# Substitution

**IMPORTANT POINTS**

1. **Substitution :** The value of an expression depends on the value of its variable (s).
2. **Use of Brackets :**
   The Symbols —, ( ), { }, [ ] are called brackets.
   If an expression is enclosed within a bracket, it is considered a single quantity, even if it is made up of many terms.
   **Keep in Mind :**
   - While simplifying an expression containing a bracket, first of all, the terms inside the bracket are operated (combined).
   - ( ) is called a small bracket or Parenthesis.
   - { } is called a middle bracket or Curly bracket.
   - [ ] is called big or square bracket.
   - If one more bracket is needed, then we use the bar bracket.
     i.e. a line ——————— is drawn over a group of terms.
     Thus, in $3x + 4y - 5z$, the line over 4y – 5z serves as the bar bracket and is called Vinculum.

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**EXERCISE 20(A)**

</div>

**Question 1.**
Fill in the following blanks, when :
x = 3, y = 6, z = 18, a = 2, b = 8, c = 32 and d = 0.

(i) $x + y =$

(ii) $y - x =$ ................

(iii) $\dfrac{y}{x} =$ ................

(iv) $c + b =$ ................

(v) $z + x =$ ................

(vi) $y \times d =$ ................

(vii) $d + x =$ ................

(viii) $ab + y =$ ................

(ix) $a + b + x =$ ................

(x) $b + z - d =$ ................

(xi) $a - b + y =$ ................

(xii) $z - a - b =$ ................

(xiii) $d - a + x =$ ................

(xiv) $xy - bd =$ ................

(xv) $xz + cd =$ ................

**Solution:**

(i) $x + y = 3 + 6 = 9$

(ii) $y - x = 6 - 3 = 3$

(iii) $\dfrac{y}{x} = \dfrac{6}{3} = 2$

(iv) $c \div b = \dfrac{c}{b} = \dfrac{32}{8} = 4$

(v) $z \div x = \dfrac{z}{x} = \dfrac{18}{3} = 6$

(vi) $y \times d = 6 \times 0 = 0$

(vii) $d \div x = \dfrac{d}{x} = \dfrac{0}{3} = 0$

(viii) $ab + y = 2 \times 8 + 6 = 16 + 6 = 22$

(ix) $a + b + x = 2 + 8 + 3 = 13$

(x) $b + z - d = 8 + 18 - 0 = 26$

(xi) $a - b + y = 2 - 8 + 6 = 8 - 8 = 0$

(xii) $z - a - b = 18 - 2 - 8 = 18 - 10 = 8$

(xiii) $d - a + x = 0 - 2 + 3 = 1$

(xiv) $xy - bd = 3 \times 6 - 8 \times 0 = 18 - 0 = 18$

(xv) $xz + cd = 3 \times 18 + 32 \times 0 = 54 + 0 = 54$

## Question 2.

Find the value of :

(i) $p + 2q + 3r$, when $p = 1, q = 5$ and $r = 2$

(ii) $2a + 4b + 5c$, when $a = 5, b = 10$ and $c = 20$

(iii) $3a - 2b$, when $a = 8$ and $b = 10$

(iv) $5x + 3y - 6z$, when $x = 3$, $y = 5$ and $z = 4$

(v) $2p - 3q + 4r - 8s$, when $p = 10$, $q = 8, r = 6$, and $s = 2$

(vi) $6m - 2n - 5p - 3q$, when $m = 20$, $n = 10, p = 2$ and $q = 9$

**Solution:**

(i) $p + 2q + 3r$

$$= 1 + 2 \times 5 + 3 \times 2$$
$$= 1 + 10 + 6 = 17$$

(ii) $2a + 4b + 5c$

$$= 2 \times 5 + 4 \times 10 + 5 \times 20$$
$$= 10 + 40 + 100 = 150$$

(iii) $3a - 2b = 3 \times 8 - 2 \times 10$

$$= 24 - 20 = 4$$

(iv) $5x + 3y - 6z$

$$= 5 \times 3 + 3 \times 5 - 6 \times 4$$
$$= 15 + 15 - 24 = 30 - 24 = 6$$

(v) $2p - 3q + 4r - 8s$

$$= 2 \times 10 - 3 \times 8 + 4 \times 6 - 8 \times 2$$
$$= 20 - 24 + 24 - 16$$
$$= 20 - 16 = 4$$

