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PURE MATH

ALGEBRA AND FUNCTION

Level & Board	EDEXCEL (A-LEVEL)
TOPIC:	QUADRATICS
PAPER TYPE:	SOLUTION 6
TOTAL QUESTIONS	8
TOTAL MARKS	38

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Q.1

- (i) $3x^3 - 17x^2 - 6x = 0$

  We can first factor out the common form of x

  $\Longrightarrow \quad x(3x^2 - 17x - 6) = 0$

  $\Longrightarrow \quad x = 0 \quad or \quad 3x^2 - 17x - 6 = 0$

  Now, $\quad 3x^2 - 17x - 6 = 0$

  Here

  $a = 3, \quad b = -17, c = -6$

  Using quadratic formula

  $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

  Plugging these values into the formula

  $$x = \frac{-(-17) \pm \sqrt{(-17)^2 - 4)(3)(-6)}}{2(3)}$$

  $$x = \frac{17 \pm \sqrt{284 + 72}}{6}$$

  $$x = \frac{17 \pm \sqrt{361}}{6}$$

  $$x = \frac{17 \pm 19}{6}$$

  $$x = \frac{17 + 19}{6} \quad or \quad x = \frac{17 - 19}{6}$$

  $$x = \frac{36}{6} \quad , \quad x = \frac{-2}{6}$$

  $$x = 6 \quad , \quad x = \frac{-1}{3}$$

- Now, We have three solution for the equation

  $3x^3 - 17x^2 - 6x = 0$

  $x = 0 \, , x = 6 \, , x = \frac{-1}{3}$

  So, these are all the solutions to the given condition.

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- (ii) $3(y - 2)^6 - 17(y - 2)^4 - 6(y - 2)^2 = 0$

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

$\Longrightarrow$ $3x^3 - 17x^2 - 6x = 0$

$\Longrightarrow$ $x(3x^2 - 17x - 6) = 0$

$x = 0$ or $3x^2 - 17x - 6 = 0$

But , Here

$(y-2)^2 = 0$, $a = 3$, $b = -17$, $c = -6$

$y - 2 = 0$, using quadratic formula

$y = 2$, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

, $x = \frac{-(-17) \pm \sqrt{(17)^2 - 4(3)(-6)}}{2(3)}$

, $x = \frac{17 \pm \sqrt{36}}{6}$

, $x = \frac{17 \pm 19}{6}$

, $x = \frac{17+19}{6}$, $x = \frac{17-19}{6}$

, $x = 6$, $x = \frac{-1}{3}$

$X = 6$, $x = \frac{-1}{3}$

$\Longrightarrow$ $(y-2)^2 = 6$, $(y-2)^2 = \frac{-1}{2}$

$\Longrightarrow$ $Y - 2 = \pm\sqrt{6}$, However, since the square of a real number

$y - 2 = \pm\sqrt{6}$, cannot be negative a this equation has no

$y - 2 = \pm\sqrt{6}$, real solution for y.

and

$y = 2 \pm \sqrt{6}$

So, the real solutions for the original equation

$3(y-2)^6 - 17(y-2)^4 - 6(y-2)^2 = 0$

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are:

$y = 2 + \sqrt{6}$ $Y = 2 - \sqrt{6}$ $Y = 2$

Q.2

The discriminant is given by:

Discriminant = 0

$b^2 - 4ac = 0$

But, the coefficient are

$a = k$, $b = k-3$, $c = 1$

$\Longrightarrow$

$(k-3)^2 - 4(k)(1) = 0$

$k^2 + 9 - 6k - 4k = 0$

$k^2 - 10k + 9 = 0$

Factorization

$k^2 - 9k - k + 9 = 0$

$K(k-9) - 1(k-9) = 0$

$(k-1)(k-9) = 0$

$K - 1 = 0$, $k - 9 = 0$

$K = 1$, $k = 9$

So, the possible values of k for the quadratic equation to have two equal real roots are:

$k = 9$ and $k = 1$.

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Q.3

(a)

Substitute $x = -4$ into $kx^2 + (3k+1)x - 8 = 0$

$k(-4)^2 + (3k+1)(-4) - 8 = 0$

$\Longrightarrow$

$16k - 12k - 4 - 8 = 0$

$4k - 12 = 0$

$4k = 12$

$K = 3$

(b)

First we have the value of k, which is 4, So k=3

$\therefore$ By parts (a)

$\Longrightarrow$

$kx^2 + (3k+1)x + 8 = 0$

$3x^2 + 10x - 8 = 0$

Factorization

$3x^2 + 12x - 2x - 8 = 0$

$3x(x+4) - 2(x+4) = 0$

$(3x-2)(x+4) = 0$

$3x - 2 = 0$ or $x + 4 = 0$

$x = \frac{2}{3}$ or $x = -4$

So, the second possible value of x is:

$x = \frac{2}{3}$ and $x = -4$

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Q.4

This equation is Based on the nature of roots.

Let

Equation is $ax^2 + bx + c = 0$ and the discriminant = $b^2 - 4ac$

If Discriminant = 0

Then equation has real roots.

$b^2 - 4ac = 0$

Here, a = k+3, b = 2(k+3), c=4

$\Longrightarrow \quad [2(k+3)]^2 - 4[k+3]\,[4] = 0$

$\Longrightarrow \quad 4(k+3)^2 - 16(k+3) = 0$

Dividing by 4 on both side

$(k+3)^2 - 4(k+3) = 0$

$k^2 + 6k + 9 - 4k - 12 = 0$

$k^2 + 2k - 3 = 0$ $\qquad \because$ Factorize

$k^2 + 3k - k - 3 = 0$

$K(k+3) - 1(k+3) = 0$

$(k+3)(k-1) = 0$

K = -3 , k = 1

But k = -3 not possible (Coefficient of $x^2 \pm 0$

So, value of k = 1.

