

Factorization Ex-7.1

3. $7x$, $21x^2$ and $14xy^2$

2

The numerical coefficients of given monomials are

7, 21, 14

Greatest Common factor of 7, 21, 14 is 7

Common literals appearing in given monomials are, x, y .

Smallest power of x in three monomials = 1

Smallest power of y in three monomials = 0

Monomial of common literals with smallest powers = x

Hence, the greatest Common factor = $7x$.

4. $42x^2yz$ and $63x^3y^2z^3$.

The numerical coefficients of given monomials are 42, 63.

Greatest Common factor of 42, 63 is 21.

Common literals appearing in given monomials are x, y, z .

Smallest power of x in two monomials = 2

Smallest power of y in two monomials = 1

Smallest power of z in two monomials = 1

Monomial of common literals with smallest powers = x^2yz .

Hence, the greatest Common factor = $21x^2yz$.

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

3

The numerical coefficients of given monomials are 12, 6 and 2.

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

Common literals appearing in given monomials are a, x .

Smallest power of a in three monomials = 1

Smallest power of x in three monomials = 2

Monomials of common literals with smallest powers
= ax^2 .

Hence, the greatest common factor = $2ax^2$.

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

Numerical coefficients of given monomials are 9, 15, 6 and 21

Greatest common factor of 9, 15, 6, 21 is 3.

Common literals appearing in given monomials are x, y .

Smallest power of x in given monomials = 2

Smallest power of y in given monomials = 2

Monomials of common literals with smallest powers = x^2y^2 .

Hence, the greatest common factor = $3x^2y^2$.

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

Numerical coefficients of given monomials are
4, -12 and 18.

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

Common literals appearing in given monomials
are 'a' and 'b'.

Smallest power of a in three monomials = 2

Smallest power of b in three monomials = 1

Monomial of common literals with smallest powers
= a^2b

Hence, the greatest common factor = $2a^2b$.

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

Numerical coefficients of given monomials are
6, 9, 3.

Greatest common factor of 6, 9, 3 is 3

Common literals appearing in given monomials
are x and y.

Smallest power of x in three monomials = 1

Smallest power of y in three monomials = 2

Monomial of common literals with smallest powers
= $x \cdot y^2$

Hence, the greatest common factor = $3xy^2$

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

There are no numerical coefficients.

Common literals appearing in given monomials are a and b .

Smallest power of a in given monomials = 2

Smallest power of b in given monomials = 2

Monomial of common literals with smallest powers is the greatest Common factor = a^2b^2 .

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

Numerical coefficients of given monomials are

36, 54, 90.

Greatest Common factor of 36, 54, 90 is 18.

Common literals appearing in given monomials are a, b, c .

Smallest power of a in three monomials = 2

Smallest power of b in three monomials = 2

Smallest power of c in three monomials = 2

Monomial of Common literals with smallest power
= $a^2b^2c^2$

Hence, the greatest Common factor = $18a^2b^2c^2$

⑪ $x^3, -yx^2$.

There are no numerical coefficients.

Common literals appearing in given monomials are x and y .

Smallest power of x in both monomials $= 2$.

Smallest power of y in both monomials $= 0$

$\therefore$ Greatest common factor $= x^2$.

⑫ $15a^3, -5a^2, -150a$.

Numerical coefficients of given monomials are 15, -5, -150

Greatest common factor of 15, -5, -150 is 15

Common literal in given monomials is a .

Smallest power of a in given monomials $= 1$.

Hence, the greatest common factor $= 15a$.

⑬ $2x^3y^2, 10x^2y^3, 14xy$.

Numerical coefficients of given monomials are 2, 10, 14.

Greatest common factor of 2, 10, 14 is 2.

Common literals in given monomials are x and y .

Smallest power of x in three monomials $= 1$

Smallest power of y in three monomials $= 1$

Monomial of common literals with smallest powers
 $= xy$.

Hence, the greatest common factor $= 2xy$.

⑭ $14x^3y^5, 10x^5y^3, 2x^2y^2$

Numerical coefficients of given monomials are
14, 10, 2.

Greatest common factor of 14, 10, 2 is 2.

Common literals appearing in given monomials are x and y .

Smallest power of x in three monomials is 2.

Smallest power of y in three monomials is 2.

Monomial of common literals with smallest powers
 $= x^2y^2$.

Hence, the greatest common factor $= 2x^2y^2$.

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

⑮ $5a^4 + 10a^3 - 15a^2$

The greatest common factor of the terms

$5a^4, 10a^3, -15a^2$ is $5a^2$. Also, $5a^4 = 5a^2(a^2)$

$$10a^3 = 5a^2(2a)$$

$$-15a^2 = 5a^2(-3)$$

$$\therefore 5a^4 + 10a^3 - 15a^2 = 5a^2(a^2 + 2a - 3)$$

$\therefore$ Greatest common factor $= 5a^2$.

⑯ $2xy^3 + 3x^2y + 4y^2$

The greatest common factor of three terms

namely $2xy^3, 3x^2y, 4y^2$ is y

Also $2xy^3 = y(2x^3), 3x^2y = y(3x^2), 4y^2 = y(4y)$

$$2xy^3 + 3x^2y + 4y^2 = y(2x^3 + 3x^2 + 4y)$$

$\therefore$ Greatest common factor is y .

⑰ $3a^2b^2 + ub^2c^2 + 12a^2b^2c^2$

The greatest common factor of three terms

namely $3a^2b^2, ub^2c^2, 12a^2b^2c^2$ is b^2 .

Also, $3a^2b^2 = b^2(3a^2), ub^2c^2 = b^2(uc^2), 12a^2b^2c^2 = b^2(12a^2c^2)$

$$3a^2b^2 + ub^2c^2 + 12a^2b^2c^2 = b^2(3a^2 + uc^2 + 12a^2c^2)$$

EXE

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EXERCISE-7.2.

① factorize the following

① $3x-9$.

Greatest Common factor of the two terms namely $3x$ and -9 of expression $3x-9$ is 3 .

Also $3x = 3 \times x$ and $-9 = 3 \times (-3)$

$$3x-9 = 3(x-3)$$

and Greatest Common factor $= 3$.

② $5x-15x^2$.

Greatest Common factor of two terms namely $5x$ and $-15x^2$ of expression $5x-15x^2$ is $5x$.

Also $5x = 5x \times 1$ and $-15x^2 = 5x(-3x)$.

$$5x-15x^2 = 5x(1-3x)$$

and Greatest Common factor $= 5x$.

③ $20a^{12}b^2-15a^8b^4$

Greatest Common factor of two terms namely $20a^{12}b^2$ and $-15a^8b^4$ of expression $20a^{12}b^2-15a^8b^4$ is $5a^3b^2$.

