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SAMPLE PAPER 03 - CHAPTER 02 POLYNOMIALS (2025-26)

SUBJECT: MATHEMATICS **MAX. MARKS:** 40

CLASS: X **DURATION:** 1½ hrs

General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five Sections A, B, C, D and E.
3. **Section A** comprises of 10 MCQs of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
4. There is no overall choice.
5. Use of Calculators is not permitted.

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. If α and β are zeroes of $p(x) = x^2 - 5x + k$ and $\alpha - \beta = 1$, then k equals:

(a) 5 (b) 6 (c) 7 (d) 8

2. The zeroes of polynomial $x^2 - 3$ are:

(a) 3 and -3 (b) √3 and -√3 (c) 3 and √3 (d) 1 and 3

3. If product of zeroes of polynomial $ax^2 - 6x - 6$ is 4, then a equals:

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

4. A quadratic polynomial whose zeroes are 3/5 and -1/2 is:

(a) $10x^2 - x - 3$ (b) $10x^2 + x - 3$ (c) $10x^2 + x + 3$ (d) $10x^2 - x + 3$

5. If α, β are zeroes of polynomial $t^2 - 4t + 3$, then $\alpha^2 + \beta^2$ equals:

(a) 10 (b) 12 (c) 14 (d) 16

6. If sum of zeroes of polynomial $2x^2 + kx + 11$ is -3/2, then k equals:

(a) -3 (b) 3 (c) -6 (d) 6

7. The graph of y = p(x) is given, where p(x) is a polynomial. The number of zeroes of p(x) is:
[Graph shows parabola cutting x-axis at 2 points]

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

8. If α and β are zeroes of $x^2 + 4x + 3$, then $1/\alpha + 1/\beta$ equals:

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

9. **Assertion (A):** If sum and product of zeroes of quadratic polynomial are -3 and 2 respectively, then polynomial is $x^2 + 3x + 2$.
Reason (R): Quadratic polynomial with given zeroes is x^2 - (sum)x + product.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

10. **Assertion (A):** Degree of polynomial $p(x) = 2x - x^2$ is 1.

Reason (R): Degree is the highest power of variable in polynomial.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. Find the quadratic polynomial sum of whose zeroes is 0 and product is -4.

12. If one zero of polynomial $3x^2 - 8x + 2k + 1$ is 7 times the other, find k.

13. If α and β are zeroes of polynomial $x^2 - 2x + 3$, find $\alpha^2\beta + \alpha\beta^2$.

14. Find a polynomial whose zeroes are $3 + \sqrt{2}$ and $3 - \sqrt{2}$.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Find the zeroes of quadratic polynomial $x^2 + 7x + 10$ and verify the relationship between zeroes and coefficients.

16. If α and β are zeroes of polynomial $x^2 + x - 6$, find a polynomial whose zeroes are 2α and 2β.

17. If one zero of polynomial $(a^2 + 9)x^2 + 13x + 6a$ is reciprocal of the other, find a.

SECTION – D

Question 18 carries 5 marks.

18. If α and β are zeroes of polynomial $x^2 - 1$, find:

(a) $\alpha^3 + \beta^3$ (2 marks)

(b) A quadratic polynomial whose zeroes are α^2 and β^2 (3 marks)

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. A water tank design requires a parabolic shape. The height h (in meters) of water from base at distance x meters from center is given by $h(x) = -x^2 + 4x$.

(i) Find the zeroes of polynomial h(x). (1 mark)

(ii) What is the sum of zeroes? (1 mark)

(iii) At what distance from center does water level reach maximum height? (2 marks)

20. A manufacturer finds that revenue R(x) and cost C(x) for producing x units are: $R(x) = 5x$ and $C(x) = x^2 + x$. Profit $P(x) = R(x) - C(x)$.

(i) Find profit polynomial P(x). (1 mark)

(ii) Find the zeroes of P(x). (2 marks)

(iii) What does positive zero represent? (1 mark)

✓ DETAILED SOLUTIONS - SAMPLE PAPER 03

SECTION – A (SOLUTIONS)

Solution 1:

$\alpha + \beta = 5$, $\alpha\beta = k$

Given: $\alpha - \beta = 1$

$(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$

$1 = 25 - 4k$

$k = 6$

Answer: (b) 6

Solution 2:

$x^2 - 3 = 0$

$x^2 = 3$

$x = \pm\sqrt{3}$

Answer: (b) √3 and -√3

Solution 3:

Product = $c/a = -6/a = 4$

$-6 = 4a$

$a = -3/2$

Answer: (a) -3/2

Solution 4:

Sum = $3/5 + (-1/2) = 6/10 - 5/10 = 1/10$

Product = $(3/5)(-1/2) = -3/10$

Polynomial = $x^2 - (1/10)x + (-3/10)$

Multiply by 10: $10x^2 - x - 3$

Answer: (a) $10x^2 - x - 3$

Solution 5:

For $t^2 - 4t + 3$: $\alpha + \beta = 4$, $\alpha\beta = 3$

$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = 16 - 6 = 10$

Answer: (a) 10

Solution 6:

Sum = -k/2 = -3/2

k = 3

Answer: (b) 3

Solution 7:

Parabola cuts x-axis at 2 distinct points = 2 zeroes

Answer: (c) 2

Solution 8:

For $x^2 + 4x + 3$: $\alpha + \beta = -4$, $\alpha\beta = 3$

$1/\alpha + 1/\beta = (\alpha + \beta)/\alpha\beta = -4/3$

Answer: (b) -4/3

Solution 9:

Using formula: x^2 - (sum)x + product = x^2 - (-3)x + 2 = $x^2 + 3x + 2$ ✓

Both A and R are true, R explains A

Answer: (a) Both A and R are true and R is the correct explanation of A

Solution 10:

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

Highest power = 2, so degree = 2, not 1

Assertion FALSE, Reason TRUE

Answer: (d) A is false but R is true

SECTION – B (SOLUTIONS)

Solution 11:

Sum = 0, Product = -4

Polynomial = $x^2 - 0 \cdot x + (-4) = x^2 - 4$

$x^2 - 4$

Solution 12:

Let zeroes be α and 7α

Sum: $\alpha + 7\alpha = 8/3$, so $8\alpha = 8/3$, $\alpha = 1/3$

Product: $\alpha(7\alpha) = 7\alpha^2 = (2k+1)/3$

$7(1/9) = (2k+1)/3$

$7/9 = (2k+1)/3$

$7/3 = 2k+1$

$k = 2/3$

k = 2/3

Solution 13:

For $x^2 - 2x + 3$: $\alpha + \beta = 2$, $\alpha\beta = 3$

$\alpha^2\beta + \alpha\beta^2 = \alpha\beta(\alpha + \beta) = 3(2) = 6$

Value = 6

Solution 14:

Sum = $(3 + \sqrt{2}) + (3 - \sqrt{2}) = 6$

Product = $(3 + \sqrt{2})(3 - \sqrt{2}) = 9 - 2 = 7$

$x^2 - 6x + 7$

SECTION – C (SOLUTIONS)

Solution 15:

$x^2 + 7x + 10 = 0$

$(x + 2)(x + 5) = 0$

$x = -2$ or $x = -5$

Verification:

Sum = $-2 + (-5) = -7 = -(7)/1$ ✓

Product = $(-2)(-5) = 10 = 10/1$ ✓

Zeroes: -2 and -5

Solution 16:

For $x^2 + x - 6$: $\alpha + \beta = -1$, $\alpha\beta = -6$

New zeroes: 2α and 2β

Sum = $2\alpha + 2\beta = 2(\alpha + \beta) = 2(-1) = -2$

Product = $2\alpha \times 2\beta = 4\alpha\beta = 4(-6) = -24$

$x^2 + 2x - 24$

Solution 17:

Let zeroes be α and 1/α

Product = $6a/(a^2 + 9) = 1$

$6a = a^2 + 9$

$a^2 - 6a + 9 = 0$

$(a - 3)^2 = 0$

$a = 3$

$a = 3$

SECTION – D (SOLUTIONS)

Solution 18(a):

For $x^2 - 1$: $\alpha + \beta = 0$, $\alpha\beta = -1$

$\alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$

$= 0^3 - 3(-1)(0) = 0$

$\alpha^3 + \beta^3 = 0$

Solution 18(b):

$x^2 - 1 = 0$ gives $\alpha = 1$, $\beta = -1$

$\alpha^2 = 1$, $\beta^2 = 1$

New zeroes are both 1

Sum = 1 + 1 = 2

Product = 1 × 1 = 1

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

SECTION – E (SOLUTIONS)

Solution 19(i):

$-x^2 + 4x = 0$

$-x(x - 4) = 0$

$x = 0$ or $x = 4$

Zeroes: 0 and 4

Solution 19(ii):

Sum = 0 + 4 = 4

Sum = 4

Solution 19(iii):

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

Maximum at x = 2 (vertex of parabola)

Or: By calculus/symmetry, maximum between zeroes at x = (0+4)/2 = 2

Maximum height at x = 2 meters from center

Solution 20(i):

$P(x) = R(x) - C(x) = 5x - (x^2 + x) = -x^2 + 4x$

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

Solution 20(ii):

$-x^2 + 4x = 0$

$-x(x - 4) = 0$

x = 0 or x = 4

Zeroes: 0 and 4

Solution 20(iii):

Positive zero (x = 4) represents break-even point where profit = 0

Producing 4 units results in zero profit

Break-even at 4 units