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Emil:asherrana@chemistryonlinetuition.com

PURE MATH

ALGEBRA AND FUNCTION

Level & Board	EDEXCEL (A-LEVEL)
TOPIC:	QUADRATICS
PAPER TYPE:	SOLUTION 4
TOTAL QUESTIONS	8
TOTAL MARKS	42

Quadratics 4

Q.1

(a) Two real solutions

$\Longrightarrow$

$b^2 - 4ac > 0$

kx^2 + 4x + (5 – k+ = 0

$(4)^2$ – 4k (5 – k) > 0

16 – 20k + 4k^2 > = 0

$\Longrightarrow$

4k^2 – 20k + 16 > 0

$\Longrightarrow$

k^2- 5k + 4 > 0

(b) As

k^2 – 5k + 4 > 0

k^2 – k – 4k + 4 > 0

K(k-1) – 4(k-1) > 0

(k-4) (k-1) = 0

$\Longrightarrow$

Either k < 1 or k > 4

Q.2

- To prove that the equation Kx^2 + 4Kx + 3 = 0 has no real roots if and only if O ≤ K < $\frac{3}{4}$, We can use the discriminant of a quadratic equation. The discriminant of a quadratic equation ax^2 + bx + c = 0 is given by
D = b^2 – 4ac. For real roots, the discriminant must be greater than or equal to zero.

$\Longrightarrow$ kx^2 +4kx + 3 = 0

Here

A = k , b = 4k , c = 3

Then,

D = b^2 – 4ac

$\text{D} = (4k)^2 - 4(\text{k})(3)$

$\text{D} = (16k)^2 - 12\text{k}$

- To have real roots, D must be greater than or equal to zero.
  $\Longrightarrow$

  $$16k^2 - 12\text{k} \geq 0$$

  $\Longrightarrow$

  $$4\text{k}(4\text{k} - 3) \geq 0$$

  Here,
- (1) 4k is always non-negative (zero or positive) for all real values of k.
- (2) 4k – 3 is zero when k = $\frac{3}{4}$, and it's negative for k< $\frac{3}{4}$ and positive for k> $\frac{3}{4}$.

  So, the inequality 4k(4k-3)≥ 0 is true when
- Both factors are positive, which occurs when k> $\frac{3}{4}$.
- Both factors are positive, which occurs when k = $\frac{3}{4}$.

  For real roots, we want the discriminant to be greater than or equal to zero, which corresponds to the values of k where 4k(4k-3)≥0
  Therefore, the equation $kx^2 + 4kx + 3 = 0$ has no real roots if and only if k< $\frac{3}{4}$. so, we have shown that o ≤ k< $\frac{3}{4}$ is the range of values for which the equation has no real roots.

Q.3

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.

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

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

$\Longrightarrow$ $4(k+3)^2$-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 $\because$ 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 Here a = 1 , b = 3p , c = p

$\because$ Discriminant = 0

$b^2 - 4ac = 0$

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

$9p^2 - 4p = 0$

P(9p – 4) = 0

P = 0 or $p = \frac{4}{9}$ Thus, $P = 0, \frac{4}{9}$

Q.6 $kx^2 + 4x + (5-k) = 0$

(a) We know that the equation has 2 different real solution for x

So,

$D > 0$

$\Longrightarrow \quad b^2 - 4ac > 0$

So,,

$(4)^2 - 4(k)(5-k) > 0$

$16 - 20k + 4k^2 > 0$

$\Longrightarrow \quad 4k^2 - 20k + 16 > 0$

$\Longrightarrow \quad k^2 - 5k + 4 > 0$

So, it has proved

$= -2\,(x-3)^2 + 20$

Q.7

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.

(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

$\Rightarrow$ -8 < q < 0

Q.8

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

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

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

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

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DR. ASHAR RANA

CHEMISTRY ONLINE
TUITION

Phone: +442081445350
www.chemistryonlinetuition.com
Email: asherrana@chemistryonlinetuition.com

- Founder & CEO of Chemistry Online Tuition Ltd.
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CONTACT INFORMATION FOR **CHEMISTRY ONLINE TUITION**

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: www.chemistryonlinetuition.com
- Email: asherrana@chemistryonlinetuition.com
- Address: 210-Old Brompton Road, London SW5 OBS, UK