Also $20a^{12}b^2 = 5a^3b^2(4a^9)$ and $-15a^8b^4 = 5a^3b^2(-3a^5b^2)$

$$\therefore 20a^{12}b^2-15a^8b^4 = 5a^3b^2(4a^9-3a^5b^2)$$

④ $72x^6y^7 - 96x^7y^6$

The greatest common factor of the two terms namely $72x^6y^7$ and $96x^7y^6$ is $24x^6y^6$

Also $72x^6y^7 = 24x^6y^6(3y)$, $96x^7y^6 = 24x^6y^6(4x)$

$$\therefore 72x^6y^7 - 96x^7y^6 = 24x^6y^6(3y - 4x)$$

⑤ $20x^3 - 40x^2 + 80x$

The greatest common factor of three terms namely $20x^3$, $40x^2$, $80x$ is $20x$.

Also $20x^3 = 20x(x^2)$, $40x^2 = 20x(2x)$, $80x = 20x(4)$

$$\therefore 20x^3 - 40x^2 + 80x = 20x(x^2 - 2x + 4)$$

⑥ $2x^3y^2 - 4x^2y^3 + 8xy^4$

The greatest common factor of three terms namely $2x^3y^2$, $4x^2y^3$, $8xy^4$ is $2xy^2$.

Also $2x^3y^2 = 2xy^2(x^2)$, $4x^2y^3 = 2xy^2(2xy)$, $8xy^4 = 2xy^2(4y^2)$

$$\therefore 2x^3y^2 - 4x^2y^3 + 8xy^4 = 2xy^2(x^2 - 2xy + 4y^2)$$

⑦ $10m^3n^2 + 15m^4n - 20m^2n^3$

The greatest common factor of three terms namely $10m^3n^2$, $15m^4n$, $20m^2n^3$ is $5m^2n$.

Also, $10m^3n^2 = 5m^2n(2mn)$, $15m^4n = 5m^2n(3m^2)$, $20m^2n^3 = 5m^2n(4n^2)$

$$\therefore 10m^3n^2 + 15m^4n - 20m^2n^3 = 5m^2n(2mn + 3m^2 - 4n^2)$$

⑧ $2a^4b^4 - 3a^3b^5 + 4a^2b^5$

The greatest common factor of three terms namely $2a^4b^4$, $3a^3b^5$, $4a^2b^5$ is a^2b^4 .

Also, $2a^4b^4 = a^2b^4(2a^2)$, $3a^3b^5 = a^2b^4(3ab)$, $4a^2b^5 = a^2b^4(4b)$

$$\therefore 2a^4b^4 - 3a^3b^5 + 4a^2b^5 = a^2b^4(2a^2 - 3ab + 4b)$$

⑨ $28a^2 + 14a^2b^2 - 21a^4$

The greatest common factor of three terms namely $28a^2$, $14a^2b^2$, $21a^4$ is $7a^2$.

Also $28a^2 = 7a^2(4)$, $14a^2b^2 = 7a^2(2b^2)$, $21a^4 = 7a^2(3a^2)$

$$\therefore 28a^2 + 14a^2b^2 - 21a^4 = 7a^2(4 + 2b^2 - 3a^2)$$

⑩ $a^4b - 3a^2b^2 - 6ab^3$

The greatest common factor of three terms namely a^4b , $3a^2b^2$, $6ab^3$ is ab .

Also $a^4b = ab(a^3)$, $3a^2b^2 = ab(3ab)$, $6ab^3 = ab(6ab^2)$

$$\therefore a^4b - 3a^2b^2 - 6ab^3 = ab(a^3 - 3ab - 6ab^2)$$

⑪ $21lmn - 3lm^2n + 4lmn^2$

The greatest common factor of three terms namely $21lmn$, $3lm^2n$, $4lmn^2$ is lmn .

Also $21lmn = lmn(21)$, $3lm^2n = lmn(3m)$, $4lmn^2 = lmn(4n)$

$$\therefore 21lmn - 3lm^2n + 4lmn^2 = lmn(21 - 3m + 4n)$$

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

12

The greatest common factor of three terms namely x^4y^2 , x^2y^4 , x^4y^4 is x^2y^2 .

Also $x^4y^2 = x^2y^2(x^2)$, $x^2y^4 = x^2y^2(y^2)$, $x^4y^4 = x^2y^2(x^2y^2)$

$$\therefore x^4y^2 - x^2y^4 - x^4y^4 = x^2y^2(x^2 - y^2 - x^2y^2).$$

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

The greatest common factor of two terms

namely $9x^2y$, $3axy$ is $3xy$

Also, $9x^2y = 3xy(3x)$, $3axy = 3xy(a)$

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

14. $16m - um^2$

The greatest common factor of two terms

namely $16m$, um^2 is um .

Also, $16m = um(u)$, $um^2 = um(m)$

$$16m - um^2 = um(u - m)$$

15. $-ua^2 + uab - uca$.

The greatest common factor of two terms

namely $-ua^2$, uab , $-uca$ is $-ua$

Also $-ua^2 = -ua(a)$, $uab = -ua(-b)$, $-uca = -ua(c)$

$$\therefore -ua^2 + uab - uca = -ua(a - b + c)$$

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

The greatest common factor of three terms

is xyz , Also $x^2yz = xyz(x)$, $xy^2z = xyz(y)$, $xyz^2 = xyz(z)$

$$\therefore x^2yz + xy^2z + xyz^2 = xyz(x + y + z)$$

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

Greatest common factor of given terms is xy .

Also $ax^2y = xy(ax)$, $bxy^2 = xy(by)$, $cxyz = xy(cz)$

$$\therefore ax^2y + bxy^2 + cxyz = xy(ax + by + cz).$$

(16) $x^2yz + xy^2z + xyz^2$

The greatest common factor of given

three terms is xyz .

Also $x^2yz = xyz(x)$, $xy^2z = xyz(y)$, $xyz^2 = xyz(z)$

$$x^2yz + xy^2z + xyz^2 = xyz(x + y + z).$$

(17) $ax^2y + bxy^2 + cxyz$

The greatest common factor of given

three terms is xy .

Also $ax^2y = xy(ax)$, $bxy^2 = xy(by)$, $cxyz = xy(cz)$

$$\therefore ax^2y + bxy^2 + cxyz = xy(ax + by + cz).$$

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EXERCISE - 7.3.