(vi) $6m - 2n - 5p - 3q$

$$= 6 \times 20 - 2 \times 10 - 5 \times 2 - 3 \times 9$$
$$= 120 - 20 - 10 - 27$$
$$= 120 - 57 = 63$$

**Question 3.**
Find the value of :
(i) $4pq \times 2r$, when $p = 5$, $q = 3$ and $r = 1/2$

(ii) $\dfrac{yx}{z}$, when $x = 8$, $y = 4$ and $z = 16$

(iii) $\dfrac{a+b-c}{2a}$, when $a = 5$, $b = 7$ and $c = 2$

**Solution:**

(i) $4pq \times 2r = 4 \times 5 \times 3 \times 2 \times \dfrac{1}{2} = 60$

(ii) $\dfrac{yx}{z} = \dfrac{4 \times 8}{16} = \dfrac{32}{16} = 2$

(iii) $\dfrac{a+b-c}{2a} = \dfrac{5+7-2}{2\times 5} = \dfrac{12-2}{10} = \dfrac{10}{10} = 1$

**Question 4.**
If $a = 3$, $b = 0$, $c = 2$ and $d = 1$, find the value of :

(i) $3a + 2b - 6c + 4d$

(ii) $6a - 3b - 4c - 2d$

(iii) $ab - bc + cd - da$

(iv) $abc - bcd + cda$

(v) $a^2 + 2b^2 - 3c^2$

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

(vii) $2a^2 - 3b^2 + 4c^2 - 5d^2$

**Solution:**

(i) $3a + 2b - 6c + 4d$
$$= 3 \times 3 + 2 \times 0 - 6 \times 2 + 4 \times 1$$
$$= 9 + 0 - 12 + 4 = 13 - 12 = \mathbf{1}$$

(ii) $6a - 3b - 4c - 2d$
$$= 6 \times 3 - 3 \times 0 - 4 \times 2 - 2 \times 1$$
$$= 18 - 0 - 8 - 2 = 18 - 10 = \mathbf{8}$$

(iii) $ab - bc + cd - da$
$$= 3 \times 0 - 0 \times 2 + 2 \times 1 - 1 \times 3$$
$$= 0 + 0 + 2 - 3 = \mathbf{-1}$$

(iv) $abc - bcd + cda$
$$= 3 \times 0 \times 2 - 0 \times 2 \times 1 + 2 \times 1 \times 3$$
$$= 0 - 0 + 6 = \mathbf{6}$$

(v) $a^2 + 2b^2 - 3c^2$
$$= 3^2 + 2 \times 0^2 - 3 \times 2^2$$
$$= 9 + 0 - 3 \times 4$$
$$= 9 - 12 = \mathbf{-3}$$

(vi) $a^2 + b^2 - c^2 + d^2$
$$= (3)^2 + (0)^2 - (2^2) + (1)^2$$
$$= 9 + 0 - 4 + 1 = \mathbf{6}$$

(vii) $2a^2 - 3b^2 + 4c^2 - 5d^2$
$$= 2(3)^2 - 3(0)^2 + 4(2)^2 - 5(1)^2$$
$$= 2 \times 9 - 0 + 4 \times 4 - 5 \times 1$$
$$= 18 - 0 + 16 - 5 = 34 - 5 = \mathbf{29}$$

**Question 5.**
Find the value of $5x^2 - 3x + 2$, when x = 2.
**Solution:**

$$5x^2 - 3x + 2 = 5(2)^2 - 3(2) + 2$$
$$= 5(4) - 6 + 2$$
$$= 20 + 2 - 6 = \mathbf{16}$$

