Polynomials

OBJECTIVE TYPE QUESTIONS

Multiple Choice Questions (MCQs)

1. Which of the following is a constant polynomial?

(a) $x+\frac{1}{x}-3$ (b) $\frac{1}{x}+3$

(c) $\sqrt{x}+2$ (d) -4

2. Degree of polynomial $2x^3+\sqrt{3}x+\frac{1}{3}x^5-7$ is

(a) 1 (b) 3 (c) 0 (d) 5

3. The coefficient of the highest power of x in the polynomial $3x^3-4x^4+5x^2-2x^5+3$ is

(a) 2 (b) -4 (c) 3 (d) -2

4. Which of the following polynomials has -5 as its zero?

(a) $(x-5)$ (b) x^2-25

(c) x^2-5x (d) x^2+5

5. If $p(y)=y^2-y+1$, then find the value of $p(0)-p(1)$.

(a) 1 (b) 3 (c) 0 (d) 2

6. If $p(x)=x^2+kx+6$, then for what value of k, $p(3)=0$?

(a) 2 (b) -5 (c) 3 (d) -1

7. If $p(x)=x^{160}+2x^{141}+k$ and $p(-1)=0$, then the value of k is

(a) 1 (b) -3 (c) 2 (d) -2

8. Factors of polynomial $12x^2+7x+1$ are

(a) $(3x-1)(4x+1)$ (b) $(3x-1)(4x-1)$

(c) $(4x-1)(3x-1)$ (d) $(4x+1)(3x+1)$

9. The factors of $x^3+9x^2+23x+15$ are

(a) $(x+1)$, $(x+3)$, $(x+5)$

(b) $(x+1)$, $(x+3)$, $(x-5)$

(c) $(x+1)$, $(x-3)$, $(x-5)$

(d) $(x-1)$, $(x-3)$, $(x-5)$

10. The value of $(369)^2-(368)^2$ is

(a) 1^2 (b) 81 (c) 37 (d) 737

11. Using algebraic identity, find the value of 209×191.

(a) 39851 (b) 39919

(c) 39961 (d) 38951

12. If $a+b+c=13$ and $ab+bc+ca=84$, then find the value of $a^2+b^2+c^2$.

(a) 1 (b) 2 (c) 3 (d) 4

13. If $\frac{a}{b}+\frac{b}{a}=1$, then a^3+b^3 equals

(a) 1 (b) -1 (c) 1/2 (d) 0

14. The value of $(9)^3+(-3)^3$ is

(a) -81 (b) 54

(c) 164 (d) 702

15. If $a^3+b^3+c^3=3abc$, then $\frac{a^2}{bc}+\frac{b^2}{ca}+\frac{c^2}{ab}=$

(a) 0 (b) 1 (c) -1 (d) 3

16. If $p(x)=x+3$, then $p(x)+p(-x)$ is equal to

(a) 3 (b) $2x$ (c) 0 (d) 6

17. One of the zeroes of the polynomial $2x^2+7x-4$ is

(a) 2 (b) $\frac{1}{2}$ (c) $-\frac{1}{2}$ (d) -2

18. If $a+b+c=0$, then $a^3+b^3+c^3$ is equal to

(a) 0 (b) abc (c) $3abc$ (d) $2abc$

19. $\sqrt{2}$ is a polynomial of degree

(a) 2 (b) 0 (c) 1 (d) $\frac{1}{2}$

20. Number of terms in the polynomial $4x^3+3x^2-6x+7$ is

(a) 1 (b) 2 (c) 3 (d) 4

21. If $p(x)=x^2-2\sqrt{2}x+1$, then $p(2\sqrt{2})=$

(a) 0 (b) 1 (c) $4\sqrt{2}$ (d) -1

22. A cubic polynomial cannot have more than ______ zeroes.

(a) 0 (b) 1 (c) 2 (d) 3

23. If $p(x)=x^{51}+51$, then value of $p(-1)$ is

(a) 0 (b) 1 (c) 49 (d) 50

24. Degree of the polynomial $p(x)=(x+2)(x-2)$ is

(a) 2 (b) 1 (c) 0 (d) 3

25. Factorise: $x^2 + (a + b + c)x + ab + bc$
(a) $(x + a)(x + b + c)$ (b) $(x + a)(x + a + c)$
(c) $(x + b)(x + a + c)$ (d) $(x + b)(x + b + c)$

26. Factors of $(42 - x - x^2)$ are
(a) $(x - 7), (x - 6)$ (b) $(x + 7), (x - 6)$
(c) $(x + 7), (6 - x)$ (d) $(x - 7), (x + 6)$

27. The common quantity that must be added to each term of $a^2 : b^2$ to make it equal to $a : b$ is
(a) ab (b) $a + b$ (c) $a - b$ (d) $\frac{a}{b}$

28. Find the value of $x + y + z$, if $x^2 + y^2 + z^2 = 18$ and $xy + yz + zx = 9$.
(a) 9 (b) 3 (c) 6 (d) 8

29. If $f(x) = x^3 - 3x^2 + 4x + 50$, then $f(-3) =$
(a) –16 (b) –12 (c) –20 (d) –10

30. If $x = -2$ and $x^2 + y^2 + 3xy = -5$, then find y.
(a) –2 (b) 3 (c) – 4 (d) 9

31. Simplify : $\dfrac{x^3 - 4 - x + 4x^2}{x^2 + 3x - 4}$
(a) $4 + x$ (b) $2 + x$ (c) $1 - x$ (d) $x + 1$

32. If $p(x) = x^3 + 3x^2 - 2x + 4$, then find the value of $[p(2) + p(-2) - p(0)]$.
(a) 28 (b) 14 (c) 12 (d) 16

33. Which of the following is a cubic polynomial?
(a) $2x + \sqrt{3} + x^4$ (b) $-x - x^2 - 7x^3$
(c) 9 (d) $2 - 3x^2 - 9x$

34. The value of the polynomial $5x - 4x^2 + 3$, when $x = -1$ is
(a) – 6 (b) 6 (c) 2 (d) – 2

35. $(x + y)^3 - (x - y)^3 - 6y(x^2 - y^2) =$
(a) y^3 (b) $2y^3$ (c) $4y^3$ (d) $8y^3$

36. If the volume of a cuboid is $x^3 + x^2 - 9x - 9$, then its possible dimensions are
(a) $x + 1, x^2, x + 3$ (b) $x + 1, x - 3, x + 3$
(c) $3, x^2, 9x$ (d) 3, 3, 3

37. The degree of the polynomial $(y^3 - 3)(y^2 + 8)$ is
(a) 2 (b) 3 (c) 0 (d) 5

Case Based MCQs

Case I : Read the following passage and answer the questions from 38 to 42.

