Chapter 12: Algebraic Expressions

Exercise 12.1 (Page 234)

Q1. Get the algebraic expressions in the following cases using variables, constants and arithmetic operations.

Reasoning:
Let us first understand the meaning or definition of terms variable, constants and arithmetic operations.

Variables are the letters used in an algebraic expression that can take any value.
For e.g. *a, b, c* or *z* etc. and it can take any value which can be either 2 or 5 or any other number. Constants always have fixed values in the algebraic expressions. They cannot be assumed or changed. Arithmetic Operations are Addition, subtraction, multiplication and division.

Solution:

(i)   Subtraction of *z* from *y*.
$$y - z$$

(ii)   One-half of the sum of numbers *x* and *y*.
$$\frac{1}{2}(x + y)$$

(iii)   The number *z* multiplied by itself.
$$z \times z = z^2$$

(iv)   One-fourth of the product of numbers *p* and *q*.
$$\frac{1}{4}pq$$

(v)   Numbers *x* and *y* both squared and added.
$$(x \times x) + (y \times y) = x^2 + y^2$$

(vi)   Number 5 added to three times the product of numbers *m* and *n*.
$$5 + 3(m \times n) = 5 + 3mn$$

(vii)   Product of numbers *y* and *z* subtracted from 10.
$$10 - (y \times z) = 10 - yz$$

(viii) Sum of numbers *a* and *b* subtracted from their product.
$$(a \times b) - (a + b) = ab - (a + b)$$

Q2. (i) Identify the terms and their factors in the following expressions. Show the terms and factors by tree diagrams.
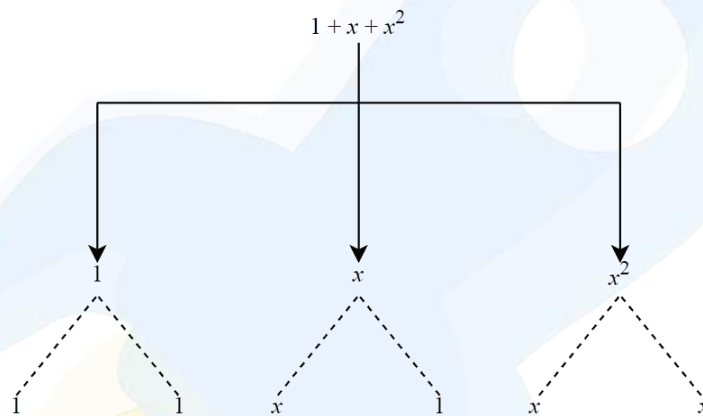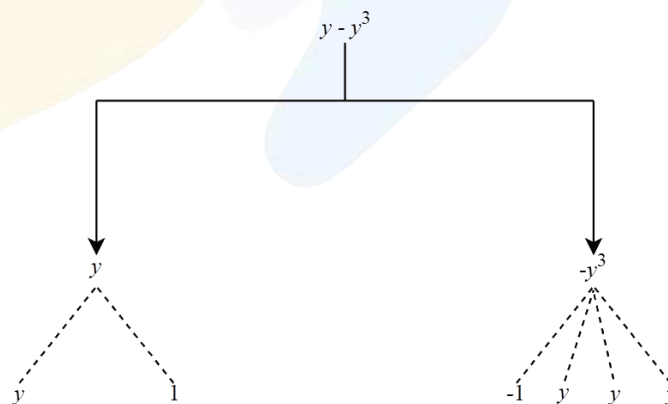
(a) $x - 3$
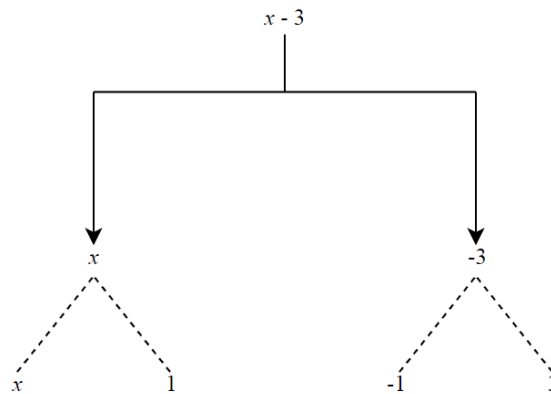
Answer:

Term $= x$ and Factor $= 1$

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

Answer:

Term $= x$ and Factor $= 1$; Term $= x^2$ and Factor $= 1$

(c) $y - y^3$

Answer:

Term $= y$ and Factor $= 1$; Term $= y^3$ and Factor $= -1$

(d) $5xy^2 + 7x^2y$

$$5xy^2 + 5x^2y$$
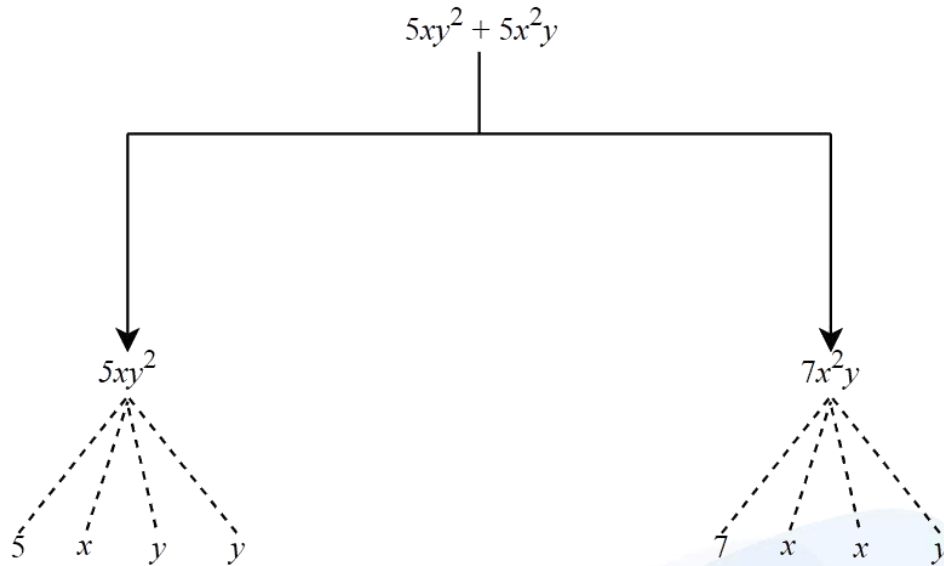
Answer:
    Term $= xy^2$ and Factor $= 5$; Term $= x^2y$ and Factor $= 7$

