

EXERCISE 7.1

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Find the greatest common factor (GCF/HCF) of the following polynomials: (1-14)**1. $2x^2$ and $12x^2$** **Solution:**

We know that the numerical coefficients of given numerical are 2 and 12

The greatest common factor of 2 and 12 is 2

The common literals appearing in given monomial is x

The smallest power of x in two monomials is 2

The monomial of common literals with smallest power is x^2 \therefore The greatest common factor = $2x^2$ **2. $6x^3y$ and $18x^2y^3$** **Solution:**

We know that the numerical coefficients of given numerical are 6 and 18

The greatest common factor of 6 and 18 is 6

Common literals appearing in given numerical are x and y

Smallest power of x in three monomial is 2

Smallest power of y in three monomial is 1

Monomial of common literals with smallest power is x^2y \therefore The greatest common factor = $6x^2y$ **3. $7x$, $21x^2$ and $14xy^2$** **Solution:**

We know that the numerical coefficients of given numerical are 7, 21 and 14

Greatest common factor of 7, 21 and 14 is 7

Common literals appearing in given numerical are x and y

Smallest power of x in three monomials is 1

Smallest power of y in three monomials is 0

Monomials of common literals with smallest power is x

 \therefore The greatest common factor = $7x$ **4. $42x^2yz$ and $63x^3y^2z^3$** **Solution:**

We know that the numerical coefficients of given numerical are 42 and 63.

Greatest common factor of 42, 63 is 21.

Common literals appearing in given numerical are x, y and z

Smallest power of x in two monomials is 2

Smallest power of y in two monomials is 1

Smallest power of z in two monomials is 1

Monomials of common literals with smallest power is x^2yz

\therefore The greatest common factor = $21x^2yz$

5. $12ax^2$, $6a^2x^3$ and $2a^3x^5$

Solution:

We know that the numerical coefficients of given numerical are 12, 6 and 2

Greatest common factor of 12, 6 and 2 is 2.

Common literals appearing in given numerical are a and x

Smallest power of x in three monomials is 2

Smallest power of a in three monomials is 1

Monomials of common literals with smallest power is ax^2

\therefore The greatest common factor = $2ax^2$

6. $9x^2$, $15x^2y^3$, $6xy^2$ and $21x^2y^2$

Solution:

We know that the numerical coefficients of given numerical are 9, 15, 16 and 21

Greatest common factor of 9, 15, 16 and 21 is 3.

Common literals appearing in given numerical are x and y

Smallest power of x in four monomials is 1

Smallest power of y in four monomials is 0

Monomials of common literals with smallest power is x

\therefore The greatest common factor = $3x$

7. $4a^2b^3$, $-12a^3b$, $18a^4b^3$

Solution:

We know that the numerical coefficients of given numerical are 4, -12 and 18.

Greatest common factor of 4, -12 and 18 is 2.

Common literals appearing in given numerical are a and b

Smallest power of a in three monomials is 2

Smallest power of b in three monomials is 1

Monomials of common literals with smallest power is a^2b

\therefore The greatest common factor = $2a^2b$

8. $6x^2y^2$, $9xy^3$, $3x^3y^2$

Solution:

We know that the numerical coefficients of given numerical are 6, 9 and 3

Greatest common factor of 6, 9 and 3 is 3.

Common literals appearing in given numerical are x and y

Smallest power of x in three monomials is 1

Smallest power of y in three monomials is 2

Monomials of common literals with smallest power is xy^2

\therefore The greatest common factor = $3xy^2$

9. a^2b^3, a^3b^2

Solution:

We know that the numerical coefficients of given numerical are 0

Common literals appearing in given numerical are a and b

Smallest power of a in two monomials = 2

Smallest power of b in two monomials = 2

Monomials of common literals with smallest power is a^2b^2

\therefore The greatest common factor = a^2b^2

10. $36a^2b^2c^4, 54a^5c^2, 90a^4b^2c^2$

Solution:

We know that the numerical coefficients of given numerical are 36, 54 and 90

Greatest common factor of 36, 54 and 90 is 18.

Common literals appearing in given numerical are a, b and c

Smallest power of a in three monomials is 2

Smallest power of b in three monomials is 0

Smallest power of c in three monomials is 2

Monomials of common literals with smallest power is a^2c^2

\therefore The greatest common factor = $18a^2c^2$

11. $x^3, -yx^2$

Solution:

We know that the numerical coefficients of given numerical are 0

Common literals appearing in given numerical are x and y

Smallest power of x in two monomials is 2

Smallest power of y in two monomials is 0

Monomials of common literals with smallest power is x^2

\therefore The greatest common factor = x^2

12. $15a^3, -45a^2, -150a$

Solution:

We know that the numerical coefficients of given numerical are 15, -45 and 150

Greatest common factor of 15, -45 and 150 is 15.

Common literals appearing in given numerical is a
Smallest power of a in three monomials is 1
Monomials of common literals with smallest power is a
 \therefore The greatest common factor = $15a$

13. $2x^3y^2$, $10x^2y^3$, $14xy$

Solution:

We know that the numerical coefficients of given numerical are 2, 10 and 14.
Greatest common factor of 2, 10 and 14 is 2.
Common literals appearing in given numerical are x and y
Smallest power of x in three monomials is 1
Smallest power of y in three monomials is 1
Monomials of common literals with smallest power is xy
 \therefore The greatest common factor = $2xy$

14. $14x^3y^5$, $10x^5y^3$, $2x^2y^2$

Solution:

We know that the numerical coefficients of given numerical are 14, 10 and 2.
Greatest common factor of 14, 10 and 2 is 2.
Common literals appearing in given numerical are x and y
Smallest power of x in three monomials is 2
Smallest power of y in three monomials is 2
Monomials of common literals with smallest power is x^2y^2
 \therefore The greatest common factor = $2x^2y^2$

Find the greatest common factor of the terms in each of the following expressions:

15. $5a^4 + 10a^3 - 15a^2$

Solution:

The greatest common factor of the three terms is $5a^2$.

16. $2xyz + 3x^2y + 4y^2$

Solution:

The greatest common factor of the three terms is y.

17. $3a^2b^2 + 4b^2c^2 + 12a^2b^2c^2$

Solution:

The greatest common factor of the three terms is b^2 .

EXERCISE 7.2

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Factorize the following:

1. $3x - 9$

Solution:

The greatest common factor in the given two terms is 3

$3x - 9$

$3(x - 3)$

2. $5x - 15x^2$

Solution:The greatest common factor in the given two terms is $5x$

$5x - 15x^2$

$5x(1 - 3x)$

3. $20a^{12}b^2 - 15a^8b^4$

Solution:Greatest common factor in the given two terms is $5a^8b^2$

$20a^{12}b^2 - 15a^8b^4$

$5a^8b^2(4a^4 - 3b^2)$

4. $72x^6y^7 - 96x^7y^6$

Solution:Greatest common factor in the given two terms is $24x^6y^6$

$72x^6y^7 - 96x^7y^6$

$24x^6y^6(3y - 4x)$

5. $20x^3 - 40x^2 + 80x$

Solution:Greatest common factor in the given three terms is $20x$

$20x^3 - 40x^2 + 80x$

$20x(x^2 - 2x + 4)$

6. $2x^3y^2 - 4x^2y^3 + 8xy^4$

Solution:Greatest common factor in the given three terms is $2xy^2$

$2x^3y^2 - 4x^2y^3 - 8xy^4$

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

7. $10m^3n^2 + 15m^4n - 20m^2n^3$

Solution:Greatest common factor in the given three terms is $5mn^2$

$$10m^3n^2 + 15m^4n - 20m^2n^3$$

$$5m^2n (2mn + 3m^2 - 4n^2)$$

8. $2a^4b^4 - 3a^3b^5 + 4a^2b^5$

Solution:Greatest common factor in the given three terms is a^2b^4

$$2a^4b^4 - 3a^3b^5 + 4a^2b^5$$

$$a^2b^4 (2a^2 - 3ab + 4b)$$

9. $28a^2 + 14a^2b^2 - 21a^4$

Solution:Greatest common factor in the given three terms is $7a^2$

$$28a^2 + 14a^2b^2 - 21a^4$$

$$7a^2 (4a + 2b^2 - 3a^2)$$

10. $a^4b - 3a^2b^2 - 6ab^3$

Solution:Greatest common factor in the given three terms is ab

$$a^4b - 3a^2b^2 - 6ab^3$$

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

11. $2l^2mn - 3lm^2n + 4lmn^2$

Solution:Greatest common factor in the given three terms is lmn

$$2l^2mn - 3lm^2n + 4lmn^2$$

$$lmn (2l - 3m + 4n)$$

12. $x^4y^2 - x^2y^4 - x^4y^4$

Solution:Greatest common factor in the given three terms is x^2y^2

$$x^4y^2 - x^2y^4 - x^4y^4$$

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

13. $9x^2y + 3axy$

Solution:Greatest common factor in the given three terms is $3xy$

$$9x^2y + 3axy$$
$$3xy(3x + a)$$

14. $16m - 4m^2$

Solution:Greatest common factor in the given two terms is $4m$

$$16m - 4m^2$$

$$4m(4 - m)$$

15. $-4a^2 + 4ab - 4ca$

Solution:Greatest common factor in the given three terms is $-4a$

$$-4a^2 + 4ab - 4ca$$

$$-4a(a - b + c)$$

16. $x^2yz + xy^2z + xyz^2$

Solution:Greatest common factor in the given three terms is xyz

$$x^2yz + xy^2z + xyz^2$$

$$xyz(x + y + z)$$

17. $ax^2y + bxy^2 + cxyz$

Solution:Greatest common factor in the given three terms is xy

$$ax^2y + bxy^2 + cxyz$$

$$xy(ax + by + cz)$$

EXERCISE 7.3

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Factorize each of the following algebraic expressions:

1. $6x(2x - y) + 7y(2x - y)$

Solution:

We have,

$$6x(2x - y) + 7y(2x - y)$$

By taking $(2x - y)$ as common we get,

$$(6x + 7y)(2x - y)$$

2. $2r(y - x) + s(x - y)$

Solution:

We have,

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

By taking (-1) as common we get,

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

By taking $(x - y)$ as common we get,

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

$$(x - y)(s - 2r)$$

3. $7a(2x - 3) + 3b(2x - 3)$

Solution:

We have,

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

By taking $(2x - 3)$ as common we get,

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

4. $9a(6a - 5b) - 12a^2(6a - 5b)$

Solution:

We have,

$$9a(6a - 5b) - 12a^2(6a - 5b)$$

By taking $(6a - 5b)$ as common we get,

$$(9a - 12a^2)(6a - 5b)$$

$$3a(3 - 4a)(6a - 5b)$$

5. $5(x - 2y)^2 + 3(x - 2y)$

Solution:

We have,

$$5(x - 2y)^2 + 3(x - 2y)$$

By taking $(x - 2y)$ as common we get,
 $(x - 2y) [5(x - 2y) + 3]$
 $(x - 2y) (5x - 10y + 3)$

6. $16(2l - 3m)^2 - 12(3m - 2l)$

Solution:

We have,

$$16(2l - 3m)^2 - 12(3m - 2l)$$

By taking (-1) as common we get,

$$16(2l - 3m)^2 + 12(2l - 3m)$$

By taking $4(2l - 3m)$ as common we get,

$$4(2l - 3m) [4(2l - 3m) + 3]$$

$$4(2l - 3m) (8l - 12m + 3)$$

7. $3a(x - 2y) - b(x - 2y)$

Solution:

We have,

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

By taking $(x - 2y)$ as common we get,

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

8. $a^2(x + y) + b^2(x + y) + c^2(x + y)$

Solution:

We have,

$$a^2(x + y) + b^2(x + y) + c^2(x + y)$$

By taking $(x + y)$ as common we get,

$$(a^2 + b^2 + c^2)(x + y)$$

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

Solution:

We have,

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

By taking $(x - y)$ as common we get,

$$(x - y)(x - y + 1)$$

10. $6(a + 2b) - 4(a + 2b)^2$

Solution:

We have,

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

By taking $(a + 2b)$ as common we get,
 $[6 - 4(a + 2b)](a + 2b)$
 $(6 - 4a - 8b)(a + 2b)$
 $2(3 - 2a - 4b)(a + 2b)$

11. $a(x - y) + 2b(y - x) + c(x - y)^2$

Solution:

We have,

$$a(x - y) + 2b(y - x) + c(x - y)^2$$

By taking (-1) as common we get,

$$a(x - y) - 2b(x - y) + c(x - y)^2$$

By taking $(x - y)$ as common we get,

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

$$(x - y)(a - 2b + cx - cy)$$

12. $-4(x - 2y)^2 + 8(x - 2y)$

Solution:

We have,

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

By taking $4(x - 2y)$ as common we get,

$$[-(x - 2y) + 2]4(x - 2y)$$

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

13. $x^3(a - 2b) + x^2(a - 2b)$

Solution:

We have,

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

By taking $x^2(a - 2b)$ as common we get,

$$(x + 1)[x^2(a - 2b)]$$

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

14. $(2x - 3y)(a + b) + (3x - 2y)(a + b)$

Solution:

We have,

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

By taking $(a + b)$ as common we get,

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

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

$$(a + b)[5x - 5y]$$

$$(a + b) 5(x - y)$$

15. $4(x + y) (3a - b) + 6(x + y) (2b - 3a)$

Solution:

We have,

$$4(x + y) (3a - b) + 6(x + y) (2b - 3a)$$

By taking $(x + y)$ as common we get,

$$(x + y) [4(3a - b) + 6(2b - 3a)]$$

$$(x + y) [12a - 4b + 12b - 18a]$$

$$(x + y) [-6a + 8b]$$

$$(x + y) 2(-3a + 4b)$$

$$(x + y) 2(4b - 3a)$$



EXERCISE 7.4

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Factorize each of the following expressions:

1. $qr - pr + qs - ps$

Solution:

We have,

$$qr - pr + qs - ps$$

By grouping similar terms we get,

$$qr + qs - pr - ps$$

$$q(r + s) - p(r + s)$$

$$(q - p)(r + s)$$

2. $p^2q - pr^2 - pq + r^2$

Solution:

We have,

$$p^2q - pr^2 - pq + r^2$$

By grouping similar terms we get,

$$p^2q - pq - pr^2 + r^2$$

$$pq(p - 1) - r^2(p - 1)$$

$$(p - 1)(pq - r^2)$$

3. $1 + x + xy + x^2y$

Solution:

We have,

$$1 + x + xy + x^2y$$

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

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

4. $ax + ay - bx - by$

Solution:

We have,

$$ax + ay - bx - by$$

$$a(x + y) - b(x + y)$$

$$(a - b)(x + y)$$

5. $xa^2 + xb^2 - ya^2 - yb^2$

Solution:

We have,

$$xa^2 + xb^2 - ya^2 - yb^2$$

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

6. $x^2 + xy + xz + yz$

Solution:

We have,

$$x^2 + xy + xz + yz$$
$$x(x + y) + z(x + y)$$
$$(x + y)(x + z)$$

7. $2ax + bx + 2ay + by$

Solution:

We have,

$$2ax + bx + 2ay + by$$

By grouping similar terms we get,

$$2ax + 2ay + bx + by$$
$$2a(x + y) + b(x + y)$$
$$(2a + b)(x + y)$$

8. $ab - by - ay + y^2$

Solution:

We have,

$$ab - by - ay + y^2$$

By grouping similar terms we get,

$$ab - ay - by + y^2$$
$$a(b - y) - y(b - y)$$
$$(a - y)(b - y)$$

9. $axy + bcxy - az - bcz$

Solution:

We have,

$$axy + bcxy - az - bcz$$

By grouping similar terms we get,

$$axy - az + bcxy - bcz$$
$$a(xy - z) + bc(xy - z)$$
$$(a + bc)(xy - z)$$

10. $lm^2 - mn^2 - lm + n^2$

Solution:

We have,

$$lm^2 - mn^2 - lm + n^2$$

By grouping similar terms we get,

$$lm^2 - lm - mn^2 + n^2$$

$$lm(m - 1) - n^2(m - 1)$$

$$(lm - n^2)(m - 1)$$

11. $x^3 - y^2 + x - x^2y^2$

Solution:

We have,

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

By grouping similar terms we get,

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

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

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

12. $6xy + 6 - 9y - 4x$

Solution:

We have,

$$6xy + 6 - 9y - 4x$$

By grouping similar terms we get,

$$6xy - 4x - 9y + 6$$

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

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

13. $x^2 - 2ax - 2ab + bx$

Solution:

We have,

$$x^2 - 2ax - 2ab + bx$$

By grouping similar terms we get,

$$x^2 + bx - 2ax - 2ab$$

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

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

14. $x^3 - 2x^2y + 3xy^2 - 6y^3$

Solution:

We have,

$$x^3 - 2x^2y + 3xy^2 - 6y^3$$

By grouping similar terms we get,

$$\begin{aligned} & x^3 + 3xy^2 - 2x^2y - 6y^3 \\ & x(x^2 + 3y^2) - 2y(x^2 + 3y^2) \\ & (x - 2y)(x^2 + 3y^2) \end{aligned}$$

15. $abx^2 + (ay - b)x - y$

Solution:

We have,

$$abx^2 + (ay - b)x - y$$

$$abx^2 - ayx - bx - y$$

By grouping similar terms we get,

$$abx^2 - bx - ayx - y$$

$$bx(ax - 1) + y(ax - 1)$$

$$(bx + y)(ax - 1)$$

16. $(ax + by)^2 + (bx - ay)^2$

Solution:

We have,

$$(ax + by)^2 + (bx - ay)^2$$

$$a^2x^2 + b^2y^2 + 2axby + b^2x^2 + a^2y^2 - 2axby$$

$$a^2x^2 + b^2y^2 + b^2x^2 + a^2y^2$$

By grouping similar terms we get,

$$a^2x^2 + a^2y^2 + b^2y^2 + b^2x^2$$

$$a^2(x^2 + y^2) + b^2(x^2 + y^2)$$

$$(a^2 + b^2)(x^2 + y^2)$$

17. $16(a - b)^3 - 24(a - b)^2$

Solution:

We have,

$$16(a - b)^3 - 24(a - b)^2$$

$$8(a - b)^2 [2(a - b) - 3]$$

$$8(a - b)^2 (2a - 2b - 3)$$

18. $ab(x^2 + 1) + x(a^2 + b^2)$

Solution:

We have,

$$ab(x^2 + 1) + x(a^2 + b^2)$$

$$abx^2 + ab + xa^2 + xb^2$$

By grouping similar terms we get,

$$abx^2 + xa^2 + ab + xb^2$$

$$ax (bx + a) + b (bx + a) \\ (ax + b) (bx + a)$$

19. $a^2x^2 + (ax^2 + 1)x + a$

Solution:

We have,

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

$$a^2x^2 + ax^3 + x + a$$

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

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

20. $a (a - 2b - c) + 2bc$

Solution:

We have,

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

$$a^2 - 2ab - ac + 2bc$$

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

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

21. $a (a + b - c) - bc$

Solution:

We have,

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

$$a^2 + ab - ac - bc$$

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

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

22. $x^2 - 11xy - x + 11y$

Solution:

We have,

$$x^2 - 11xy - x + 11y$$

By grouping similar terms we get,

$$x^2 - x - 11xy + 11y$$

$$x (x - 1) - 11y (x - 1)$$

$$(x - 11y) (x - 1)$$

23. $ab - a - b + 1$

Solution:

We have,

$$ab - a - b + 1$$
$$a(b - 1) - 1(b - 1)$$
$$(a - 1)(b - 1)$$

24. $x^2 + y - xy - x$

Solution:

We have,

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

By grouping similar terms we get,

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

$$x(x - 1) - y(x - 1)$$

$$(x - y)(x - 1)$$



EXERCISE 7.5

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Factorize each of the following expressions:

1. $16x^2 - 25y^2$

Solution:

We have,

$$16x^2 - 25y^2$$

$$(4x)^2 - (5y)^2$$

By using the formula $(a^2 - b^2) = (a + b)(a - b)$ we get,

$$(4x + 5y)(4x - 5y)$$

2. $27x^2 - 12y^2$

Solution:

We have,

$$27x^2 - 12y^2$$

By taking 3 as common we get,

$$3[(3x)^2 - (2y)^2]$$

By using the formula $(a^2 - b^2) = (a - b)(a + b)$

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

3. $144a^2 - 289b^2$

Solution:

We have,

$$144a^2 - 289b^2$$

$$(12a)^2 - (17b)^2$$

By using the formula $(a^2 - b^2) = (a - b)(a + b)$

$$(12a + 17b)(12a - 17b)$$

4. $12m^2 - 27$

Solution:

We have,

$$12m^2 - 27$$

By taking 3 as common we get,

$$3(4m^2 - 9)$$

$$3[(2m)^2 - 3^2]$$

By using the formula $(a^2 - b^2) = (a - b)(a + b)$

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

5. $125x^2 - 45y^2$

Solution:

We have,

$$125x^2 - 45y^2$$

By taking 5 as common we get,

$$5 (25x^2 - 9y^2)$$

$$5 [(5x)^2 - (3y)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$5 (5x + 3y) (5x - 3y)$$

6. $144a^2 - 169b^2$ **Solution:**

We have,

$$144a^2 - 169b^2$$

$$(12a)^2 - (13b)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(12a + 13b) (12a - 13b)$$

7. $(2a - b)^2 - 16c^2$ **Solution:**

We have,

$$(2a - b)^2 - 16c^2$$

$$(2a - b)^2 - (4c)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(2a - b + 4c) (2a - b - 4c)$$

8. $(x + 2y)^2 - 4(2x - y)^2$ **Solution:**

We have,

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

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

By using the formula $(a^2 - b^2) = (a + b)(a - b)$ we get,

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

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

$$(5x) (4y - 3x)$$

9. $3a^5 - 48a^3$ **Solution:**

We have,

$$3a^5 - 48a^3$$

By taking 3 as common we get,

$$3a^3 (a^2 - 16)$$

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

By using the formula $(a^2 - b^2) = (a-b) (a+b)$

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

10. $a^4 - 16b^4$

Solution:

We have,

$$a^4 - 16b^4$$

$$(a^2)^2 - (4b^2)^2$$

By using the formula $(a^2 - b^2) = (a-b) (a+b)$

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

By using the formula $(a^2 - b^2) = (a-b) (a+b)$

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

11. $x^8 - 1$

Solution:

We have,

$$x^8 - 1$$

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

By using the formula $(a^2 - b^2) = (a-b) (a+b)$

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

By using the formula $(a^2 - b^2) = (a-b) (a+b)$

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

12. $64 - (a + 1)^2$

Solution:

We have,

$$64 - (a + 1)^2$$

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

By using the formula $(a^2 - b^2) = (a-b) (a+b)$

$$[8 + (a + 1)] [8 - (a + 1)]$$

$$(a + 9) (7 - a)$$

13. $36l^2 - (m + n)^2$

Solution:

We have,

$$36l^2 - (m + n)^2$$

$$(6l)^2 - (m + n)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(6l + m + n)(6l - m - n)$$

14. $25x^4y^4 - 1$

Solution:

We have,

$$25x^4y^4 - 1$$

$$(5x^2y^2)^2 - (1)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(5x^2y^2 - 1)(5x^2y^2 + 1)$$

15. $a^4 - 1/b^4$

Solution:

We have,

$$a^4 - 1/b^4$$

$$(a^2)^2 - (1/b^2)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(a^2 + 1/b^2)(a^2 - 1/b^2)$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(a^2 + 1/b^2)(a - 1/b)(a + 1/b)$$

16. $x^3 - 144x$

Solution:

We have,

$$x^3 - 144x$$

$$x [x^2 - (12)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$x (x + 12)(x - 12)$$

17. $(x - 4y)^2 - 625$

Solution:

We have,

$$(x - 4y)^2 - 625$$

$$(x - 4y)^2 - (25)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(x - 4y + 25)(x - 4y - 25)$$

18. $9(a - b)^2 - 100(x - y)^2$

Solution:

We have,

$$9(a - b)^2 - 100(x - y)^2$$

$$[3(a - b)]^2 - [10(x - y)]^2$$

By using the formula $(a^2 - b^2) = (a - b)(a + b)$

$$[3(a - b) + 10(x + y)][3(a - b) - 10(x - y)]$$

$$[3a - 3b + 10x - 10y][3a - 3b - 10x + 10y]$$

19. $(3 + 2a)^2 - 25a^2$

Solution:

We have,

$$(3 + 2a)^2 - 25a^2$$

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

By using the formula $(a^2 - b^2) = (a - b)(a + b)$

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

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

$$(3 + 7a)3(1 - a)$$

20. $(x + y)^2 - (a - b)^2$

Solution:

We have,

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

By using the formula $(a^2 - b^2) = (a - b)(a + b)$

$$[(x + y) + (a - b)][(x + y) - (a - b)]$$

$$(x + y + a - b)(x + y - a + b)$$

21. $1/16x^2y^2 - 4/49y^2z^2$

Solution:

We have,

$$1/16x^2y^2 - 4/49y^2z^2$$

$$(1/4xy)^2 - (2/7yz)^2$$

By using the formula $(a^2 - b^2) = (a - b)(a + b)$

$$(xy/4 + 2yz/7)(xy/4 - 2yz/7)$$

$$y^2(x/4 + 2/7z)(x/4 - 2/7z)$$

22. $75a^3b^2 - 108ab^4$

Solution:

We have,

$$75a^3b^2 - 108ab^4$$

$$3ab^2 (25a^2 - 36b^2)$$

$$3ab^2 [(5a)^2 - (6b)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$3ab^2 (5a + 6b)(5a - 6b)$$

23. $x^5 - 16x^3$

Solution:

We have,

$$x^5 - 16x^3$$

$$x^3 (x^2 - 16)$$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

24. $50/x^2 - 2x^2/81$

Solution:

We have,

$$50/x^2 - 2x^2/81$$

$$2 (25/x^2 - x^2/81)$$

$$2 [(5/x)^2 - (x/9)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$2 (5/x + x/9)(5/x - x/9)$$

25. $256x^3 - 81x$

Solution:

We have,

$$256x^3 - 81x$$

$$x (256x^2 - 81)$$

$$x [(16x^2)^2 - 9^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$x (4x + 3)(4x - 3)(16x^2 + 9)$$

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

Solution:

We have,

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

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$
 $[a^2 + (2b + c)^2] [a + 2b + c] [a - 2b - c]$

27. $(3x + 4y)^4 - x^4$

Solution:

We have,

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

$$[(3x + 4y)^2]^2 - (x^2)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$[(3x + 4y)^2 + x^2] [(3x + 4y)^2 - x^2]$$

$$[(3x + 4y)^2 + x^2] [3x + 4y + x] [3x + 4y - x]$$

$$[(3x + 4y)^2 + x^2] [4x + 4y] [2x + 4y]$$

$$[(3x + 4y)^2 + x^2] 8[x + 2y] [x + y]$$

28. $p^2q^2 - p^4q^4$

Solution:

We have,

$$p^2q^2 - p^4q^4$$

$$(pq)^2 - (p^2q^2)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(pq + p^2q^2)(pq - p^2q^2)$$

$$p^2q^2(1 + pq)(1 - pq)$$

29. $3x^3y - 24xy^3$

Solution:

We have,

$$3x^3y - 24xy^3$$

$$3xy(x^2 - 8y^2)$$

$$3xy[x^2 - (8y)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(3xy)(x + 8y)(x - 8y)$$

30. $a^4b^4 - 16c^4$

Solution:

We have,

$$a^4b^4 - 16c^4$$

$$(a^2b^2)^2 - (4c^2)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$
 $(a^2b^2 + 4c^2)(ab + 2c)(ab - 2c)$

31. $x^4 - 625$

Solution:

We have,

$$x^4 - 625$$

$$(x^2)^2 - (25)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

32. $x^4 - 1$

Solution:

We have,

$$x^4 - 1$$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

33. $49(a - b)^2 - 25(a + b)^2$

Solution:

We have,

$$49(a - b)^2 - 25(a + b)^2$$

$$[7(a - b)]^2 - [5(a + b)]^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$[7(a - b) + 5(a + b)][7(a - b) - 5(a + b)]$$

$$(7a - 7b + 5a + 5b)(7a - 7b - 5a - 5b)$$

$$(12a - 2b)(2a - 12b)$$

$$2(6a - b)2(a - 6b)$$

$$4(6a - b)(a - 6b)$$

34. $x - y - x^2 + y^2$

Solution:

We have,

$$x - y - x^2 + y^2$$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

$$(x - y)(1 - x - y)$$

35. $16(2x - 1)^2 - 25y^2$

Solution:

We have,

$$16(2x - 1)^2 - 25y^2$$

$$[4(2x - 1)]^2 - (5y)^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(8x + 5y - 4)(8x - 5y - 4)$$

36. $4(xy + 1)^2 - 9(x - 1)^2$

Solution:

We have,

$$4(xy + 1)^2 - 9(x - 1)^2$$

$$[2x(xy + 1)]^2 - [3(x - 1)]^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

$$(2xy + 3x - 1)(2xy - 3x + 5)$$

37. $(2x + 1)^2 - 9x^4$

Solution:

We have,

$$(2x + 1)^2 - 9x^4$$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

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

38. $x^4 - (2y - 3z)^2$

Solution:

We have,

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

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

39. $a^4 - b^2 + a - b$

Solution:

We have,

$$a^4 - b^2 + a - b$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

$$(a - b)(a + b + 1)$$

40. $16a^4 - b^4$

Solution:

We have,

$$16a^4 - b^4$$

$$(4a^2)^2 - (b^2)^2$$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

41. $a^4 - 16(b - c)^4$

Solution:

We have,

$$a^4 - 16(b - c)^4$$

$$(a^2)^2 - [4(b - c)^2]^2$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$[a^2 + 4(b - c)^2][a^2 - 4(b - c)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$[a^2 + 4(b - c)^2][(a + 2b - 2c)(a - 2b + 2c)]$$

42. $2a^4 - 32a$

Solution:

We have,

$$2a^4 - 32a$$

$$2a(a^4 - 16)$$

$$2a[(a^2)^2 - (4)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

43. $a^4b^4 - 81c^4$

Solution:

We have,

$$a^4b^4 - 81c^4$$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$(a^2b^2 + 9c^2)(ab + 3c)(ab - 3c)$$

44. $xy^9 - yx^9$

Solution:

We have,

$$xy^9 - yx^9$$

$$-xy(x^8 - y^8)$$

$$-xy[(x^4)^2 - (y^4)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

$$-xy(x^4 + y^4)(x^4 - y^4)$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

