

Framing Algebraic Expressions

EXERCISE 21

Question 1.

Write in the form of an algebraic expression :

- (i) Perimeter (P) of a rectangle is two times the sum of its length (l) and its breadth (b).
- (ii) Perimeter (P) of a square is four times its side.
- (iii) Area of a square is square of its side.
- (iv) Surface area of a cube is six times the square of its edge.

Solution:

(i) Let P be the perimeter and l be the length, and b be the breadth.

$$P = 2(l + b)$$

(ii) Let P be the perimeter and a be the side of the square.

$$P = 4a$$

(iii) Let A be the area of the square and a be the sides of the square.

$$A = (a)^2$$

(iv) Let S be the surface area and a be the edges of the cube.

$$S = 6a^2$$

Question 2.

Express each of the following as an algebraic expression :

- (i) The sum of x and y minus m.
- (ii) The product of x and y divided by m.
- (iii) The subtraction of 5m from 3n and then adding 9p to it.
- (iv) The product of 12, x, y and z minus the product of 5, m and n.
- (v) Sum of p and $2r - s$ minus sum of a and $3n + 4x$.

Solution:

(i) $x + y - m$

(ii) $\frac{xy}{m}$

(iii) $3n - 5m + 9p$

(iv) $12xyz - 5mn$

(v) $p + 2r - s - (a + 3n + 4x)$

Question 3.

Construct a formula for the following :

Total wages (₹ W) of a man whose basic wage is (₹ B) for t hours week plus (₹ R) per hour, if he Works a total of T hours.

Solution:

Wages for t hours = ₹ B

Wages for overtime = $R(T - t)$

=> Total wages = Wages for t hours + wages for overtime of $(T - t)$ hours

$$\Rightarrow ₹ W = ₹ B + ₹ R (T - t)$$

Question 4.

If $x = 4$, evaluate :

(i) $3x + 8$

(ii) $x^2 - 2x$

(iii) $\frac{x^2}{2}$

Solution:

(i) $3x + 8$

$$= (3 \times 4) + 8$$

$$= 12 + 8 = 20$$

(ii) $x^2 - 2x$

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

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

$$= 16 - 8 = 8$$

(iii) $\frac{x^2}{2}$

$$= \frac{(4)^2}{2} = \frac{4 \times 4}{2} = \frac{16}{2} = 8$$

Question 5.

If $m = 6$, evaluate :

(i) $5m - 6$

(ii) $2m^2 + 3m$

(iii) $(2m)^2$

Solution:

(i) $5m - 6$

$$= (5 \times 6) - 6$$

$$= 36 - 6 = 30$$

(ii) $2m^2 + 3m$

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

$$= 2 \times 6 \times 6 + 3 \times 6$$

$$= 72 + 18 = 90$$

(iii) $(2m)^2$

$$= (2 \times m) \times (2 \times m)$$

$$= (2 \times 6) \times (2 \times 6)$$

$$= 12 \times 12 = 144$$

Question 6.

If $x = 4$, evaluate :

(i) $12x + 7$

(ii) $5x^2 + 4x$

(iii) $\frac{x^2}{8}$

Solution:

$$(i) 12x + 7$$

$$= (12 \times 4) + 7$$

$$= 48 + 7 = 55$$

$$(ii) 5x^2 + 4x$$

$$= (5 \times 4 \times 4) + 4(4)$$

$$= 80 + 16 = 96$$

$$(iii) \frac{x^2}{8}$$

$$= \frac{(4)^2}{8} = \frac{4 \times 4}{8} = \frac{16}{8} = 2$$

Question 7.

If $m = 2$, evaluate :

$$(i) 16m - 7$$

$$(ii) 15m^2 - 10m$$

$$(iii) \frac{1}{4} \times m^3$$

Solution:

$$16m - 7$$

$$= (16 \times 2) - 7$$

$$= 32 - 7 = 25$$

$$(ii) 15m^2 - 10m$$

$$= 15(2)^2 - 10(2)$$

$$= (15 \times 2 \times 2) - (10 \times 2)$$

$$= 60 - 20 = 40$$

$$(iii) \frac{1}{4} \times m^3$$

$$= \frac{1}{4} \times (2)^3$$

$$= \frac{1}{4} \times 2 \times 2 \times 2$$

$$= \frac{1}{4} \times 8 = 2$$

Question 8.