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

$$-ab + 2b^2 - 3a^2$$
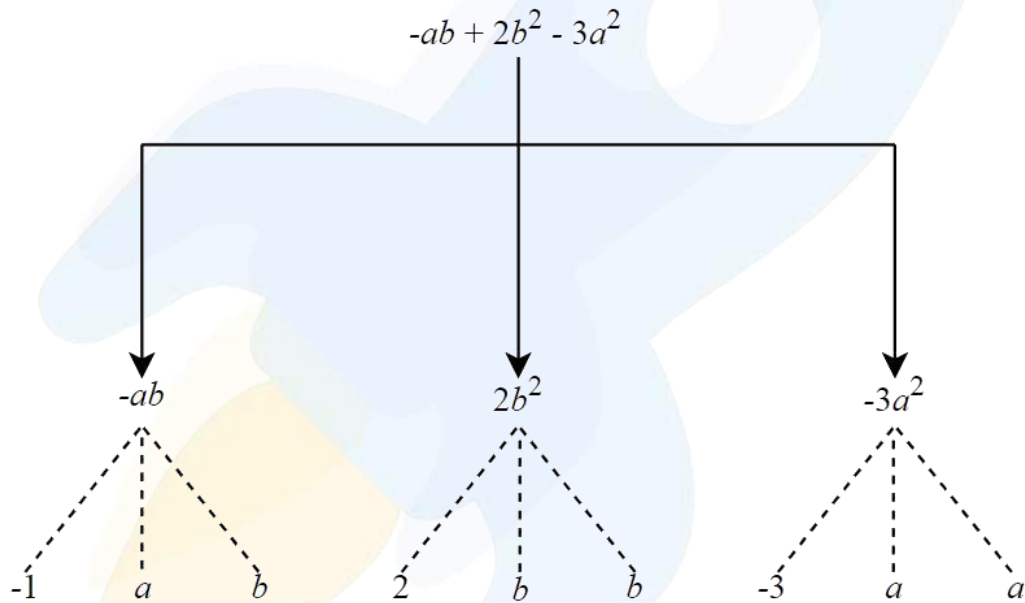
Answer:
    Term $= ab$ and Factor $= -1$; Term $= b^2$ and Factor $= 2$; Term a^2 and Factor $= -3$

(ii) Identify terms and factors in the expressions given below:

(a) $-4x + 5$ (b) $-4x + 5y$ (c) $5y + 3y^2$

(d) $xy + 2x^2y^2$ (e) $pq + q$ (f) $1.2ab - 2.4b + 3.6a$

(g) $\dfrac{3}{4}x + \dfrac{1}{4}$ (h) $0.1p^2 + 0.2q^2$

S.No.	Expression	Term	Factors
a)	$-4x + 5$	$-4x$ and 5	-4, x and 5
b)	$-4x + 5y$	$-4x$ and $5y$	-4, x and 5, y
c)	$5y + 3y^2$	$5y$ and $3y^2$	5, y and 3, y, y
d)	$xy + 2x^2y^2$	xy and $2x^2y^2$	x, y and 2, x, x, y, y
e)	$pq + q$	pq and q	p, q and q
f)	$1.2ab - 2.4b + 3.6a$	$1.2ab$, $-2.4b$ and $3.6a$	1.2, a, b, -2.4, b and 3.6, a
g)	$\frac{3}{4}x + \frac{1}{4}$	$\frac{3}{4}x$ and $\frac{1}{4}$	$\frac{3}{4}$, x and $\frac{1}{4}$
h)	$0.1\,p^2 + 0.2\,q^2$	$0.1p^2$ and $0.2q^2$	0.1, p, p and 0.2, q, q

Q3. Identify the numerical coefficients of terms (other than constants) in the following expressions:

(i) $5 - 3t^2$

(ii) $1 + t + t^2 + t^3$

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

(iv) $100m + 1000n$

(v) $-p^2q^2 + 7pq$

(vi) $1.2a + 0.8b$

(vii) $3.14r^2$

(viii) $2(l + b)$

(ix) $0.1y + 0.01y^2$

S.No.	Expression	Term	Numerical Coefficient
(i)	$5 - 3t^2$	$-3t^2$	-3
(ii)	$1 + t + t^2 + t^3$	t, t^2 and t^3	1, 1 and 1
(iii)	$x + 2xy + 3y$	x, $2xy$ and $3y$	1, 2 and 3
(iv)	$100\,m + 1000\,n$	$100\,m$ and $1000\,n$	100 and 1000
(v)	$-p^2q^2 + 7pq$	$-p^2q^2$ and $7pq$	-1 and 7
(vi)	$1.2\,a + 0.8\,b$	$1.2a$ and $0.8b$	1.2 and 0.8
(vii)	$3.14r^2$	$3.14r^2$	3.14
(viii)	$2(l + b)$	$2l$ and $2b$	2 and 2
(ix)	$0.1y + 0.01y^2$	$0.1y$ and $0.01\,y^2$	and 0.01

Q4. (a) Identify terms which contain x and give the coefficient of x.

(i) $y^2x + y$ (ii) $13y^2 - 8yx$ (iii) $x + y + 2$

(iv) $5 + z + zx$ (v) $1 + x + xy$ (vi) $12xy^2 + 25$

(vii) $7x + xy^2$

S.No.	Expression	Term containing x	Coefficient of x
(i)	$y^2x + y$	y^2x	y^2
(ii)	$13y^2 - 8yx$	$-8yx$	$-8y$
(iii)	$x + y + 2$	x	1
(iv)	$5 + z + zx$	zx	z
(v)	$1 + x + xy$	x and xy	1 and y
(vi)	$12xy^2 + 25$	$12xy^2$	$12y^2$
(vii)	$7x + xy^2$	$7x$ and xy^2	7 and y^2

(b) Identify terms which contain y^2 and give the coefficient of y^2.

(i) $8 - xy^2$ (ii) $5y^2 + 7x$ (iii) $2x^2y - 15xy^2 + 7y^2$

S.No.	Expression	Term containing y^2	Coefficient of y^2
(i)	$8 - xy^2$	$-xy^2$	$-x$
(ii)	$5y^2 + 7x$	$5y^2$	5
(iii)	$2x^2y - 15xy^2 + 7y^2$	$-15xy^2$ and $7y^2$	$-15x$ and 7

Q5. Classify into monomials, binomials and trinomials.