## Question 6.
Find the value of $3x^3 - 4x^2 + 5x - 6$, when x = -1.
**Solution:**

$3x^3 - 4x^2 + 5x - 6$

$\quad = 3(-1)^3 - 4(-1)^2 + 5(-1) -6$

$\quad = 3 \times -1 - 4 \times 1 - 5 - 6$

$\quad = -3 - 4 - 5 - 6 = -18$

## Question 7.
Show that the value of $x^3 - 8x^2 + 12x - 5$ is zero, when x = 1.
**Solution:**

$x^3 - 8x^2 + 12x - 5$

$\quad = (1)^3 - 8(1)^2 + 12(1) - 5$

$\quad = 1 - 8 + 12 - 5$

$\quad = 13 - 13 = 0$ **Hence proved.**

## Question 8.
State true and false :
(i) The value of x + 5 = 6, when x = 1
(ii) The value of 2x – 3 = 1, when x = 0
(iii) $\frac{2x-4}{x+1}$ = -1,when x = 1
**Solution:**

(i) True, verification $x + 5 = 6$,

When $x = 1$, $1 + 5 = 6$

$\qquad 6 = 6$ **Hence proved.**

(ii) $2x - 3 = 1$, when $x = 0$

$\quad 2 \times 0 - 3 = 1, 0 - 3 = 1,$

$\qquad - 3 = 1$ **False.**

(iii) $\dfrac{2x-4}{x+1} = -1$, when $x = 1 = \dfrac{2 \times 1 - 4}{1+1} = -1$

$\qquad = \dfrac{2-4}{2} = -1 = \dfrac{-2}{2} = -1$

$\qquad = -1 = -1$ **True.**

## Question 9.
If x = 2, y = 5 and z = 4, find the value of each of the following :

(i) $\dfrac{x}{2x^2}$           (ii) $\dfrac{xz}{yz}$

(iii) $z^x$           (iv) $y^x$

(v) $\dfrac{x^2y^2z^2}{xz}$           (vi) $\dfrac{5x^4y^2z^2}{2x^2}$

(vii) $xy \div y^2z$           (viii) $\dfrac{x^2y^x}{x}$

**Solution:**

(i) $\dfrac{x}{2x^2} = \dfrac{2}{2(2)^2} = \dfrac{2}{2\times 4} = \dfrac{1}{4}$

(ii) $\dfrac{xz}{yz} = \dfrac{2\times 4}{5\times 4} = \dfrac{2}{5}$

(iii) $z^x = 4^2 = 4\times 4 = 16$

(iv) $y^x = 5^2 = 5\times 5 = 25$

(v) $\dfrac{x^2y^2z^2}{xz} = \dfrac{(2)^2\times(5)^2\times(4)^2}{2\times 4}$

$= (2)^{2-1}\times(5)^2\times(4)^{2-1}$

$= 2\times 5\times 5\times 4 = 200$

(vi) $\dfrac{5x^4y^2z^2}{2x^2} = \dfrac{5x^{4-2}y^2z^2}{2} = \dfrac{5x^2y^2z^2}{2}$

$= \dfrac{5(2)^2(5)^2(4)^2}{2} = \dfrac{5\times 4\times 25\times 16}{2}$

$= 5\times 2\times 25\times 16 = 4,000$

(vii) $\dfrac{xy}{y^2z} = \dfrac{x}{y^{2-1}z} = \dfrac{x}{yz} = \dfrac{2}{5\times 4} = \dfrac{1}{10}$

(viii) $\dfrac{x^2y^x}{x} = x^{2-1}y^x = xy^x = (2)(5)^2$

$= 2\times 25 = 50$

**Question 10.**
If a = 3, find the values of $a^2$ and $2^a$.
**Solution:**
$a^2 = (3)^2 = 3 \times 3 = 9$
$2^a = (2)^3 = 2 \times 2 \times 2 = 8$

**Question 11.**
If m = 2, find the difference between the values of $4m^3$ and $3m^4$.
**Solution:**
$4m^3 = 4(2)^3 = 4 \times 2 \times 2 \times 2 = 32$
$3m^4 = 3(2)^4 = 3 \times 2 \times 2 \times 2 \times 2 = 48$
Now, a difference $3m^4 - 4m^3 = 48 - 32 = 16$