45. $x^3 - x$

Solution:

We have,

$$x^3 - x$$

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

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

46. $18a^2x^2 - 32$

Solution:

We have,

$$18a^2x^2 - 32$$

$$2[(3ax)^2 - (4)^2]$$

By using the formula $(a^2 - b^2) = (a-b)(a+b)$

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

EXERCISE 7.6

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Factorize each of the following algebraic expressions:

1. $4x^2 + 12xy + 9y^2$

Solution:

We have,

$$4x^2 + 12xy + 9y^2$$

By using the formula $(x + y)^2 = x^2 + y^2 + 2xy$

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

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

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

2. $9a^2 - 24ab + 16b^2$

Solution:

We have,

$$9a^2 - 24ab + 16b^2$$

By using the formula $(x - y)^2 = x^2 + y^2 - 2xy$ Here $x = 3a$, $y = 4b$ So,

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

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

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

3. $p^2q^2 - 6pqr + 9r^2$

Solution:

We have,

$$p^2q^2 - 6pqr + 9r^2$$

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

$$(pq)^2 + (3r)^2 - 2(pq)(3r)$$

$$(pq - 3r)^2$$

$$(pq - 3r)(pq - 3r)$$

4. $36a^2 + 36a + 9$

Solution:

We have,

$$36a^2 + 36a + 9$$

$$9(4a^2 + 4a + 1)$$

$$9[(2a)^2 + 2(2a) + 1^2]$$

$$9(2a + 1)^2$$

$$9(2a + 1)(2a + 1)$$

5. $a^2 + 2ab + b^2 - 16$

Solution:

We have,

$$a^2 + 2ab + b^2 - 16$$

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$(a + b + 4)(a + b - 4)$$

6. $9z^2 - x^2 + 4xy - 4y^2$

Solution:

We have,

$$9z^2 - x^2 + 4xy - 4y^2$$

$$(3z)^2 - [x^2 - 2(x)(2y) + (2y)^2]$$

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$[(x - 2y) + 3z][-(x - 2y) + 3z]$$

7. $9a^2 - 24a^2b^2 + 16b^4 - 256$

Solution:

We have,

$$9a^2 - 24a^2b^2 + 16b^4 - 256$$

$$(3a^2)^2 - 2(4a^2)(3b^2) + (4b^2)^2 - (16)^2$$

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

$$(3a^2 - 4b^2)^2 - (16)^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$(3a^2 - 4b^2 + 16)(3a^2 - 4b^2 - 16)$$

8. $16 - a^6 + 4a^3b^3 - 4b^6$

Solution:

We have,

$$16 - a^6 + 4a^3b^3 - 4b^6$$

$$4^2 - [(a^3)^2 - 2(a^3)(2b^3) + (2b^3)^2]$$

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$[4 + (a^3 - 2b^3)][4 - (a^3 - 2b^3)]$$

9. $a^2 - 2ab + b^2 - c^2$

Solution:

We have,

$$a^2 - 2ab + b^2 - c^2$$

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

$$(a - b)^2 - c^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

10. $x^2 + 2x + 1 - 9y^2$

Solution:

We have,

$$x^2 + 2x + 1 - 9y^2$$

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

11. $a^2 + 4ab + 3b^2$

Solution:

We have,

$$a^2 + 4ab + 3b^2$$

By using factors for 3 i.e., 3 and 1

$$a^2 + ab + 3ab + 3b^2$$

By grouping we get,

$$a(a + b) + 3b(a + b)$$

$$(a + 3b)(a + b)$$

12. $96 - 4x - x^2$

Solution:

We have,

$$96 - 4x - x^2$$

$$-x^2 - 4x + 96$$

By using factors for 96 i.e., 12 and 8

$$-x^2 - 12x + 8x + 96$$

By grouping we get,

$$-x(x + 12) + 8(x + 12)$$

$$(x + 12)(-x + 8)$$

13. $a^4 + 3a^2 + 4$

Solution:

We have,

$$a^4 + 3a^2 + 4$$

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

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

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

14. $4x^4 + 1$

Solution:

We have,

$$4x^4 + 1$$

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

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

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

15. $4x^4 + y^4$

Solution:

We have,

$$4x^4 + y^4$$

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

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

16. $(x + 2)^4 - 6(x + 2) + 9$

Solution:

We have,

$$(x + 2)^4 - 6(x + 2) + 9$$

$$(x^2 + 2^2)^2 - 6x - 12 + 9$$

$$(x^2 + 2^2 + 2(2)(x)) - 6x - 12 + 9$$

$$x^2 + 4 + 4x - 6x - 12 + 9$$

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

By using the formula $(a - b)^2 = a^2 + b^2 - 2ab$

$$(x - 1)^2$$

17. $25 - p^2 - q^2 - 2pq$

Solution:

We have,

$$25 - p^2 - q^2 - 2pq$$

$$25 - (p^2 + q^2 + 2pq)$$

$$(5)^2 - (p + q)^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$(5 + p + q)(5 - p - q)$$

$$-(p + q + 5)(p + q - 5)$$

18. $x^2 + 9y^2 - 6xy - 25a^2$

Solution:

We have,

$$x^2 + 9y^2 - 6xy - 25a^2$$

$$(x - 3y)^2 - (5a)^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$(x - 3y + 5a)(x - 3y - 5a)$$

19. $49 - a^2 + 8ab - 16b^2$

Solution:

We have,

$$49 - a^2 + 8ab - 16b^2$$

$$49 - (a^2 - 8ab + 16b^2)$$

$$49 - (a - 4b)^2$$

By using the formula $(a^2 - b^2) = (a + b)(a - b)$

$$(7 + a - 4b)(7 - a + 4b)$$

$$-(a - 4b + 7)(a - 4b - 7)$$

20. $a^2 - 8ab + 16b^2 - 25c^2$

Solution:

We have,

$$a^2 - 8ab + 16b^2 - 25c^2$$

$$(a - 4b)^2 - (5c)^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$(a - 4b + 5c)(a - 4b - 5c)$$

21. $x^2 - y^2 + 6y - 9$

Solution:

We have,

$$x^2 - y^2 + 6y - 9$$

$$x^2 + 6y - (y^2 - 6y + 9)$$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

22. $25x^2 - 10x + 1 - 36y^2$

Solution:

We have,

$$25x^2 - 10x + 1 - 36y^2$$

$$(5x)^2 - 2(5x) + 1 - (6y)^2$$

$$(5x - 1)^2 - (6y)^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$(5x - 6y - 1)(5x + 6y - 1)$$

23. $a^2 - b^2 + 2bc - c^2$

Solution:

We have,

$$a^2 - b^2 + 2bc - c^2$$

$$a^2 - (b^2 - 2bc + c^2)$$

$$a^2 - (b - c)^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

24. $a^4 + 2b + b^2 - c^2$

Solution:

We have,

$$a^4 + 2b + b^2 - c^2$$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

25. $49 - x^2 - y^2 + 2xy$

Solution:

We have,

$$49 - x^2 - y^2 + 2xy$$

$$49 - (x^2 + y^2 - 2xy)$$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$[7 + (x - y)] [7 - x + y]$$

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

26. $a^2 + 4b^2 - 4ab - 4c^2$

Solution:

We have,

$$a^2 + 4b^2 - 4ab - 4c^2$$

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

$$(a - 2b)^2 - (2c)^2$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

27. $x^2 - y^2 - 4xz + 4z^2$

Solution:

We have,

$$x^2 - y^2 - 4xz + 4z^2$$

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

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

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

EXERCISE 7.7

PAGE NO: 7.27

Factorize each of the following algebraic expressions:

1. $x^2 + 12x - 45$

Solution:

We have,

$$x^2 + 12x - 45$$

To factorize the given expression we have to find two numbers p and q such that $p+q = 12$ and $pq = -45$