(i) $4y - 7z$ (ii) y^2 (iii) $x + y - xy$ (iv) 100

(v) $ab - a - b$ (vi) $5 - 3t$ (vii) $4p^2q - 4pq^2$ (viii) $7mn$

(ix) $z^2 - 3z + 8$ (x) $a^2 + b^2$ (xi) $z^2 + z$ (xii) $1 + x + x^2$

Solution:

Monomial means expression having single term.
Binomials means expression having two terms.
Trinomials means expression having three terms.

S No.	Expression	No. of terms	Classification
(i)	$4y - 7z$	2	Binomial
(ii)	y^2	1	Monomial
(iii)	$x + y - xy$	3	Trinomial
(iv)	100	1	Monomial
(v)	$ab - a - b$	3	Trinomial
(vi)	$5 - 3t$	2	Binomial
(vii)	$4p^2q - 4pq^2$	2	Binomial
(viii)	$7mn$	1	Monomial
(ix)	$z^2 - 3z + 8$	3	Trinomial
(x)	$a^2 + b^2$	2	Binomial
(xi)	$z^2 + z$	2	Binomial
(xii)	$1 + x + x^2$	3	Trinomial

Q6. State whether a given pair of terms is of like or unlike terms.

(i) 1, 100   (ii) $-7x, \frac{5}{2}x$ (iii) $-29x, -29y$

(iv) $14xy, 42yx$ (v) $4m^2p, 4mp^2$ (vi) $12xz, 12x^2z^2$

S.No.	Expression	Terms	Factors	Like/ Unlike	Reason
(i)	1, 100	1 and 100	1 and 100	Like	Bothe the terms has no variables
(ii)	$-7x, \frac{5}{2}x$	$-7x$ and $\frac{5}{2}x$	$-7, x$ and $\frac{5}{2}, x$	Like	Both terms have same variable x
(iii)	$-29x, -29y$	$-29x$ and $-29y$	$-29, x,$ and $-29, y$	Unlike	Both terms have different variables x & y
(iv)	$14xy, 42yx$	$14xy$ and $42yx$	$14, x,y,$ and $42, y,x$	Like	Both terms have same variable xy & xy
(v)	$4m^2p, 4mp^2$	$4m^2p$ and $4mp^2$	$4, m^2, p$ and $4, m, p^2$	Unlike	Both terms have same variable but with different powers
(vi)	$12xz, 12x^2z^2$	$12xz$ and $12x^2z^2$	$12, x ,z$ and $12, x^2 ,z^2$	Unlike	Both terms have same variable but with different powers

Q7. Identify like terms in the following:

(a) $-xy^2$, $-4yx^2$, $8x^2$, $2xy^2$, $7y$, $-11x^2$, $-100x$, $-11yx$, $20x^2y$, $-6x^2$, y, $2xy$, $3x$

(b) $10pq$, $7p$, $8q$, $-p^2q^2$, $-7qp$, $-100q$, -23, $12q^2p^2$, $-5p^2$, 41, $2405p$, $78qp$, $13p^2q$, qp^2, $701p^2$

Difficulty Level: Easy

How can you use the known information to arrive at the solution?

This question is based on the concept of like terms. If there are same variable in all the terms in the expression, then the expression has like terms. We have to ignore constants here.

Solution:

S.No.	Terms	Like terms
(i)	$-xy^2$, $-4yx^2$, $8x^2$, $2xy^2$, $7y$, $-11x^2$, $-100x$, $-11yx$, $20x^2y$, $-6x^2$, y, $2xy$, $3x$	$-xy^2$, $2xy^2$; $-4yx^2$, $20x^2y$; $8x^2$, $-11x^2$, $-6x^2$; $7y$, y; $-100x$, $3x$; $-11yx$, $2xy$
(ii)	$10pq$, $7p$, $8q$, $-p^2q^2$, $-7qp$, $-100q$, -23, $12q^2p^2$, $-5p^2$, 41, $2405p$, $78qp$, $13p^2q$, qp^2, $701p^2$	$10pq$, $-7qp$, $78qp$; $8q$, $-100q$; $-5p^2$, $701p^2$; $7p$, $2405p$; $-p^2q^2$, $12q^2p^2$; -23, 41; $13p^2q$, qp^2

Chapter 12: Algebraic Expressions

Exercise 12.2 (Page 239)

Q1. Simplify combining like terms:

    (i) $21b - 32 + 7b - 20b$

    (ii) $-z^2 + 13z^2 - 5z + 7z^3 - 15z$

    (iii) $p - (p - q) - q - (q - p)$

    (iv) $3a - 2b - ab - (a - b + ab) + 3ab + b - a$

    (v) $5x^2y - 5x^2 + 3yx^2 - 3y^2 + x^2 - y^2 + 8xy^2 - 3y^2$

    (vi) $(3y^2 + 5y - 4) - (8y - y^2 - 4)$

Difficulty Level: Medium

What is known/given
Like Terms

What is unknown
How to simplify Like Terms

Reasoning
This is based on concept identifying like terms and then performing the arithmetic operation of like terms to simplify them.

Solution:

    (i) $21b - 32 + 7b - 20b$

           $= 21b + 7b - 20b - 32$

           $= 8b - 32$

    (ii) $-z^2 + 13z^2 - 5z + 7z^3 - 15z$

           $= 7z^3 + 12z^2 - 20z$

    (iii) $p - (p - q) - q - (q - p)$

           $= p - p + q - q - q + p$

           $= p - q$

    (iv) $3a - 2b - ab - (a - b + ab) + 3ab + b - a$

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

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

           $= a + ab$

(v) $5x^2y - 5x^2 + 3yx^2 - 3y^2 + x^2 - y^2 + 8xy^2 - 3y^2$

         $= 5x^2y + 3yx^2 - 3y^2 - y^2 + x^2 - 5x^2 + 8xy^2 - 3y^2$

         $= 8x^2y - 7y^2 - 4x^2 + 8xy^2$

(vi) $(3y^2 + 5y - 4) - (8y - y^2 - 4)$

         $= 3y^2 + 5y - 4 - 8y + y^2 + 4$

         $= 3y^2 + y^2 + 5y - 8y + 4 - 4$

         $= 4y^2 - 3y$

Q2. Add:

     (i) $3mn, -5mn, 8mn, -4mn$

    (ii) $t - 8tz, 3tz - z, z - t$

   (iii) $-7mn + 5, 12mn + 2, 9mn - 8, -2mn - 3$

   (iv) $a + b - 3, b - a + 3, a - b + 3$

    (v) $14x + 10y - 12xy - 13, 18 - 7x - 10y + 8xy, 4xy$

   (vi) $5m - 7n, 3n - 4m + 2, 2m - 3mn - 5$

  (vii) $4x^2y, -3xy^2, -5xy^2, 5x^2y$

(viii) $3p^2q^2 - 4pq + 5, -10p^2q^2, 15 + 9pq + 7p^2q^2$

   (ix) $ab - 4a, 4b - ab, 4a - 4b$

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

Difficulty Level: Medium

What is known/given
Like Terms

What is unknown
How to add or subtract Like Terms

Reasoning
This is based on concept identifying like terms and then performing the addition operation of like terms.