**EXERCISE 20(B)**

**Question 1.**
Evaluate :
(i) (23 – 15) + 4
(ii) 5x + (3x + 7x)
(iii) 6m – (4m – m)
(iv) (9a – 3a) + 4a
(v) 35b – (16b + 9b)
(vi) (3y + 8y) – 5y
**Solution:**
(i) (23 – 15) + 4 = 8 + 4 = 12
(ii) 5x + (3x + 7x) = 5x + 10x = 15x
(iii) 6m – (4m – m) = 6m – 3m = 3m
(iv) (9a – 3a) + 4a = 6a + 4a = 10a
(v) 35b – (16b + 9b)= 35b – 25b = 10b
(vi) (3y + 8y) – 5y = 11y – 5y = 6y

**Question 2.**
Simplify :
(i) $12x - (5x + 2x)$
(ii) $10m + (4n - 3n) - 5n$
(iii) $(15b - 6b) - (8b + 4b)$
(iv) $-(-4a - 8a)$
(v) $x - (x - y) - (-x + y)$
(vi) $p + (-q - r - s) - (p - q - r)$
(vii) $(a + b) - (c + d) - (e - f)$
(viii) $3x + (8x - 5x) - (7x - x)$
(ix) $a - (a - b - c)$
(x) $6a^2 + (2a^2 - a^2) - (a^2 - b^2)$
(xi) $2m - (3m + 2n - 6n)$
(xii) $-m - n - (-m) - m$
(xiii) $x + y - (x + \overline{y - x})$
(xiv) $25y - (5x - 10y + 6x - 3y)$
(xv) $3x + (2x - \overline{x + 2})$
(xvi) $a - (2a - \overline{4a + 3a})$
(xvii) $5x^2 - (3x - \overline{x^2 - 4})$
(xviii) $-(y - x) - (x + y - \overline{2x + y})$
**Solution:**

(i) $12x - (5x + 2x) = 12x - 7x = \mathbf{5x}$

(ii) $10m + (4n - 3n) - 5n$
$$= 10\,m + n - 5n = \mathbf{10m - 4n}$$

(iii) $(15b - 6b) - (8b + 4b)$
$$= 9b - 12b = -\mathbf{3b}$$

(iv) $-(-4a - 8a) = -(-12a) = \mathbf{12a}$

(v) $x - (x - y) - (-x + y)$
$$= x - x + x + y - y = \mathbf{x}$$

(vi) $p + (-q - r - s) - (p - q - r)$
$$= p - q - r - s - p + q + r$$
$$= p - p - q + q - r + r - s = -\mathbf{s}$$

(vii) $(a + b) - (c + d) - (e - f)$
$$= \mathbf{a + b - c - d - e + f}$$

(viii) $3x + (8x - 5x) - (7x - x)$
$$= 3x + 3x - 6x = 6x - 6x = \mathbf{0}$$

(ix) $a - (a - b - c) = a - a + b + c$
$$= \mathbf{b + c}$$

(x) $6a^2 + (2a^2 - a^2) - (a^2 - b^2)$
$$= 6a^2 + a^2 - a^2 + b^2 = \mathbf{6a^2 + b^2}$$

(xi) $2m - (3m + 2n - 6n)$
$$= 2m - 3m - 2n + 6n$$
$$= -m + 4n = \mathbf{4n - m}$$

(xii) $-m - n - (-m) - m$
$$= -m - n + m - m = -\mathbf{m - n}$$

(xiii) $x + y - (x + \overline{y - x})$
$$= x + y - (x + y - x)$$
$$= x + y - x - y + x$$
$$= x - x + x + y - y = \mathbf{x.}$$

(xiv) $25y - (5x - 10y + 6x - 3y)$
$$= 25y - 5x + 10y - 6x + 3y$$
$$= 25y + 10y + 3y - 5x - 6x$$
$$= \mathbf{38y - 11x}$$

