

R.4 Factoring Polynomials  
Honors Algebra 2 with Trig

**Prime Polynomial:** a polynomial w/ variable terms that cannot be written as a product of 2 polynomials of lesser degree

**Factored Completely:** a polynomial written as a product of prime polynomials

**Factoring Out the Greatest Common Factor**

1. Factor out the greatest common factor from each polynomial

a.  $15r - 27$

$$= 3(5r - 9)$$

c.  $-3z^5w^2 - 18z^3w^4$

$$= -3z^3w^2(z^2 + 6w^2)$$

b.  $9z^4 + 81z$

$$= 9z(z^3 + 9)$$

d.  $6x(a+b) - 4y(a+b)$

$$= 2(a+b)[3x - 2y]$$

$$= 2(a+b)(3x - 2y)$$

**Factoring by Grouping**

2. Factor each polynomial by grouping.

a.  $4x^3 + 2x^2 - 2x - 1$

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

$$= 2x^2(2x+1) - 1(2x+1) \quad \text{= factor GCF}$$

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

c.  $10ab - 6b + 35a - 21$

$$= (10ab - 6b) + (35a - 21)$$

$$= 2b(5a - 3) + 7(5a - 3)$$

$$= \boxed{(2b + 7)(5a - 3)}$$

b.  $8r^3 - 64r^2 + r - 8$

$$= (8r^3 - 64r^2) + (r - 8)$$

$$= 8r^2(r - 8) + (r - 8)$$

$$= \boxed{(8r^2 + 1)(r - 8)}$$

d.  $4x^6 + 36 - x^6y - 9y$

$$= (4x^6 + 36) + (-x^6y - 9y)$$

$$= 4(x^6 + 9) - y(x^6 + 9)$$

$$= \boxed{(4 - y)(x^6 + 9)}$$

**Factoring Trinomials**

3. Factor each trinomial, if possible.

a.  $8h^2 - 2h - 21$

$= (2h + 3)(4h - 7)$

c.  $6p^2 - 7p - 5$

$= (3p - 5)(2p + 1)$

b.  $9y^2 - 18y + 8$

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

d.  $16y^3 + 24y^2 - 16y$

$= (8y + 16)(2y - 1)$

Helpful

- \* identify signs
- \* to get middle term does pos or neg term need to be larger?

**Factoring Perfect Square Trinomials**

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

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

4. Factor each trinomial

a.  $16p^2 - 40p + 25$

$= (4p - 5)^2$

b.  $16p^2 - 40pq + 25q^2$

$= (4p - 5q)^2$

c.  $9m^2n^2 + 12mn + 4$

$= (3mn + 2)^2$

**Difference of Squares**

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

5. Factor each polynomial

a.  $16q^2 - 25$

$= (4q - 5)(4q + 5)$

b.  $4m^2 - 9$

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

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c.  $36z^2 - 81y^4$

$$= (6z - 9y^2)$$

d.  $(a+2b)^2 - 4c^2$

$$= [(a+2b) - 2c]$$

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

**Factoring Sum or Difference of Cubes**

$$x^3 - y^3 = (x - y)(x^2 + xy + y^2) \quad \star \text{ minus plus plus}$$

$$x^3 + y^3 = (x + y)(x^2 - xy + y^2) \quad \star \text{ plus minus plus}$$

6. Factor each polynomial

a.  $27 - r^3 = (3^3 - r^3)$   
 $= (3 - r)(3^2 + 3r + r^2)$

$$= (3 - r)(9 + 3r + r^2)$$

b.  $8m^3 - 27n^3 = ((2m)^3 - (3n)^3)$   
 $= (2m - 3n)((2m)^2 + (2m)(3n) + (3n)^2)$

$$= (2m - 3n)(4m^2 + 6mn + 9n^2)$$

c.  $(b+3)^3 - 27 = (b+3)^3 - 3^3$   
 $= [(b+3) - 3][(b+3)^2 + 3(b+3) + 3^2]$

$$= b((b+3)^2 + 3b + 9 + 9)$$

$$= b(b^2 + 6b + 9 + 3b + 18)$$

$$= b(b^2 + 9b + 27)$$

d.  $x^3 + 27$   
 $= (x+3)(x^2 - 3x + 3^2)$   
 $= (x+3)(x^2 - 3x + 9)$

**Factoring by Substitution**

7. Factor each polynomial

a.  $10(2a-1)^2 - 19(2a-1) - 15$

let  $u = 2a - 1$

$$10u^2 - 19u - 15$$

$$(5u + 3)(2u - 5)$$

$$(5(2a-1) + 3)(2(2a-1) - 5)$$

$$(10a - 5 + 3)(4a - 2 - 5)$$

$$(10a - 2)(4a - 7)$$

$$2(5a - 1)(4a - 7)$$

b.  $(2a-1)^3 + 8$

let  $u = 2a - 1$

$$u^3 + 8$$

$$(u + 2)(u^2 - 2u + 2^2)$$

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

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

$$(2a+1)(4a^2 - 8a + 7)$$

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d.  $(2y - 1)^2 - 4(2y - 1) + 4$

let  $u = 2y - 1$

$$u^2 - 4u + 4$$

$$(u - 2)^2$$

$$(2y - 1 - 2)^2$$

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

c.  $6z^4 - 13z^2 - 5$

let  $u = z^2$

$$6u^2 - 13u - 5$$

$$(2u - 5)(3u + 1)$$

$$(2z^2 - 5)(3z^2 + 1)$$

Homework:

Pg. 43

13, 19, 21, 29-37, 49, 59, 63, 91, 95, 97

Most Difficult First:

Pg. 44

34, 81, 85, 110, 112