Ankur and Ranjan start a new business together. The amount invested by both partners together is given by the polynomial $p(x) = 4x^2 + 12x + 5$, which is the product of their individual shares.

38. Coefficient of x^2 in the given polynomial is
(a) 2 (b) 3 (c) 4 (d) 12

39. Total amount invested by both, if $x = 1000$ is
(a) ₹301506 (b) ₹370561
(c) ₹4012005 (d) ₹490621

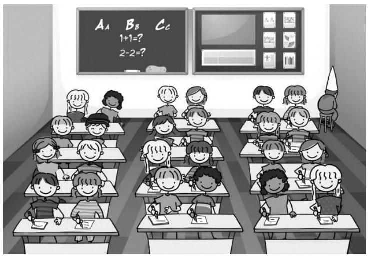
40. The shares of Ankur and Ranjan invested individually are
(a) ₹$(2x + 1)$, ₹$(2x + 5)$ (b) ₹$(2x + 3)$, ₹$(x + 1)$
(c) ₹$(x + 1)$, ₹$(x + 3)$ (d) None of these

41. Name the polynomial of amounts invested by each partner.
(a) Cubic (b) Quadratic
(c) Linear (d) None of these

42. Find the value of x, if the total amount invested is equal to 0.
(a) –1/2 (b) –5/2
(c) Both (a) and (b) (d) None of these

Case II : Read the following passage and answer the questions from 43 to 47.

A class teacher decided to organise an educational trip for his class. He asked the students for their preferences, where they want to go. $\frac{1}{12}$th times the square of total number of students want to go to old age home, $\frac{7}{12}$th times the total number of students plan to visit historical monuments, while 15 students decide to teach children of orphanage home.



43. Which of the following polynomial represents the above situation, if x is the total number of students?

(a) $\frac{7}{12}x^2+\frac{1}{12}x+15$ (b) $\frac{1}{12}x^2+\frac{7}{12}x+15$

(c) $7x^2 + 12x + 15$ (d) None of these

44. The coefficient of x^2 in the above polynomial is

(a) $\frac{7}{12}$ (b) $-\frac{1}{12}$ (c) $-\frac{7}{12}$ (d) $\frac{1}{12}$

45. Write the coefficient of x in the polynomial.

(a) $-\frac{1}{12}$ (b) $\frac{1}{12}$ (c) $\frac{7}{12}$ (d) $-\frac{7}{12}$

46. Value of the polynomial at $x = 1$, is

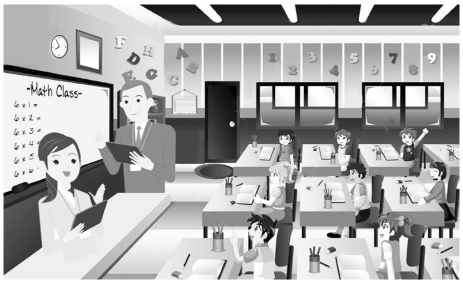
(a) 172 (b) 150 (c) $\frac{176}{12}$ (d) $\frac{47}{3}$

47. Value of the polynomial at $x = 2$ is

(a) $\frac{170}{12}$ (b) $\frac{182}{12}$ (c) 190 (d) $\frac{33}{2}$

Case III : Read the following passage and answer the questions from 48 to 52.

On one day, principal of a particular school visited the classroom. Class teacher was teaching the concept of polynomial to students. He was very much impressed by her way of teaching. To check, whether the students also understand the concept taught by her or not, he asked various questions to students. Some of them are given below. Answer them.



48. Which one of the following is not a polynomial?

(a) $4x^2 + 2x - 1$ (b) $y+\frac{3}{y}$

(c) $x^3 - 1$ (d) $y^2 + 5y + 1$

49. The polynomial of the type $ax^2 + bx + c$, $a = 0$ is called

(a) Linear polynomial

(b) Quadratic polynomial

(c) Cubic polynomial

(d) Biquadratic polynomial

50. The value of k, if $(x - 1)$ is a factor of $4x^3 + 3x^2 - 4x + k$, is

(a) 1 (b) –2 (c) –3 (d) 3

51. If $x + 2$ is the factor of $x^3 - 2ax^2 + 16$, then value of a is

(a) –7 (b) 1 (c) –1 (d) 7

52. The number of zeroes of the polynomial $x^2 + 4x + 2$ is

(a) 1 (b) 2 (c) 3 (d) 4

Assertion & Reasoning Based MCQs

Directions (Q.53 to 60) : In these questions, a statement of Assertion is followed by a statement of Reason is given. Choose the correct answer out of the following choices :

(a) Assertion and Reason both are correct statements and Reason is the correct explanation of Assertion.

(b) Assertion and Reason both are correct statements but Reason is not the correct explanation of Assertion.

(c) Assertion is correct statement but Reason is wrong statement.

(d) Assertion is wrong statement but Reason is correct statement.

53. Assertion : The expression $3x^4 - 4x^{3/2} + x^2 = 2$ is not a polynomial because the term $-4x^{3/2}$ contains a rational power of x.

Reason : The highest exponent in various terms of an algebraic expression in one variable is called its degree.

54. Assertion : $3x^2 + x - 1 = (x + 1)(3x - 2) + 1$.

Reason : To factorise $ax^2 + bx + c$, write b as sum of two numbers whose product is ac.

55. Assertion : –7 is a constant polynomial.

Reason : Degree of a constant polynomial is zero.

56. Assertion : The degree of the polynomial $(x^2 - 2)(x - 3)(x + 4)$ is 3.

Reason : A polynomial of degree 3 is called a cubic polynomial.