If $x = 10$, evaluate :

(i) $100x + 225$

(ii) $6x^2 - 25x$

(iii) $\frac{1}{50} \times x^3$

Solution:

(i) $100x + 225$

$$= (100 \times 10) + 225$$

$$= 1000 + 225 = 1225$$

(ii) $6x^2 - 25x$

$$= 6(10)^2 - 25(10)$$

$$= (6 \times 10 \times 10) - (25 \times 10)$$

$$= 600 - 250 = 350$$

(iii) $\frac{1}{50} \times x^3$

$$= \frac{1}{50} \times 10 \times 10 \times 10$$

$$= \frac{1}{50} \times 1000 = 20$$

Question 9.

If $a = -10$, evaluate :

(i) $5a$

(ii) a^2

(iii) a^3

Solution:

(i) $5a$

$$= 5 \times (-10) = -50$$

(ii) a^2

$$= (-10)^2$$

$$= -10 \times (-10)$$

$$= 100$$

(iii) $a^3 = a \times a \times a$

$$= (-10)^3$$

$$= (-10) \times (-10) \times (-10)$$

$$= -1000$$

Question 10.

If $x = -6$, evaluate :

(i) $11x$

(ii) $4x^2$

(iii) $2x^3$

Solution:

(i) $11x$

$$= 11 \times (-6) = -66$$

(ii) $4x^2$

$$= 4 \times (-6) \times (-6)$$

$$= 4 \times 36 = 144$$

(iii) $2x^3$

$$= 2 \times (-6)^3$$

$$= 2 \times (-6) \times (-6) \times (-6)$$

$$= 2 \times (-216) = -432$$

Question 11.

If $m = -7$, evaluate :

(i) $12m$

(ii) $2m^2$

(iii) $2m^3$

Solution:

(i) $12m$

$$= 12 \times (-7)$$

$$= -84$$

(ii) $2m^2$

$$= 2 \times m \times m$$

$$= 2 \times (-7) \times (-7)$$

$$= 2 \times 49 = 98$$

(iii) $2m^3$

$$= 2 \times m \times m \times m$$

$$= 2 \times (-7) \times (-7) \times (-7)$$

$$= 2 \times (-343)$$

$$= -686$$

Question 12.

Find the average (A) of four quantities p, q, r and s. If $A = 6$, $p = 3$, $q = 5$ and $r = 7$; find the value of s.

Solution:

Given, average of four quantities (A) = 6

and $p = 3, q = 5, r = 7$ and $s = ?$

$$\therefore A = \frac{p+q+r+s}{4}$$

$$\Rightarrow 6 = \frac{3+5+7+s}{4}$$

$$\Rightarrow 6 \times 4 = 15 + s$$

$$\Rightarrow s = 24 - 15 \quad \Rightarrow s = 9$$

Question 13.

If $a = 5$ and $b = 6$, evaluate :

(i) $3ab$

(ii) $6a^2b$

(iii) $2b^2$

Solution:

(i) $3ab$

$$= 3 \times a \times b$$

$$= 3 \times 5 \times 6 = 90$$

(ii) $6a^2b$

$$= 6 \times a \times a \times b$$

$$= 6 \times 5 \times 5 \times 6$$

$$= 900$$

(iii) $2b^2$

$$= 2 \times b \times b$$

$$= 2 \times 6 \times 6$$

$$= 72$$

Question 14.

If $x = 8$ and $y = 2$, evaluate :

(i) $9xy$

(ii) $5x^2y$

(iii) $(4y)^2$

Solution:

(i) $9xy$

$$= 9 \times x \times y$$

$$= 9 \times 8 \times 2$$

$$= 144$$

(ii) $5x^2y$

$$= 5 \times x \times x \times y$$

$$= 5 \times 8 \times 8 \times 2$$

$$= 640$$

(iii) $(4y)^2$

$$= 4 \times y \times 4 \times y$$

$$= 4 \times 2 \times 4 \times 2$$

$$= 8 \times 8 = 64$$

Question 15.

