

Find the value of c that makes the expression a perfect square trinomial. Then write the expression as a square of a binomial.

10. $x^2 + 8x + c$ $(x+4)^2$ $c=16$

11. $x^2 - 22x + c$ $(x-11)^2$ $c=121$

12. $x^2 + 16x + c$ $(x+8)^2$ $c=64$

13. $x^2 + 3x + c$ $(x + \frac{3}{2})^2$ $c = \frac{9}{4}$

14. $x^2 - 9x + c$ $(x - \frac{9}{2})^2$ $c = \frac{81}{4}$

15. $9x^2 - 12x + c$ $(3x-2)^2$ $c=4$
 $-6x-6x$

A polynomial f and a factor of f are given. Factor f completely.

13. $f(x) = x^3 + 9x^2 - 37x - 165; x - 5$ $(x+3)(x+11)(x-5)$

14. $f(x) = 4x^3 + 8x^2 - 25x - 50; x + 2$ $(2x+5)(2x-5)(x+2)$

15. $f(x) = x^4 - 4x^3 + 8x^2 - 32; x - 4$ $(x+2)(x^2-2x+4)(x-4)$

16. $f(x) = 4x^4 + 26x^3 - 8x^2 + 39x - 21; x + 7$ $(2x^2+3)(2x-1)(x+7)$

17. $f(x) = x^5 - 3x^4 - 4x^3 + x^2 - 3x - 4; x + 1$ $(x+1)^2(x^2-x+1)(x-4)$

18. $f(x) = 6x^5 - 38x^4 + 12x^3 - 15x^2 + 95x - 30; x - 6$ $(3x-1)(2x^3-5)(x-6)$

13.
$$\begin{array}{r|rrrr} 5 & 1 & 9 & -37 & -165 \\ & & 5 & 70 & 165 \\ \hline & 1 & 14 & 33 & 0 \end{array}$$

 $x^2 + 14x + 33$
 $(x+3)(x+11)(x-5)$

14.
$$\begin{array}{r|rrrr} 2 & 4 & 8 & -25 & -50 \\ & & -8 & 0 & 50 \\ \hline & 4 & 0 & -25 & 0 \end{array}$$

 $4x^2 - 25$
 $(2x+5)(2x-5)(x+2)$

15.
$$\begin{array}{r|rrrrr} 4 & 1 & -4 & 0 & 8 & -32 \\ & & 4 & 0 & 0 & 32 \\ \hline & 1 & 0 & 0 & 8 & 0 \end{array}$$

 $x^3 + 8$
 $(x+2)(x^2-2x+4)(x-4)$

16.
$$\begin{array}{r|rrrrr} 7 & 4 & 26 & -8 & 39 & -21 \\ & & -28 & 14 & -42 & 21 \\ \hline & 4 & -2 & 6 & -3 & 0 \end{array}$$

 $4x^3 - 2x^2 + 6x - 3$
 $2x^2(2x-1) + 3(2x-1)$
 $(2x^2+3)(2x-1)(x+7)$

17.
$$\begin{array}{r|rrrrrr} 1 & 1 & -3 & -4 & 1 & -3 & -4 \\ & & -1 & 4 & 0 & -1 & 4 \\ \hline & 1 & -4 & 0 & 1 & -4 & 0 \end{array}$$

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

18.
$$\begin{array}{r|rrrrrr} 6 & 6 & -38 & 12 & -15 & 95 & -30 \\ & & 36 & -12 & 0 & -90 & 30 \\ \hline & 6 & -2 & 0 & -15 & 5 & 0 \end{array}$$

 $6x^4 - 2x^3 - 15x^2 + 5$
 $2x^3(3x-1) - 5(3x-1)$
 $(3x-1)(2x^3-5)(x-6)$

Factor the sum or difference of cubes.

- $x^3 + 125$ $(x+5)(x^2-5x+25)$
- $y^3 - 8$ $(y-2)(y^2+2y+4)$
- $64n^3 - 27$ $(4n-3)(16n^2+12n+9)$
- $27g^3 + 343$ $(3g+7)(9g^2-21g+49)$
- $2w^3 + 54$ $2(w+3)(w^2-3w+9)$
- $40v^3 - 625$ $5(2v-5)(4v^2+10v+25)$

Factor the polynomial by grouping.

- $r^3 - 3r^2 + 6r - 18$ $(r^2+6)(r-3)$
- $x^3 + 6x^2 + 7x + 42$ $(x^2+7)(x+6)$
- $c^3 + 4c^2 - 9c - 36$ $(c^2-9)(c+4)$
- $z^3 - 2z^2 - 16z + 32$ $(z^2-16)(z-2) = (z+4)(z-4)(z-2)$
- $25p^3 - 25p^2 - p + 1$ $(c+3)(c-3)(c+4)$
- $9m^3 + 18m^2 - 4m - 8$ $(m+2)(3m+2)(3m-2)$
- $(25p^2-1)(p-1)$ $(5p+1)(5p-1)(p-1)$
- $9m^2(m+2) - 4(m+2)$

Factor the polynomial in quadratic form.

