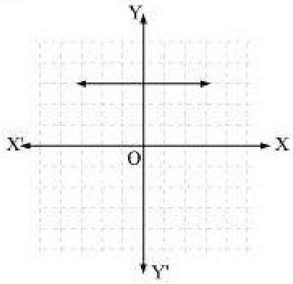
MATHS -10 (CH-02- POLYNOMIALS)

MATHS -10 (CH-02-2.1- POLYNOMIALS)

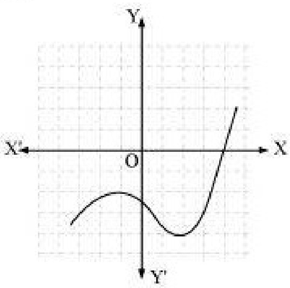
Question 1:

The graphs of $y = p(x)$ are given in following figure, for some polynomials $p(x)$. Find the number of zeroes of $p(x)$, in each case.

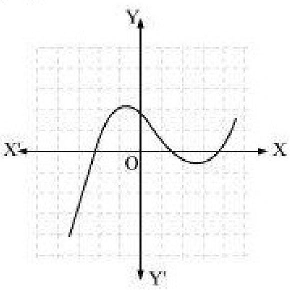
(i)



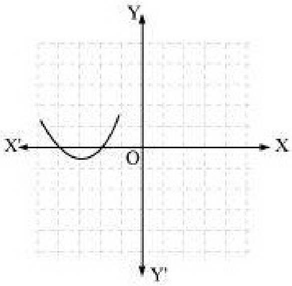
(ii)



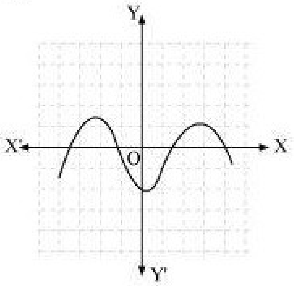
(iii)



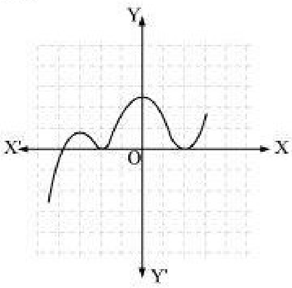
(iv)



(v)



(v)



Answer 1:

(i) The number of zeroes is 0 as the graph does not cut the x-axis at any point.
(ii) The number of zeroes is 1 as the graph intersects the x-axis at only 1 point.
(iii) The number of zeroes is 3 as the graph intersects the x-axis at 3 points.
(iv) The number of zeroes is 2 as the graph intersects the x-axis at 2 points.
(v) The number of zeroes is 4 as the graph intersects the x-axis at 4 points.
(vi) The number of zeroes is 3 as the graph intersects the x-axis at 3 points.

MATHS -10 (CH-02-2.2- POLYNOMIALS)

Question 1:

Find the zeroes of the following quadratic polynomials and verify the relationship between the zeroes and the coefficients.

(i) x^2-2x-8 (ii) $4s^2-4s+1$ (iii) $6x^2-3-7x$

(iv) $4u^2+8u$ (v) t^2-15 (vi) $3x^2-x-4$

Answer 1:

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

The value of x^2-2x-8 is zero when $x-4=0$ or $x+2=0$, i.e., when $x=4$ or $x=-2$

Therefore, the zeroes of x^2-2x-8 are 4 and −2.

Sum of zeroes = $4-2=2=\frac{-(-2)}{1}=\frac{-(\text{Coefficient of } x)}{\text{Coefficient of } x^2}$

Product of zeroes $=4\times(-2)=-8=\frac{(-8)}{1}=\frac{\text{Constant term}}{\text{Coefficient of } x^2}$

(ii) $4s^2-4s+1=(2s-1)^2$

The value of $4s^2-4s+1$ is zero when $2s-1=0$, i.e., $s=\frac{1}{2}$

Therefore, the zeroes of $4s^2-4s+1$ are $\frac{1}{2}$ and $\frac{1}{2}$.

Sum of zeroes = $\frac{1}{2}+\frac{1}{2}=1=\frac{-(-4)}{4}=\frac{-(\text{Coefficient of } s)}{(\text{Coefficient of } s^2)}$

Product of zeroes $=\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}=\frac{\text{Constant term}}{\text{Coefficient of } s^2}$

(iii) $6x^2-3-7x=6x^2-7x-3=(3x+1)(2x-3)$

The value of $6x^2-3-7x$ is zero when $3x+1=0$ or $2x-3=0$, i.e., $x=\frac{-1}{3}$ or $x=\frac{3}{2}$

Therefore, the zeroes of $6x^2-3-7x$ are $\frac{-1}{3}$ and $\frac{3}{2}$.