57. Assertion : If $2x^2 - 32$ is the volume of a cuboid, then length of cuboid can be $x - 8$.

Reason : Volume of a cuboid = $l \times b \times h$.

58. Assertion : The value of 593×607 is 359951.

Reason : $(a + b)(a - b) = a^2 - b^2$

59. Assertion : The value of $(-27)^3 + (-9)^3$ is -20412.

Reason : If $a + b = 0$, then $a^3 + b^3 + c^3 = 0$

60. Assertion : If $x = \frac{3}{2}$ is a zero of polynomial $2x^2 + kx - 12$, then $k = 5$.

Reason : If $x = a$ is zero of a polynomial $f(x)$, then $f(a) = 0$.

SUBJECTIVE TYPE QUESTIONS

Very Short Answer Type Questions (VSA)

1. How many terms are there in the polynomial $5 - 3t + 2t^6$?

2. If, $p\left(-\frac{1}{4}\right) = 0$, where $p(x) = 8x^3 - ax^2 - x + 2$, then find the value of a.

3. Factorise : $14a^2b - 7ab^2$

4. Find the value of $p(x) = \sqrt{2}x^2 + \sqrt{2}x + 6$ at $x = \sqrt{2}$.

5. Find the zero of the polynomial $q(x) = 3x + 2$.

6. Is $x + 2$ a zero of $p(x) = 2x^3 - x^2 + 3$?

7. Find the factors of $x^2 + 2x - 15$.

8. Find the product of $(lx + my)$ and $(lx - my)$.

9. Factorise : $a^3 - b^3 + 3ba^2 - 3ab^2$

10. Find the zeroes of the polynomial $3x + \pi$.

Short Answer Type Questions (SA-I)

11. If $f(x) = 7x^2 - 3x + 7$, find $f(2) + f(-1) + f(0)$.

12. Simplify: $\left(y - \frac{1}{y}\right)\left(y + \frac{1}{y}\right)\left(y^2 + \frac{1}{y^2}\right)\left(y^4 + \frac{1}{y^4}\right)$

13. Write the coefficients of x and x^3 in polynomial $2x^4 + 3x^2 - 7x + 5$.

14. If $p(t) = t^3 - 3t^2 + t - 4$, then find $p(1)$ and $p(-1)$.

15. Verify whether $-\frac{1}{2}$ and $\frac{1}{5}$ are the zeroes of the polynomial $p(y) = 5y - 1$.

16. If x and y be two positive real numbers such that $4x^2 + y^2 = 40$ and $xy = 6$, then find the value of $2x + y$.

17. If $(2a + b) = 12$ and $ab = 15$, then find the value of $8a^3 + b^3$.

18. For what integral values of 'a', $p(a) = 0$, where $p(x) = x^n - a^n$?

19. Factorise the following polynomials by splitting the middle term:

(i) $2x^2 + 7x + 6$ (ii) $6x^2 + 7x - 10$.

20. Factorise $\frac{36}{25}x^4 - \frac{y^4}{16}$.

Short Answer Type Questions (SA-II)

21. If the perimeter of a rectangle is 24 units and the length exceeds the breadth by 4 units, then find the area of the rectangle.

22. Factorise : $(x - y)^2 - 9(x^2 - y^2) + 20(x + y)^2$

23. Factorise the following using appropriate identities:

(i) $27y^3 - 27y^2 + 9y - 1$

(ii) $40x^3 - 135$

24. Factorise: $(2y + x)^2 (y - 2x) + (2x + y)^2 (2x - y)$

25. If $(3x - 1)^3 = 6a_3x^3 + a_2x^2 + a_1x + a_0$, then find $a_3 + a_2 + a_1 + a_0$.

26. Find the coefficient of x in the expansion of $(x + 7)^3$.

27. Give one example of a

(i) monomial of degree 100

(ii) binomial of degree 50

(iii) trinomial of degree 205

28. Identify whether the following are polynomials or not. Justify your answer.

(i) $\frac{x^2}{2} - \frac{2}{x^2}$ (ii) $\sqrt{2x} - 1$

(iii) $x^2 + \frac{3x^{3/2}}{\sqrt{x}}$ (iv) $\frac{x-1}{x+1}$

29. Factorise: $x^3 - 12x^2 + 47x - 60$.

30. Factorize $x^{16} - y^{16}$.

31. Simplify : $\left(\frac{x}{3}+\frac{y}{5}\right)^3 - \left(\frac{x}{3}-\frac{y}{5}\right)^3$.

Long Answer Type Questions (LA)

32. If $x = 2$ and $x = 0$ are zeroes of the polynomial $2x^3 - 5x^2 + ax + b$, then find the values of a and b.

33. If $x + \frac{1}{x} = 6$, find

(i) $x^2 + \frac{1}{x^2}$ (ii) $x^4 + \frac{1}{x^4}$

34. Prove that : $(a + b + c)^3 - a^3 - b^3 - c^3 = 3(a + b)(b + c)(c + a)$.

35. Verify that $x^3 + y^3 + z^3 - 3xyz$

$= \frac{1}{2}(x+y+z)[(x-y)^2+(y-z)^2+(z-x)^2]$

ANSWERS

OBJECTIVE TYPE QUESTIONS

1. **(d) :** Clearly, –4 is a constant polynomial as its degree is 0.

2. **(d) :** Degree of polynomial $2x^3 + \sqrt{3}x + \frac{1}{3}x^5 - 7$ is 5.

3. **(d) :** Term with highest power of x is $-2x^5$.