13

① factorize each of the following algebraic expressions

① $6x(2x-y) + 7y(2x-y)$

$$= (6x+7y)(2x-y) \quad [\therefore \text{Taking } (2x-y) \text{ common}]$$

② $2r(y-x) + 5(x-y)$

$$= -2r(x-y) + 5(x-y) \quad [\therefore \text{Taking } -1 \text{ common from } (y-x)]$$

$$= (x-y)(-2r+5) \quad [\therefore \text{Taking } (x-y) \text{ common}]$$

$$= (x-y)(5-2r)$$

③ $7a(2x-3) + 3b(2x-3)$

$$= (7a+3b)(2x-3) \quad [\therefore \text{Taking } (2x-3) \text{ common}]$$

④ $9a(6a-5b) - 12a^2(6a-5b)$

$$= (9a-12a^2)(6a-5b) \quad [\therefore \text{Taking } (6a-5b) \text{ common}]$$

⑤ $5(x-2y)^2 + 3(x-2y)$

$$= (x-2y)[5(x-2y) + 3] \quad [\therefore \text{Taking } (x-2y) \text{ common}]$$

$$= (x-2y)[5x-10y+3]$$

⑥ $16(2l-3m)^2 - 12(3m-2l)$

$$= 16(2l-3m)^2 + 12(2l-3m) \quad [\therefore 3m-2l = -(2l-3m)]$$

$$= u(2l-3m)[u(2l-3m) + 3] \quad [\therefore \text{Taking } u(2l-3m) \text{ common}]$$

$$= u(2l-3m)[8l-12m+3]$$

$$\begin{aligned} \textcircled{7} \quad 3a(x-2y) - b(x-2y) \\ = (3a-b)(x-2y) \quad [\because \text{Taking } (x-2y) \text{ as common}] \end{aligned}$$

$$\begin{aligned} \textcircled{8} \quad a^2(x+y) + b^2(x+y) + c^2(x+y) \\ = (a^2 + b^2 + c^2)(x+y) \quad [\because \text{Taking } (x+y) \text{ common in each term}] \end{aligned}$$

$$\begin{aligned} \textcircled{9} \quad (x-y)^2 + (x-y) \\ = (x-y)[x-y+1] \quad [\because \text{Taking } (x-y) \text{ common}] \end{aligned}$$

$$\begin{aligned} \textcircled{10} \quad 6(a+2b) - u(a+2b)^2 \\ = [6 - u(a+2b)](a+2b) \quad [\because \text{Taking } (a+2b) \text{ as common}] \\ = (6 - ua - 2ub)(a+2b) \end{aligned}$$

$$\begin{aligned} \textcircled{11} \quad a(x-y) + 2b(y-x) + c(x-y)^2 \\ = a(x-y) - 2b(x-y) + c(x-y)^2 \quad [\because (y-x) = -(x-y)] \\ = (x-y)[a - 2b + c(x-y)] \\ = (x-y)[a - 2b + cx - cy] \end{aligned}$$

$$\begin{aligned} \textcircled{12} \quad -u(x-2y)^2 + 8(x-2y) \\ = -(x-2y)[+u(x-2y) - 8] \quad [\because \text{Taking } -(x-2y) \text{ as common}] \\ = -(x-2y)[ux - 2uy - 8] \end{aligned}$$

$$\begin{aligned} \textcircled{13} \quad x^3(a-2b) + x^2(a-2b) \\ = x^2(a-2b)[x+1] \quad [\because \text{Taking } x^2(a-2b) \text{ common}] \end{aligned}$$

$$\begin{aligned} \textcircled{14} \quad (2x-3y)(a+b) + (3x-2y)(a+b) \\ = (a+b)[2x-3y+3x-2y] \quad [\because \text{By taking } (a+b) \text{ common}] \\ = (a+b)[5x-5y] \end{aligned}$$

$$\begin{aligned} \textcircled{15} \quad 4(x+y)(3a-b) + 6(x+y)(2b-3a) \\ = 2(x+y)[2(3a-b) + 3(2b-3a)] \quad [\because \text{By taking } 2(x+y) \text{ common}] \\ = 2(x+y)[6a-2b+6b-9a] \\ = 2(x+y)[4b-3a] \end{aligned}$$

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EXERCISE - 7-4.

factorize each of the following expressions.

$$\textcircled{1} \quad qr - pr + qs - ps$$

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

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

$$\textcircled{2} \quad p^2q - pr^2 - pq + r^2$$

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

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

$$\textcircled{3} \quad 1+x+xy+x^2y.$$

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

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

$$\textcircled{4} \quad ax+ay-bx-by.$$

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

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

$$\textcircled{5} \quad xa^2+xb^2-ya^2-yb^2.$$

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

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

$$\textcircled{6} \quad x^2+xy+xz+yx$$

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

$$= (x+y)(x+z)$$

$$\textcircled{7} \quad 2ax + bx + 2ay + by.$$

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

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

$$\textcircled{8} \quad ab - by - ay + y^2$$

$$= a(b-y) - y(b-y)$$

$$= (a-y)(b-y)$$

$$\textcircled{9} \quad axy + bcy - az - bcz$$

$$= a(xy-z) + bc(xy-z)$$

$$= (a+bc)(xy-z)$$

$$\textcircled{10} \quad 2m^2 - mn^2 - 2m + n^2$$

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

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

$$\textcircled{11} \quad x^3 - y^2 + x - x^2y^2$$

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

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

$$\textcircled{12} \quad 6xy + b - 9y - 4x$$

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

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

$$\textcircled{13} \quad x^2 - 2ax - 2ab + b^2$$

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

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

$$\textcircled{14} \quad x^3 - 2x^2y + 3xy^2 - 6y^3$$

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

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

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

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

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

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

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

$$= a^2x^2 + b^2y^2 + 2axy + b^2x^2 + a^2y^2 - 2bxy$$

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

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

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

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

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

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

$$= a \cdot b \cdot x^2 + ab + x \cdot a^2 + x \cdot b^2$$

$$= ax(bxa) + b(bxa)$$

$$= (ax+b)(bxa)$$

$$(19) \quad a^2x^2 + (ax^2+1)x + a$$

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

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

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

$$\begin{aligned}
 (20) \quad & a(a-2b-c) + 2bc \\
 &= a^2 - 2ab - ac + 2bc \\
 &= a(a-c) - 1b(a-c) \\
 &= (a-2b)(a-c)
 \end{aligned}$$

$$\begin{aligned}
 (21) \quad & a(a+b+c) - bc \\
 &= a^2 + ab + ac - bc \\
 &= a(a-c) + b(a-c) \\
 &= (a+b)(a-c)
 \end{aligned}$$

$$\begin{aligned}
 (22) \quad & x^2 - 11xy + x + 11y \\
 &= x(x-1) - 11y(x-1) \\
 &= (x-11y)(x-1)
 \end{aligned}$$

$$\begin{aligned}
 (23) \quad & ab - a - b + 1 \\
 &= a(b-1) - 1(b-1) \\
 &= (a-1)(b-1)
 \end{aligned}$$

$$\begin{aligned}
 (24) \quad & x^2 + y - xy - x \\
 &= x(x-1) - y(x-1) \\
 &= (x-y)(x-1)
 \end{aligned}$$