If $x = 5$ and $y = 4$, evaluate :

(i) $8xy$

(ii) $3x^2y$

(iii) $3y^2$

Solution:

(i) $8xy$

$$= 8 \times x \times y$$

$$= 8 \times 5 \times 4$$

$$= 160$$

(ii) $3x^2y$

$$= 3 \times x \times x \times y$$

$$= 3 \times 5 \times 5 \times 4$$

$$= 300$$

(iii) $3y^2$

$$= 3 \times y \times y$$

$$= 3 \times 4 \times 4$$

$$= 48$$

Question 16.

If $y = 5$ and $z = 2$, evaluate :

(i) $100yz$

(ii) $9y^2z$

(iii) $5y^2$

(iv) $(5z)^3$

Solution:

(i) $100yz$

$$= 100 \times y \times z$$

$$= 100 \times 5 \times 2$$

$$= 1000$$

(ii) $9y^2z$

$$= 9 \times y \times y \times z$$

$$= 9 \times 5 \times 5 \times 2$$

$$= 450$$

(iii) $5y^2$

$$= 5 \times y \times y$$

$$= 5 \times 5 \times 5$$

$$= 125$$

(iv) $(5z)^3$

$$= (5 \times z) \times (5 \times z) \times (5 \times z)$$

$$= 5 \times 2 \times 5 \times 2 \times 5 \times 2$$

$$= 10 \times 10 \times 10 = 1000$$

Question 17.

If $x = 2$ and $y = 10$, evaluate :

(i) $30xy$

(ii) $50xy^2$

(iii) $(10x)^2$

(iv) $5y^2$

Solution:

(i) $30xy$

$$= 30 \times x \times y$$

$$= 30 \times 2 \times 10 = 600$$

(ii) $50xy^2$

$$= 50 \times x \times y \times y$$

$$= 50 \times 2 \times 10 \times 10$$

$$= 10000$$

(iii) $(10x)^2$

$$= (10 \times x) \times (10 \times x)$$

$$= 10 \times 2 \times 10 \times 2$$

$$= 400$$

(iv) $5y^2$

$$= 5 \times y \times y$$

$$= 5 \times 10 \times 10$$

$$= 500$$

Question 18.

If $m = 3$ and $n = 7$, evaluate :

(i) $12mn$

(ii) $5mn^2$

(iii) $(10m)^2$

(iv) $4n^2$

Solution:

(i) $12mn$

$$= 12 \times m \times n$$

$$= 12 \times 3 \times 7$$

$$= 252$$

(ii) $5mn^2$

$$= 5 \times m \times n \times n$$

$$= 5 \times 3 \times 7 \times 7$$

$$= 735$$

(iii) $(10m)^2$

$$= (10 \times m) \times (10 \times m)$$

$$= (10 \times 3) \times (10 \times 3)$$

$$= 30 \times 30 = 900$$

(iv) $4n^2$

$$= 4 \times n \times n$$

$$= 4 \times 7 \times 7$$

$$= 196$$

Question 19.

If $a = -10$, evaluate :

(i) $3a - 2$

(ii) $a^2 + 8a$

(iii) $\frac{1}{5} \times a^2$

Solution:

$$(i) 3a - 2$$

$$= (3 \times a) - 2$$

$$= 3 \times (-10) - 2$$

$$= -30 - 2 = -32$$

$$(ii) a^2 + 8a$$

$$= (a \times a) + (8 \times a)$$

$$= (-10 \times (-10)) + (8 \times (-10))$$

$$= 100 + (-80)$$

$$= 100 - 80 = 20$$

$$(iii) \frac{1}{5} \times a^2$$

$$= \frac{1}{5} \times (a \times a)$$

$$= \frac{1}{5} \times (-10) \times (-10)$$

$$= \frac{1}{5} \times 100 = 20$$

Question 20.