Sum of zeroes = $\frac{-1}{3}+\frac{3}{2}=\frac{7}{6}=\frac{-(-7)}{6}=\frac{-(\text{Coefficient of } x)}{\text{Coefficient of } x^2}$

Product of zeroes = $\frac{-1}{3}\times\frac{3}{2}=\frac{-1}{2}=\frac{-3}{6}=\frac{\text{Constant term}}{\text{Coefficient of } x^2}$

(iv) $4u^2+8u=4u^2+8u+0$

$=4u(u+2)$

The value of $4u^2+8u$ is zero when $4u=0$ or $u+2=0$, i.e., $u=0$ or $u=-2$

Therefore, the zeroes of $4u^2+8u$ are 0 and −2.

Sum of zeroes = $0+(-2)=-2=\frac{-(8)}{4}=\frac{-(\text{Coefficient of } u)}{\text{Coefficient of } u^2}$

Product of zeroes = $0\times(-2)=0=\frac{0}{4}=\frac{\text{Constant term}}{\text{Coefficient of } u^2}$

(v) $t^2 - 15$

$= t^2 - 0t - 15$

$= \left(t - \sqrt{15}\right)\left(t + \sqrt{15}\right)$

The value of $t^2 - 15$ is zero when $t - \sqrt{15} = 0$ or $t + \sqrt{15} = 0$, i.e., when $t = \sqrt{15}$ or $t = -\sqrt{15}$

Therefore, the zeroes of $t^2 - 15$ are $\sqrt{15}$ and $-\sqrt{15}$.

Sum of zeroes $= \sqrt{15} + \left(-\sqrt{15}\right) = 0 = \frac{-0}{1} = \frac{-\left(\text{Coefficient of } t\right)}{\left(\text{Coefficient of } t^2\right)}$

Product of zeroes $= \left(\sqrt{15}\right)\left(-\sqrt{15}\right) = -15 = \frac{-15}{1} = \frac{\text{Constant term}}{\text{Coefficient of } x^2}$

(vi) $3x^2 - x - 4$

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

The value of $3x^2 - x - 4$ is zero when $3x - 4 = 0$ or $x + 1 = 0$, i.e., when $x = \frac{4}{3}$ or $x = -1$

Therefore, the zeroes of $3x^2 - x - 4$ are $\frac{4}{3}$ and -1.

Sum of zeroes $= \frac{4}{3} + (-1) = \frac{1}{3} = \frac{-(-1)}{3} = \frac{-\left(\text{Coefficient of } x\right)}{\text{Coefficient of } x^2}$

Product of zeroes $= \frac{4}{3}(-1) = \frac{-4}{3} = \frac{\text{Constant term}}{\text{Coefficient of } x^2}$

MATHS -10 (CH-02-2.3- POLYNOMIALS)

Question 1:

Divide the polynomial $p(x)$ by the polynomial $g(x)$ and find the quotient and remainder in each of the following:

(i) $p(x) = x^3 - 3x^2 + 5x - 3, \quad g(x) = x^2 - 2$

(ii) $p(x) = x^4 - 3x^2 + 4x + 5, \quad g(x) = x^2 + 1 - x$

(iii) $p(x) = x^4 - 5x + 6, \quad g(x) = 2 - x^2$

Answer 1:

(i) $p(x) = x^3 - 3x^2 + 5x - 3$

$q(x) = x^2 - 2$

$$
\begin{array}{r|l}
 & x - 3 \\
\hline
x^2 - 2 & x^3 - 3x^2 + 5x - 3 \\
 & x^3 \qquad - 2x \\
 & - \qquad\quad + \\
\hline
 & -3x^2 + 7x - 3 \\
 & -3x^2 \qquad + 6 \\
 & + \qquad\quad - \\
\hline
 & 7x - 9 \\
\hline
\end{array}
$$

Quotient = $x - 3$

Remainder = $7x - 9$

(ii) $p(x) = x^4 - 3x^2 + 4x + 5 = x^4 + 0.x^3 - 3x^2 + 4x + 5$

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

$$
\begin{array}{r|l}
 & x^2 + x - 3 \\
\hline
x^2 - x + 1 & x^4 + 0.x^3 - 3x^2 + 4x + 5 \\
 & x^4 - x^3 + x^2 \\
 & - \quad + \quad - \\
\hline
 & x^3 - 4x^2 + 4x + 5 \\
 & x^3 - x^2 + x \\
 & - \quad + \quad - \\
\hline
 & -3x^2 + 3x + 5 \\
 & -3x^2 + 3x - 3 \\
 & + \quad - \quad + \\
\hline
 & 8 \\
\hline
\end{array}
$$