Solution:

     (i) $3mn, -5mn, 8mn, -4mn$

         $= 3mn + (-5mn) + 8mn + (-4mn)$

         $= 11mn - 9mn$

         $= 2mn$

    (ii) $t - 8tz, 3tz - z, z - t$

         $= t - 8tz + 3tz - z + z - t$

         $= -5tz$

(iii) $-7mn + 5, 12mn + 2, 9mn - 8, -2mn - 3$
$= -7mn + 5 + 12mn + 2 + 9mn - 8 + (-2mn) - 3$
$= -7mn + 5 + 12mn + 2 + 9mn - 8 - 2mn - 3$
$= 12mn - 4$

(iv) $a + b - 3, b - a + 3, a - b + 3$
$= a + b - 3 + b - a + 3 + a - b + 3$
$= a + b + 3$

(v) $14x + 10y - 12xy - 13, 18 - 7x - 10y + 8xy, 4xy$
$= 14x + 10y - 12xy - 13 + 18 - 7x - 10y + 8xy + 4xy$
$= 7x + 5$

(vi) $5m - 7n, 3n - 4m + 2, 2m - 3mn - 5$
$= 5m - 7n + 3n - 4m + 2 + 2m - 3mn - 5$
$= 5m - 4m + 2m - 7n + 3n + 2 - 5 - 3mn$
$= 3m - 4n - 3mn - 3$

(vii) $4x^2y, -3xy^2, -5xy^2, 5x^2y$
$= 4x^2y + (-3xy^2) + (-5xy^2) + 5x^2y$
$= 4x^2y - 3xy^2 - 5xy^2 + 5x^2y$
$= 9x^2y - 8xy^2$

(viii) $3p^2q^2 - 4pq + 5, -10p^2q^2, 15 + 9pq + 7p^2q^2$
$= 3p^2q^2 - 4pq + 5 - 10p^2q^2 + 15 + 9pq + 7p^2q^2$
$= 3p^2q^2 + 7p^2q^2 - 10p^2q^2 - 4pq + 9pq + 5 + 15$
$= 5pq + 20$

(ix) $ab - 4a, 4b - ab, 4a - 4b$
$= ab - 4a + 4b - ab + 4a - 4b$
$= 0$

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

Q3. Subtract:
(i) $-5y^2$ from y^2
(ii) $6xy$ from $-12xy$
(iii) $(a - b)$ from $(a + b)$
(iv) $a (b - 5)$ from $b (5 - a)$
(v) $-m^2 + 5mn$ from $4m^2 - 3mn + 8$
(vi) $-x^2 + 10x - 5$ from $5x - 10$
(vii) $5a^2 - 7ab + 5b^2$ from $3ab - 2a^2 - 2b^2$
(viii) $4pq - 5q^2 - 3p^2$ from $5p^2 + 3q^2 - pq$

Difficulty Level: Medium

What is known
Like Terms

Reasoning
This is based on concept identifying like terms and then performing the subtraction operation of like terms.

Solution:

(i) $-5y^2$ from y^2
$= y^2 - (-5y^2)$
$= y^2 + 5y^2$
$= 6y^2$

(ii) $6xy$ from $-12xy$
$= -12xy - 6xy$
$= -18xy$

(iii) $(a - b)$ from $(a + b)$
$= (a + b) - (a - b)$
$= a + b - a + b$
$= 2b$

(iv) $a(b - 5)$ from $b(5 - a)$
$= b(5 - a) - a(b - 5)$
$= 5b - ab - ab + 5a$
$= 5a + 5b - 2ab$

(v) $-m^2 + 5mn$ from $4m^2 - 3mn + 8$
$= 4m^2 - 3mn + 8 - (-m^2 + 5mn)$
$= 4m^2 - 3mn + 8 + m^2 - 5mn$
$= 5m^2 - 8mn + 8$

(vi) $-x^2 + 10x - 5$ from $5x - 10$
$= 5x - 10 - (-x^2 + 10x - 5)$
$= 5x - 10 + x^2 - 10x + 5$
$= x^2 - 5x - 5$

(vii) $5a^2 - 7ab + 5b^2$ from $3ab - 2a^2 - 2b^2$
$= 3ab - 2a^2 - 2b^2 - (5a^2 - 7ab + 5b^2)$
$= 3ab - 2a^2 - 2b^2 - 5a^2 + 7ab - 5b^2$
$= 10ab - 7a^2 - 7b^2$

(viii) $4pq - 5q^2 - 3p^2$ from $5p^2 + 3q^2 - pq$
$= 5p^2 + 3q^2 - pq - (4pq - 5q^2 - 3p^2)$
$= 5p^2 + 3q^2 - pq - 4pq + 5q^2 + 3p^2$
$= 8p^2 + 8q^2 - 5pq$

Q4. (a) What should be added to $x^2 + xy + y^2$ to obtain $2x^2 + 3xy$?
(b) What should be subtracted from $2a + 8b + 10$ to get $-3a + 7b + 16$?

(a) What should be added to $x^2 + xy + y^2$ to obtain $2x^2 + 3xy$?
Difficulty Level: Easy

What is known
We know that arithmetic operation will be applied.

Reasoning
In this question basic concept of arithmetic operations is applied. We are given two terms and asked what should be added to one term to get the required answer. For this we will subtract the first term from the answer to get what should be added. E.g. what should be added to 3 to get 5. We will subtract 3 from 5.

