac{(x+y)(x+y)}{(x-y)(x+y)(x^2+y^2)} = \frac{(x+y)\cancel{(x+y)}}{(x-y)\cancel{(x+y)}(x^2+y^2)}$$

$$\textcircled{1} x^2 + 2xy + y^2 \quad p=1$$

$$(x^2 + 1xy) + (xy + y^2) \quad s=2$$

$$x(x+y) + y(x+y) \quad 1,1$$

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

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

$$\textcircled{2} x^4 - y^4$$

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

$$\begin{array}{ccc} \swarrow & & \downarrow \\ (x-y) & (x+y) & (x^2+y^2) \end{array}$$

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

$$11. \frac{\textcircled{1} 2d-6}{\textcircled{2} 2d^2-7d+6}$$

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

$$\textcircled{1} 2d^2 - 7d + 6 \quad p=12$$

$$s=-7$$

$$-3, -4$$

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

$$d(2d-3) - 2(2d-3)$$

$$(d-2)(2d-3)$$

* tempting to cancel something ... but nothing cancels here!

$$12. \frac{\textcircled{1} 3x^2 + 10x + 8}{\textcircled{2} 2x^2 + 9x + 10} = \frac{(x+2)(3x+4)}{(2x+5)(x+2)} = \frac{3x+4}{2x+5}$$

$$\textcircled{1} 3x^2 + 10x + 8 \quad p=24$$

$$s=10$$

$$(3x^2 + 4x) + (6x + 8) \quad 4,6$$

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

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

$$\textcircled{2} 2x^2 + 9x + 10 \quad p=20$$

$$s=9$$

$$(2x^2 + 4x) + (5x + 10) \quad 4,5$$

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

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

$$16. \frac{b^2+b}{b^3+2b^2+b} = \frac{b(b+1)}{b(b+1)(b+1)} = \frac{\cancel{b(b+1)}}{\cancel{b(b+1)}(b+1)} = \boxed{\frac{1}{b+1}}$$

$b(b^2+2b+1)$
 $(b^2+1b)(b+1)$
 $b(b+1) + 1(b+1)$
 $b(b+1)(b+1)$

$p=1$
 $s=2$
 $1,1$

$$17. \frac{2m+2n}{(m+n)^2} = \frac{2(m+n)}{(m+n)(m+n)} = \boxed{\frac{2}{m+n}}$$

$$18. \frac{5b^2-b^3}{-5+b+bc-5c} = \frac{b^2(5-b)}{(1+c)(-5+b)} = \frac{b^2(-1)(-5+b)}{(1+c)(-5+b)} = \boxed{\frac{-b^2}{1+c}}$$

$(-5+b) + (bc-5c)$
 $1(-5+b) + c(b-5)$
 $(1+c)(-5+b)$

$$19. \frac{c^2 - 4d^2}{2d + c} = \frac{(c - 2d)(c + 2d)}{(2d + c)} = \boxed{c - 2d}$$

$$20. \frac{5x^3 + 20x^2}{3x^4 + 12x^3} = \frac{5x^2(x + 4)}{3x^3(x + 4)} = \frac{5x^2 \cancel{(x + 4)}}{3x^3 \cancel{(x + 4)}} = \boxed{\frac{5}{3x}}$$

$$21. \frac{(2j + 6)^2}{4j^2 - 36} = \frac{(2j + 6)(2j + 6)}{4(j^2 - 9)} = \frac{2(j + 3)(2)(j + 3)}{4(j - 3)(j + 3)}$$

$$= \frac{4(j + 3)(j + 3)}{4(j - 3)(j + 3)}$$

$$= \frac{4(j + 3) \cancel{(j + 3)}}{4(j - 3) \cancel{(j + 3)}}$$

$$= \boxed{\frac{j + 3}{j - 3}}$$

$$22. \frac{\textcircled{1} 2y^2 + y - 3}{\textcircled{2} 2y^2 - 5y - 12} = \frac{(y-1)(2y+3)}{(y-4)(2y+3)} = \boxed{\frac{y-1}{y-4}}$$

$$\textcircled{1} \begin{array}{l} 2y^2 + y - 3 \quad p = -6 \\ (2y^2 + 3y) - 2y - 3 \quad s = +1 \\ \quad \quad \quad \quad \quad \quad \quad 3, -2 \end{array}$$