(xv) $3x + (2x - \overline{x + 2})$
$$= 3x + (2x - x - 2)$$

$$= 3x + 2x - x - 2 = \mathbf{4x - 2}$$

(xvi) $a - (2a - \overline{4a + 3a})$

$$= a - (2a - 4a - 3a)$$
$$= a - 2a + 4a + 3a = 8a - 2a = \mathbf{6a}.$$

(xvii) $5x^2 - (3x - \overline{x^2 - 4})$

$$= 5x^2 - (3x - x^2 + 4) = 5x^2 - 3x + x^2 - 4$$
$$= 5x^2 + x^2 - 3x - 4 = \mathbf{6x^2 - 3x - 4}$$

(xviii) $-(y - x) - (x + y - \overline{2x + y})$

$$= -(y - x) - (x + y - 2x - y)$$
$$= -y + x - x - y + 2x + y$$
$$= x - x + 2x - y - y + y = \mathbf{2x - y}$$

**Question 3.**
Simplify :

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

(ii) $x - [y + \{x - (y + x)\}]$

(iii) $4x + 3 (2x - 5y)$

(iv) $2 (3a - b) - 5 (a - 3b)$

(v) $p + 2 (q - \overline{r + p})$

(vi) $a - [-\{-(a - \overline{b - c})\}]$

(vii) $3x - [5y - \{6y + 2 (10y - x)\}]$

(viii) $5\{a^2 - a(a - \overline{a - 2})\}$

**Solution:**

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

$\quad = x - y + z + x + y - z + y - z - x$

$\quad = x + x - x - y + y + y + z - z - z$

$\quad = x + y - z$

(ii) $x - [y + \{ x - (y + x)\}]$

$\quad = x - [y + \{x - y - x\}]$

$\quad = x - [y + x - y - x]$

$\quad = x - y - x + y + x$

$\quad = x - x + x - y + y = x$

(iii) $4x + 3(2x - 5y)$

$\quad = 4x + 6x - 15y$

$\quad = 10x - 15y$

(iv) $2(3a - b) - 5(a - 3b)$

$\quad = 6a - 2b - 5a + 15b$

$\quad = 6a - 5a + 15b - 2b = a + 13b$

(v) $p + 2(q - \overline{r + p})$

$\quad = p + 2(q - r - p)$

$\quad = p + 2q - 2r - 2p = 2q - 2r - p$

(vi) $a - [-\{-(a - \overline{b - c})\}]$

$\quad = a - [-\{-(a - b + c)\}]$

$\quad = a - [- \{- a + b - c \}]$

$\quad = a - [+ a - b + c]$

$\quad = a - a + b - c = b - c$

(vii) $3x - [5y - \{6y + 2(10y - x)\}]$

$\quad = 3x - [5y - \{6y + 20y - 2x\}]$

$\quad = 3x - [5y - 6y - 20y + 2x]$

$\quad = 3x - 5y + 6y + 20y - 2x$

$\quad = 3x - 2x + 6y + 20y - 5y$

$\quad = x + 21y$

(viii) $5\{a^2 - a(a - \overline{a - 2})\}$

$\quad = 5 \{a^2 - a (a - a + 2)\}$

$\quad = 5 \{a^2 - a^2 + a^2 - 2a)$

$\quad = 5a^2 - 5a^2 + 5a^2 - 10a$

$\quad = 5a^2 - 10a$

**EXERCISE 20(C)**

## Question 1.
**Fill in the blanks :**

    (i) $2a + b - c = 2a + (\ldots\ldots)$
    (ii) $3x - z + y = 3x - (\ldots\ldots)$
    (iii) $6p - 5x + q = 6p - (\ldots\ldots)$
    (iv) $a + b - c + d = a + (\ldots\ldots)$
    (v) $5a + 4b + 4x - 2c = 4x - (\ldots\ldots)$
    (vi) $7x + 2z + 4y - 3 = -3 + 4y + (\ldots\ldots)$
    (vii) $3m - 2n + 6 = 6 - (\ldots\ldots)$
    (viii) $2t + r - p - q + s = 2t + r - (\ldots\ldots)$