If $x = -6$, evaluate :

$$(i) 4x - 9$$

$$(ii) 3x^2 + 8x$$

$$(iii) \frac{x^2}{2}$$

Solution:

$$\begin{aligned}
 & \text{(i) } 4x - 9 \\
 &= (4 \times x) - 9 \\
 &= (4 \times (-6)) - 9 \\
 &= -24 - 9 = -33
 \end{aligned}$$

$$\begin{aligned}
 & \text{(ii) } 3x^2 + 8x \\
 &= (3 \times x \times x) + (8 \times x) \\
 &= (3 \times (-6) \times (-6)) + (8 \times (-6)) \\
 &= -108 + (-48) \\
 &= 60
 \end{aligned}$$

$$\begin{aligned}
 & \text{(iii) } \frac{x^2}{2} \\
 &= \frac{x \times x}{2} \\
 &= \frac{(-6) \times (-6)}{2} \\
 &= \frac{36}{2} = 18
 \end{aligned}$$

Question 21.

If $m = -8$, evaluate :

(i) $2m + 21$

(ii) $m^2 + 9m$

(iii) $\frac{m^2}{4}$

Solution:

(i) $2m + 21$

$$= 2 \times m + 21$$

$$= 2 \times (-8) + 21$$

$$= -16 + 21 = 5$$

(ii) $m^2 + 9m$

$$= (m \times m) + (9 \times m)$$

$$= (-8 \times -8) + (9 \times (-8))$$

$$= 64 + (-72)$$

$$= 64 - 72 = -8$$

(iii) $\frac{m^2}{4} = \frac{m \times m}{4}$

$$= \frac{(-8)^2}{4} = \frac{(-8) \times (-8)}{4}$$

$$= \frac{64}{4} = 16$$

Question 22.

If $p = -10$, evaluate :

(i) $6p + 50$

(ii) $3p^2 - 20p$

(iii) $\frac{p^2}{50}$

Solution:

(i) $6p + 50$

$$= (6 \times p) + 50$$

$$= (6 \times (-10)) + 50$$

$$= -60 + 50 = -10$$

(ii) $3p^2 - 20p$

$$= (3 \times p \times p) - (20 \times p)$$

$$= (3 \times (-10) \times (-10)) - (20 \times (-10))$$

$$= 300 - (-200)$$

$$= 300 + 200 = 500$$

(iii) $\frac{p^2}{50}$

$$= \frac{p \times p}{50}$$

$$= \frac{(-10) \times (-10)}{50}$$

$$= \frac{100}{50} = 2$$

Question 23.

If $y = -8$, evaluate :

(i) $6y + 53$

(ii) $y^2 + 12y$

(iii) $\frac{y^3}{4}$

Solution:

(i) $6y + 53$

$$= (6 \times y) + 53$$

$$= (6 \times (-8)) + 53$$

$$= -48 + 53$$

$$= 5$$

(ii) $y^2 + 12y$

$$= (y \times y) + (12 \times y)$$

$$= ((-8) \times (-8)) + (12 \times (-8))$$

$$= 64 + (-96)$$

$$= -32$$

(iii) $\frac{y^3}{4} = \frac{y \times y \times y}{4}$

$$= \frac{(-8) \times (-8) \times (-8)}{4}$$

$$= \frac{-256}{4} = -64$$

Question 24.

If $x = 2$ and $y = -4$, evaluate :

(i) $11xy$

(ii) $5x^2y$

(iii) $(5y)^2$

(iv) $8x$

Solution:

$$\begin{aligned}\text{(i) } 11xy &= 11 \times x \times y \\ &= 11 \times 2 \times (-4) \\ &= -88\end{aligned}$$

$$\begin{aligned}\text{(ii) } 5x^2y &= 5 \times x \times x \times y \\ &= 5 \times 2 \times 2 \times (-4) \\ &= -80\end{aligned}$$

$$\begin{aligned}\text{(iii) } (5y)^2 &= 5 \times y \times 5 \times y \\ &= 5 \times (-4) \times 5 \times (-4) \\ &= (-20) \times (-20) \\ &= 400\end{aligned}$$

$$\begin{aligned}\text{(iv) } 8x^2 &= 8 \times x \times x \\ &= 8 \times 2 \times 2 \\ &= 32\end{aligned}$$

Question 25.