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

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

$$\textcircled{2} \begin{array}{l} 2y^2 - 5y - 12 \quad p = -24 \\ (2y^2 + 3y) - 8y - 12 \quad s = -5 \\ \quad \quad \quad \quad \quad \quad \quad 3, -8 \end{array}$$

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

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

$$23. \frac{3p-9}{3p^2+6p-9} = \frac{3(p-3)}{3(p-1)(p+3)} = \boxed{\frac{p-3}{(p-1)(p+3)}}$$

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

$$(p^2+3p) - 1(p-3)$$

$$p(p+3) - 1(p+3)$$

$$\sqrt{3(p-1)(p+3)}$$

$$\begin{array}{l} p = -3 \\ s = +2 \\ +3, -1 \end{array}$$

$$24. \frac{3m^2 - 27}{6m + 18} = \frac{3(m^2 - 9)}{6(m+3)} = \frac{3(m-3)(m+3)}{6(m+3)}$$

$$= \frac{3(m-3)\cancel{(m+3)}}{6\cancel{(m+3)}}$$

$$= \frac{1(m-3)}{2} \quad \text{OR} \quad \boxed{\frac{m-3}{2}}$$

$$25. \frac{2v-3}{2v^2+v-6} = \frac{(2v-3)}{(2v-3)(v+2)} = \frac{\cancel{(2v-3)}}{\cancel{(2v-3)}(v+2)} = \boxed{\frac{1}{v+2}}$$

$$\swarrow$$

$$p = -12 \quad s = +1$$

$$+4, -3$$

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

$$2v(v+2) - 3(v+2)$$

$$(2v-3)(v+2)$$

$$26. \textcircled{1} \frac{ay^2 + 3a^2y + 2a^3}{ay^2 - a^3} = \frac{a(y+a)(y+2a)}{a(y-a)(y+a)} = \boxed{\frac{y+2a}{y-a}}$$

$$\textcircled{1} ay^2 + 3a^2y + 2a^3$$

$$a(y^2 + 3ay + 2a^2)$$

$$(y^2 + 2ay)(ay + 2a^2)$$

$$y(y+2a) + a(y+2a)$$

$$a(y+a)(y+2a)$$

$$p = 2$$

$$s = 3$$

$$2, 1$$

$$\textcircled{2} ay^2 - a^3$$

$$a(y^2 - a^2)$$

$$a(y-a)(y+a)$$

$$27. \frac{z+2}{z^2+4z+4} = \frac{z+2}{(z+2)(z+2)} = \frac{\cancel{z+2}}{\cancel{(z+2)}(z+2)} = \boxed{\frac{1}{z+2}}$$

$$\swarrow$$

$$p = 4$$

$$s = 4 \quad 2, 2$$

$$(z^2 + 2z) + (2z + 4)$$

$$z(z+2) + 2(z+2)$$

$$(z+2)(z+2)$$

$$28. \frac{4b^2 - 25}{2b - 5} = \frac{(2b - 5)(2b + 5)}{(2b - 5)} = \boxed{2b + 5}$$

$$29. \frac{g - 5}{5 - g} = \frac{-1(-g + 5)}{(5 - g)} = \boxed{-1}$$

$$30. \frac{\textcircled{1} 10x^2 - 9x - 1}{\textcircled{2} x^2 + 2x - 3} = \frac{(10x + 1)(x - 1)}{(x - 1)(x + 3)} = \frac{(10x + 1)\cancel{(x - 1)}}{\cancel{(x - 1)}(x + 3)} = \boxed{\frac{10x + 1}{x + 3}}$$