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Factorize each of the following expressions.

$$\begin{aligned} \textcircled{1} \quad 16x^2 - 25y^2 \\ &= (4x)^2 - (5y)^2 \\ &= (4x+5y)(4x-5y). \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad 3(9x^2 - 4y^2) \\ &= 3((3x)^2 - (2y)^2) \\ &= 3(3x+2y)(3x-2y) \end{aligned}$$

$$\begin{aligned} \textcircled{3} \quad 144a^2 - 289b^2 \\ &= (12a)^2 - (17b)^2 \\ &= (12a+17b)(12a-17b) \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad 12m^2 - 27 \\ &= 3(4m^2 - 9) \\ &= 3((2m)^2 - 3^2) \\ &= 3(2m+3)(2m-3) \end{aligned}$$

$$\begin{aligned} \textcircled{5} \quad 125x^2 - 45y^2 \\ &= 5(25x^2 - 9y^2) \\ &= 5((5x)^2 - (3y)^2) \\ &= 5(5x+3y)(5x-3y) \end{aligned}$$

$$\textcircled{6} \quad 144a^2 - 169b^2.$$

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

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

$$\textcircled{7} \quad (2a-b)^2 - 16c^2$$

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

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

$$\textcircled{8} \quad (x+2y)^2 - u(2x-y)^2$$

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

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

$$= [x+4x+2y-2y][x-4x+2y+2y]$$

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

$$\textcircled{9} \quad 3a^5 - 48a^3$$

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

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

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

$$\textcircled{10} \quad a^4 - 16b^4$$

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

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

$$\begin{aligned} \textcircled{11} \quad x^8 - 1 \\ &= (x^4)^2 - 1^2 \\ &= (x^4 + 1)(x^4 - 1) \end{aligned}$$

$$\begin{aligned} \textcircled{12} \quad 64 - (a+1)^2 \\ &= 8^2 - (a+1)^2 \\ &= [8 + (a+1)][8 - (a+1)] \\ &= (a+9)[7-a]. \end{aligned}$$

$$\begin{aligned} \textcircled{13} \quad 36l^2 - (m+n)^2 \\ &= (6l)^2 - (m+n)^2 \\ &= (6l+m+n)(6l-m-n). \end{aligned}$$

$$\begin{aligned} \textcircled{14} \quad 25x^4y^4 - 1 \\ &= (5x^2y^2)^2 - (1)^2 \\ &= (5x^2y^2 - 1)(5x^2y^2 + 1). \end{aligned}$$

$$\begin{aligned} \textcircled{15} \quad a^4 - \frac{1}{b^4} \\ &= (a^2)^2 - \left(\frac{1}{b^2}\right)^2 \\ &= \left[a^2 + \frac{1}{b^2}\right]\left[a^2 - \frac{1}{b^2}\right]. \end{aligned}$$

$$\begin{aligned}
 (16) \quad & x^3 - 144x \\
 &= x [x^2 - (12)^2] \\
 &= x [x+12] [x-12].
 \end{aligned}$$

$$\begin{aligned}
 (17) \quad & (x-y)^2 - 625 \\
 &= (x-y)^2 - (25)^2 \\
 &= [x-y+25] [x-y-25]
 \end{aligned}$$

$$\begin{aligned}
 (18) \quad & 9(a-b)^2 - 100(x-y)^2 \\
 &= [3(a-b)]^2 - [10(x-y)]^2 \\
 &= [3(a-b) + 10(x-y)] [3(a-b) - 10(x-y)] \\
 &= [3a-3b+10x-10y] [3a-3b-10x+10y].
 \end{aligned}$$

$$\begin{aligned}
 (19) \quad & (3+2a)^2 - 25a^2 \\
 &= (3+2a)^2 - (5a)^2 \\
 &= (3+2a+5a) (3+2a-5a) \\
 &= (7a+3) (3-3a)
 \end{aligned}$$

$$\begin{aligned}
 (20) \quad & (x+y)^2 - (a-b)^2 \\
 &= [(x+y)+(a-b)] [(x+y)-(a-b)] \\
 &= (x+y+a-b) (x+y-a+b)
 \end{aligned}$$

$$\begin{aligned}
 (21) \quad & \frac{1}{16} x^2 y^2 - \frac{4}{49} y^2 z^2 \\
 & \left[\frac{1}{u} (xy) \right]^2 - \left[\frac{2}{7} (yz) \right]^2 \\
 & \left[\frac{xy}{u} + \frac{2(yz)}{7} \right] \left[\frac{xy}{u} - \frac{2(yz)}{7} \right] \\
 & = y^2 \left[\frac{x}{u} + \frac{2}{7} z \right] \left[\frac{x}{u} - \frac{2}{7} z \right]
 \end{aligned}$$

$$\begin{aligned}
 (22) \quad & 75a^3b^2 - 108a \cdot b^4 \\
 & = 3ab^2 [25a^2 - 36b^2] \\
 & = 3ab^2 [(5a)^2 - (6b)^2] \\
 & = 3ab^2 [5a+6b] [5a-6b].
 \end{aligned}$$

$$\begin{aligned}
 (23) \quad & x^5 - 16x^3 \\
 & = x^3 [x^2 - 16] \\
 & = x^3 [x^2 - 4^2] \\
 & = x^3 (x+4) (x-4)
 \end{aligned}$$

$$\begin{aligned}
 (24) \quad & \frac{50}{x^2} - \frac{2x^2}{81} \\
 & = 2 \left[\frac{25}{x^2} - \frac{x^2}{81} \right] \\
 & = 2 \left[\left(\frac{5}{x} \right)^2 - \left(\frac{x}{9} \right)^2 \right] \\
 & = 2 \left[\frac{5}{x} + \frac{x}{9} \right] \left[\frac{5}{x} - \frac{x}{9} \right].
 \end{aligned}$$

$$(25) \quad 256x^5 - 81x.$$

$$= x(256x^4 - 81)$$

$$= x((16x^2)^2 - 9^2)$$

$$= x(16x+9)(16x-9)$$

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

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

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

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

$$(27) \quad (3x+4y)^4 - x^4$$

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

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

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

$$(28) \quad p^2q^2 - p^4q^4$$

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

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

$$(pq)^2 [1+pq][1-pq]$$

$$29. 3x^2y - 243xy^3$$

$$3xy [x^2 - 81y^2]$$

$$= 3xy [x^2 - (9y)^2]$$

$$= (3xy) (x+9y) (x-9y)$$

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

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

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

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

$$(31) x^4 - 625$$

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

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

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

$$(32) x^4 - 1$$

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

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

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

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

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

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

$$\begin{aligned} &= (x^2)^2 - (2y-3z)^2 \\ &= (x^2+2y-3z)(x^2-2y+3z). \end{aligned}$$

$$(39) a^2 - b^2 + a - b.$$

$$\begin{aligned} &= (a+b)(a-b) + (a-b) \\ &= (a-b)(a+b+1). \end{aligned}$$

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

$$\begin{aligned} &= (4a^2)^2 - (b^2)^2 \\ &= (4a^2+b^2)(4a^2-b^2) \\ &= (4a^2+b^2)(2a+b)(2a-b) \end{aligned}$$