**Solution:**

    (i) $2a + b - c = 2a + (b - c)$
    (ii) $3x - z + y = 3x - (z - y)$
    (iii) $6p - 5x + q = 6p - (5x - q)$
    (iv) $a + b - c + d = a + (b - c + d)$
    (v) $5a + 4b + 4x - 2c = 4x - (2c - 5a - 4b)$
    (vi) $7x + 2z + 4y - 3 = -3 + 4y + (7x + 2z)$
    (vii) $3m - 2n + 6 = 6 - (2n - 3m)$

(viii) $2t + r - p - q + s = 2t + r - (p + q - s)$

## Question 2.
**Insert the bracket as indicated :**

    (i) $x - 2y = - (\ldots\ldots)$
    (ii) $m + n - p = - (\ldots\ldots)$
    (iii) $a + 4b - 4c = a + (\ldots\ldots)$
    (iv) $a - 3b + 5c = a - (\ldots\ldots)$
    (v) $x^2 - y^2 + z^2 = x^2 - (\ldots\ldots)$
    (vi) $m^2 + x^2 - p^2 = - (\ldots\ldots)$
    (vii) $2x - y + 2z = 2z - (\ldots\ldots)$
    (viii) $ab + 2bc - 3ac = 2bc - (\ldots\ldots)$

**Solution:**

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

(ii) $m + n - p = -(p - m - n)$

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

(iv) $a - 3b + 5c = a - (3b - 5c)$

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

(vi) $m^2 + x^2 - p^2 = -(p^2 - m^2 - x^2)$

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

(viii) $ab + 2bc - 3ac = 2bc - (3ac - ab)$

## REVISION EXERCISE

**Question 1.**
Find the value of 3ab + 10bc – 2abc when a = 2, b = 5 and c = 8.
**Solution:**

$a = 2, b = 5, c = 8$

$\therefore 3ab + 10bc - 2abc$

$= 3 \times 2 \times 5 + 10 \times 5 \times 8 - 2 \times 2 \times 5 \times 8$

$= 30 + 400 - 160 = 430 - 160$

$= 270$

**Question 2.**
If x = 2, = 3 and z = 4, find the value of $3x^2 - 4y^2 + 2z^2$.
**Solution:**

$x = 2, y = 3, z = 4$

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

$= 3 \times 4 - 4 \times 9 + 2 \times 16$

$= 12 - 36 + 32$

$= 12 + 32 - 36 = 44 - 36 = 8$

**Question 3.**
If x = 3, y = 2 and z = 1; find the value of:
(i) $x^y$
(ii) $y^x$
(iii) $3x^2 - 5y^2$
(iv) 2x – 3y + 4z + 5
(v) $y^2 - x^2 + 6z^2$
(vi) $xy + y^2z - 4zx$

**Solution:**

$x = 3, y = 2, z = 1$

(i) $x^y = 3^2 = 3 \times 3 = \mathbf{9}$

(ii) $y^x = 2^3 = 2 \times 2 \times 2 = \mathbf{8}$

(iii) $3x^2 - 5y^2 = 3\,(3)^2 - 5\,(2)^2$
$= 3 \times 9 - 5 \times 4 = 27 - 20 = 7$

(iv) $2x - 3y + 4z + 5 = 2 \times 3 - 3 \times 2 + 4 \times 1 + 5$
$= 6 - 6 + 4 + 5 = 15 - 6 = \mathbf{9}$

(v) $y^2 - x^2 + 6z^2$
$= (2)^2 - (3)^2 + 6\,(1)^2$
$= 4 - 9 + 6 \times 1 = 4 - 9 + 6$
$= 10 - 9 = \mathbf{1}$

(vi) $xy + y^2z - 4zx$
$= 3 \times 2 + (2)^2 \times 1 - 4 \times 1 \times 3$
$= 6 + 4 - 12 = 10 - 12 = -2$