- $x^4 - 36$ $(x^2+6)(x^2-6)$
- $c^4 - 81$ $(c^2+9)(c+3)(c-3)$
- $x^4 + x^2 - 20$ $(x^2+5)(x+2)(x-2)$
- $6y^6 - 5y^3 - 4$ $(2y^3+1)(3y^3-4)$
- $(x^2+5)(x^2-4)$

Factor the polynomial completely.

- $x^6 - 4$ $(x^3+2)(x^3-2)$
- $d^4 - 7d^2 + 10$ $(d^2-2)(d^2-5)$
- $24q^3 - 81$ $3(8q^3-27)$ $3(2q+3)(4q^2+6q+9)$
- $a^6 + 7a^3 + 6$ $(a^3+6)(a^3+1)$ $(a^3+6)(a+1)(a^2-a+1)$
- $-4x^4 + 26x^2 - 30$ $-2(2x^2-3)(x^2-5)$
- $2b^4 + 14b^3 - 16b - 112$ $(2b^3-16)(b+7) = 2(b-2)(b^2+2b+4)(b+7)$

Factor the expression. If the expression cannot be factored, say so.

- $4x^2 - 15x + 9$ $(4x-3)(x-3)$
- $6x^2 - 13x - 28$ $(3x+4)(2x-7)$
- $10x^2 + 29x + 10$ $(5x+2)(2x+5)$
- $9x^2 + 24x + 16$ $(3x+4)^2$
- $-12x^2 + 27$ $-3(2x+3)(2x-3)$
- $12x^2 - 40x - 32$ $4(3x+2)(x-4)$
- $-15x^2 + 3x + 12$ $-3(5x+4)(x-1)$
- $6x^3 - 5x^2 + x$ $x(6x-1)(2x+1)$
- $3x^3 - 7x^2 + x$ $x(3x^2-7x+1)$
- $4x^4 + 12x^3 + 9x^2$ $x^2(2x+3)^2$
- $24x^4 + 18x^3 - 27x^2$ $3x^2(8x^2+6x-9) = 3(2x+3)(4x-3)$
- $72x^3 - 228x^2 + 140x$ $4x(3x-7)(6x-5)$
- $x^4 - 81$ $(x^2+9)(x+3)(x-3)$
- $2x^4 + 5x^2 + 3$ $3x^2(8x^2+6x-9) = 3(2x+3)(4x-3)$
- $6x^4 - 9x^2 + 3$ $3(2x^4-3x^2+1) = 3(2x-1)(x-1)$

Factor the polynomial completely using any method.

- $x^3 - 512$ $(x-8)(x^2+8x+64)$
- $2a^3 + 432$ $2(a+6)(a^2-6a+36)$
- $7h^3 + 448$ $7(h+4)(h^2-4h+16)$
- $-3c^3 + 24$ $-3(c^3-8) = -3(c-2)(c^2+2c+4)$
- $12x^3 - 6x^2 + 2x - 1$ $(6x^2+1)(2x-1)$
- $3k^4 + 27k^3 - 7k - 63$ $= (3k^3-7)(k+9)$
- $3n^3 - 10n^2 - 48n + 160$ $(3n-10)(n+4)(n+4)$
- $x^6 + x^5 - x^4 - x^3$ $= x^3(x+1)(x^2-1)$
- $y^4 - 81$ $= (y^2+9)(y+3)(y-3)$
- $2z^4 - 1250$ $2(z^4-625) = 2(z^2+25)(z+5)(z-5)$
- $6a^4 + 13a^2 - 5$ $(2a+5)(3a-1)$
- $6b^4 - 17b^2 - 28$ $(6b^2+7)(b^2-4) = (6b^2+7)(b+2)(b-2)$
- $r^5 + r^3 - r^2 + 1$ $r^3(r^2+1) - 1(r^2-1)$ not factorable/prime
- $-4w^8 - 8w^6 + 4w^4 + 8w^2$ $-4w^2(w^6+2w^4) + (-w^2-2) = -4w^2[w^4(w^2+2) - 1(w^2+2)] = -4w^2(w^2+2)(w^4-1)$
- $a^6b^3 + 125$ $(a^2b+5)(a^4b^2-5a^2b+25)$
- $2ac^2 - 5bc^2 - 2ad^2 + 5bd^2$ $c^2(2a-5b) - d^2(2a-5b) = (2a-5b)(c+d)(c-d)$