$\therefore$ Coefficient of $x^5 = -2$

4. **(b) :** Put $x = -5$ in each of the given polynomials, we get

(a) $-5 - 5 = -10 \neq 0$

(b) $(-5)^2 - 25 = 0$

(c) $(-5)^2 - 5(-5) = 25 + 25 = 50 \neq 0$

(d) $(-5)^2 + 5 = 25 + 5 = 30 \neq 0$

5. **(c) :** We have, $p(y) = y^2 - y + 1$

Now, $p(0) = (0)^2 - (0) + 1 = 1$

Also, $p(1) = (1)^2 - (1) + 1 = 1$

$\therefore p(0) - p(1) = 1 - 1 = 0$

6. **(b) :** $p(x) = x^2 + kx + 6$

Now, $p(3) = 0 \Rightarrow 3^2 + k \times 3 + 6 = 0$

$\Rightarrow 3k = -15 \Rightarrow k = -5$

7. **(a) :** We have, $p(-1) = 0$

$\Rightarrow (-1)^{160} + 2(-1)^{141} + k = 0$

$\Rightarrow 1 - 2 + k = 0 \Rightarrow k - 1 = 0$

$\therefore k = 1$

8. **(d) :** We have, $12x^2 + 7x + 1$

$= 12x^2 + 3x + 4x + 1$

$= 3x(4x + 1) + 1(4x + 1)$

$= (3x + 1)(4x + 1)$

9. **(a) :** Let $f(x) = x^3 + 9x^2 + 23x + 15$

Here, constant term of $f(x)$ is 15

$\because$ Factors of 15 are ±1, ±3, ±5 and ±15

$\therefore f(-1) = (-1)^3 + 9(-1)^2 + 23(-1) + 15 = 0$

$f(-3) = (-3)^3 + 9(-3)^2 + 23(-3) + 15 = 0$

$f(-5) = (-5)^3 + 9(-5)^2 + 23(-5) + 15 = 0$

$\therefore (x + 1), (x + 3), (x + 5)$ are the factors of $f(x)$.

10. **(d) :** Since $a^2 - b^2 = (a + b)(a - b)$

$\therefore (369)^2 - (368)^2 = (369 + 368)(369 - 368)$

$= 737 \times 1 = 737$

11. **(b) :** We have, $209 \times 191 = (200 + 9)(200 - 9)$

$= (200)^2 - (9)^2$ $[\because (a + b)(a - b) = a^2 - b^2]$

$= 40000 - 81 = 39919$

12. **(a) :** Given that, $a + b + c = 13$

Squaring both sides, we get

$(a + b + c)^2 = (13)^2$

$\Rightarrow a^2 + b^2 + c^2 + 2ab + 2bc + 2ca = 169$

$\Rightarrow a^2 + b^2 + c^2 + 2(ab + bc + ca) = 169$

Putting $ab + bc + ca = 84$, we get

$a^2 + b^2 + c^2 + 2 \times 84 = 169$

$\therefore a^2 + b^2 + c^2 = 169 - 168 = 1$

13. **(d) :** $\left(\frac{a}{b}\right) + \left(\frac{b}{a}\right) = 1$

$\Rightarrow \frac{a^2 + b^2}{ab} = 1 \Rightarrow a^2 + b^2 = ab$

$\therefore a^2 + b^2 - ab = 0$ ...(i)

Now, $a^3 + b^3 = (a + b)(a^2 + b^2 - ab)$

$\Rightarrow$ $a^3 + b^3 = (a + b) \times 0$ [Using eq. (i)]

$= 0$

$\therefore$ $a^3 + b^3 = 0$

14. (d) : $\therefore$ $(9)^3 + (-3)^3 = (9 + (-3))\ (9^2 + (-3)^2 - (9)(-3))$

$= 6 \times (81 + 9 + 27)$

$= 6 \times 117 = 702$

15. (d) : We have, $\frac{a^2}{bc} + \frac{b^2}{ca} + \frac{c^2}{ab} = \frac{a^3 + b^3 + c^3}{abc} = \frac{3abc}{abc} = 3$

16. (d) : We have, $p(x) = x + 3$ ... (i)

Substitute $x = -x$ in (i), we get

$p(-x) = -x + 3$ ... (ii)

Adding (i) and (ii), we get

$p(x) + p(-x) = x + 3 + (-x) + 3 = 6$

17. (b) : Let $p(x) = 2x^2 + 7x - 4$

$= 2x^2 + 8x - x - 4 = 2x(x + 4) - 1(x + 4)$

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

To find zeroes of the polynomial, put $p(x) = 0$

$\Rightarrow$ $(2x - 1)(x + 4) = 0$

$\Rightarrow$ $2x - 1 = 0$ and $x + 4 = 0$

$\Rightarrow$ $x = \frac{1}{2}$ and $x = -4$

18. (c) : We have, $a + b + c = 0$ ...(i)

$\Rightarrow a + b = -c$

Cubing both sides, we get

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

$\Rightarrow$ $a^3 + b^3 + c^3 = -3ab(a + b)$

$\Rightarrow$ $a^3 + b^3 + c^3 = -3ab(-c)$ [Using (i)]

$\Rightarrow$ $a^3 + b^3 + c^3 = 3abc$

19. (b) : The given polynomial, $\sqrt{2}$ can be written as $\sqrt{2}x^0$. Since exponent of x is 0, therefore, $\sqrt{2}$ is a polynomial of degree 0.

20. (d) : There are four terms in the polynomial $4x^3 + 3x^2 - 6x + 7$.

21. (b) : $p(2\sqrt{2}) = (2\sqrt{2})^2 - (2\sqrt{2})(2\sqrt{2}) + 1 = 1.$

22. (d) : A cubic polynomial cannot have more than three zeroes.

23. (d) : Let $p(x) = x^{51} + 51$

Now, $p(-1) = (-1)^{51} + 51 = -1 + 51 = 50$

24. (a) : $p(x) = (x + 2)(x - 2) = x^2 - 4$

$\therefore$ Degree of $p(x) = 2$.