If $m = 9$ and $n = -2$, evaluate

(i) $4mn$

(ii) $2m^2n$

(iii) $(2n)^3$

Solution:

$$\begin{aligned}\text{(i) } 4mn &= 4 \times m \times n \\ &= 4 \times 9 \times (-2) \\ &= -72\end{aligned}$$

$$\begin{aligned}\text{(ii) } 2m^2n &= 2 \times m \times m \times n \\ &= 2 \times 9 \times 9 \times (-2) \\ &= 2 \times 81 \times (-2) \\ &= -324\end{aligned}$$

$$\begin{aligned}\text{(iii) } (2n)^3 &= (2 \times n) \times (2 \times n) \times (2 \times n) \\ &= (2 \times (-2)) \times (2 \times (-2)) \times (2 \times (-2)) \\ &= (-4) \times (-4) \times (-4) \\ &= -64\end{aligned}$$

Question 26.

If $m = -8$ and $n = -2$, evaluate :

(i) $12mn$

(ii) $3m^2n$

(iii) $(4n)^2$

Solution:

(i) $12mn$

$$= 12 \times m \times n$$

$$= 12 \times (-8) \times (-2)$$

$$= 192$$

(ii) $3m^2n$

$$= 3 \times m \times m \times n$$

$$= 3 \times 64 \times (-2) = -384$$

(iii) $(4n)^2$

$$= 4 \times n \times 4 \times n$$

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

$$= (-8) \times (-8) = 64$$

Question 27.

If $x = -5$ and $y = -8$, evaluate :

(i) $4xy$

(ii) $2xy^2$

(iii) $4x^2$

(iv) $3y^2$

Solution:

(i) $4xy$

$$= 4 \times x \times y$$

$$= 4 \times (-5) \times (-8) = 160$$

(ii) $2xy^2$

$$= 2 \times x \times y \times y$$

$$= 2 \times (-5) \times (-8) \times (-8)$$

$$= -10 \times 64$$

$$= -640$$

(iii) $4x^2$

$$= 4 \times x \times x$$

$$= 4 \times (-5) \times (-5)$$

$$= 100$$

(iv) $3y^2$

$$= 3 \times y \times y = 3 \times (-8) \times (-8)$$

$$= 192$$

Question 28.

Find T, if $T = 2a - b$, $a = 7$ and $b = 3$.

Solution:

$$T = 2a - b, a = 7 \text{ and } b = 3$$

Put the value of $a = 7$, and $b = 3$ in above equation

$$T = (2 \times 7) - 3$$

$$T = 14 - 3 = 11$$

$$T = 11$$

Question 29.

From the formula $B = 2a^2 - b^2$, calculate the value of B when $a = 3$ and $b = -1$.

Solution:

$$B = 2a^2 - b^2$$

Put the values of $a = 3$ and $b = -1$ in above equation

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

$$B = 18 - 1$$

$$B = 17$$

Value of B is = 17

Question 30.

The wages ₹ W of a man earning ₹ x per hour for t hours are given by the formula $W = xt$. Find his wages for working 40 hours at a rate of ₹ 39.45 per hour.

Solution:

$$t = 40 \text{ hours}$$

$$x = ₹ 39.45$$

$$W = xt = 40 \times 39.45$$

$$W = ₹ 1578$$

Question 31.

The temperature in Fahrenheit scale is represented by F and the temperature in Celsius scale is represented by C. If $F = \frac{9}{5} \times C + 32$, find F when $C = 40$.

Solution:

$$F = \frac{9}{5} \times C + 32$$

$$\text{Given, } C = 40$$

$$F = \frac{9}{5} \times 40 + 32 = 9 \times 8 + 32$$

$$F = 104^\circ$$