Q.5

The quadratic equation is given

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$x^2 - 4x - 1 = 2p(x-5)$

$x^2 - 4x - 1 = 2px - 10p$

$x^2 - 4x - 2px - 1 + 10p = 0$

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$\Longrightarrow$ $x^2 + (-4-2p)x + (10p-1) = 0$

Here,

$a - 1$, $b = -4-2p$, $c = 10p - 1$

Two equal root

$b^2 - 4ac = 0$

$(-4-2p)^2 - 4(1)(10p-1) = 0$

$16 + 16p + 4p^2 - 40p + 4 = 0$

$4p^2 - 24p + 20 = 0$

$\Longrightarrow$ $p^2 - 6p + 5 = 0$

Factorization

$p^2 - 5p - p + 5 = 0$

$P(p-5) - 1(p-5) = 0$

$(p-1)(p-5) = 0$

$P - 1 = 0$ or $p - 5 = 0$

$P = 1$ or $p = 5$

So,

$P = 1, 5$

Q.6

Given

$2qx^2 + qx - 1 = 0$

For a quadratic equation,

$ax^2 + bx + c = 0$

The expression for solutions

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Where $b^2 - 4ac$ is called discriminant.

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(a) Since, given is a quadratic equation with no real roots, its discriminant must be:

$b^2 - 4ac < 0$

$(q)^2 - 4(2q)(-1) < 0$

$q^2 + 8q < 0$ (Hence Proved)

(b)

$q^2 + 8q = 0$

$q(q + 8) = 0$

$q = 0$ or $q = -8$

So, the critical points on curve for given condition are -8 and 0.

Therefore, conditions for

$q^2 + 8q < 0$ are:

$q > -8$

$q < 0$

$\Longrightarrow \quad -8 < q < 0$

Q.7

$4 - 3x - x^2$

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

Complete the square coefficient of the x term: 3 divide it in half: $\frac{3}{2}$

Square it: $\left(\frac{3}{2}\right)^2$

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Use $\left(\frac{3}{2}\right)^2$ to complete the square:

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

$= \frac{25}{4} - \left(x + \frac{3}{2}\right)^2$

Q.8

$x^2 + 13x + 21 = 21$ or $x^2 + 13x + 21 = -21$

$\Longrightarrow \quad x^2 + 13x + 21 - 21 = 0$ or $x^2 + 13x + 21 + 21 = 0$

$\Longrightarrow \quad x^2 + 13x = 0$ or $x^2 + 13x + 42 = 0$

$\Longrightarrow \quad x(x + 13) = 0$ or $(x + 6)(x + 7) = 0$

$\Longrightarrow \quad x = 0 \text{ and } x = -13$ or $x = -6 \text{ and } x = -7$

$S.S = \{-13, -7, -6, 0\}$

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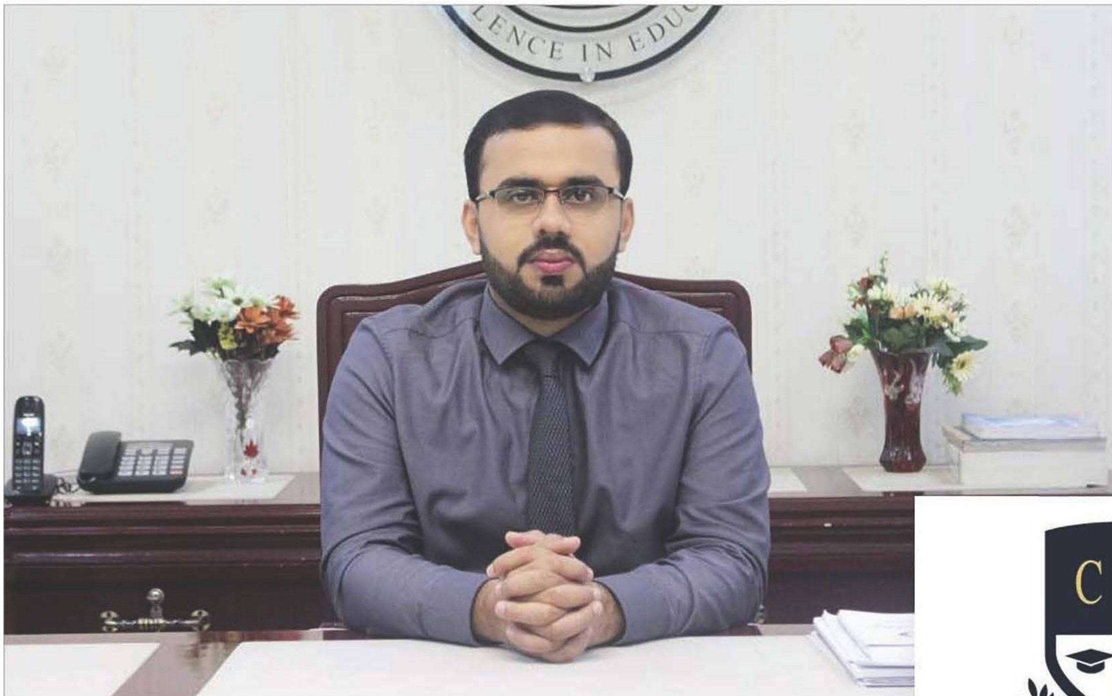

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