$$\textcircled{1} 10x^2 - 9x - 1$$

$$(10x^2 - 10x) + (1x - 1)$$

$$10x(x - 1) + 1(x - 1)$$

$$(10x + 1)(x - 1)$$

$$p = -10$$

$$s = -9$$

$$-10, +1$$

$$\textcircled{2} x^2 + 2x - 3$$

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

$$x(x + 3) - 1(x + 3)$$

$$(x - 1)(x + 3)$$

$$p = -3$$

$$s = +2$$

$$+3, -1$$

$$31. \frac{2xy+3xz}{-x} = \frac{x(2y+3z)}{-1x} = \frac{2y+3z}{-1}$$

$$\text{OR } \boxed{-1(2y+3z)}$$

$$\text{OR } -2y-3z$$

$$32. \frac{\textcircled{1} 6a^2 - 14a + 4}{\textcircled{2} 3a^2 + 11a - 4} = \frac{2(3a-1)(a-2)}{(3a-1)(a+4)} = \boxed{\frac{2(a-2)}{(a+4)}}$$

$$\textcircled{1} 6a^2 - 14a + 4$$

$$2(3a^2 - 7a + 2)$$

$$(3a^2 - 6a)(a+2)$$

$$3a(a-2) - 1(a-2)$$

$$\dots \Rightarrow 2(3a-1)(a-2)$$

$$p=6$$

$$s=-7$$

$$-6, -1$$

$$\textcircled{2} 3a^2 + 11a - 4$$

$$(3a^2 + 12a)(a-4)$$

$$3a(a+4) - 1(a+4)$$

$$(3a-1)(a+4)$$

$$p=-12$$

$$s=+11$$

$$+12, -1$$

$$33. \frac{8k-h}{h^2-64k^2} = \frac{8k-h}{(h-8k)(h+8k)} = \frac{-1(-8k+h)}{(h-8k)(h+8k)}$$

$$= \frac{-1(-8k+h)}{(h-8k)(h+8k)}$$

$$= \boxed{\frac{-1}{h+8k}}$$

$$34. \frac{x^2 - 6x + 5}{50 - 2x^2} = \frac{(x-5)(x-1)}{2(5-x)(5+x)} = \frac{-1(-x+5)(x-1)}{2(5-x)(5+x)}$$

$$50 - 2x^2 = 2(25 - x^2) = 2(5-x)(5+x)$$

$$= \frac{-1(-x+5)(x-1)}{2(5-x)(5+x)}$$

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

$$35. \frac{\textcircled{1} 2q^2 + 17qr + 21r^2}{\textcircled{2} 3q^2 + 26qr + 35r^2} = \frac{(2q+3r)(q+7r)}{(3q+5r)(q+7r)} = \frac{2q+3r}{3q+5r}$$

$$\boxed{\frac{2q+3r}{3q+5r}}$$

$$\textcircled{1} 2q^2 + 17qr + 21r^2$$

$$(2q^2 + 14qr) + (3qr + 21r^2) \quad p = 42$$

$$2q(q+7r) + 3r(q+7r) \quad s = 17$$

$$(2q+3r)(q+7r) \quad 14, 3$$

$$\textcircled{2} 3q^2 + 26qr + 35r^2$$

$$(3q^2 + 21qr) + (5qr + 35r^2) \quad p = 105$$

$$3q(q+7r) + 5r(q+7r) \quad s = 26$$

$$(3q+5r)(q+7r)$$

$$36. \frac{4x^2 - y^4}{3x^2y^2 - 6x^3} = \frac{(2x-y^2)(2x+y^2)}{3x^2(y^2-2x)}$$