25. (c) : $x^2 + (a + b + c)x + ab + bc$

$= x^2 + (a + c)x + bx + b(a + c) = x^2 + bx + (a + c)(x + b)$

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

26. (c) : $42 - x - x^2 = 42 - 7x + 6x - x^2$

$= 7(6 - x) + x(6 - x) = (6 - x)(7 + x)$

27. (a) : Consider $a^2 : b^2$,

Adding ab on both sides, we get

$(a^2 + ab) : (b^2 + ab) = a(a + b) : b(a + b) = a : b.$

28. (c) : $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$

$= 18 + 2(9) = 36$

$\Rightarrow$ $x + y + z = 6$

29. (a) : $f(-3) = [(-3)^3 - 3 \times (-3)^2 + 4 \times (-3) + 50]$

$= (-27 - 27 - 12 + 50) = -16.$

30. (b) : We have, $x^2 + y^2 + 3xy = -5$ and $x = -2$

$\Rightarrow$ $(-2)^2 + y^2 - 6y = -5$

$\Rightarrow$ $y^2 - 6y + 9 = 0 \Rightarrow (y - 3)^2 = 0$

$\Rightarrow$ $y - 3 = 0 \Rightarrow y = 3$

31. (d) : $\frac{x^3 - 4 - x + 4x^2}{x^2 + 3x - 4}$

$= \frac{x^3 + 4x^2 - x - 4}{x^2 + 4x - x - 4} = \frac{x^2(x+4) - 1(x+4)}{x(x+4) - 1(x+4)}$

$= \frac{(x^2 - 1)(x+4)}{(x-1)(x+4)} = \frac{(x+1)(x-1)(x+4)}{(x-1)(x+4)} = x + 1.$

32. (a) : Here, $p(x) = x^3 + 3x^2 - 2x + 4$

Now, $p(2) = 2^3 + 3(2)^2 - 2(2) + 4 = 8 + 12 - 4 + 4 = 20$

$p(-2) = (-2)^3 + 3(-2)^2 - 2(-2) + 4 = -8 + 12 + 4 + 4 = 12$

and $p(0) = 0 + 0 - 0 + 4 = 4$

$\therefore$ $p(2) + p(-2) - p(0) = 20 + 12 - 4 = 28.$

33. (b) : Clearly, $-x - x^2 - 7x^3$ is a polynomial of degree 3. So, it is a cubic polynomial.

34. (a) : Let $p(x) = 5x - 4x^2 + 3$

Now, value of $p(x)$ at $x = -1$ is,

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

35. (d) : We have, $(x + y)^3 - (x - y)^3 - 6y(x^2 - y^2)$

$= x^3 + y^3 + 3xy(x + y) - [x^3 - y^3 - 3xy(x - y)] - 6x^2y + 6y^3$

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

$= 8y^3$

36. (b) : We have, $x^3 + x^2 - 9x - 9$

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

$= (x + 1)(x - 3)(x + 3)$ [$\because a^2 - b^2 = (a - b)(a + b)$]

37. (d) : We have, $(y^3 - 3)(y^2 + 8) = y^5 + 8y^3 - 3y^2 - 24$

$\therefore$ Degree of given polynomial = 5

38. (c)

39. (c) : We have, $p(x) = 4x^2 + 12x + 5$

At $x = 1000$,

$p(1000) = 4(1000)^2 + 12(1000) + 5 =$ ₹ 4012005.

40. (a) : We have, $p(x) = 4x^2 + 12x + 5$

$= 4x^2 + 10x + 2x + 5 = 2x(2x + 5) + 1(2x + 5)$

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

$\therefore$ Their individual shares are ₹ $(2x + 1)$ and ₹ $(2x + 5)$.

41. **(c)**

42. **(c) :** We have, total amount invested = 0

$\Rightarrow$ $4x^2 + 12x + 5 = 0$

$\Rightarrow$ $(2x + 1)(2x + 5) = 0$

$\Rightarrow$ $x = -1/2$ or $x = -5/2$

43. **(b) :** Required polynomial,

$p(x) = \frac{1}{12}x^2 + \frac{7}{12}x + 15$

44. **(d) :** Coefficient of x^2 in $p(x) = \frac{1}{12}$

45. **(c) :** Coefficient of x in $p(x) = \frac{7}{12}$

46. **(d) :** We have, $p(x) = \frac{1}{12}x^2 + \frac{7}{12}x + 15$

At $x = 1$, $p(1) = \frac{1}{12}(1)^2 + \frac{7}{12}(1) + 15$

$= \frac{1+7+180}{12} = \frac{188}{12} = \frac{47}{3}$

47. **(d) :** At $x = 2$, we have

$p(2) = \frac{1}{12}(2)^2 + \frac{7}{12}(2) + 15$

$= \frac{4+14+180}{12} = \frac{198}{12} = \frac{33}{2}$

48. **(b)**

49. **(a) :** $\because$ $a = 0$. So, the given polynomial becomes $bx + c$, which is a linear polynomial.

50. **(c) :** Let $p(x) = 4x^3 + 3x^2 - 4x + k$.

If $(x - 1)$ is a factor of $p(x)$, then by factor theorem $p(1) = 0$.

$\Rightarrow$ $p(1) = 4(1)^3 + 3(1)^2 - 4(1) + k$

$\Rightarrow$ $0 = 4 + 3 - 4 + k$

$\Rightarrow$ $k = -3$

51. **(b) :** Let $p(x) = x^3 - 2ax^2 + 16$

If $x + 2$ is a factor of $p(x)$, then by factor theorem $p(-2) = 0$.

$\Rightarrow$ $p(-2) = (-2)^3 - 2a(-2)^2 + 16 = 0$

$\Rightarrow$ $-8 - 8a + 16 = 0$

$\Rightarrow$ $8a = 8$ $\Rightarrow$ $a = 1$

52. **(b)**

53. **(b) :** Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

54. **(a) :** We have, $3x^2 + x - 1$

$= 3x^2 + x - 2 + 1$

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

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

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

Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

55. **(a)**

56. **(d) :** Clearly Reason is correct.

Let $p(x) = (x^2 - 2)(x - 3)(x + 4)$

$= (x^2 - 2)[x^2 + 4x - 3x - 12]$

$= (x^2 - 2)(x^2 + x - 12)$

$= x^4 + x^3 - 12x^2 - 2x^2 - 2x + 24$

$\Rightarrow$ $p(x) = x^4 + x^3 - 14x^2 - 2x + 24$

So, degree of $p(x) = 4$.

$\therefore$ Assertion is wrong.

57. **(d) :** Clearly, Reason is correct.

Now, let $p(x) = 2x^2 - 32 = 2(x^2 - 16) = 2(x^2 - 4^2)$

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

Hence, the possible length of cuboid can be any of 2, $x + 4$ and $x - 4$.

$\therefore$ Assertion is wrong.

58. **(a) :** Clearly, Reason is correct.