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

$$\begin{aligned} &= (a^2)^2 - [4(b-c)^2]^2 \\ &= [a^2+4(b-c)^2][a^2-4(b-c)^2] \\ &= [a^2+4(b-c)^2][(a+2b-2c)(a-2b+2c)]. \end{aligned}$$

$$\begin{aligned}
 \textcircled{42} \quad & 2a^5 - 32a \\
 &= 2a(a^4 - 16) \\
 &= 2a((a^2)^2 - 4^2) \\
 &= 2a(a^2 + 4)(a^2 - 4) \\
 &= 2a(a^2 + 4)(a + 2)(a - 2)
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{43} \quad & a^4b^4 - 81c^4 \\
 &= (a^2b^2)^2 - (9c^2)^2 \\
 &= (a^2b^2 + 9c^2)(a^2b^2 - 9c^2) \\
 &= (a^2b^2 + 9c^2)(ab + 3c)(ab - 3c)
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{44} \quad & x(y^9 - xy^8 - yx^8) \\
 &= xy(y^8 - x^8) \\
 &= xy((y^4)^2 - (x^4)^2) \\
 &= xy(y^4 + x^4)(y^4 - x^4) \\
 &= xy(y^4 + x^4)(y^2 + x^2)(y^2 - x^2) \\
 &= xy(y^4 + x^4)(y^2 + x^2)(y + x)(y - x)
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{45} \quad & x^3 - x \\
 &= x(x^2 - 1) = x(x + 1)(x - 1)
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{46} \quad & 18a^2x^2 - 32 \\
 &= 2((3ax)^2 - 4^2) \\
 &= 2(3ax + 4)(3ax - 4)
 \end{aligned}$$

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EXERCISE - 7.6.

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I. factorize each of the following expressions.

$$\textcircled{1} \quad ux^2 + 12xy + 9y^2.$$

$$= \cancel{(4x)^2} + (3y)^2 + 2(2x)(3y) \\ = (2x+3y)^2$$

$$\textcircled{2} \quad 9a^2 - 24ab + 16b^2.$$

$$= (3a)^2 + (4b)^2 - 2(3a)(4b) \\ = (3a-4b)^2.$$

$$\textcircled{3} \quad (pq)^2 + (3r)^2 - 6pqr.$$

$$= (pq)^2 + (3r)^2 - 2(pq)(3r) \\ = (pq-3r)^2.$$

$$\textcircled{4} \quad 36a^2 + 36a + 9.$$

$$9(4a^2 + 4a + 1) \\ 9((2a)^2 + 2(2a) + 1^2) \\ = 9(2a+1)^2.$$

$$\textcircled{5} \quad a^2 + 2ab + b^2 - 16$$

$$= (a+b)^2 - 4^2 \\ = (a+b+4)(a+b-4).$$

$$\textcircled{6} \quad 9z^2 - x^2 + 4xy - 4y^2.$$

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

$$(7) \quad 9a^4 - 2ua^2b^2 + 16b^4 - 25b^2$$

$$(3a^2)^2 - 2(ua^2)(3b^2) + (4b^2)^2 - (1b)^2$$

$$(3a^2 - 4b^2)^2 - (1b)^2$$

$$(3a^2 - 4b^2 + 1b)(3a^2 - 4b^2 - 1b)$$

$$(8) \quad 16 - a^6 + ua^3b^3 - ub^6$$

$$= u^2 - ((a^3)^2 - 2(a^3)(2b^3) + (2b^3)^2)$$

$$= u^2 - [a^3 - 2b^3]^2$$

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

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

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

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

$$(10) \quad x^2 + 2x + 1 - 9y^2$$

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

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

$$(11) \quad a^2 + uab + 3b^2$$

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

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

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

$$(12) \quad 96 - 4x - x^2$$

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

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

$$= 2x(x+12) + 8(x+12)$$

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

$$(13) \quad a^4 + 3a^2 + 4$$

$$(a^2)^2 + (a^2)^2 + 2 \cdot 2a^2 + 4 = a^4.$$

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

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

$$(14) \quad u \cdot x^4 + 1$$

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

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

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

$$(15) \quad 4x^4 + y^4$$

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

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

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

$$(16) \quad (x+2)^2 + 6(x+2) + 9$$

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

$$= x^2 + 10x + 25$$

$$= (x+5)^2$$

$$(17) \quad 25 - p^2 - q^2 - 2pq$$

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

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

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

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

$$(18) \quad x^2 + y^2 - 6xy - 25a^2$$

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

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

$$(19) \quad 49 - a^2 + 8ab - 16b^2$$

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

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

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

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

$$(20) \quad a^2 - 8ab + 16b^2 - 25c^2$$

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

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

$$(21) \quad x^2 - y^2 + 6y - 9$$

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

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

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

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

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

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

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

$$(23) \quad a^2 - b^2 + 2bc - c^2$$

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

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

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

$$(24) \quad a^2 + 2ab + b^2 - c^2$$

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

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

$$(25) \quad 49 - x^2 - y^2 + 2xy$$

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

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

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

$$(26) \quad a^2 + ab^2 - 4ab - 4a^2$$

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

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

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

$$(27) \quad x^2 - y^2 - 4x + 4$$

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

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

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

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Factorization Ex 7.7

EXERCISE- 7.7.

25.

factorize each of the following algebraic expressions.

① $x^2 + 12x - 45$.

In order to factorize the given expression, we have to find two numbers, p and q such that

$$p+q=12, \quad pq=-45$$

clearly $15-3=12$, $15(-3)=-45$.

$\therefore$ split $12x$ as $15x - 3x$.

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

② $40+3x-x^2$
 $= -(x^2-3x-40)$

In order to find factors, we need p and q ,

such that

$$p+q=-3, \quad pq=-40$$

clearly $5-8=-3$, $5(-8)=-40$.

$\therefore$ split $-3x$ as $5x - 8x$.

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

$$-(x^2 - 3x - 40) = (x+5)(-x+8)$$

③ $a^2 + 3a - 88$

In order to factorize it, we need to find P and Q , where $P+Q=3$, $PQ=-88$.

$\therefore$ split $3a$ as $11a - 8a$.

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

④ $a^2 - 14a - 51$

In order to factorize it, we need to find

P and Q , where $P+Q=-14$, $PQ=-51$

Clearly $3-17=-14$, $3(-17)=-51$

$\therefore$ split $-14a$ as $3a - 17a$.