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

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

$$\boxed{\frac{-1(2x+y^2)}{3x^2}}$$

$$37. \frac{5u - u^2}{3u^3 - 9u^2 - 30u} = \frac{u(5-u)}{3u(u-5)(u+2)} = \frac{u(-1)(-5+u)}{3u(u-5)(u+2)}$$

$$= \frac{u(-1)(-5+u)}{3u(u-5)(u+2)}$$

$$= \frac{u(-1)(-5+u)}{3u(u-5)(u+2)}$$

$$\boxed{\frac{-u}{3u(u+2)}}$$

$$38. \frac{-2x^2y - 2xy + 4y}{x^2 - 1} = \frac{2y(-x+1)(x+2)}{(x-1)(x+1)} = \frac{2y(-1)(x-1)(x+2)}{(x-1)(x+1)}$$

$$-2x^2y - 2xy + 4y$$

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

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

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

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

$$p = -2$$

$$s = -1$$

$$-2, +1$$

$$= \frac{2y(-1)(x-1)(x+2)}{(x-1)(x+1)}$$

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

$$39. \frac{-s^2 + 7st - 12t^2}{s^2 - 5st + 6t^2} = \frac{(-s+4t)(s-3t)}{(s-2t)(s-3t)} = \boxed{\frac{-s+4t}{s-2t}}$$

$$-s^2 + 7st - 12t^2$$

$$(-s+3st)(4st-12t^2)$$

$$-s(s-3t) + 4t(s-3t)$$

$$(-s+4t)(s-3t)$$

$$p = 12$$

$$s = 7$$

$$3, 4$$

$$40. \frac{-b^2 - 5b - 6}{9 - b^2} = \frac{(-b-3)(b+2)}{(3-b)(3+b)} = \frac{-1(b+3)(b+2)}{(3-b)(3+b)}$$

$$p = 6$$

$$s = -5$$

$$-2, -3$$

$$(-b^2 - 2b)(-3b - 6)$$

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

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

$$= \boxed{\frac{-1(b+2)}{3-b}}$$

$$41. \frac{4t^2 - 36t + 80}{(4t - t^2)(5 - t)} = \frac{4(t-4)(t-5)}{t(4-t)(5-t)} = \frac{4(-1)(-t+4)(-1)(-t+5)}{t(4-t)(5-t)}$$

$$4(t^2 - 9t + 20)$$

$$(t-4)(t-5)$$

$$= \frac{4(-1)(-t+4)(-1)(-t+5)}{t(4-t)(5-t)}$$

$$= \boxed{\frac{4}{t}}$$

$$42. \frac{9 - m^2}{-m^2 + m + 6} = \frac{(3-m)(3+m)}{(m+2)(-m+3)} = \frac{(3-m)(3+m)}{(m+2)(-m+3)}$$

$$p = -6$$

$$s = +1$$

$$3, -2$$

$$(-m^2 + 3m)(2m + 6)$$

$$m(-m+3) + 2(-m+3)$$

$$(m+2)(-m+3)$$

$$= \boxed{\frac{3+m}{m+2}}$$

$$43. \frac{2y^2 - 4yz + 2z^2}{10x^2y - 10yz^2} = \frac{2(y-z)(y-z)}{10y(x-z)(x+z)}$$

$$= \frac{(y-z)^2}{5y(x-z)(x+z)}$$

$2(y^2 - 2yz + z^2)$
 $2(y-z)(y-z)$
 $10y(x^2 - z^2)$
 $10y(x-z)(x+z)$

$$44. \frac{-x^2 + 5x - 6}{4 - x^2} = \frac{(-x+3)(x-2)}{(2-x)(2+x)} = \frac{(-x+3)(-1)(-x+2)}{(2-x)(2+x)}$$

$$p = 6$$

$$s = 5$$

$$2, 3$$

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

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

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

$$= \frac{(-x+3)(-1)(-x+2)}{(2-x)(2+x)}$$

$$= \frac{-1(-x+3)}{2+x}$$

$$45. \frac{\textcircled{1} 2a^2 - 11a + 12}{\textcircled{2} -2a^2 - a + 6} = \frac{(a-4)(2a-3)}{(-2a+3)(a+2)} = \frac{(a-4)(-1)(-2a+3)}{(-2a+3)(a+2)}$$