Now, $593 \times 607 = (600 - 7) \times (600 + 7)$

$= (600)^2 - (7)^2$ [$\because (a - b)(a + b) = a^2 - b^2$]

$= 360000 - 49 = 359951$

$\therefore$ Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

59. **(c) :** Clearly, Reason is wrong.

Now, $(-27)^3 + (-9)^3$

$= [-27 - 9][(-27)^2 + (-9)^2 - (-27)(-9)]$

$= -36 \times 567 = -20412$

$\therefore$ Assertion is correct.

60. **(a) :** Clearly, Reason is correct.

Let $f(x) = 2x^2 + kx - 12$

Since, $x = 3/2$ is a zero of $f(x)$

$\therefore$ $f\left(\frac{3}{2}\right) = 0$ $\therefore$ $2\left(\frac{3}{2}\right)^2 + k\left(\frac{3}{2}\right) - 12 = 0$

$\Rightarrow$ $\frac{9}{2} + \frac{3k}{2} = 12$ $\Rightarrow$ $\frac{3}{2}k = 12 - \frac{9}{2} = \frac{15}{2}$ $\Rightarrow$ $k = \frac{15}{2} \times \frac{2}{3} = 5$

$\therefore$ Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

SUBJECTIVE TYPE QUESTIONS

1. Number of terms = 3

2. $\because$ $p\left(\frac{-1}{4}\right) = 0$

$\Rightarrow$ $8\left(\frac{-1}{4}\right)^3 - a\left(-\frac{1}{4}\right)^2 - \left(-\frac{1}{4}\right) + 2 = 0$

$\Rightarrow$ $\frac{-8}{64} - \frac{a}{16} + \frac{1}{4} + 2 = 0$

$\Rightarrow$ $\frac{-1}{8} + \frac{1}{4} + 2 = \frac{a}{16}$ $\Rightarrow$ $\frac{-1+2+16}{8} = \frac{a}{16}$

$\Rightarrow$ $a = 17 \times 2$

$\therefore$ $a = 34$

3. We have, $14a^2b - 7ab^2 = 7ab(2a - b)$

4. $p(\sqrt{2}) = \sqrt{2}(\sqrt{2})^2 + \sqrt{2}(\sqrt{2}) + 6$

$= 2\sqrt{2} + 2 + 6$

$= 2\sqrt{2} + 8$

5. We have, $q(x) = 3x + 2$

Put $q(x) = 0 \Rightarrow 3x + 2 = 0 \Rightarrow x = \frac{-2}{3}$.

$\therefore$ $\frac{-2}{3}$ is the zero of the polynomial $q(x) = 3x + 2$.

6. $(x + 2)$ will be a zero of $p(x)$, if $p(-2) = 0$

$\therefore$ $p(-2) = 2(-2)^3 - (-2)^2 + 3 = -16 - 4 + 3 = -17 \neq 0$

$\therefore$ $x + 2$ is not a zero of $p(x)$.

7. We have, $x^2 + 2x - 15 = x^2 + 5x - 3x - 15$

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

$\therefore$ Factors of $x^2 + 2x - 15$ are $(x + 5)$ and $(x - 3)$.

8. Product of $(lx + my)$ and $(lx - my) = (lx + my)(lx - my)$

$= (lx)^2 - (my)^2 = l^2x^2 - m^2y^2$

9. We have, $a^3 - b^3 + 3a^2b - 3ab^2$

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

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

10. $3x + \pi = 0 \Rightarrow 3x = -\pi \Rightarrow x = -\frac{\pi}{3}$.

$\therefore$ $x = -\frac{\pi}{3}$ is the zero of the polynomial $3x + \pi$.

11. $f(x) = 7x^2 - 3x + 7$

Now, $f(2) = 7(2)^2 - 3(2) + 7 = 28 - 6 + 7 = 29$

Also, $f(-1) = 7(-1)^2 - 3(-1) + 7 = 7 + 3 + 7 = 17$

Also, $f(0) = 7$

$\therefore$ $f(2) + f(-1) + f(0) = 29 + 17 + 7 = 53$

12. We have, $\left(y - \frac{1}{y}\right)\left(y + \frac{1}{y}\right)\left(y^2 + \frac{1}{y^2}\right)\left(y^4 + \frac{1}{y^4}\right)$

$= \left(y^2 - \frac{1}{y^2}\right)\left(y^2 + \frac{1}{y^2}\right)\left(y^4 + \frac{1}{y^4}\right)$ $[\because (a + b)(a - b) = a^2 - b^2]$

$= \left(y^4 - \frac{1}{y^4}\right)\left(y^4 + \frac{1}{y^4}\right) = \left(y^8 - \frac{1}{y^8}\right)$

13. The given polynomial can be written as

$2x^4 + 0 \cdot x^3 + 3x^2 - 7x + 5$

$\therefore$ Coefficient of $x = -7$

And coefficient of $x^3 = 0$

14. We have, $p(t) = t^3 - 3t^2 + t - 4$

$\therefore$ $p(1) = 1^3 - 3(1)^2 + 1 - 4 = 1 - 3 + 1 - 4 = -5$ and

$p(-1) = (-1)^3 - 3(-1)^2 + (-1) - 4 = -1 - 3 - 1 - 4 = -9$

15. We have, $p(y) = 5y - 1$

$p\left(\frac{-1}{2}\right) = 5\left(\frac{-1}{2}\right) - 1 = \frac{-5}{2} - 1 = \frac{-7}{2} \neq 0$

$\therefore$ $\frac{-1}{2}$ is not a zero of $p(y) = 5y - 1$.

$p\left(\frac{1}{5}\right) = 5\left(\frac{1}{5}\right) - 1 = 1 - 1 = 0$

$\therefore$ $\frac{1}{5}$ is a zero of $p(y) = 5y - 1$

16. We have, $4x^2 + y^2 = 40$ and $xy = 6$

Now, consider $(2x + y)^2 = (2x)^2 + 2(2x)(y) + (y)^2$

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

$= (40) + 4(6) = 40 + 24 = 64 = (8)^2$

Therefore, $2x + y = 8$.