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

⑤ $x^2 + 14x + 45$

In order to factorize it, we need to find

P and Q , where $P+Q=14$, $PQ=45$.

Clearly $5+9=14$, $5(9)=45$.

$\therefore$ split $14x$ into $5x + 9x$

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

⑥ $x^2 - 22x + 120$

In order to factorize it, we need to find P and Q , where

$$P+Q = -22, \quad P \cdot Q = 120.$$

clearly $-12-10 = -22$, $(-12)(-10) = 120$.

$\therefore$ split $(-22x)$ into $-12x - 10x$.

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

⑦ $x^2 - 11x - 42$

In order to factorize it, we need to find P and Q , where

$$P+Q = -11, \quad P \cdot Q = -42.$$

clearly $3-14 = -11$, $3(-14) = -42$.

$\therefore$ split $(-11x)$ into $3x - 14x$

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

⑧ $a^2 + 2a - 3$

In order to factorize it, we need to find P and Q , where $P+Q = 2$, $P \cdot Q = -3$, Clearly $P=3$, $Q=-1$

$\therefore$ split $(2a)$ into $(3a - a)$

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

⑨ $a^2 + 14a + 48$

In order to factorize the given polynomial, we need to find P and Q , where

$$P+Q=14, P \cdot Q=48$$

clearly $8+6=14$, $8 \cdot 6=48$

$\therefore$ split $(14a)$ into $8a+6a$.

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

⑩ $x^2 - 4x - 21$

In order to factorize the given polynomial,

we need to find P and Q , where

$$P+Q=-4, P \cdot Q=-21$$

clearly $3-7=-4$, $(3)(-7)=-21$.

$\therefore$ split $(-4x)$ into $3x-7x$.

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

⑪ $y^2 + 5y - 36$

In order to factorize the given polynomial,

we need to find P and Q , where

$$P+Q=5, P \cdot Q=-36, \text{ clearly } 9-4=5, 9(-4)=-36$$

$\therefore$ split $5y$ into $9y-4y$

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

⑫ $(a^2 - 5a)^2 - 36$

It can be written as $(a^2 - 5a)^2 - 6^2$.

using $a^2 - b^2 = (a+b)(a-b)$, $(a^2 - 5a)^2 - 6^2 = (a^2 - 5a + 6)(a^2 - 5a - 6)$

To factorize $(a^2 - 5a + 6)$, we need to find p and q where $p+q = -5$, $p \cdot q = 6$, clearly $-2-3 = -5$, $(-2)(-3) = 6$.

$\therefore$ split $-5a$ into $-2a-3a$.

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

To factorize $(a^2 - 5a - 6)$, we need to find p and q

where $p+q = -5$, $p \cdot q = -6$, clearly $1-6 = -5$, $1(-6) = -6$.

$\therefore$ split $-5a$ as $a-6a$.

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

$$\therefore (a^2 - 5a)^2 - 36 = (a^2 - 5a + 6)(a^2 - 5a - 6) = (a-1)(a-2)(a-3)(a-6)$$

⑬ $(a+7)(a-10) + 16$

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

To factorize it, we need to find p and q , where

$p+q = -3$, $p \cdot q = -54$, clearly $6-9 = -3$, $6(-9) = -54$.

$\therefore$ split $-3a$ into $6a-9a$.

$$\begin{aligned} \therefore a^2 - 3a - 54 &= a^2 + 6a - 9a - 54 \\ &= (a-9)(a+6) \end{aligned}$$

$$\therefore (a+7)(a-10) + 16 = (a-9)(a+6)$$

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Factorization Ex 7.8

④ $7x^2 - 6 - 2x^2 = -2x^2 + 7x - 6$ 42

Here Coefficient of $x^2 = -2$, Coefficient of $x = 7$, and Constant term $= -6$.

We shall now split up the coefficient of x , i.e. 7 into two parts whose sum is 7 and product is $-2 \times -6 = 12$, clearly $4+3=7$, $4 \times 3 = 12$. So we write the middle term $7x$ as

$$4x + 3x$$

Thus we have

$$\begin{aligned} -2x^2 + 7x - 6 &= -2x^2 + 4x + 3x - 6 \\ &= -2x(x-2) + 3(x-2) \\ &= (x-2)(3-2x) \end{aligned}$$

⑤ $7x^2 - 19x - 6$

Here Coefficient of $x^2 = 7$, Coefficient of $x = -19$ and Constant term $= -6$.

We shall now split up the coefficient of x , i.e. -19 into two parts, whose sum is -19 and product is $7 \times -6 = -42$, clearly $2 - 21 = -19$ and $2(-21) = -42$. So we write the middle term $-19x$ as $2x - 21x$

Thus we have

$$\begin{aligned} 7x^2 - 19x - 6 &= 7x^2 + 2x - 21x - 6 \\ &= x(7x+2) - 3(7x+2) \\ &= (x-3)(7x+2) \end{aligned}$$

⑥ $28 - 31x - 5x^2$

43

$$= -5x^2 - 31x + 28$$

Here coefficient of $x^2 = -5$, coefficient of $x = -31$ and constant term $= 28$.

We shall now split up the coefficient of x , i.e. -31 into two parts whose sum is -31 and product is $-5(28) = -140$. Clearly, $4 - 35 = -31$ and $4(-35) = -140$. So we write the middle term $-31x$ as $4x - 35x$.

Thus, we have

$$\begin{aligned} -5x^2 - 31x + 28 &= -5x^2 + 4x - 35x + 28 \\ &= -x(5x - 4) - 7(5x - 4) \\ &= -(x + 7)(5x - 4) \end{aligned}$$

⑦ $3 + 23y - 8y^2$

$$= -8y^2 + 23y + 3$$

Here coefficient of $y^2 = -8$, coefficient of $y = 23$, and constant term $= 3$.

We shall now split up the coefficient of y , i.e. 23 into two parts, whose sum is 23 and product is $-8(3) = -24$. Clearly $24 - 1 = 23$ and $24(-1) = -24$. So we write the middle term $23y$ as $24y - y$.

Thus, we have

$$\begin{aligned}-8y^2 + 23y + 3 &= -8y^2 + 24y - y + 3 \\ &= -8y(y-3) - 1(y-3) \\ &= -(8y+1)(y-3)\end{aligned}$$

⑧ $11x^2 - 54x + 63$

Here coefficient of $x^2 = 11$, coefficient of $x = -54$ and constant term $= 63$.