Quotient = $x^2 + x - 3$

Remainder = 8

(iii) $p(x) = x^4 - 5x + 6 = x^4 + 0.x^2 - 5x + 6$

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

$$
\begin{array}{r|l}
 & -x^2 - 2 \\
\hline
-x^2 + 2 & x^4 + 0.x^2 - 5x + 6 \\
 & x^4 - 2x^2 \\
 & - \quad + \\
\hline
 & 2x^2 - 5x + 6 \\
 & 2x^2 \qquad - 4 \\
 & - \qquad\quad + \\
\hline
 & -5x + 10 \\
\hline
\end{array}
$$

Quotient = $-x^2 - 2$

Remainder = $-5x + 10$

Question 2:

Check whether the first polynomial is a factor of the second polynomial by dividing the second polynomial by the first polynomial:

(i) $t^2-3, 2t^4+3t^3-2t^2-9t-12$

(ii) $x^2+3x+1, 3x^4+5x^3-7x^2+2x+2$

(iii) $x^3-3x+1, x^5-4x^3+x^2+3x+1$

Answer 2:

(i) $t^2-3,\ 2t^4+3t^3-2t^2-9t-12$

$t^2-3 = t^2+0.t-3$

$$\begin{array}{r|l}
 & 2t^2+3t+4 \\
t^2+0.t-3 & 2t^4+3t^3-2t^2-9t-12 \\
 & 2t^4+0.t^3-6t^2 \\
 & -\quad -\quad + \\
\hline
 & 3t^3+4t^2-9t-12 \\
 & 3t^3+0.t^2-9t \\
 & -\quad -\quad + \\
\hline
 & 4t^2+0.t-12 \\
 & 4t^2+0.t-12 \\
 & -\quad -\quad + \\
\hline
 & 0
\end{array}$$

Since the remainder is 0,

Hence, t^2-3 is a factor of $2t^4+3t^3-2t^2-9t-12$.

(ii) $x^2+3x+1,\ 3x^4+5x^3-7x^2+2x+2$

$$\begin{array}{r|l}
 & 3x^2-4x+2 \\
x^2+3x+1 & 3x^4+5x^3-7x^2+2x+2 \\
 & 3x^4+9x^3+3x^2 \\
 & -\quad -\quad - \\
\hline
 & -4x^3-10x^2+2x+2 \\
 & -4x^3-12x^2-4x \\
 & +\quad +\quad + \\
\hline
 & 2x^2+6x+2 \\
 & 2x^2+6x+2 \\
\hline
 & 0
\end{array}$$

Since the remainder is 0,

Hence, x^2+3x+1 is a factor of $3x^4+5x^3-7x^2+2x+2$.

(iii) $x^3 - 3x + 1,\ x^5 - 4x^3 + x^2 + 3x + 1$

$$
\begin{array}{r|l}
 & x^2 - 1 \\
x^3 - 3x + 1 & x^5 - 4x^3 + x^2 + 3x + 1 \\
 & x^5 - 3x^3 + x^2 \\
 & - \quad + \quad - \\
\hline
 & -x^3 \qquad + 3x + 1 \\
 & -x^3 \qquad + 3x - 1 \\
 & + \qquad\quad - \quad + \\
\hline
 & \qquad\qquad 2 \\
\hline
\end{array}
$$

Since the remainder $\neq 0$,

Hence, $x^3 - 3x + 1$ is not a factor of $x^5 - 4x^3 + x^2 + 3x + 1$.

Question 3:

Obtain all other zeroes of $3x^4 + 6x^3 - 2x^2 - 10x - 5$, if two of its zeroes are $\sqrt{\frac{5}{3}}$ and $-\sqrt{\frac{5}{3}}$.

Answer 3:

$p(x) = 3x^4 + 6x^3 - 2x^2 - 10x - 5$

Since the two zeroes are $\sqrt{\frac{5}{3}}$ and $-\sqrt{\frac{5}{3}}$,

$\therefore \left(x - \sqrt{\frac{5}{3}}\right)\left(x + \sqrt{\frac{5}{3}}\right) = \left(x^2 - \frac{5}{3}\right)$ is a factor of $3x^4 + 6x^3 - 2x^2 - 10x - 5$.