So we can replace $12x$ by $15x - 3x$

-45 by 15×3

$$\begin{aligned}x^2 + 12x - 45 &= x^2 + 15x - 3x - 45 \\ &= x(x + 15) - 3(x + 15) \\ &= (x - 3)(x + 15)\end{aligned}$$

2. $40 + 3x - x^2$

Solution:

We have,

$$40 + 3x - x^2$$

$$-(x^2 - 3x - 40)$$

By considering, $p+q = -3$ and $pq = -40$

So we can replace $-3x$ by $5x - 8x$

-40 by 5×-8

$$\begin{aligned}-(x^2 - 3x - 40) &= x^2 + 5x - 8x - 40 \\ &= -x(x + 5) - 8(x + 5) \\ &= -(x - 8)(x + 5) \\ &= (-x + 8)(x + 5)\end{aligned}$$

3. $a^2 + 3a - 88$

Solution:

We have,

$$a^2 + 3a - 88$$

By considering, $p+q = 3$ and $pq = -88$

So we can replace $3a$ by $11a - 8a$

-88 by -11×8

$$\begin{aligned}a^2 + 3a - 88 &= a^2 + 11a - 8a - 88 \\ &= a(a + 11) - 8(a + 11) \\ &= (a - 8)(a + 11)\end{aligned}$$

4. $a^2 - 14a - 51$

Solution:

We have,

$$a^2 - 14a - 51$$

By considering, $p+q = -14$ and $pq = -51$ So we can replace $-14a$ by $3a - 17a$ -51 by -17×3

$$\begin{aligned}a^2 - 14a - 51 &= a^2 + 3a - 17a - 51 \\ &= a(a + 3) - 17(a + 3) \\ &= (a - 17)(a + 3)\end{aligned}$$

5. $x^2 + 14x + 45$

Solution:

We have,

$$x^2 + 14x + 45$$

By considering, $p+q = 14$ and $pq = 45$ So we can replace $14x$ by $5x + 9x$ 45 by 5×9

$$\begin{aligned}x^2 + 14x + 45 &= x^2 + 5x + 9x + 45 \\ &= x(x + 5) + 9(x + 5) \\ &= (x + 9)(x + 5)\end{aligned}$$

6. $x^2 - 22x + 120$

Solution:

We have,

$$x^2 - 22x + 120$$

By considering, $p+q = -22$ and $pq = 120$ So we can replace $-22x$ by $-12x - 10x$ 120 by -12×-10

$$\begin{aligned}x^2 - 22x + 120 &= x^2 - 12x - 10x + 120 \\ &= x(x - 12) - 10(x - 12) \\ &= (x - 10)(x - 12)\end{aligned}$$

7. $x^2 - 11x - 42$

Solution:

We have,

$$x^2 - 11x - 42$$

By considering, $p+q = -11$ and $pq = -42$ So we can replace $-11x$ by $3x - 14x$

-42 by 3×-14

$$\begin{aligned}x^2 - 11x - 42 &= x^2 + 3x - 14x - 42 \\ &= x(x + 3) - 14(x + 3) \\ &= (x - 14)(x + 3)\end{aligned}$$

8. $a^2 + 2a - 3$

Solution:

We have,

$$a^2 + 2a - 3$$

By considering, $p+q = 2$ and $pq = -3$

So we can replace $2a$ by $3a - a$

-3 by 3×-1

$$\begin{aligned}a^2 + 2a - 3 &= a^2 + 3a - a - 3 \\ &= a(a + 3) - 1(a + 3) \\ &= (a - 1)(a + 3)\end{aligned}$$

9. $a^2 + 14a + 48$

Solution:

We have,

$$a^2 + 14a + 48$$

By considering, $p+q = 14$ and $pq = 48$

So we can replace $14a$ by $8a + 6a$

48 by 8×6

$$\begin{aligned}a^2 + 14a + 48 &= a^2 + 8a + 6a + 48 \\ &= a(a + 8) + 6(a + 8) \\ &= (a + 6)(a + 8)\end{aligned}$$

10. $x^2 - 4x - 21$

Solution:

We have,

$$x^2 - 4x - 21$$

By considering, $p+q = -4$ and $pq = -21$

So we can replace $-4x$ by $3x - 7x$

-21 by 3×-7

$$\begin{aligned}x^2 + 4x - 21 &= x^2 + 3x - 7x - 21 \\ &= x(x + 3) - 7(x + 3) \\ &= (x - 7)(x + 3)\end{aligned}$$

11. $y^2 + 5y - 36$

Solution:

We have,

$$y^2 + 5y - 36$$

By considering, $p+q = 5$ and $pq = -36$ So we can replace $5y$ by $9y - 4y$ -36 by 9×-4

$$\begin{aligned}y^2 + 5y - 36 &= y^2 + 9y - 4y - 36 \\ &= y(y + 9) - 4(y + 9) \\ &= (y - 4)(y + 9)\end{aligned}$$

12. $(a^2 - 5a)^2 - 36$ **Solution:**

We have,

$$(a^2 - 5a)^2 - 36$$

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

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

So now we shall factorize the expression $(a^2 - 5a + 6)$ By considering, $p+q = -5$ and $pq = 6$ So we can replace $-5a$ by $a - 6a$ 6 by 1×-6

$$\begin{aligned}a^2 - 5a - 6 &= a^2 + a - 6a - 6 \\ &= a(a + 1) - 6(a + 1) \\ &= (a - 6)(a + 1)\end{aligned}$$

So now we shall factorize the expression $(a^2 - 5a + 6)$ By considering, $p+q = -5$ and $pq = -6$ So we can replace $-5a$ by $-2a - 3a$ 6 by -2×-3

$$\begin{aligned}a^2 - 5a + 6 &= a^2 - 2a - 3a + 6 \\ &= a(a - 2) - 3(a - 2) \\ &= (a - 3)(a - 2)\end{aligned}$$

$$\begin{aligned}\therefore (a^2 - 5a)^2 - 36 &= (a^2 - 5a + 6)(a^2 - 5a - 6) \\ &= (a + 1)(a - 6)(a - 2)(a - 3)\end{aligned}$$

13. $(a + 7)(a - 10) + 16$ **Solution:**

We have,

$$(a + 7)(a - 10) + 16$$

$$a^2 - 10a + 7a - 70 + 16$$

$$a^2 - 3a - 54$$

By considering, $p+q = -3$ and $pq = -54$

So we can replace $-3a$ by $6a - 9a$

-54 by 6×-9

$$a^2 - 3a - 54 = a^2 + 6a - 9a - 54$$

$$= a(a + 6) - 9(a + 6)$$

$$= (a - 9)(a + 6)$$



EXERCISE 7.8

PAGE NO: 7.30

Resolve each of the following quadratic trinomials into factors:

1. $2x^2 + 5x + 3$

Solution:

We have,

$$2x^2 + 5x + 3$$

The coefficient of x^2 is 2The coefficient of x is 5

Constant term is 3

We shall split up the center term i.e., 5 into two parts such that their sum $p+q$ is 5 and product $pq = 2 \times 3$ is 6So, we express the middle term $5x$ as $2x + 3x$

$$\begin{aligned} 2x^2 + 5x + 3 &= 2x^2 + 2x + 3x + 3 \\ &= 2x(x + 1) + 3(x + 1) \\ &= (2x + 3)(x + 1) \end{aligned}$$

2. $2x^2 - 3x - 2$

Solution:

We have,

$$2x^2 - 3x - 2$$

The coefficient of x^2 is 2The coefficient of x is -3

Constant term is -2

So, we express the middle term $-3x$ as $-4x + x$

$$\begin{aligned} 2x^2 - 3x - 2 &= 2x^2 - 4x + x - 2 \\ &= 2x(x - 2) + 1(x - 2) \\ &= (x - 2)(2x + 1) \end{aligned}$$