Solution:
1st term $= x^2 + xy + y^2$
Answer term $= 2x^2 + 3xy$
2nd term $=$ Answer term $- 1^{st}$ term
2nd term $= 2x^2 + 3xy - (x^2 + xy + y^2)$
$\qquad = 2x^2 + 3xy - x^2 - xy - y^2$
$\qquad = x^2 + 2xy - y^2$
So, $x^2 + 2xy - y^2$ should be added to $x^2 + xy + y^2$ to obtain $2x^2 + 3xy$

(b) What should be subtracted from $2a + 8b + 10$ to get $-3a + 7b + 16$?
Difficulty Level: Easy

What is known
We know that arithmetic operation will be applied.

Reasoning
In this question basic concept of arithmetic operations is applied. We are given two terms and asked what should be subtracted from one term to get the required answer. For this we will subtract the given answer from the 1st term to get what should be subtracted. E.g: what should be subtracted from 5 to get 3. We will subtract 3 from 5.

Solution:
1st term $= 2a + 8b + 10$
Answer term $= -3a + 7b + 16$
2nd term $= 1^{st}$ term - Answer
2nd term $= 2a + 8b + 10 - (-3a + 7b + 16)$
$\qquad = 2a + 8b + 10 + 3a - 7b - 16$
$\qquad = 5a + b - 6$
So, $5a + b - 6$ should be subtracted from $2a + 8b + 10$ to obtain $-3a + 7b + 16$

Q5. What should be taken away from $3x^2 - 4y^2 + 5xy + 20$ to obtain $-x^2 - y^2 + 6xy + 20$?

Difficulty Level: Easy

What is known
we know that arithmetic operation will be applied.

Reasoning
In this question basic concept of arithmetic operations is applied. We are given two terms and asked what should be subtracted from one term to get the required answer. For this we will subtract the given answer from the 1st term to get what should be subtracted. E.g: what should be subtracted from 5 to get 3. We will subtract 3 from 5.

Solution:
1st term $= 3x^2 - 4y^2 + 5xy + 20$
Answer term $= -x^2 - y^2 + 6xy + 20$
2nd term $=$ 1st term $-$ Answer
2nd term $= 3x^2 - 4y^2 + 5xy + 20 - (-x^2 - y^2 + 6xy + 20)$
$\qquad = 3x^2 - 4y^2 + 5xy + 20 + x^2 + y^2 - 6xy - 20$
$\qquad = 4x^2 - 3y^2 - xy$

Q6. (a) From the sum of $3x - y + 11$ and $-y - 11$, subtract $3x - y - 11$.
(b) From the sum of $4 + 3x$ and $5 - 4x + 2x^2$, subtract the sum *of* $3x^2 - 5x$ and $-x^2 + 2x + 5$

Difficulty Level: Moderate

What is known
Like Terms

Reasoning
This is based on concept identifying like terms and then performing the arithmetic operation of like terms as given in the question.

Solution:
(a) From the sum of $3x - y + 11$ and $-y - 11$, subtract $3x - y - 11$.

First, we add $3x - y + 11$ and $-y - 11$
$= 3x - y + 11 + (-y - 11)$
$= 3x - y + 11 - y - 11$
$= 3x - 2y$

Now from 3x $-$ 2y subtract $3x - y - 11$
$= 3x - 2y - (3x - y - 11)$
$= 3x - 2y - 3x + y + 11$
$= -y + 11$

(b) From the sum of $4 + 3x$ and $5 - 4x + 2x^2$, subtract the sum of $3x^2 - 5x$ and $-x^2 + 2x + 5$

Step 1 = First, add $4 + 3x$ and $5 - 4x + 2x^2$
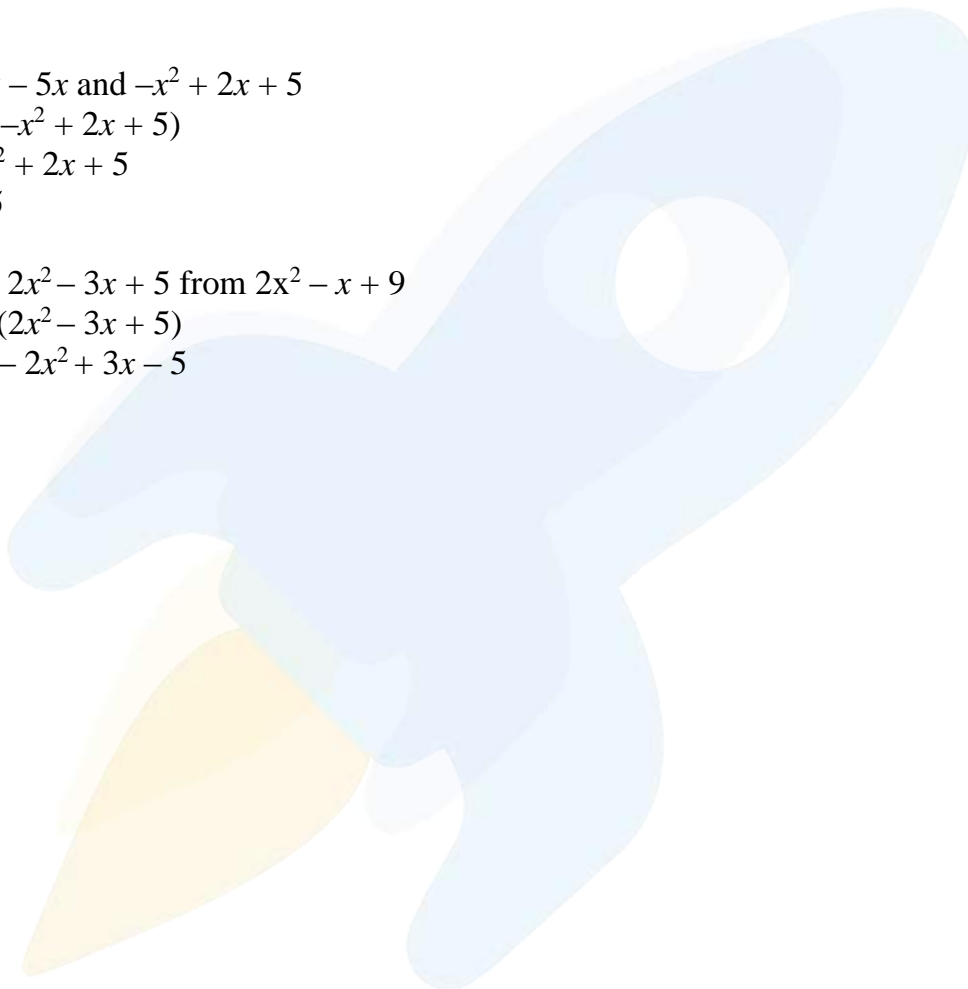Step 2 = Then, add $3x^2 - 5x$ and $-x^2 + 2x + 5$
Step 3 = Subtract the resultant in step 2 from resultant of step 1