Therefore, we divide the given polynomial by $x^2 - \frac{5}{3}$.

$$
\begin{array}{r|l}
 & 3x^2 + 6x + 3 \\
x^2 + 0.x - \frac{5}{3} & 3x^4 + 6x^3 - 2x^2 - 10x - 5 \\
 & 3x^4 + 0x^3 - 5x^2 \\
 & - \quad - \quad + \\
\hline
 & \qquad 6x^3 + 3x^2 - 10x - 5 \\
 & \qquad 6x^3 + 0x^2 - 10x \\
 & \qquad - \quad - \quad + \\
\hline
 & \qquad\qquad 3x^2 + 0x - 5 \\
 & \qquad\qquad 3x^2 + 0x - 5 \\
 & \qquad\qquad - \quad - \quad + \\
\hline
 & \qquad\qquad\qquad 0 \\
\hline
\end{array}
$$

$$3x^4+6x^3-2x^2-10x-5=\left(x^2-\frac{5}{3}\right)\left(3x^2+6x+3\right)$$
$$=3\left(x^2-\frac{5}{3}\right)\left(x^2+2x+1\right)$$

We factorize x^2+2x+1

$=(x+1)^2$

Therefore, its zero is given by $x+1=0$

$x=-1$

As it has the term $(x+1)^2$, therefore, there will be 2 zeroes at $x=-1$.

Hence, the zeroes of the given polynomial are $\sqrt{\frac{5}{3}}$, $-\sqrt{\frac{5}{3}}$, −1 and −1.

Question 4:

On dividing x^3-3x^2+x+2 by a polynomial $g(x)$, the quotient and remainder were $x-2$ and $-2x+4$, respectively. Find $g(x)$.

Answer 4:

$p(x)=x^3-3x^2+x+2$ (Dividend)

$g(x)$ = ? (Divisor)

Quotient = $(x-2)$

Remainder = $(-2x+4)$

Dividend = Divisor × Quotient + Remainder

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

$x^3-3x^2+x+2+2x-4=g(x)(x-2)$

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

$g(x)$ is the quotient when we divide (x^3-3x^2+3x-2) by $(x-2)$

$$\begin{array}{r|l} & x^2-x+1 \\ \hline x-2 & x^3-3x^2+3x-2 \\ & x^3-2x^2 \\ & -\quad + \\ \hline & -x^2+3x-2 \\ & -x^2+2x \\ & +\quad - \\ \hline & x-2 \\ & x-2 \\ & -\quad + \\ \hline & 0 \end{array}$$

$\therefore g(x)=(x^2-x+1)$

Question 5:

Give examples of polynomial $p(x)$, $g(x)$, $q(x)$ and $r(x)$, which satisfy the division algorithm and
(i) deg $p(x)$ = deg $q(x)$
(ii) deg $q(x)$ = deg $r(x)$
(iii) deg $r(x) = 0$

Answer 5:

According to the division algorithm, if $p(x)$ and $g(x)$ are two polynomials with $g(x) \neq 0$, then we can find polynomials $q(x)$ and $r(x)$ such that
$p(x) = g(x) \times q(x) + r(x)$,
where $r(x) = 0$ or degree of $r(x)$ < degree of $g(x)$
Degree of a polynomial is the highest power of the variable in the polynomial.

(i) deg $p(x)$ = deg $q(x)$
Degree of quotient will be equal to degree of dividend when divisor is constant (i.e., when any polynomial is divided by a constant).
Let us assume the division of $6x^2+2x+2$ by 2.
Here, $p(x) = 6x^2+2x+2$
$g(x) = 2$
$q(x) = 3x^2+x+1$ and $r(x) = 0$
Degree of $p(x)$ and $q(x)$ is the same i.e., 2.
Checking for division algorithm,
$p(x) = g(x) \times q(x) + r(x)$
$6x^2+2x+2 = 2(3x^2+x+1)$
$= 6x^2+2x+2$
Thus, the division algorithm is satisfied.

(ii) deg $q(x)$ = deg $r(x)$
Let us assume the division of $x^3 + x$ by x^2,
Here, $p(x) = x^3 + x$
$g(x) = x^2$
$q(x) = x$ and $r(x) = x$
Clearly, the degree of $q(x)$ and $r(x)$ is the same i.e., 1.
Checking for division algorithm,
$p(x) = g(x) \times q(x) + r(x)$
$x^3 + x = (x^2) \times x + x$
$x^3 + x = x^3 + x$
Thus, the division algorithm is satisfied.