$$\textcircled{1} 2a^2 - 11a + 12$$

$$(2a^2 - 3a) + (-8a + 12)$$

$$a(2a-3) - 4(2a-3)$$

$$(a-4)(2a-3)$$

$$p = 24$$

$$s = -11$$

$$-3, -8$$

$$\textcircled{2} -2a^2 - a + 6$$

$$p = -12$$

$$s = -1$$

$$-4, +3$$

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

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

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

$$= \frac{-1(a-4)}{a+2}$$

$$46. \frac{\textcircled{1} -8x^2 + 38x - 24}{\textcircled{2} -2x^2 + 32} = \frac{2(-4x+3)(x-4)}{-2(x-4)(x+4)} = \boxed{\frac{-4x+3}{-1(x+4)}}$$

$$\textcircled{1} 2(-4x^2 + 19x - 12)$$

$$(-4x^2 + 16x) + (3x - 12) \quad p=48 \quad s=19$$

$$-4x(x-4) + 3(x-4) \quad 16, 3$$

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

$$\textcircled{2} -2x^2 + 32$$

$$-2(x^2 - 16)$$

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

$$47. \frac{3a^2 - 13a + 14}{-3a^2 + a + 14} = \frac{(3a-7)(a-2)}{(a+2)(-3a+7)} = \frac{-1(-3a+7)(a-2)}{(a+2)(-3a+7)}$$

$$p=42 \\ s=-13 \\ -6, -7$$

$$(3a^2 - 6a) + (-7a + 14)$$

$$3a(a-2) - 7(a-2)$$

$$(3a-7)(a-2)$$

$$p=-42 \\ s=1 \\ +7, -6$$

$$(-3a^2 + 7a) + (-6a + 14)$$

$$a(-3a+7) + 2(-3a+7)$$

$$(a+2)(-3a+7)$$

$$= \boxed{\frac{-1(a-2)}{a+2}}$$

$$48. \frac{-x^2 + 6x - 8}{4 - x^2} = \frac{(-x+4)(x-2)}{(2-x)(2+x)} = \frac{(-x+4)(-1)(-x+2)}{(2-x)(2+x)}$$

$$p=8 \\ s=6 \quad 2, 4$$

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

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

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

$$= \frac{(-x+4)(-1)(-x+2)}{(2-x)(2+x)}$$

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

49. $\frac{-2a^2 + 13a - 15}{15a - 10a^2} = \frac{(-a+5)(2a-3)}{5a(3-2a)} = \frac{(-a+5)(-1)(-2a+3)}{5a(3-2a)}$

$p=30 \quad s=13$
3, 10

$(-2a^2 + 3a) + (10a - 15)$
 $-a(2a-3) + 5(2a-3)$
 $(-a+5)(2a-3)$

$= \frac{(-a+5)(-1)(-2a+3)}{5a(3-2a)}$
 $= \frac{-1(-a+5)}{5a}$

50. $\frac{9k^2 - 3k^3}{k^2 + 3km - 3k - 9m} = \frac{3k^2(3-k)}{(k-3)(k+3m)} = \frac{3k^2(-1)(-3+k)}{(k-3)(k+3m)}$

$(k^2 + 3km) + (-3k - 9m)$
 $k(k+3m) - 3(k+3m)$
 $(k-3)(k+3m)$

$= \frac{-3k^2}{k+3m}$

51. $\frac{3x^3 - 3xy^2}{-x^2 + xy} = \frac{3x(x-y)(x+y)}{x(-x+y)} = \frac{3x(x-y)(x+y)}{x(-1)(x-y)}$

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

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

$= \frac{3(x+y)}{-1}$

$= -3(x+y)$