Solution:

Add $4 + 3x$ and $5 - 4x + 2x^2$
$= 4 + 3x + 5 - 4x + 2x^2$
$= 2x^2 - x + 9$

Now add $3x^2 - 5x$ and $-x^2 + 2x + 5$
$= 3x^2 - 5x + (-x^2 + 2x + 5)$
$= 3x^2 - 5x - x^2 + 2x + 5$
$= 2x^2 - 3x + 5$

Now subtract $2x^2 - 3x + 5$ from $2x^2 - x + 9$
$2x^2 - x + 9 - (2x^2 - 3x + 5)$
$= 2x^2 - x + 9 - 2x^2 + 3x - 5$
$= 2x + 4$

Chapter 12: Algebraic Expressions

Exercise 12.3 (Page 242)

Q1. If $m = 2$, find the value of:
  (i) $m - 2$ (ii) $3m - 5$ (iii) $9 - 5m$

  (iv) $3m^2 - 2m - 7$ (v) $\dfrac{5m}{2} - 4$

Difficulty Level: Medium

What is known?
Value of m.

What is unknown?
Value of the given expressions.

Reasoning:
This is based on concept of putting given value of variable and then performing the arithmetic operation as given in the question.

Solution:
Value of m is given as 2.

  (i) $m - 2$

$$= 2 - 2$$
$$= 0 \text{ Ans}$$

  (ii) $3m - 5$

$$= 3 \times 2 - (5)$$
$$= 6 - 5$$
$$= 1 \text{ Ans}$$

  (iii) $9 - 5m$

$$= 9 - (5 \times 2)$$
$$= 9 - 10$$
$$= -1 \text{ Ans}$$

  (iv) $3m^2 - 2m - 7$

$$= 3(2)^2 - (2 \times 2) - 7$$
$$= 3 \times 2 \times 2 - (4) - 7$$
$$= 12 - 4 - 7$$
$$= 1 \text{ Ans}$$

(v) $\dfrac{5m}{2} - 4$

$$= \dfrac{5 \times 2}{2} - 4$$

$$= \dfrac{10}{2} - 4$$

$$= 5 - 4$$

$$= 1 \text{ Ans}$$

Q2. If $p = -2$, find the value of:

(i) $4p + 7$ (ii) $-3p^2 + 4p + 7$ (iii) $-2p^3 - 3p^2 + 4p + 7$

Difficulty Level: Moderate

What is known/given?
Value of p.

What is unknown?
Value of the given expressions.

Reasoning:
This is based on concept of putting given value of variable and then performing the arithmetic operation as given in the question.

Solution:
Value of p is given as -2

(i) $4p + 7$

$$= 4 \times -2 + (7)$$

$$= -8 + 7$$

$$= -1 \text{ Ans}$$

(ii) $-3p^2 + 4p + 7$

$$= -3 \times (-2)^2 + 4 \times (-2) + 7$$

$$= (-3 \times -2 \times -2) + (-8) + 7$$

$$= -12 - 8 + 7$$

$$= -13 \text{ Ans}$$

(iii) $-2p^3 - 3p^2 + 4p + 7$

$$= -2(-2)^3 - 3(-2)^2 + 4(-2) + 7$$

$$= -2 \times -2 \times -2 \times -2 - (3 \times -2 \times -2) + (4 \times -2) + 7$$

$$= 16 - (12) + (-8) + 7$$

$$= 3 \text{ Ans}$$

Q3. Find the value of the following expressions, when $x = -1$:

   (i) $2x - 7$ (ii) $-x + 2$ (iii) $x^2 + 2x + 1$

   (iv) $2x^2 - x - 2$

Difficulty Level: Medium

What is known?
Value of x

What is unknown?
Value of the given expressions.

Reasoning:
This is based on concept of putting given value of variable and then performing the arithmetic operation as given in the question.

Solution:
Value of x is given as -1

(i) $2x - 7$

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

   $= -2 - 7$

   $= -9$ Ans

(ii) $-x + 2$

   $= -(-1) + 2$

   $= 1 + 2$

   $= 3$ Ans

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

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

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

   $= 1 - 2 + 1$

   $= 0$ Ans

(iv) $2x^2 - x - 2$

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

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

   $= 2 + 1 - 2$

   $= 1$ Ans

Q4. If $a = 2$, $b = -2$, find the value of:

(i) $a^2 + b^2$ (ii) $a^2 + ab + b^2$ (iii) $a^2 - b^2$

Difficulty Level: Moderate

What is known?
Value of a and b

What is unknown?
Value of the given expressions.

Reasoning:
This is based on concept of putting given value of variable and then performing the arithmetic operation as given in the question.

Solution:
Value of a is given as 2 and b is –2

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

$$= 2^2 + (-2)^2$$
$$= (2 \times 2) + (-2 \times -2)$$
$$= 4 + 4$$
$$= 8 \, \text{Ans}$$

(ii) $a^2 + ab + b^2$

$$= 2^2 + \{(2) \times (-2)\} + (-2)^2$$
$$= 4 + (-4) + 4$$
$$= 4 - 4 + 4$$
$$= 4 \, \text{Ans}$$

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

$$= 2^2 - (-2)^2$$
$$= 4 - 4$$
$$= 0 \, \text{Ans}$$

Q5. When $a = 0$, $b = -1$, find the value of the given expressions:

(i) $2a + 2b$ (ii) $2a^2 + b^2 + 1$ (iii) $2a^2b + 2ab^2 + ab$ (iv) $a^2 + ab + 2$

Difficulty Level: Moderate

What is known?
Value of a and b

What is unknown?
Value of the given expressions.

Reasoning:
This is based on concept of putting given value of variable and then performing the arithmetic operation as given in the question.