(iii)deg $r(x) = 0$
Degree of remainder will be 0 when remainder comes to a constant.
Let us assume the division of $x^3 + 1$by x^2.
Here, $p(x) = x^3 + 1$
$g(x) = x^2$
$q(x) = x$ and $r(x) = 1$
Clearly, the degree of $r(x)$ is 0.
Checking for division algorithm,
$p(x) = g(x) \times q(x) + r(x)$
$x^3 + 1 = (x^2) \times x + 1$
$x^3 + 1 = x^3 + 1$
Thus, the division algorithm is satisfied.

MATHS -10 (CH-02-2.4- POLYNOMIALS)

Question 1:

Verify that the numbers given alongside of the cubic polynomials below are their zeroes. Also verify the relationship between the zeroes and the coefficients in each case:

(i) $2x^3 + x^2 - 5x + 2; \quad \frac{1}{2}, 1, -2$

(ii) $x^3 - 4x^2 + 5x - 2; \quad 2, 1, 1$

Answer 1:

(i) $p(x)=2x^3+x^2-5x+2.$

Zeroes for this polynomial are $\frac{1}{2},1,-2$

$$p\left(\frac{1}{2}\right)=2\left(\frac{1}{2}\right)^3+\left(\frac{1}{2}\right)^2-5\left(\frac{1}{2}\right)+2$$

$$=\frac{1}{4}+\frac{1}{4}-\frac{5}{2}+2$$

$$=0$$

$$p(1)=2\times1^3+1^2-5\times1+2$$

$$=0$$

$$p(-2)=2(-2)^3+(-2)^2-5(-2)+2$$

$$=-16+4+10+2=0$$

Therefore, $\frac{1}{2}$, 1, and −2 are the zeroes of the given polynomial.

Comparing the given polynomial with ax^3+bx^2+cx+d, we obtain a = 2, b = 1, c = −5, d = 2

We can take $\alpha=\frac{1}{2},\beta=1,\gamma=-2$

$$\alpha+\beta+\gamma=\frac{1}{2}+1+(-2)=-\frac{1}{2}=\frac{-b}{a}$$

$$\alpha\beta+\beta\gamma+\alpha\gamma=\frac{1}{2}\times1+1(-2)+\frac{1}{2}(-2)=\frac{-5}{2}=\frac{c}{a}$$

$$\alpha\beta\gamma=\frac{1}{2}\times1\times(-2)=\frac{-1}{1}=\frac{-(2)}{2}=\frac{-d}{a}$$

Therefore, the relationship between the zeroes and the coefficients is verified.

(ii) $p(x)=x^3-4x^2+5x-2$

Zeroes for this polynomial are 2, 1, 1.

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

$$=8-16+10-2=0$$

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

$$=1-4+5-2=0$$

Therefore, 2, 1, 1 are the zeroes of the given polynomial.

Comparing the given polynomial with ax^3+bx^2+cx+d, we obtain a = 1, b = −4, c = 5, d = −2.

Verification of the relationship between zeroes and coefficient of the given polynomial

$$\text{Sum of zeroes}=2+1+1=4=\frac{-(-4)}{1}=\frac{-b}{a}$$

Multiplication of zeroes taking two at a time = (2)(1) + (1)(1) + (2)(1) =2 + 1 + 2 = 5 $=\frac{(5)}{1}=\frac{c}{a}$

Multiplication of zeroes = 2 × 1 × 1 = 2 $=\frac{-(-2)}{1}=\frac{-d}{a}$

Hence, the relationship between the zeroes and the coefficients is verified.

Question 2:

Find a cubic polynomial with the sum, sum of the product of its zeroes taken two at a time, and the product of its zeroes as 2, − 7, − 14 respectively.

Answer 2:

Let the polynomial be ax^3+bx^2+cx+d and the zeroes be $\alpha, \beta,$ and γ.
It is given that

$$\alpha+\beta+\gamma=\frac{2}{1}=\frac{-b}{a}$$

$$\alpha\beta+\beta\gamma+\alpha\gamma=\frac{-7}{1}=\frac{c}{a}$$

$$\alpha\beta\gamma=\frac{-14}{1}=\frac{-d}{a}$$

If a = 1, then b = −2, c = −7, d = 14
Hence, the polynomial is $x^3-2x^2-7x+14$.

Question 3:

If the zeroes of polynomial x^3-3x^2+x+1 are $a-b, a, a+b$, find a and b.

