Cambridge International AS & A Level

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Mathematics 9709/12

Paper 1 Pure Mathematics 1 **October/November 2025**

Question No (1)

1 **(a)** Express $9x^2 - 36x + 8$ in the form $p(x+q)^2 + r$, where p, q and r are constants.

(b) Hence find the set of values of the constant k for which the equation $9x^2 - 36x + 8 = k$ has no real roots.

(c) Find the exact roots of the equation $9x^2 - 36x + 8 = -15$.

Solution:

(a)

$$9x^2 - 36x + 8$$
$$9(x^2 - 4x) + 8$$
$$9(x^2 - 2(2)(x)) + 8$$
$$9(x^2 - 2(2)(x) + (2)^2 - (2)^2) + 8$$
$$9((x-2)^2 - (2)^2) + 8$$
$$9((x-2)^2 - 4) + 8$$
$$9(x-2)^2 - 36 + 8$$
$$9(x-2)^2 - 28$$

(b)

$$9x^2 - 36x + 8 = K$$
$$9x^2 - 36x + 8 - K = 0$$

For no real roots

$$b^2 - 4ac < 0$$
$$(-36)^2 - 4(9)(8-K) < 0$$
$$1296 - 36(8-K) < 0$$
$$1296 - 288 + 36K < 0$$
$$1008 + 36K < 0$$
$$36K < -1008$$
$$K < \frac{-1008}{36}$$
$$K < -28$$

(c) $9x^2 - 36x + 8 = -15$

$9x^2 - 36x + 8 + 15 = 0$

$9x^2 - 36x + 23 = 0$

using the quadratic formula

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

$$= \frac{-(-36) \pm \sqrt{(-36)^2 - 4(9)(23)}}{2 \times 9}$$

$$x = \frac{36 \pm \sqrt{1296 - 828}}{18}$$

$$x = \frac{36 \pm \sqrt{468}}{18}$$

$$= \frac{2 \times 18 \pm \sqrt{2 \times 2 \times 117}}{18}$$

$$= \frac{2 \times 18 \pm 2\sqrt{117}}{18}$$

$$= \frac{2(18 \pm \sqrt{117})}{18}$$

$$x = \frac{18 \pm \sqrt{117}}{9}$$