3. $3x^2 + 10x + 3$

Solution:

We have,

$$3x^2 + 10x + 3$$

The coefficient of x^2 is 3The coefficient of x is 10

Constant term is 3

So, we express the middle term $10x$ as $9x + x$

$$\begin{aligned} 3x^2 + 10x + 3 &= 3x^2 + 9x + x + 3 \\ &= 3x(x + 3) + 1(x + 3) \end{aligned}$$

$$= (3x + 1)(x + 3)$$

4. $7x - 6 - 2x^2$

Solution:

We have,

$$7x - 6 - 2x^2$$

$$- 2x^2 + 7x - 6$$

$$2x^2 - 7x + 6$$

The coefficient of x^2 is 2The coefficient of x is -7

Constant term is 6

So, we express the middle term $-7x$ as $-4x - 3x$

$$2x^2 - 7x + 6 = 2x^2 - 4x - 3x + 6$$

$$= 2x(x - 2) - 3(x - 2)$$

$$= (x - 2)(2x - 3)$$

5. $7x^2 - 19x - 6$

Solution:

We have,

$$7x^2 - 19x - 6$$

The coefficient of x^2 is 7The coefficient of x is -19

Constant term is -6

So, we express the middle term $-19x$ as $2x - 21x$

$$7x^2 - 19x - 6 = 7x^2 + 2x - 21x - 6$$

$$= x(7x + 2) - 3(7x + 2)$$

$$= (7x + 2)(x - 3)$$

6. $28 - 31x - 5x^2$

Solution:

We have,

$$28 - 31x - 5x^2$$

$$- 5x^2 - 31x + 28$$

$$5x^2 + 31x - 28$$

The coefficient of x^2 is 5The coefficient of x is 31

Constant term is -28

So, we express the middle term $31x$ as $-4x + 35x$

$$5x^2 + 31x - 28 = 5x^2 - 4x + 35x - 28$$

$$\begin{aligned} &= x(5x - 4) + 7(5x - 4) \\ &= (x + 7)(5x - 4) \end{aligned}$$

7. $3 + 23y - 8y^2$ **Solution:**

We have,

$$\begin{aligned} &3 + 23y - 8y^2 \\ &- 8y^2 + 23y + 3 \\ &8y^2 - 23y - 3 \end{aligned}$$

The coefficient of y^2 is 8The coefficient of y is -23

Constant term is -3

So, we express the middle term $-23y$ as $-24y + y$

$$\begin{aligned} 8y^2 - 23y - 3 &= 8y^2 - 24y + y - 3 \\ &= 8y(y - 3) + 1(y - 3) \\ &= (8y + 1)(y - 3) \end{aligned}$$

8. $11x^2 - 54x + 63$ **Solution:**

We have,

$$11x^2 - 54x + 63$$

The coefficient of x^2 is 11The coefficient of x is -54

Constant term is 63

So, we express the middle term $-54x$ as $-33x - 21x$

$$\begin{aligned} 11x^2 - 54x + 63 &= 11x^2 - 33x - 21x + 63 \\ &= 11x(x - 3) - 21(x - 3) \\ &= (11x - 21)(x - 3) \end{aligned}$$

9. $7x - 6x^2 + 20$ **Solution:**

We have,

$$\begin{aligned} &7x - 6x^2 + 20 \\ &- 6x^2 + 7x + 20 \\ &6x^2 - 7x - 20 \end{aligned}$$

The coefficient of x^2 is 6The coefficient of x is -7

Constant term is -20

So, we express the middle term $-7x$ as $-15x + 8x$

$$\begin{aligned}6x^2 - 7x - 20 &= 6x^2 - 15x + 8x - 20 \\ &= 3x(2x - 5) + 4(2x - 5) \\ &= (3x + 4)(2x - 5)\end{aligned}$$

10. $3x^2 + 22x + 35$ **Solution:**

We have,

$$3x^2 + 22x + 35$$

The coefficient of x^2 is 3The coefficient of x is 22

Constant term is 35

So, we express the middle term $22x$ as $15x + 7x$

$$\begin{aligned}3x^2 + 22x + 35 &= 3x^2 + 15x + 7x + 35 \\ &= 3x(x + 5) + 7(x + 5) \\ &= (3x + 7)(x + 5)\end{aligned}$$

11. $12x^2 - 17xy + 6y^2$ **Solution:**

We have,

$$12x^2 - 17xy + 6y^2$$

The coefficient of x^2 is 12The coefficient of x is $-17y$ Constant term is $6y^2$ So, we express the middle term $-17xy$ as $-9xy - 8xy$

$$\begin{aligned}12x^2 - 17xy + 6y^2 &= 12x^2 - 9xy - 8xy + 6y^2 \\ &= 3x(4x - 3y) - 2y(4x - 3y) \\ &= (3x - 2y)(4x - 3y)\end{aligned}$$

12. $6x^2 - 5xy - 6y^2$ **Solution:**

We have,

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

The coefficient of x^2 is 6The coefficient of x is $-5y$ Constant term is $-6y^2$ So, we express the middle term $-5xy$ as $4xy - 9xy$

$$\begin{aligned}6x^2 - 5xy - 6y^2 &= 6x^2 + 4xy - 9xy - 6y^2 \\ &= 2x(3x + 2y) - 3y(3x + 2y) \\ &= (2x - 3y)(3x + 2y)\end{aligned}$$

13. $6x^2 - 13xy + 2y^2$

Solution:

We have,

$$6x^2 - 13xy + 2y^2$$

The coefficient of x^2 is 6The coefficient of x is $-13y$ Constant term is $2y^2$ So, we express the middle term $-13xy$ as $-12xy - xy$

$$\begin{aligned}6x^2 - 13xy + 2y^2 &= 6x^2 - 12xy - xy + 2y^2 \\ &= 6x(x - 2y) - y(x - 2y) \\ &= (6x - y)(x - 2y)\end{aligned}$$

14. $14x^2 + 11xy - 15y^2$

Solution:

We have,

$$14x^2 + 11xy - 15y^2$$

The coefficient of x^2 is 14The coefficient of x is $11y$ Constant term is $-15y^2$ So, we express the middle term $11xy$ as $21xy - 10xy$

$$\begin{aligned}14x^2 + 11xy - 15y^2 &= 14x^2 + 21xy - 10xy - 15y^2 \\ &= 2x(7x - 5y) + 3y(7x - 5y) \\ &= (2x + 3y)(7x - 5y)\end{aligned}$$

15. $6a^2 + 17ab - 3b^2$

Solution:

We have,

$$6a^2 + 17ab - 3b^2$$

The coefficient of a^2 is 6The coefficient of a is $17b$ Constant term is $-3b^2$ So, we express the middle term $17ab$ as $18ab - ab$

$$\begin{aligned}6a^2 + 17ab - 3b^2 &= 6a^2 + 18ab - ab - 3b^2 \\ &= 6a(a + 3b) - b(a + 3b) \\ &= (6a - b)(a + 3b)\end{aligned}$$

16. $36a^2 + 12abc - 15b^2c^2$

Solution:

We have,

$$36a^2 + 12abc - 15b^2c^2$$

The coefficient of a^2 is 36

The coefficient of a is $12bc$

Constant term is $-15b^2c^2$

So, we express the middle term $12abc$ as $30abc - 18abc$

$$36a^2 - 12abc - 15b^2c^2 = 36a^2 + 30abc - 18abc - 15b^2c^2$$

$$= 6a(6a + 5bc) - 3bc(6a + 5bc)$$

$$= (6a + 5bc)(6a - 3bc)$$

$$= (6a + 5bc)3(2a - bc)$$

17. $15x^2 - 16xyz - 15y^2z^2$

Solution:

We have,

$$15x^2 - 16xyz - 15y^2z^2$$

The coefficient of x^2 is 15

The coefficient of x is $-16yz$

Constant term is $-15y^2z^2$

So, we express the middle term $-16xyz$ as $-25xyz + 9xyz$

$$15x^2 - 16xyz - 15y^2z^2 = 15x^2 - 25yz + 9yz - 15y^2z^2$$

$$= 5x(3x - 5yz) + 3yz(3x - 5yz)$$

$$= (5x + 3yz)(3x - 5yz)$$

18. $(x - 2y)^2 - 5(x - 2y) + 6$

Solution:

We have,

$$(x - 2y)^2 - 5(x - 2y) + 6$$

The coefficient of $(x - 2y)^2$ is 1

The coefficient of $(x - 2y)$ is -5

Constant term is 6

So, we express the middle term $-5(x - 2y)$ as $-2(x - 2y) - 3(x - 2y)$

$$(x - 2y)^2 - 5(x - 2y) + 6 = (x - 2y)^2 - 2(x - 2y) - 3(x - 2y) + 6$$

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

19. $(2a - b)^2 + 2(2a - b) - 8$

Solution:

We have,

$$(2a - b)^2 + 2(2a - b) - 8$$

The coefficient of $(2a - b)^2$ is 1

The coefficient of $(2a-b)$ is 2

Constant term is -8

So, we express the middle term $2(2a - b)$ as $4(2a - b) - 2(2a - b)$

$$\begin{aligned}(2a - b)^2 + 2(2a - b) - 8 &= (2a - b)^2 + 4(2a - b) - 2(2a - b) - 8 \\ &= (2a - b)(2a - b + 4) - 2(2a - b + 4) \\ &= (2a - b + 4)(2a - b - 2)\end{aligned}$$



EXERCISE 7.9

PAGE NO: 7.32

Factorize each of the following quadratic polynomials by using the method of completing the square:

1. $p^2 + 6p + 8$

Solution:

We have,

$$p^2 + 6p + 8$$

Coefficient of p^2 is unity. So, we add and subtract square of half of coefficient of p .

$$\begin{aligned} p^2 + 6p + 8 &= p^2 + 6p + 3^2 - 3^2 + 8 \text{ (Adding and subtracting } 3^2\text{)} \\ &= (p + 3)^2 - 1^2 \text{ (By completing the square)} \end{aligned}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$\begin{aligned} &= (p + 3 - 1)(p + 3 + 1) \\ &= (p + 2)(p + 4) \end{aligned}$$

2. $q^2 - 10q + 21$

Solution:

We have,

$$q^2 - 10q + 21$$

Coefficient of q^2 is unity. So, we add and subtract square of half of coefficient of q .

$$\begin{aligned} q^2 - 10q + 21 &= q^2 - 10q + 5^2 - 5^2 + 21 \text{ (Adding and subtracting } 5^2\text{)} \\ &= (q - 5)^2 - 2^2 \text{ (By completing the square)} \end{aligned}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$\begin{aligned} &= (q - 5 - 2)(q - 5 + 2) \\ &= (q - 3)(q - 7) \end{aligned}$$

3. $4y^2 + 12y + 5$

Solution:

We have,

$$4y^2 + 12y + 5$$

$$4(y^2 + 3y + 5/4)$$

Coefficient of y^2 is unity. So, we add and subtract square of half of coefficient of y .

$$\begin{aligned} 4(y^2 + 3y + 5/4) &= 4[y^2 + 3y + (3/2)^2 - (3/2)^2 + 5/4] \text{ (Adding and subtracting } (3/2)^2\text{)} \\ &= 4[(y + 3/2)^2 - 1^2] \text{ (Completing the square)} \end{aligned}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$\begin{aligned} &= 4(y + 3/2 + 1)(y + 3/2 - 1) \\ &= 4(y + 1/2)(y + 5/2) \text{ (by taking LCM)} \\ &= 4[(2y + 1)/2][(2y + 5)/2] \\ &= (2y + 1)(2y + 5) \end{aligned}$$

4. $p^2 + 6p - 16$ **Solution:**

We have,

$$p^2 + 6p - 16$$

Coefficient of p^2 is unity. So, we add and subtract square of half of coefficient of p .

$$p^2 + 6p - 16 = p^2 + 6p + 3^2 - 3^2 - 16 \text{ (Adding and subtracting } 3^2)$$

$$= (p + 3)^2 - 5^2 \text{ (Completing the square)}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

$$= (p + 8)(p - 2)$$

5. $x^2 + 12x + 20$ **Solution:**

We have,

$$x^2 + 12x + 20$$

Coefficient of x^2 is unity. So, we add and subtract square of half of coefficient of x .

$$x^2 + 12x + 20 = x^2 + 12x + 6^2 - 6^2 + 20 \text{ (Adding and subtracting } 6^2)$$

$$= (x + 6)^2 - 4^2 \text{ (Completing the square)}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$= (x + 6 + 4)(x + 6 - 4)$$

$$= (x + 2)(x + 10)$$

6. $a^2 - 14a - 51$ **Solution:**

We have,

$$a^2 - 14a - 51$$

Coefficient of a^2 is unity. So, we add and subtract square of half of coefficient of a .

$$a^2 - 14a - 51 = a^2 - 14a + 7^2 - 7^2 - 51 \text{ (Adding and subtracting } 7^2)$$

$$= (a - 7)^2 - 10^2 \text{ (Completing the square)}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$= (a - 7 + 10)(9 - 7 - 10)$$

$$= (a - 17)(a + 3)$$

7. $a^2 + 2a - 3$ **Solution:**

We have,

$$a^2 + 2a - 3$$

Coefficient of a^2 is unity. So, we add and subtract square of half of coefficient of a .

$$a^2 + 2a - 3 = a^2 + 2a + 1^2 - 1^2 - 3 \text{ (Adding and subtracting } 1^2\text{)}$$
$$= (a + 1)^2 - 2^2 \text{ (Completing the square)}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

8. $4x^2 - 12x + 5$ **Solution:**

We have,

$$4x^2 - 12x + 5$$

$$4(x^2 - 3x + 5/4)$$

Coefficient of x^2 is unity. So, we add and subtract square of half of coefficient of x .

$$4(x^2 - 3x + 5/4) = 4[x^2 - 3x + (3/2)^2 - (3/2)^2 + 5/4] \text{ (Adding and subtracting } (3/2)^2\text{)}$$
$$= 4[(x - 3/2)^2 - 1^2] \text{ (Completing the square)}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

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

$$= 4(x - 1/2)(x - 5/2) \text{ (by taking LCM)}$$

$$= 4[(2x-1)/2][(2x - 5)/2]$$

$$= (2x - 5)(2x - 1)$$

9. $y^2 - 7y + 12$ **Solution:**

We have,

$$y^2 - 7y + 12$$

Coefficient of y^2 is unity. So, we add and subtract square of half of coefficient of y .

$$y^2 - 7y + 12 = y^2 - 7y + (7/2)^2 - (7/2)^2 + 12 \text{ [Adding and subtracting } (7/2)^2\text{]}$$
$$= (y - 7/2)^2 - (7/2)^2 \text{ (Completing the square)}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$= (y - (7/2 - 1/2))(y - (7/2 + 1/2))$$

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

10. $z^2 - 4z - 12$ **Solution:**

We have,

$$z^2 - 4z - 12$$

Coefficient of z^2 is unity. So, we add and subtract square of half of coefficient of z .

$$z^2 - 4z - 12 = z^2 - 4z + 2^2 - 2^2 - 12 \text{ [Adding and subtracting } 2^2\text{]}$$
$$= (z - 2)^2 - 4^2 \text{ (Completing the square)}$$

By using the formula $(a^2 - b^2) = (a+b)(a-b)$

$$\begin{aligned} &= (z - 2 + 4)(z - 2 - 4) \\ &= (z - 6)(z + 2) \end{aligned}$$