17. We have, $(2a + b) = 12$ ... (i)

Cubing both sides of (i), we get

$(2a + b)^3 = (12)^3$

$\Rightarrow$ $(2a)^3 + b^3 + 3 \times 2a \times b(2a + b) = 1728$

$\Rightarrow$ $8a^3 + b^3 + 3 \times 2 \times 15(12) = 1728$

[Substituting $ab = 15$ and $(2a + b) = 12$]

$\Rightarrow$ $8a^3 + b^3 + 1080 = 1728$

$\Rightarrow$ $8a^3 + b^3 = 1728 - 1080 = 648$.

$\Rightarrow$ $8a^3 + b^3 = 648$.

18. We have, $p(x) = x^n - a^n$

$P(a) = a^n - a^n = 0$, for any value of a.

$\therefore$ $p(a) = 0$, for any value of a.

19. (i) Let $p(x) = 2x^2 + 7x + 6$

By splitting the middle term, we get

$p(x) = 2x^2 + 3x + 4x + 6$

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

(ii) Let $p(x) = 6x^2 + 7x - 10$

By splitting the middle term, we get

$p(x) = 6x^2 + 12x - 5x - 10$

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

20. We have, $\frac{36}{25}x^4 - \frac{y^4}{16} = \left(\frac{6}{5}x^2\right)^2 - \left(\frac{y^2}{4}\right)^2$

$= \left(\frac{6}{5}x^2 + \frac{y^2}{4}\right)\left(\frac{6}{5}x^2 - \frac{y^2}{4}\right)$

$= \left(\frac{6}{5}x^2 + \frac{y^2}{4}\right)\left[\left(\sqrt{\frac{6}{5}}x\right)^2 - \left(\frac{y}{2}\right)^2\right]$

$= \left(\frac{6}{5}x^2 + \frac{y^2}{4}\right)\left[\left(\sqrt{\frac{6}{5}}x + \frac{y}{2}\right)\left(\sqrt{\frac{6}{5}}x - \frac{y}{2}\right)\right]$

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

$= \left(\frac{6}{5}x^2 + \frac{y^2}{4}\right)\left(\frac{\sqrt{30}}{5}x + \frac{y}{2}\right)\left(\frac{\sqrt{30}}{5}x - \frac{y}{2}\right)$

21. Let l units be the length and b units be the breadth of a rectangle.

Perimeter $= 2(l + b) = 24$

i.e., $l + b = 12$ ... (1)

Also, we are given that $l = b + 4$

i.e., $l - b = 4$ ... (2)

From (1) and (2), we get

$(l + b)^2 - (l - b)^2 = (12)^2 - (4)^2$

$\Rightarrow \{(l + b) + (l - b)\}\{(l + b) - (l - b)\} = (12 + 4)(12 - 4)$

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

$\Rightarrow (2l)(2b) = (16)(8)$

$\Rightarrow 4(l \times b) = 128 \Rightarrow lb = 32$

Therefore, the area of the rectangle is 32 square units.

22. We have, $(x - y)^2 - 9(x^2 - y^2) + 20(x + y)^2$

$= (x - y)^2 - 9(x + y)(x - y) + 20(x + y)^2$

$= (x - y)^2 - 4(x + y)(x - y) - 5(x + y)(x - y) + 20(x + y)^2$

$= (x - y)[x - y - 4x - 4y] - 5(x + y)[x - y - 4x - 4y]$

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

$= (-5y - 3x)[x - y - 5(x + y)] = -(5y + 3x)(-4x - 6y)$

$= (5y + 3x)(4x + 6y) = 2(2x + 3y)(5y + 3x)$

23. (i) We have, $27y^3 - 27y^2 + 9y - 1$

$= (3y)^3 - 3 \cdot (3y)^2 \cdot 1 + 3 \cdot 3y \cdot 1^2 - 1^3 = (3y - 1)^3$

$= (3y - 1)(3y - 1)(3y - 1)$

(ii) $40x^3 - 135 = 5(8x^3 - 27) = 5[(2x)^3 - 3^3]$

$= 5(2x - 3)[(2x)^2 + 2x \cdot 3 + 3^2]$

$= 5(2x - 3)(4x^2 + 6x + 9)$

24. We have, $(2y + x)^2 (y - 2x) + (2x + y)^2 (2x - y)$

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

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

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

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

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

25. We have, $(3x - 1)^3 = 6a_3x^3 + a_2x^2 + a_1x + a_0$

$\Rightarrow (3x)^3 - (1)^3 - 3 \times 3x \times 1(3x - 1) = 6a_3x^3 + a_2x^2 + a_1x + a_0$

$[\therefore (a - b)^3 = a^3 - b^3 - 3ab(a - b)]$

$\Rightarrow 27x^3 - 1 - 9x(3x - 1) = 6a_3x^3 + a_2x^2 + a_1x + a_0$

$\Rightarrow 27x^3 - 27x^2 + 9x - 1 = 6a_3x^3 + a_2x^2 + a_1x + a_0$

Comparing the coefficient of x^3, x^2, x and x^0, we get

$6a_3 = 27 \Rightarrow a_3 = 9/2$, $a_2 = -27$, $a_1 = 9$ and $a_0 = -1$

Now, $a_3 + a_2 + a_1 + a_0 = \frac{9}{2} - 27 + 9 - 1$

$= \frac{9}{2} - 19 = \frac{9 - 38}{2} = \frac{-29}{2}$

26. We have, $(x + 7)^3 = x^3 + (7)^3 + 3(x)(7)(x + 7)$

$= x^3 + 343 + 21x(x + 7)$ $[\because (a + b)^3 = a^3 + b^3 + 3ab(a + b)]$

$= x^3 + 21x^2 + 147x + 343$

$\therefore$ Coefficient of x in the expansion of $(x + 7)^3$ is 147

27. (i) $-8y^{100}$

(ii) $3z^{50} + z^2$

(iii) $9x^{205} - 7x^3 + 4$

28. (i) The given polynomial can be written as, $\frac{x^2}{2} - 2x^{-2}$.

It is not a polynomial, because one of the exponents of x is -2, which is not a whole number.

(ii) The given polynomial can be written as $\sqrt{2}x^{1/2} - 1$

It is not a polynomial, because exponent of x is $\frac{1}{2}$, which is not a whole number.