Solution:
Value of a is given as 0 and b is –1

(i) $2a + 2b$

$$= (2 \times 0) + (2 \times -1)$$
$$= 0 + (-2)$$
$$= -2 \text{ Ans}$$

(ii) $2a^2 + b^2 + 1$

$$= (2 \times 0^2) + (-1)^2 + 1$$
$$= 0 + 1 + 1$$
$$= 2$$

(iii) $2a^2 b + 2ab^2 + ab$

$$= 2 \times 0 \times 0 \times -1 + (2 \times 0 \times -1^2) + 0 \times -1$$
$$= 0 + 0 + 0$$
$$= 0 \text{ Ans}$$

(iv) $a^2 + ab + 2$

$$= 0^2 + 0 \times -1 + 2$$
$$= 0 + 0 + 2$$
$$= 2 \text{ Ans}$$

Q6. Simplify the expressions and find the value if x is equal to 2

(i) $x + 7 + 4(x - 5)$ (ii) $3(x + 2) + 5x - 7$

(iii) $6x + 5(x - 2)$ (iv) $4(2x - 1) + 3x + 11$

Difficulty Level: Moderate

What is known?
Value of x

What is unknown?
Value of the given expressions.

Reasoning:
This is based on concept of simplification of like terms and then putting given value of variable and then performing the arithmetic operation as given in the question.

Solution:
Value of x is given as 2

(i) $x + 7 + 4(x - 5)$

$$= x + 7 + 4x - 20$$
$$= 5x - 13$$

Now putting value of $x = 2$

$5x - 13$

$$= (5 \times 2) - 13$$
$$= 10 - 13$$
$$= -3 \text{ Ans}$$

(ii) $3(x + 2) + 5x - 7$

$$= 3x + 6 + 5x - 7$$
$$= 8x - 1$$

Now putting value of $x = 2$

$$= (8 \times 2) - 1$$
$$= 16 - 1$$
$$= 15$$

(iii) $6x + 5(x - 2)$

$$= 6x + 5x - 10$$
$$= 11x - 10$$

Now putting value of $x = 2$

$$= (11 \times 2) - 10$$
$$= 12 \text{ Ans}$$

(iv) $4(2x - 1) + 3x + 11$

$$= 8x - 4 + 3x + 11$$
$$= 11x + 7$$

Now putting value of $x = 2$

$$= (11 \times 2) + 7$$
$$= 22 + 7$$
$$= 29 \text{ Ans}$$

Q7. Simplify these expressions and find their values if $x = 3$, $a = -1$, $b = -2$.

(i) $3x - 5 - x + 9$ (ii) $2 - 8x + 4x + 4$

(iii) $3a + 5 - 8a + 1$ (iv) $10 - 3b - 4 - 5b$

(v) $2a - 2b - 4 - 5 + a$

Difficulty Level: Moderate

What is known?
Value of x, a and b

What is unknown?
Value of the given expressions.

Reasoning:
This is based on concept of simplification of like terms and then putting given value of variable and then performing the arithmetic operation as given in the question.

Solution:
Value of x is given as 3, a as –1 and b is –2

$$\text{(i)} \quad 3x - 5 - x + 9$$
$$= 2x + 4$$
Now putting value of $x = 3$
$$= (2 \times 3) + 4$$
$$= 6 + 4$$
$$= 10 \text{ Ans}$$

$$\text{(ii)} \quad 2 - 8x + 4x + 4$$
$$= -4x + 6$$
Now putting value of $x = 3$
$$= (-4 \times 3) + 6$$
$$= -12 + 6$$
$$= -6 \text{ Ans}$$

$$\text{(iii)} \quad 3a + 5 - 8a + 1$$
$$= -5a + 6$$
Now putting value of $a = -1$
$$= (-5 \times -1) + 6$$
$$= 5 + 6$$
$$= 11 \text{ Ans}$$

(iv) $10 - 3b - 4 - 5b$

$\qquad = -8b + 6$

Now putting value of $b = -2$

$\qquad = (-8 \times -2) + 6$

$\qquad = 16 + 6$

$\qquad = 22$ Ans

(v) $2a - 2b - 4 - 5 + a$

$\qquad = 3a - 2b - 9$

Now putting value of $a = -1$ and $b = -2$

$(3 \times -1) - (2 \times -2) - 9$

$\qquad = -3 - (-4) - 9$

$\qquad = -3 + 4 - 9$

$\qquad = -8$ Ans

Q8.

(i) If $z = 10$, find the value of $z^3 - 3(z - 10)$

(ii) If $p = -10$, find the value of $p^2 - 2p - 100$

Difficulty Level: Moderate

Solution:

(i) If $z = 10$, find the value of $z^3 - 3(z - 10)$

First simplify the expression

$\qquad = z^3 - 3z + 30$

Now putting value of $z = 10$

$\qquad = (10)^3 - (3 \times 10) + 30$

$\qquad = 1000 - 30 + 30$

$\qquad = 1000$ Ans

(ii) If $p = -10$, find the value of $p^2 - 2p - 100$

Put value of $p = -10$ to solve the expression

$\qquad = (-10)^2 - (2 \times -10) - 100$

$\qquad = 100 + 20 - 100$

$\qquad = 20$ Ans

Q9. What should be the value of *a* if the value of $2x^2 + x - a$ equals to 5, when $x = 0$?

Difficulty Level: Low

Solution:
Given that
$$2x^2 + x - a = 5$$
Also, value of x is 0
$$2 \times 0^2 + 0 - a = 5$$
$$0 - a = 5$$
$$-a = 5$$
$$a = -5 \text{ Ans}$$

Q10. Simplify the expression and find its value when $a = 5$ and $b = -3$.

Difficulty Level: Low

Solution:
$2(a^2 + ab) + 3 - ab$

$$= 2a^2 + 2ab + 3 - ab$$
$$= 2a^2 + ab + 3$$
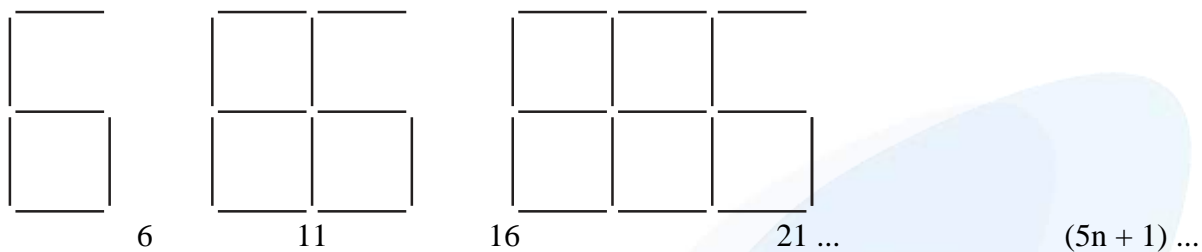$$= (2 \times 5 \times 5) + (5 \times -3) + 3$$
$$= 50 - 15 + 3$$
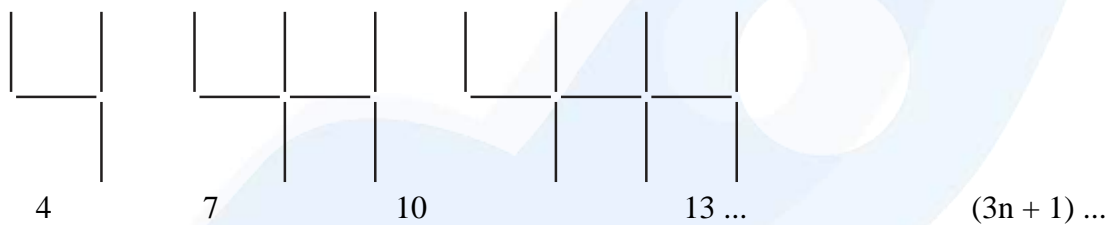$$= 38$$

