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PRACTICE PAPER 02 - CHAPTER 02 POLYNOMIALS (2023-24)
(ANSWERS)

SUBJECT: MATHEMATICS **MAX. MARKS : 40**
CLASS : X **DURATION : $1\frac{1}{2}$ hrs**

General Instructions:

(i). **All** questions are compulsory.
(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.
(iii). **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** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
(iv). There is no overall choice.
(v). Use of Calculators is not permitted

SECTION – A
Questions 1 to 10 carry 1 mark each.

1. If one of the zeroes of the quadratic polynomial $(k – 1)x^2 + kx + 1$ is –3, then the value of k is
(a) 4/3 (b) -4/3 (c) 2/3 (d) -2/3
Ans: (a) $(k – 1)x^2 + kx + 1$
One zero is – 3, so it must satisfy the equation and make it zero.
$\therefore (k – 1) (– 3)^2 + k(– 3) + 1 = 0$
$\Rightarrow 9k – 9 – 3k + 1 = 0$
$\Rightarrow 6k – 8 = 0 \Rightarrow k = \frac{8}{6} = \frac{4}{3}$

2. If the zeroes of the quadratic polynomial $x^2 + (a + 1) x + b$ are 2 and –3, then
(a) a = –7, b = –1 (b) a = 5, b = –1 (c) a = 2, b = –6 (d) a = 0, b = –6
Ans: (d) $x^2 + (a + 1)x + b$
$\because$ x = 2 is a zero and x = – 3 is another zero
$\therefore (2)^2 + (a + 1)^2 + b = 0$
and $(– 3)^2 + (a + 1) (– 3) + b = 0$
$\Rightarrow 4 + 2a + 2 + b = 0$ and $9 – 3a – 3 + b = 0$
$\Rightarrow 2a + b = – 6$ ...(i) and $– 3a + b = – 6$ ...(ii)
Solving (i) and (ii), we get 5a = 0
$\Rightarrow$ a = 0 and b = – 6.

3. Zeroes of a polynomial p(x) can be determined graphically. No. of zeroes of a polynomial is equal to no. of points where the graph of polynomial
(a) intersects y-axis (b) intersects x-axis
(c) intersects y-axis or intersects x-axis (d) none of these
Ans: (b) Intersects x-axis

4. If graph of a polynomial p(x) does not intersects the x-axis but intersects y-axis in one point, then no. of zeroes of the polynomial is equal to
(a) 0 (b) 1 (c) 0 or 1 (d) none of these
Ans : (a) 0

5. If $p(x) = ax^2 + bx + c$ and a + b + c = 0, then one zero is
(a) -b/a (b) c/a (c) b/c (d) none of these
Ans: (b) p(1) = 0; $a(1)^2 + b(1) + c = 0 \Rightarrow a + b + c = 0 \therefore$ one zero (a) = 1
$\alpha\beta$ = product of zeroes = c/a
$\Rightarrow 1. \beta = c/a \Rightarrow \beta = c/a$

∴ zeroes are 1 and c/a

6. The number of polynomials having zeroes as –2 and 5 is
(a) 1 (b) 2 (c) 3 (d) more than 3
Ans: (d) ∵ $x^2 - 3x - 10$, $2x^2 - 6x - 20$, $\frac{1}{2}x^2 - \frac{3}{2}x - 5$, $3x^2 - 9x - 30$ etc.,
have zeroes – 2 and 5.

7. The quadratic polynomial, the sum of whose zeroes is –5 and their product is 6, is
(a) $x^2 + 5x + 6$ (b) $x^2 - 5x + 6$ (c) $x^2 - 5x - 6$ (d) $-x^2 + 5x + 6$
Ans: (a), sum of zeroes = –5, product = 6
Polynomial is, x^2 – (sum of zeroes) x + product of zeroes
$\Rightarrow x^2 - (-5)x + 6 = x^2 + 5x + 6$.

8. If zeroes of $p(x) = 2x^2 - 7x + k$ are reciprocal of each other, then value of k is
(a) 1 (b) 2 (c) 3 (d) 4
Ans: (*b*) Zeroes are reciprocal of each other
∴ Product of zeroes = 1 $\Rightarrow \frac{k}{2} = 1 \Rightarrow k = 2$

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

9. **Assertion (A):** $x^2 + 4x + 5$ has two real zeroes.
Reason (R): A quadratic polynomial can have at the most two zeroes.
Ans : $p(x) = 0 \Rightarrow x^2 + 4x + 5 = 0$
Discriminant, $D = b^2 - 4ac$
$= 4^2 - 4 \times 1 \times 5$
$= 16 - 20 = -4 < 0$
Therefore, no real zeroes are there.
(d) Assertion (A) is false but reason (R) is true.