(iii) The given polynomial can be written as $x^2 + 3x^{\frac{3}{2} - \frac{1}{2}}$

i.e., $x^2 + 3x$

It is a polynomial, because each exponent of x is a whole number.

(iv) We have, $\frac{x - 1}{x + 1}$

It is not a polynomial because it is not defined for $x = -1$.

29. Let $p(x) = x^3 - 12x^2 + 47x - 60$

Factors of 60 are ± 1, ± 2, ± 3, ± 4, ± 5, ± 6, ± 10, ± 12, ± 15, ± 20, ± 30, ± 60

By trial method, we see that

$p(3) = (3)^3 - 12(3)^2 + 47(3) - 60 = 27 - 108 + 141 - 60$

$= 168 - 168 = 0$

$p(4) = 4^3 - 12(4)^2 + 47(4) - 60 = 64 - 192 + 188 - 60 = 0$

$p(5) = 5^3 - 12(5)^2 + 47(5) - 60 = 125 - 300 + 235 - 60 = 0$

$\therefore$ By factor theorem, $(x - 3)$, $(x - 4)$ and $(x - 5)$ are the factors of $p(x)$.

Thus, $x^3 - 12x^2 + 47x - 60 = (x - 3)(x - 4)(x - 5)$

30. We have, $x^{16} - y^{16} = \{(x^8)^2 - (y^8)^2\}$

$= (x^8 - y^8)(x^8 + y^8) = \{(x^4)^2 - (y^4)^2\}(x^8 + y^8)$

$= (x^4 - y^4)(x^4 + y^4)(x^8 + y^8) = \{(x^2)^2 - (y^2)^2\}(x^4 + y^4)(x^8 + y^8)$

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

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

31. We have, $\left(\frac{x}{3} + \frac{y}{5}\right)^3 - \left(\frac{x}{3} - \frac{y}{5}\right)^3$

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

$[\because a^3 - b^3 = (a - b)(a^2 + ab + b^2)]$

$$= \frac{2y}{5}\left[\left(\frac{x^2}{9} + \frac{y^2}{25} + 2 \times \frac{x}{3} \times \frac{y}{5}\right) + \left(\frac{x^2}{9} - \frac{y^2}{25}\right) + \left(\frac{x^2}{9} + \frac{y^2}{25} - 2 \times \frac{x}{3} \times \frac{y}{5}\right)\right]$$

$$= \frac{2y}{5}\left[\frac{x^2}{9} + \frac{x^2}{9} + \frac{x^2}{9} + \frac{y^2}{25} - \frac{y^2}{25} + \frac{y^2}{25} + \frac{2xy}{15} - \frac{2xy}{15}\right]$$

$$= \frac{2y}{5}\left(\frac{3x^2}{9} + \frac{y^2}{25}\right) = \frac{2y}{5}\left(\frac{x^2}{3} + \frac{y^2}{25}\right)$$

32. Let $p(x) = 2x^3 - 5x^2 + ax + b$

$\because$ $x = 2$ and $x = 0$ are zeroes of $p(x)$.

$\therefore$ $p(2) = 0$ and $p(0) = 0$

$p(2) = 0 \Rightarrow 2(2)^3 - 5(2)^2 + 2a + b = 0$

$\Rightarrow \quad 16 - 20 + 2a + b = 0 \Rightarrow 2a + b = 4$ ...(i)

$p(0) = 0 \Rightarrow 2(0)^3 - 5(0)^2 + a \cdot 0 + b = 0$

$\Rightarrow \quad 0 - 0 + 0 + b = 0 \Rightarrow b = 0$

Put $b = 0$ in (i)

$\therefore \quad 2a + 0 = 4 \Rightarrow a = 2$

$\therefore \quad a = 2$ and $b = 0$.

33. (i) We have, $x + \frac{1}{x} = 6$

$\Rightarrow \left(x + \frac{1}{x}\right)^2 = 6^2$ [On squaring both sides]

$\Rightarrow x^2 + \frac{1}{x^2} + 2 \times x \times \frac{1}{x} = 36$

$\Rightarrow x^2 + \frac{1}{x^2} + 2 = 36 \Rightarrow x^2 + \frac{1}{x^2} = 36 - 2 = 34$

(ii) We have, $x^2 + \frac{1}{x^2} = 34$

$\Rightarrow \left(x^2 + \frac{1}{x^2}\right)^2 = (34)^2$ [On squaring both sides]

$\Rightarrow (x^2)^2 + \left(\frac{1}{x^2}\right)^2 + 2 \times x^2 \times \frac{1}{x^2} = 1156$

$\Rightarrow x^4 + \frac{1}{x^4} + 2 = 1156 \Rightarrow x^4 + \frac{1}{x^4} = 1156 - 2 = 1154$

34 L.H.S. = $[(a + b + c)^3 - a^3] - (b^3 + c^3)$

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

$\left[\because x^3 - y^3 = (x - y)(x^2 + y^2 + xy) \text{ and } x^3 + y^3 = (x + y)(x^2 + y^2 - xy)\right]$

$= (b + c)[a^2 + b^2 + c^2 + 2ab + 2bc + 2ca + a^2 + a^2 + ab + ac]$
$- (b + c)(b^2 + c^2 - bc)$

$= (b + c)(3a^2 + 3ab + 3ac + 3bc) = (b + c)[3(a^2 + ab + ac + bc)]$

$= 3(b + c)[a(a + b) + c(a + b)] = 3(a + b)(b + c)(c + a) =$ R.H.S.

35. R.H.S.

$= \frac{1}{2}(x + y + z)[(x - y)^2 + (y - z)^2 + (z - x)^2]$

$= \frac{1}{2}(x + y + z)[(x^2 + y^2 - 2xy) + (y^2 + z^2 - 2yz)$
$+ (z^2 + x^2 - 2zx)]$

$= \frac{1}{2}(x + y + z)(x^2 + y^2 + y^2 + z^2 + z^2 + x^2 - 2xy - 2yz - 2zx)$

$= \frac{1}{2}(x + y + z)[2(x^2 + y^2 + z^2 - xy - yz - zx)]$

$= 2 \times \frac{1}{2} \times (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$

$= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$

$= x^3 + y^3 + z^3 - 3xyz =$ L.H.S.

Hence, verified.