We shall now split up the coefficient of x , i.e. -54 into two parts whose sum is -54 and product is 11×63 , i.e. 693 , clearly

$$-33x - 21x = -54x \text{ and product is } (-33)(-21) = 693$$

So, we write middle term $-54x$ as $-33x - 21x$

Thus, we have

$$\begin{aligned}11x^2 - 54x + 63 \\ &= 11x^2 - 33x - 21x + 63 \\ &= 11x(x-3) - 21(x-3) \\ &= (11x-21)(x-3)\end{aligned}$$

⑨ $7x - 6x^2 + 20$

$$= -6x^2 + 7x + 20$$

Here coefficient of $x^2 = -6$, coefficient of $x = 7$, constant term $= 20$

we shall now split up the coefficient⁴⁵ of x , i.e. 7 into two parts whose sum is 7 and product is $-6(20) = -120$, clearly $15 - 8 = 7$ and $15(-8) = -120$. clearly. so we write middle term $7x$ as $15x - 8x$

Thus, we have

$$\begin{aligned} 9 - 6x^2 + 7x + 20 &= -6x^2 + 15x - 8x + 20 \\ &= -3x(2x - 5) - 4(2x - 5) \\ &= -(3x + 4)(2x - 5) \end{aligned}$$

(10) $3x^2 + 22x + 35$.

Here coefficient of $x^2 = 3$, coefficient of $x = 22$ and constant term $= 35$.

we shall now split up the coefficient of x , i.e. 22 into two parts whose sum is 22 and product is $35(3) = 105$. so we write middle term $22x$ as $15x + 7x$

Thus we have

$$\begin{aligned} 3x^2 + 22x + 35 &= 3x^2 + 15x + 7x + 35 \\ &= 3x(x + 5) + 7(x + 5) \\ &= (3x + 7)(x + 5) \end{aligned}$$

⑪ $12x^2 - 17xy + 6y^2$

Here coefficient of $x^2 = 12$, coefficient of $x = -17y$ and constant term $= 6y^2$.

Now, we split coefficient of middle term i.e. $-17y$ into two parts whose sum is $-17y$ and product $12 \times 6y^2 = 72y^2$.

clearly $-9y - 8y = -17y$ and $(-9y)(-8y) = 72y^2$.

So, we replace middle term, $-17xy = -9xy - 8xy$

Thus, we have

$$\begin{aligned} 12x^2 - 17xy + 6y^2 &= 12x^2 - 9xy - 8xy + 6y^2 \\ &= 3x(4x - 3y) - 2y(4x - 3y) \\ &= (3x - 2y)(4x - 3y) \end{aligned}$$

⑫ $6x^2 - 5xy - 6y^2$

Here coefficient of $x^2 = 6$, coefficient of $x = -5y$ and constant term $= -6y^2$.

Now, we split coefficient of middle term i.e. $-5y$ into two parts whose sum is $-5y$ and product is $6(-6y^2) = -36y^2$.

clearly $4y - 9y = -5y$ and $(4y)(-9y) = -36y^2$.

So, we replace $-5xy = 4xy - 9xy$, Thus we have

$$\begin{aligned} 6x^2 - 5xy - 6y^2 &= 6x^2 + 4xy - 9xy - 6y^2 \\ &= (2x - 3y)(3x + 2y) \end{aligned}$$

(13)

$$6x^2 - 13xy + 2y^2$$

Coefficient of $x^2 = 6$, Coefficient of $x = -13y$
Constant term = $2y^2$.

Now, we split coefficient of middle term
i.e. $-13y$ into two parts whose sum is $-13y$
and product $6 \times 2y^2 = 12y^2$.

$$\text{clearly } -12y - y = -13y, \quad (-12y)(-y) = 12y^2$$

$$\text{so, we replace } -13xy = -12xy - xy$$

Thus, we have

$$\begin{aligned} 6x^2 - 13xy + 2y^2 &= 6x^2 - 12xy - xy + 2y^2 \\ &= 6x(x - 2y) - y(x - 2y) \\ &= (6x - y)(x - 2y) \end{aligned}$$

(14)

$$14x^2 + 11xy - 15y^2$$

Coefficient of $x^2 = 14$, Coefficient of $x = 11y$
Constant term = $-15y^2$.

Now, we split coefficient of middle term
i.e. $11y$ into two parts whose sum is $11y$

$$\text{and product} = 14(-15)y^2 = -210y^2$$

$$\text{clearly } 21y - 10y = 11y \text{ and } (21y)(-10y) = -210y^2$$

$$\text{so, we replace } 11xy = 21xy - 10xy$$

Thus we have

$$\begin{aligned}
 14x^2 + 11xy - 15y^2 &= 14x^2 + 21xy - 10xy - 15y^2 \\
 &= 7x(2x+3y) - 5y(2x+3y) \\
 &= (2x+3y)(7x-5y)
 \end{aligned}$$

(15) $6a^2 + 17ab - 3b^2$

Coefficient of $a^2 = 6$, Coefficient of $a = 17b$

Constant term $= -3b^2$

Now, we split coefficient of middle term i.e. $17ab$ into two terms whose sum is $17b$ and product $= 6(-3b^2) = -18b^2$

Clearly $18b - b = 17b$ and $(18b)(-b) = -18b^2$

So, we replace $17ab = 18ab - ab$

Thus, we have

$$\begin{aligned}
 6a^2 + 17ab - 3b^2 &= 6a^2 + 18ab - ab - 3b^2 \\
 &= 6a(a+3b) - b(a+3b) \\
 &= (6a-b)(a+3b)
 \end{aligned}$$

(16) $36a^2 + 12abc - 15b^2c^2$

Coefficient of $a^2 = 36$, Coefficient of $a = 12bc$

Constant term $= -15b^2c^2$

Now, we split coefficient of middle term, i.e. $12bc$ into two terms whose sum is $12bc$ and product $= 36(-15b^2c^2) = -540b^2c^2$

so, we replace $12abc = 30abc - 18abc$.

Thus, we have

$$\begin{aligned} 36a^2 + 12abc - 15b^2c^2 &= 36a^2 + 30abc - 18abc - 15b^2c^2 \\ &= (a+5bc)(6a-3b) \end{aligned}$$

(12) $15x^2 - 16xyz - 15y^2z^2$

Coefficient of $x^2 = 15$, Coefficient of $x = -16yz$,

Coefficient Constant term $= -15y^2z^2$.

Now, we split coefficient of middle term
i.e. $-16yz$ into two parts whose sum is $-16yz$
and product is $15(-15y^2z^2) = -225y^2z^2$.

clearly $-25yz + 9yz = -16yz$ and $(-25yz)(9yz) = -225y^2z^2$

so, we replace $-16xyz = -25yz + 9yz$

Thus, we have

$$\begin{aligned} 15x^2 - 16xyz - 15y^2z^2 &= 15x^2 - 25yz + 9yz - 15y^2z^2 \\ &= 5x(3x - 5yz) + 3yz(3x - 5yz) \\ &= (5x + 3yz)(3x - 5yz) \end{aligned}$$

⑮ $(x-2y)^2 - 5(x-2y) + 6$

$$x^2 + y^2 - 4xy - 5x + 10y + 6$$

Coefficient of $(x-2y)^2 = 1$, Coefficient of $(x-2y) = -5$

Constant = 6.