Chapter 12: Algebraic Expressions

Exercise 12.4 (Page 246)

Q1. Observe the patterns of digits made from line segments of equal length. You will find such segmented digits on the display of electronic watches or calculators.

(a)

6   11   16   21 ... $(5n + 1)$ ...

(b)

4   7   10   13 ... $(3n + 1)$ ...

(c)

7   12   17   22 ... $(5n + 2)$ ...
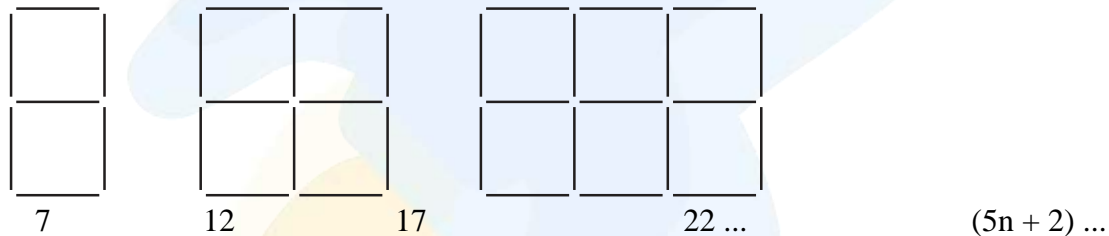
If the number of digits formed is taken to be n, the number of segments required to form n digits is given by the algebraic expression appearing on the right of each pattern. How many segments are required to form 5, 10, 100 digits of the kind, , . 6, 4, 8

Difficulty Level: Low

What is given /known?
The patterns of digits made from line segments of equal length

What is the unknown?
Number of segments required to form 5, 10, 100 digits of the kind, , . 6, 4, 8

Reasoning?
This question is very easy like simply put the value of n in the pattern formulae and you can easily find out the number of segments.

Solution:
Putting value of *n =* **5, 10** and **100** in the pattern formulae.

(i) $5n+1$

$$5 \times 5 + 1 = 25 + 1$$
$$= 26$$
$$5 \times 10 + 1 = 50 + 1$$
$$= 51$$
$$5 \times 100 + 1 = 500 + 1$$
$$= 501$$

(ii) $3n+1$

$$3 \times 5 + 1 = 15 + 1$$
$$= 16$$
$$3 \times 10 + 1 = 30 + 1$$
$$= 31$$
$$3 \times 100 + 1 = 300 + 1$$
$$= 301$$

(iii) $5n+2$

$$5 \times 5 + 2 = 25 + 2$$
$$= 27$$
$$5 \times 10 + 2 = 50 + 2$$
$$= 52$$
$$5 \times 100 + 2 = 500 + 2$$
$$= 502$$

S. No.	Symbol	Digit's Number	Pattern's Formulae	No. of. Segments
(i)	6	5	5 n+1	26
		10		51
		100		501
(ii)	4	5	3 n+1	16
		10		31
		100		301
(iii)	8	5	5 n+2	27
		10		52
		100		502

Q2. Use the given algebraic expression to complete the table of number patterns.

S. No.	Expression	Terms									
		1st	2nd	3rd	4th	5th	...	10th	…	100th	…
(i)	$2n - 1$	1	3	5	7	9	-	19	-	-	-
(ii)	$3n + 2$	5	8	11	14	-	-	-	-	-	-
(iii)	$4n + 1$	5	9	13	17	-	-	-	-	-	-
(iv)	$7n + 20$	27	34	41	48	-	-	-	-	-	-
(v)	$n^2 + 1$	2	5	10	17	-	-	-	-	10,001	-

Difficulty Level: Low

What is given /known?
Different algebraic expressions and the terms.

What is the unknown?
Some terms of the given algebraic expression.

Reasoning?
This question is very simple, put the value of n in the given algebraic expression and you can easily find out the unknown terms.

Solution:
Putting value of **n =5, 10** and **100**

(i) $2n - 1$
$$2 \times 100 - 1 = 200 - 1$$
$$= 199$$

(ii) $3n + 2$
$$3 \times 5 + 2 = 15 + 2$$
$$= 17$$
$$3 \times 10 + 2 = 30 + 2$$
$$= 32$$
$$3 \times 100 + 2 = 300 + 2$$
$$= 302$$

(iii) $4n + 1$
$$4 \times 5 + 1 = 20 + 1$$
$$= 21$$
$$4 \times 10 + 1 = 40 + 1$$
$$= 41$$
$$4 \times 100 + 1 = 400 + 1$$
$$= 401$$

(iv) $7n + 20$

$$7 \times 5 + 20 = 35 + 20$$
$$= 55$$
$$7 \times 10 + 20 = 70 + 20$$
$$= 90$$
$$7 \times 100 + 20 = 700 + 20$$
$$= 720$$

(v) $n^2 + 1$

$$5 \times 5 + 1 = 25 + 1$$
$$= 26$$
$$10 \times 10 + 1 = 100 + 1$$
$$= 101$$
$$100 \times 100 + 1 = 10000 + 1$$
$$= 10001$$

Complete table is:

S.No.	Expression	Terms									
		1st	2nd	3rd	4th	5th	...	10th	…	100th	…
(i)	$2n - 1$	1	3	5	7	9	-	19	-	199	-
(ii)	$3n + 2$	5	8	11	14	17	-	32	-	302	-
(iii)	$4n + 1$	5	9	13	17	21	-	41	-	401	-
(iv)	$7n + 20$	27	34	41	48	55	-	90	-	720	-
(v)	$n^2 + 1$	2	5	10	17	26	-	101	-	10,001	-

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