10. **Assertion (A):** If the sum of the zeroes of the quadratic polynomial $x^2 - 2kx + 8$ are is 2 then value of k is 1.
Reason (R): Sum of zeroes of a quadratic polynomial $ax^2 + bx + c$ is $-b/a$
Ans : Relation is true as we know that *Sum of zeroes* $= \frac{-b}{a}$
$\Rightarrow \frac{-(-2k)}{1} = 2 \Rightarrow k = 1$
So, Assertion is true.
Correct option is (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. Find the zeroes of $\sqrt{3}x^2 + 10x + 7\sqrt{3}$

Ans: $\sqrt{3}x^2 + 10x + 7\sqrt{3} = \sqrt{3}x^2 + 3x + 7x + 7\sqrt{3}$
$= \sqrt{3}x(x + \sqrt{3}) + 7(x + \sqrt{3})$
$= (\sqrt{3}x + 7)(x + \sqrt{3})$
For zeroes of the polynomial,
$(\sqrt{3}x + 7)(x + \sqrt{3}) = 0$
$\Rightarrow \sqrt{3}x + 7 = 0$ or $x + \sqrt{3} = 0$
$\Rightarrow \sqrt{3}x = -7$ or $x = -\sqrt{3}$
$\Rightarrow x = -7/\sqrt{3}$ or $x = -\sqrt{3}$

12. Find a quadratic polynomial whose zeroes are –9 and $-\frac{1}{9}$.

Ans: Sum of zeroes = $-9+\left(-\frac{1}{9}\right)=\frac{-81-1}{9}=\frac{-82}{9}$

Product of zeroes = $-9\times\left(-\frac{1}{9}\right)=1$

Quadratic polynomial = x^2 – (sum of zeroes) x + product of zeroes

$= x^2-\left(\frac{-82}{9}\right)x+1=9x^2+82x+9$

13. If the sum of the zeroes of the quadratic polynomial $ky^2 + 2y - 3k$ is equal to twice their product, find the value of k.
Ans: $p(y) = ky^2 + 2y - 3k$
$a = k, b = 2, c = -3k$
According to the question, Sum of zeroes = 2 × product of zeroes

$\Rightarrow \frac{-b}{a}=2\times\frac{c}{a}\Rightarrow\frac{-2}{k}=2\times\frac{-3k}{k}$

$\Rightarrow \frac{2}{k}=6\Rightarrow k=\frac{1}{3}$

14. If the product of the zeroes of the polynomial $ax^2 - 6x - 6$ is 4, then find the value of a. Also find the sum of zeroes of the polynomial.
Ans: $p(x) = ax^2 - 6x - 6$
Product of zeroes = 4

$\Rightarrow \frac{c}{a}=4\Rightarrow\frac{-6}{a}=4\Rightarrow a=\frac{-6}{4}=\frac{-3}{2}$

Now sum of zeroes = $\frac{-b}{a}=\frac{-(-6)}{\frac{-3}{2}}=-4$

$\therefore\ a=\frac{-3}{2}$ and sum of zeroes = – 4

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Find the zeroes of $p(x) = 4x^2 + 24x + 36$ quadratic polynomials and verify the relationship between the zeroes and their coefficients.
Ans: $p(x) = 4x^2 + 24x + 36$
For zeroes, $p(x) = 0$
$\Rightarrow\ 4x^2 + 24x + 36 = 0\ \Rightarrow\ 4(x^2 + 6x + 9) = 0$
$\Rightarrow\ 4(x^2 + 3x + 3x + 9) = 0\ \Rightarrow\ (x + 3)(x + 3) = 0$
$\Rightarrow\ x + 3 = 0$ or $x + 3 = 0\ \Rightarrow\ x = -3, x = -3$
$\therefore$ Zeroes are –3, –3.

Now $a = 4$, $b = 24$, $c = 36$

$\frac{-b}{a} = \frac{-24}{4} = -6$

Sum of zeroes = –3 + (–3) = –6

$\Rightarrow$ Sum of zeroes = $\frac{-b}{a}$

Also, $\frac{c}{a} = \frac{36}{4} = 9$

and Product of zeroes = (–3) × (–3) = 9

$\Rightarrow$ Product of zeroes = $\frac{c}{a}$

16. If α and β are zeroes of the quadratic polynomial $4x^2 + 4x + 1$, then form a quadratic polynomial whose zeroes are 2α and 2β.

Ans : $p(x) = 4x^2 + 4x + 1$

$\because$ α, β are zeroes of $p(x)$

$\therefore$ $\alpha + \beta$ = sum of zeroes = $\frac{-b}{a}$

$\Rightarrow \alpha + \beta = \frac{-4}{4} = -1$ ...(i)

Also α. β = Product of zeroes = $\frac{c}{a}$

$\Rightarrow \alpha.\ \beta = \frac{1}{4}$ ...(ii)

Now a quadratic polynomial whose zeroes are 2α and 2β

x^2 – (sum of zeroes)x + Product of zeroes

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

$= x^2 - 2 \times (-1)x + 4 \times \frac{1}{4}$ [Using eq. (i) and (ii)]

$= x^2 + 2x + 1$

17. If α, β re zeros of quadratic polynomial $2x^2 + 5x + k$, find the value of k such that $(\alpha + \beta)^2 - \alpha\beta = 24$

Ans: We know that $\alpha + \beta = -b/a$ and $\alpha\beta = c/a$

Given, $2x^2 + 5x + k = 0$

$\Rightarrow a = 2, b = 5, c = k$

Given that $(\alpha + \beta)^2 - \alpha\beta = 24$

$\Rightarrow (-b/a)^2 - c/a = 24$

$\Rightarrow b^2 - ca = 24a^2$ (Multiplying both sides by a^2)

$\Rightarrow 5^2 - 2k = 24(2)^2$

$\Rightarrow 2k = 25 - 96 = -71$

$\therefore k = -71/2$

SECTION – D

Questions 18 carry 5 marks.