Now, we split coefficient of middle term

i.e. -5 into two terms whose sum is -5

and product = 6 (1) = 6

Clearly $-2-3 = -5$, $-2(-3) = 6$.

So we replace $-5(x-2y) = -2(x-2y) - 3(x-2y)$

Thus we have,

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

⑯ $(2a-b)^2 + 2(2a-b) - 8$

Coefficient of $(2a-b)^2 = 1$, Coefficient of $(2a-b) = 2$

Constant = -8.

Now, we split coefficient of middle term

i.e. 2 into two terms whose sum is 2 and

Product = -8 (1) = -8.

Clearly $4-2 = 2$ and $4(-2) = -8$.

So, we replace $2(2a-b) = 4(2a-b) - 2(2a-b)$

Thus we have,

$$\begin{aligned} (2a-b)^2 + 2(2a-b) - 8 &= (2a-b)^2 + 4(2a-b) - 2(2a-b) - 8 \\ &= (2a-b)(2a-b+4) - 2(2a-b+4) \\ &= (2a-b-2)(2a-b+4) \end{aligned}$$

Factorization Ex 7.9

EXERCISE - 7.9.

51

① $p^2 + 6p + 8$

Here coefficient of p^2 is unity, so we add and subtract square of half of coefficient of p .

$$\begin{aligned}\therefore p^2 + 6p + 8 &= p^2 + 6p + 3^2 - 3^2 + 8 \left[\text{Adding and subtracting} \right. \\ &\quad \left. \left(\frac{6}{2} \right)^2 = 3^2 \right] \\ &= (p+3)^2 - 1^2 \left[\text{By completing the square} \right] \\ &= (p+3-1)(p+3+1) \\ &= (p+2)(p+4)\end{aligned}$$

② $q^2 - 10q + 21$

coefficient of q^2 is 1, so we add and subtract square of half of coefficient of q .

$$\begin{aligned}q^2 - 10q + 21 &= q^2 - 10q + 5^2 - 5^2 + 21 \left[\text{Adding and subtracting} \right. \\ &\quad \left. \left(\frac{10}{2} \right)^2 = 5^2 \right] \\ &= (q-5)^2 - 2^2 \left[\text{By completing the square} \right] \\ &= (q-5-2)(q-5+2) \\ &= (q-7)(q-3)\end{aligned}$$

③ $4y^2 + 12y + 5$

we have $4y^2 + 12y + 5 = 4 \left[y^2 + 3y + \frac{5}{4} \right]$
 $\left[\because \text{making } m^2 \text{ coefficient} = 1 \right]$

$$= 4 \left[y^2 + 3y + \left(\frac{3}{2} \right)^2 - \left(\frac{3}{2} \right)^2 + \frac{5}{4} \right]$$

$$= 4 \left[\left(y + \frac{3}{2} \right)^2 - 1^2 \right] \text{ (Completing the square)}$$

$$= 4 \left(y + \frac{3}{2} + 1 \right) \left(y + \frac{3}{2} - 1 \right)$$

$$= (2y+5)(2y+1)$$

④ $P^2 + 6P - 16$

Coefficient of $P^2 = 1$

$\therefore$ we have $P^2 + 6P + 3^2 - 3^2 - 16$ [Adding and subtracting $\left(\frac{6}{2} \right)^2 = 3^2$]

$$= (P+3)^2 - 5^2 \text{ (Completing the square)}$$

$$= (P+3+5)(P+3-5)$$

$$= (P+8)(P-2)$$

⑤ $x^2 + 12x + 20$

Coefficient of $x^2 = 1$

$\therefore$ we have $x^2 + 12x + 6^2 - 6^2 + 20$ [Adding and subtracting $\left(\frac{12}{2} \right)^2 = 6^2$]

$$= (x+6)^2 - 4^2 \text{ (Completing the square)}$$

$$= (x+6+4)(x+6-4)$$

$$= (x+10)(x+2)$$

$$= u \left[x - \frac{3}{2} + 1 \right] \left[x - \frac{3}{2} - 1 \right]$$

$$(2x-1)(2x-5).$$

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⑨ $y^2 - 7y + 12$.

Coefficient of $y^2 = 1$

$\therefore$ we have $y^2 - 7y + 12 = y^2 - 7y + \left(\frac{7}{2}\right)^2 - \left(\frac{7}{2}\right)^2 + 12$

[$\therefore$ By adding and subtracting $\left(\frac{7}{2}\right)^2$]

$$= \left(y - \frac{7}{2}\right)^2 - \left(\frac{1}{2}\right)^2 \text{ (Completing the square)}$$

$$= \left(y - \frac{7}{2} - \frac{1}{2}\right) \left(y - \frac{7}{2} + \frac{1}{2}\right)$$

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

⑩ $z^2 - 4z - 12$.

Coefficient of $z^2 = 1$

$\therefore$ we have $z^2 - 4z - 12 = z^2 - 4z + 2^2 - 2^2 - 12$

[$\therefore$ By adding and subtracting $\left(\frac{4}{2}\right)^2 = 2^2$]

$$(z-2)^2 - 4^2 \text{ (Completing the square)}$$

$$= (z-2+4)(z-2-4)$$

$$= (z+2)(z-6)$$

⑥ $a^2 - 14a - 51$

Coefficient of $a^2 = 1$

$\therefore$ we have $a^2 - 14a - 51 = a^2 - 14a + 7^2 - 7^2 - 51$

$\therefore$ Adding and subtracting $\left(\frac{14}{2}\right)^2 = 7^2$

$= (a-7)^2 - 10^2$ (Completing the square)

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

$= (a+3)(a-17)$

⑦ $a^2 + 2a - 3$

Coefficient of $a^2 = 1$

$\therefore$ we have $a^2 + 2a - 3 = a^2 + 2a + 1^2 - 1^2 - 3$

$\therefore$ Adding and subtracting $\left(\frac{2}{2}\right)^2 = 1^2$

$= (a+1)^2 - 2^2$ (Completing the square)

$= (a+1+2)(a+1-2)$

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

⑧ $4x^2 - 12x + 5$

we have $4x^2 - 12x + 5 = 4\left(x^2 - 3x + \frac{5}{4}\right)$

$= 4\left[x^2 - 3x + \left(\frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)^2 + \frac{5}{4}\right]$

(Adding and subtracting $\left(\frac{3}{2}\right)^2$) ,

$= 4\left[\left(x - \frac{3}{2}\right)^2 - 1^2\right]$ (Completing the square)