**Question 4.**
If P = -12x² – 10xy + 5y², Q = 7x² + 6xy + 2y², and R = 5x + 2xy + 4y ; find :
(i) P – Q
(ii) Q + P
(iii) P – Q + R
(iv) P + Q + R
**Solution:**

$P = -12x^2 - 10xy + 5y^2$

$Q = 7x^2 + 6xy + 2y^2$

$R = 5x^2 + 2xy + 4y^2$

(i) $P - Q = (-12x^2 - 10xy + 5y^2) - (7x^2 + 6xy + 2y^2)$

$= -12x^2 - 10xy + 5y^2 - 7x^2 - 6xy - 2y^2$

$= -12x^2 - 7x^2 - 10xy - 6xy + 5y^2 - 2y^2$

$= -19x^2 - 16xy + 3y^2$

(ii) $Q + P = (7x^2 + 6xy + 2y^2) + (-12x^2 - 10xy + 5y^2)$

$= 7x^2 + 6xy + 2y^2 - 12x^2 - 10xy + 5y^2$

$= 7x^2 - 12x^2 + 6xy - 10xy + 2y^2 + 5y^2$

$= -5x^2 - 4xy + 7y^2$

(iii) $P - Q + R = (-12x^2 - 10xy + 5y^2) - (7x^2 + 6xy + 2y^2) + (5x^2 + 2xy + 4y^2)$

$= -12x^2 - 10xy + 5y^2 - 7x^2 - 6xy - 2y^2 + 5x^2 + 2xy + 4y^2$

$= -12x^2 - 7x^2 + 5x^2 - 10xy - 6xy + 2xy + 5y^2 - 2y^2 + 4y^2$

$= -14x^2 - 14xy + 7y^2$

(iv) $P + Q + R = -12x^2 - 10xy + 5y^2 + 7x^2 + 6xy + 2y^2 + 5x^2 + 2xy + 4y^2$

$= -12x^2 + 7x^2 + 5x^2 - 10xy + 6xy + 2xy + 5y^2 + 2y^2 + 4y^2$

$= 0 - 2xy + 11y^2$

$= -2xy + 11y^2$

**Question 5.**

If $x = a^2 - bc$, $y = b^2 - ca$ and $z = c^2 - ab$ ; find the value of :

(i) ax + by + cz

(ii) ay – bx + cz

**Solution:**

$x = a^2 - bc, \ y = b^2 - ca, \ z = c^2 - ab$

(i) $ax + by + cz = a(a^2 - bc) + b(b^2 - ca) + c(c^2 - ab)$

$= a^3 - abc + b^3 - abc + c^3 - abc$

$= a^3 + b^3 + c^3 - 3abc$

(ii) $ay - bx + cz = a(b^2 - ca) - b(a^2 - bc) + c(c^2 - ab)$

$= ab^2 - ca^2 - a^2b + b^2c + c^3 - abc$

**Question 6.**
Multiply and then evaluate :
(i) $(4x + y)$ and $(x - 2y)$; when $x = 2$ and $y = 1$.
(ii) $(x^2 - y)$ and $(xy - y^2)$; when $x = 1$ and $y = 2$.
(iii) $(x - 2y + z)$ and $(x - 3z)$; when $x = -2$, $y = -1$ and $z = 1$.
**Solution:**

(i) $(4x + y) \times (x - 2y)$

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

$= 4x^2 - 8xy + xy - 2y^2$

$= 4x^2 - 7xy - 2y^2$

Verification :

When $x = 2, \ y = 1$

L.H.S. $= (4x + y)(x - 2y)$

$= (4 \times 2 + 1)(2 - 2 \times 1)$

$= (8 + 1)(2 - 2) = 9 \times 0 = 0$

R.H.S. $= 4x^2 - 7xy - 2y^2$

$= 4(2)^2 - 7 \times 2 \times 1 - 2(1)^2$

$= 4 \times 4 - 14 - 2 = 16 - 16 = 0$

∴ L.H.S. = R.H.S.