Answer 3:

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

Zeroes are $a - b$, $a + a + b$
Comparing the given polynomial with px^3+qx^2+rx+t, we obtain
p = 1, q = −3, r = 1, t = 1

$$\text{Sum of zeroes} = a-b+a+a+b$$

$$\frac{-q}{p}=3a$$

$$\frac{-(-3)}{1}=3a$$

$$3=3a$$

$$a=1$$

The zeroes are $1-b, 1, 1+b$.

Multiplication of zeroes $=1(1-b)(1+b)$

$\frac{-t}{p}=1-b^2$

$\frac{-1}{1}=1-b^2$

$1-b^2=-1$

$1+1=b^2$

$b=\pm\sqrt{2}$

Hence, $a = 1$ and $b = \sqrt{2}$ or $-\sqrt{2}$.

Question 4:

]It two zeroes of the polynomial $x^4-6x^3-26x^2+138x-35$ are $2\pm\sqrt{3}$, find other zeroes.

Answer 4:

Given that $2+\sqrt{3}$ and $2-\sqrt{3}$ are zeroes of the given polynomial.

Therefore, $\left(x-2-\sqrt{3}\right)\left(x-2+\sqrt{3}\right) = x^2 + 4 - 4x - 3$

$= x^2 - 4x + 1$ is a factor of the given polynomial

For finding the remaining zeroes of the given polynomial, we will find the quotient by dividing $x^4-6x^3-26x^2+138x-35$ by $x^2 - 4x + 1$.

$$
\begin{array}{r|l}
 & x^2-2x-35 \\
x^2-4x+1 & x^4-6x^3-26x^2+138x-35 \\
 & x^4-4x^3+x^2 \\
 & - \quad + \quad - \\
\hline
 & -2x^3-27x^2+138x-35 \\
 & -2x^3+8x^2-2x \\
 & + \quad - \quad + \\
\hline
 & -35x^2+140x-35 \\
 & -35x^2+140x-35 \\
 & + \quad - \quad + \\
\hline
 & 0
\end{array}
$$

Clearly, $x^4-6x^3-26x^2+138x-35 = \left(x^2-4x+1\right)\left(x^2-2x-35\right)$

It can be observed that $\left(x^2-2x-35\right)$ is also a factor of the given polynomial.

And $\left(x^2-2x-35\right) = (x-7)(x+5)$

Therefore, the value of the polynomial is also zero when $x-7=0$ or $x+5=0$

Or $x = 7$ or -5

Hence, 7 and −5 are also zeroes of this polynomial.

Question 5:

If the polynomial $x^4 - 6x^3 + 16x^2 - 25x + 10$ is divided by another polynomial $x^2 - 2x + k$, the remainder comes out to be $x + a$, find k and a.

Answer 5:

By division algorithm,
Dividend = Divisor × Quotient + Remainder
Dividend − Remainder = Divisor × Quotient
$x^4 - 6x^3 + 16x^2 - 25x + 10 - x - a = x^4 - 6x^3 + 16x^2 - 26x + 10 - a$ will be perfectly divisible by $x^2 - 2x + k$.
Let us divide $x^4 - 6x^3 + 16x^2 - 26x + 10 - a$ by $x^2 - 2x + k$

$$\text{Quotient: } x^2 - 4x + (8 - k)$$

$$x^2 - 2x + k \,\big)\, x^4 - 6x^3 + 16x^2 - 26x + 10 - a$$

$$x^4 - 2x^3 + kx^2$$
$$- \quad + \quad -$$
$$-4x^3 + (16 - k)x^2 - 26x$$
$$-4x^3 + 8x^2 - 4kx$$
$$+ \quad - \quad +$$
$$(8 - k)x^2 - (26 - 4k)x + 10 - a$$
$$(8 - k)x^2 - (16 - 2k)x + (8k - k^2)$$
$$- \quad + \quad -$$
$$(-10 + 2k)x + (10 - a - 8k + k^2)$$

It can be observed that $(-10 + 2k)x + (10 - a - 8k + k^2)$ will be 0.
Therefore, $(-10 + 2k) = 0$ and $(10 - a - 8k + k^2) = 0$
For $(-10 + 2k) = 0$,
$2k = 10$
And thus, $k = 5$
For $(10 - a - 8k + k^2) = 0$
$10 - a - 8 \times 5 + 25 = 0$
$10 - a - 40 + 25 = 0$
$-5 - a = 0$
Therefore, $a = -5$
Hence, $k = 5$ and $a = -5$