18. If α, β are zeroes of polynomial $p(x) = 5x^2 + 5x + 1$ then find the value of

(i) $\alpha^2 + \beta^2$ (ii) $\alpha^{-1} + \beta^{-1}$ (iii) $\alpha^3 + \beta^3$

Ans: Given polynomial is $p(x) = 5x^2 + 5x + 1$

Here $a = 5$, $b = 5$, $c = 1$

$\therefore\ \alpha + \beta$ = sum of zeroes = $\frac{-b}{a}$ $\Rightarrow$ $\alpha + \beta = \frac{-5}{5} = -1$

Also $\alpha.\ \beta$ = Product of zeroes = $\frac{c}{a}$ $\Rightarrow$ $\alpha.\ \beta = \frac{1}{5}$

(i) $\alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta = (-1)^2 - 2\times\frac{1}{5} = 1 - \frac{2}{5} = \frac{3}{5}$

(ii) $\alpha^{-1} + \beta^{-1} = \frac{1}{\alpha} + \frac{1}{\beta} = \frac{\alpha+\beta}{\alpha\beta} = -5$

(iii) $\alpha^3 + \beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta) = (-1)^3 - 3\times\frac{1}{5}\times(-1) = -1 + \frac{3}{5} = \frac{-2}{5}$

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Case Study-1 : **Lusitania Bridge**

Quadratic polynomial can be used to model the shape of many architectural structures in the world. The Lusitania Bridge is a bridge in Merida, Spain. The bridge was built over the Guadiana River in 1991 by a Spanish consortium to take the road traffic from the Romano bridge. The architect was Santiago Calatrava. The bridge takes its name from the fact that Emerita Augusta (present day Merida) was the former capital of Lusitania, an ancient Roman province.

Based on the above information, answer the following questions.

(i) If the Arch is represented by $10x^2 - x - 3$, then find its zeroes. (2)

(ii) Find the quadratic polynomial whose sum of zeroes is 0 and product of zeroes is 1. (2)

OR

(ii) Find the sum and product of zeroes of the polynomial $\sqrt{3}\,x^2 - 14x + 8\sqrt{3}$ (2)

Ans: (i) Put $10x^2 - x - 3 = 0$

$\Rightarrow 10x^2 - 6x + 5x - 3 = 0$

$\Rightarrow 2x(5x - 3) + 1(5x - 3)$

$\Rightarrow (2x + 1)(5x - 3) = 0$

$\Rightarrow x = -1/2, 3/5$

(ii) Sum of zeroes = 0 and Product of zeroes = 1

Required polynomials = $k[x^2 - (\text{sum})x + \text{Product}]$

$= k(x^2 - 0x + 1)$

$= k(x^2 + 1)$

OR

(ii) Here $a = \sqrt{3}$, $b = -14$ and $c = 8\sqrt{3}$

Sum of zeroes $= \frac{-b}{a} = \frac{-(-14)}{\sqrt{3}} = \frac{14}{\sqrt{3}}$

Product of zeroes $= \frac{c}{a} = \frac{8\sqrt{3}}{\sqrt{3}} = 8$

20. The figure given alongside shows the path of a diver, when she takes a jump from the diving board. Clearly it is a parabola. Annie was standing on a diving board, 48 feet above the water level. She took a dive into the pool. Her height (in feet) above the water level at any time 't' in seconds is given by the polynomial h(t) such that $h(t) = -16t^2 + 8t + k$.

(i) What is the value of k? (2)

(ii) At what time will she touch the water in the pool? (2)

OR

(ii) Rita's height (in feet) above the water level is given by another polynomial p(t) with zeroes -1 and 2. Then find p(t) (2)

Ans: (i) Initially, at $t = 0$, Annie's height is 48ft

So, at $t = 0$, h should be equal to 48

$h(0) = -16(0)^2 + 8(0) + k = 48 \Rightarrow k = 48$

(ii) When Annie touches the pool, her height = 0 feet

i.e. $-16t^2 + 8t + 48 = 0$ above water level

$2t^2 - t - 6 = 0$

$\Rightarrow 2t^2 - 4t + 3t - 6 = 0$

$2t(t - 2) + 3(t - 2) = 0$

$(2t + 3)(t - 2) = 0$

i.e. $t = 2$ or $t = -3/2$

Since time cannot be negative, so t = 2seconds

OR

(ii) $t = -1$ & $t = 2$ are the two zeroes of the polynomial p(t)

Then $p(t) = k(t + 1)(t - 2)$

When $t = 0$ (initially) $h_1 = 48$ft

$p(0) = k(0^2 - 0 - 2) = 48$

$\Rightarrow -2k = 48$

So the polynomial is $-24(t^2 - t - 2) = -24t^2 + 24t + 48$.