(ii) $(x^2 - y) \times (xy - y^2)$

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

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

Verification :

When $x = 1, y = 2$

∴ L.H.S. $= (x^2 - y)(xy - y^2)$

$= [(1)^2 - 2][1 \times 2 - (2)^2]$

$= (1 - 2)(2 - 4) = -1 \times -2 = 2$

R.H.S. $= x^3y - x^2y^2 - xy^2 + y^3$

$= (1)^3 \times 2 - (1)^2(2)^2 - 1(2)^2 + (2)^3$

$= 1 \times 2 - 1 \times 4 - 1 \times 4 + 8$

$= 2 - 4 - 4 + 8 = 10 - 8 = 2$

∴ L.H.S. = R.H.S.

(iii) $(x - 2y + z) \times (x - 3z)$

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

$= x^2 - 3zx - 2xy + 6yz + zx - 3z^2$

$= x^2 - 2zx - 2xy + 6yz - 3z^2$

Verification :

When $x = -2, y = -1, z = 1$

L.H.S. $= (x - 2y + z) \times (x - 3z)$

$= [-2 - 2 \times (-1) + 1] \times [-2 - 3 \times 1]$

$= (-2 + 2 + 1) \times (-2 - 3) = 1 \times (-5) = -5$

R.H.S. $= x^2 - 2zx - 2xy + 6yz - 3z^2$

$= (-2)^2 - 2(1)(-2) - 2(-2)(-1) + 6(-1)(1)$
$- 3(1)^2$

$= 4 + 4 - 4 - 6 - 3$

$= 8 - 13 = -5$

∴ L.H.S. = R.H.S.

**Question 7.**
Simplify :
(i) $5(x + 3y) - 2(3x - 4y)$
(ii) $3x - 8(5x - 10)$
(iii) $6\{3x - 8(5x - 10)\}$
(iv) $3x - 6\{3x - 8(5x - 10)\}$
(v) $2(3x - 4x - 8) - (3 - 5x - 2x)$

(vi) $8x - (3x - \overline{2x} - 3)$

(vii) $12x^2 - (7x - \overline{3x^2 + 15})$

**Solution:**

(i) $5(x + 3y) - 2(3x - 4y)$

$= 5x + 15y - 6x + 8y$

$= 5x - 6x + 15y + 8y = -x + 23y$

(ii) $3x - 8(5x - 10)$

$= 3x - 40x + 80$

$= -37x + 80$

(iii) $6\{3x - 8(5x - 10)\}$

$= 6\{3x - 40x + 80\}$

$= 18x - 240x + 480$

$= -222x + 480$

(iv) $3x - 6\{3x - 8(5x - 10)\}$

$= 3x - 6\{3x - 40x + 80\}$

$= 3x - 18x + 240x - 480$

$= 243x - 18x - 480 = 225x - 480$

(v) $2(3x^2 - 4x - 8) - (3 - 5x - 2x^2)$

$= (6x^2 - 8x - 16) - (3 - 5x - 2x^2)$

$= 6x^2 - 8x - 16 - 3 + 5x + 2x^2$

$= 6x^2 + 2x^2 - 8x + 5x - 16 - 3$

$= 8x^2 - 3x - 19$

(vi) $8x - (3x - \overline{2x - 3})$

$= 8x - (3x - 2x + 3) = 8x - 3x + 2x - 3$

$= 10x - 3x - 3 = 7x - 3$

(vii) $12x^2 - (7x - \overline{3x^2 + 15})$

$= 12x^2 - (7x - 3x^2 - 15)$

$= 12x^2 - 7x + 3x^2 + 15$

$= 12x^2 + 3x^2 - 7x + 15 = 15x^2 - 7x + 15$


**Question 8.**

If x = -3, find the value of : $2x^3 + 8x^2 - 15$.

**Solution:**

$x = -3$

$\therefore \ 2x^3 + 8x^2 - 15$

$= 2(-3)^3 + 8(-3)^2 - 15$

$= 2(-27) + 8(9) - 15$

$= -54 + 72 - 15 = -54 - 15 + 72$

$= -69 + 72 = 3$