

# Factoring Synthesis Worksheet

## SOLUTIONS KEY

①  $3x^2 + 24x + 36$   
 $= 3(x^2 + 8x + 12)$  (simple way!)  
 $\downarrow \quad \begin{matrix} 2 \times 6 = 12 \\ 2 + 6 = 8 \end{matrix}$   
 $= 3(x+2)(x+6)$

②  $2ax^2 - 6ax - 80a$   
 $= 2a(x^2 - 3x - 40)$  (simple way!)  
 $\downarrow \quad \begin{matrix} -8 \times 5 = -40 \\ -8 + 5 = -3 \end{matrix}$   
 $= 2a(x-8)(x+5)$

③  $-x^3 - 4x^2 + 21x$   
 $= -x(x^2 + 4x - 21)$  (simple way!)  
 $\downarrow \quad \begin{matrix} 7 \times -3 = -21 \\ 7 + -3 = 4 \end{matrix}$   
 $= -x(x+7)(x-3)$

④  $5x^2 - 55xy + 120y^2$   
 $= 5(x^2 - 11xy + 24y^2)$  (simple way!)  
 $\downarrow \quad \begin{matrix} -3 \times -8 = 24 \\ -3 + -8 = -11 \end{matrix}$   
 $= 5(x-3y)(x-8y)$

⑤  $8x^2 + 30x + 18$   
 $= 2(4x^2 + 15x + 9)$  (a=4, decomp.)  
 $= 2(4x^2 + 12x + 3x + 9)$  (4x9)  
 $\downarrow \quad \begin{matrix} 12 \times 3 = 36 \\ 12 + 3 = 15 \end{matrix}$   
 $= 2[4x(x+3) + 3(x+3)]$   
 $= 2(x+3)(4x+3)$

⑥  $-6y^2 - 18y + 24$   
 $= -6(y^2 + 3y - 4)$  (simple way!)  
 $\downarrow \quad \begin{matrix} 4 \times -1 = -4 \\ 4 + -1 = 3 \end{matrix}$   
 $= -6(y+4)(y-1)$

⑦  $8ax^2 - 31axy - 4ay^2$   
 $= a(8x^2 - 31xy - 4y^2)$  (a=8, decomp.)  
 $= a(8x^2 - 32xy + xy - 4y^2)$  (8x-4)  
 $\downarrow \quad \begin{matrix} -32 \times 1 = -32 \\ -32 + 1 = -31 \end{matrix}$   
 $= a[8x(x-4y) + y(x-4y)]$   
 $= a(x-4y)(8x+y)$

⑧  $5a^5 + 17a^4 + 12a^3$   
 $= a^3(5a^2 + 17a + 12)$  (a=5, decomp.)  
 $= a^3(5a^2 + 5a + 12a + 12)$  (5x12)  
 $\downarrow \quad \begin{matrix} 12 \times 5 = 60 \\ 12 + 5 = 17 \end{matrix}$   
 $= a^3[5a(a+1) + 12(a+1)]$   
 $= a^3(a+1)(5a+12)$

⑨  $6x^4 - 96$   
 $= 6(x^4 - 16)$  (diff of squares!)  
 $= 6(x^2 + 4)(x^2 - 4)$   
 $= 6(x^2 + 4)(x+2)(x-2)$

⑩  $5a^2 - 80b^2$   
 $= 5(a^2 - 16b^2)$  (diff of squares)  
 $= 5(a+4b)(a-4b)$

$$\begin{aligned} (11) \quad & 27x^2 - 75y^2 \quad \leftarrow \text{diff of squares!} \\ & = 3(9x^2 - 25y^2) \\ & = \boxed{3(3x+5y)(3x-5y)} \end{aligned}$$

$$\begin{aligned} (12) \quad & -10t^2 + 360 \quad \leftarrow \text{diff of squares!} \\ & = -10(t^2 - 36) \\ & = \boxed{-10(t+6)(t-6)} \end{aligned}$$

$$\begin{aligned} (13) \quad & x^4 - 81 \quad \leftarrow \text{diff of squares!} \\ & = (x^2+9)(x^2-9) \\ & = \boxed{(x^2+9)(x+3)(x-3)} \end{aligned}$$

$$\begin{aligned} (14) \quad & 7x^8 - 7 \quad \leftarrow \text{diff of squares!} \\ & = 7(x^8 - 1) \\ & = 7(x^4+1)(x^4-1) \\ & = 7(x^4+1)(x^2+1)(x^2-1) \\ & = \boxed{7(x^4+1)(x^2+1)(x+1)(x-1)} \end{aligned}$$

$$\begin{aligned} (15) \quad & 12ab^2 + 48a \\ & = \boxed{12a(b^2+4)} \end{aligned}$$

no shortcut to ↑  
Factor a SUM (+) of squares!

$$\begin{aligned} (16) \quad & 7x^2 + 56x + 112 \\ & = 7(x^2 + 8x + 16) \\ & \quad \begin{array}{l} a=1, \\ \text{simple way!} \end{array} \quad \begin{array}{l} \frac{4}{4} \times \frac{4}{4} = 16 \\ \frac{4}{4} + \frac{4}{4} = 8 \end{array} \\ & \quad \downarrow \qquad \downarrow \\ & = 7(x+4)(x+4) \\ & = \boxed{7(x+4)^2} \end{aligned}$$

$$\begin{aligned} (17) \quad & 5ay^2 - 70ay + 245a \\ & = 5a(y^2 - 14y + 49) \\ & \quad \begin{array}{l} a=1, \\ \text{simple way!} \end{array} \quad \begin{array}{l} \frac{-7}{-7} \times \frac{-7}{-7} = 49 \\ \frac{-7}{-7} + \frac{-7}{-7} = -14 \end{array} \\ & \quad \downarrow \qquad \downarrow \\ & = 5a(y-7)(y-7) \\ & = \boxed{5a(y-7)^2} \end{aligned}$$

$$\begin{aligned} (18) \quad & 9a^2x - 30abx + 25b^2x \\ & = x(9a^2 - 30ab + 25b^2) * \\ & \quad \begin{array}{l} \sqrt{9a^2} = 3a \\ \sqrt{25b^2} = 5b \end{array} \quad \begin{array}{l} \therefore = 2(3a)(5b) \\ \qquad \qquad \qquad \downarrow \qquad \downarrow \end{array} \\ & \quad \downarrow \qquad \downarrow \\ & \text{so...} = \boxed{x(3a-5b)^2} \\ & * \text{ you could also use decomposition!} \end{aligned}$$

$$\begin{aligned} (19) \quad & -4x^2 - 36xy - 81y^2 \\ & = -(4x^2 + 36xy + 81y^2) * \\ & \quad \begin{array}{l} \sqrt{4x^2} = 2x \\ \sqrt{81y^2} = 9y \end{array} \quad \begin{array}{l} \therefore = 2(2x)(9y) \\ \qquad \qquad \qquad \downarrow \qquad \downarrow \end{array} \\ & \quad \downarrow \qquad \downarrow \\ & \text{so...} = \boxed{-(2x+9y)^2} \end{aligned}$$

$$\begin{aligned} (20) \quad & x^4 - 3x^2 - 54 \quad \leftarrow \text{simple way!} \\ & \quad \begin{array}{l} 6x - 9 = -54 \\ 6 + -9 = -3 \end{array} \\ & = (x^2+6)(x^2-9) \quad \leftarrow \text{diff of squares!} \\ & = \boxed{(x^2+6)(x+3)(x-3)} \end{aligned}$$

\* you could also use decomposition!