Discriminants - Past Edexcel Exam Questions

1. **(Question 7 - C1 May 2018)**

The equation $20x^2 = 4kx - 13kx^2 + 2$, where k is a constant, has no real roots.

(a) Show that k satisfies the inequality [4]

$$2k^2 + 13k + 20 < 0.$$

(b) Find the set of possible values of k. [4]

---

2. **(Question 9 - C1 May 2017)**

(a) (*Curve Sketching*)
Given that $y = -3x + c$, where c is a positive constant, meets the curve $y = \frac{1}{x} + 5$ at two distinct points,

(b) show that $(5 - c)^2 > 12$. [3]

(c) Hence find the range of possible values for c. [4]

---

3. **(Question 8 - C1 May 2016)**

The straight line equation $y = 3x - 7$ does not cross or touch the curve with equation $y = 2px^2 - 6px + 4p$, where p is a constant.

(a) Show that $4p^2 - 20p + 9 < 0$. [4]

(b) Hence find the set of possible values of p. [4]

---

4. **(Question 5 - C1 May 2015)**

The equation

$$(p - 1)x^2 + 4x + (p - 5) = 0, \qquad \text{where } p \text{ is a constant}$$

has no real roots.

(a) Show that p satisfies $p^2 - 6p + 1 > 0$. [3]

(b) Hence find the set of possible values of p. [4]

---

5. **(Question 11 - C1 May 2014)**

Given that

$$f(x) = 2x^2 + 8x + 3$$

(a) find the value of the discriminant. [2]

(b) (*Completing the Square*)

(c) (*Differentiation*)

---

6. **(Question 10 - Jun 2013)**

(a) (*Simultaneous Equations*)

Given that $x^2 + 8kx + k = 0$ has equal roots (and k is non-zero)

(b) find the value of k. [3]

(c) (*Simultaneous Equations*)

---

7. **(Question 9 - Jan 2013)**

The equation

$$(k + 3)x^2 + 6x + k = 5, \text{ where } k \text{ is a constant,}$$

has two distinct real solutions for x.

(a) Show that k satisfies

$$k^2 - 2k - 24 < 0.$$

[4]

(b) Hence find the set of possible values of k. [3]

---

8. **(Question 7 - May 2011)**

$$f(x) = x^2 + (k + 3)x + k,$$

where k is a real constant.

(a) Find the discriminant of $f(x)$ in terms of k. [2]

(b) Show that the discriminant of $f(x)$ can be expressed in the form $(k + a)^2 + b$, where a and b are integers to be found. [2]

(c) Show that, for all values of k, the equation $f(x) = 0$ has real roots. [2]

9. **(Question 8 - Jan 2011)**

The equation $x^2 + (k-3)x + (3-2k) = 0$, where k is a constant, has two distinct real roots.

(a) Show that k satisfies

$$k^2 + 2k - 3 > 0.$$

[3]

(b) Find the set of possible values of k. [4]

---

10. **(Question 10 - Jan 2010)**

$$f(x) = x^2 + 4kx + (3 + 11k), \quad \text{where } k \text{ is a constant.}$$

(a) (*Completing the Square*)

Given that $f(x) = 0$ has no real roots,

(b) find the set of possible values of k. [4]

(c) (*Curve Sketching*)

---

11. **(Question 6 - Jun 2009)**

The equation $x^2 + 3px + p = 0$, where p is a non-zero constant, has equal roots. Find the value of p. [4]

---

12. **(Question 7 - Jan 2009)**

The equation $kx^2 + 4x + (5-k) = 0$, where k is a constant, has 2 different real solutions for x.

(a) Show that k satisfies

$$k^2 - 5k + 4 > 0.$$

[3]

(b) Hence find the set of possible values of k. [4]

---

13. **(Question 8 - Jun 2008)**

Given that the equation $2qx^2 + qx - 1 = 0$, where q is a constant, has no real roots

(a) show that $q^2 + 8q < 0$. [2]

(b) Hence find the set of possible values of q. [3]

---

14. **(Question 8 - Jan 2008)**

The equation

$$x^2 + kx + 8 = k$$

has no real solutions for x.

(a) Show that k satisfies $k^2 + 4k - 32 < 0$. [3]

(b) Hence find the set of possible values of k. [4]

---

15. **(Question 7 - May 2007)**

The equation $x^2 + kx + (k + 3) = 0$, where k is a constant, has different real roots.

(a) Show that $k^2 - 4k - 12 > 0$. [2]

(b) Find the set of possible values of k. [4]

---

16. **(Question 5 - Jan 2007)**

The equation $2x^2 - 3x - (k + 1) = 0$, where k is a constant, has no real roots.
Find the set of possible values of k. [4]

---

17. **(Question 8 - May 2006)**

The equation $x^2 + 2px + (3p + 4) = 0$, where p is a positive constant, has equal roots.

(a) Find the value of p. [4]

(b) For this value of p, solve the equation $x^2 + 2px + (3p + 4) = 0$. [2]

Solutions

1. (a) -
   (b) $-4 < k < -\frac{5}{2}$
2. (a) -
   (b) -
   (c) $c > 5 - 2\sqrt{3}$ or $c < 5 + 2\sqrt{3}$
3. (a) -
   (b) $\frac{1}{2} < p < \frac{9}{2}$
4. (a) -
   (b) $p < 3 - 2\sqrt{2}$ or $p > 3 + 2\sqrt{2}$.
5. (a) 40
   (b) -
   (c) -
6. (a) -
   (b) $k = \frac{1}{16}$.
   (c) -
7. (a) -
   (b) $-4 < k < 6$
8. (a) $k^2 + 2k + 9$
   (b) $(k + 1)^2 + 8$ so $a = 1$, $b = 8$
   (c) $(k + 1)^2$ is always positive so $(k + 1)^2 + 8$ is always strictly positive
9. (a) -
   (b) $k < -3$, $k > 1$
10. (a) -
    (b) $-\frac{1}{4} < k < 3$
    (c) -
11. $p = \frac{4}{9}$

12. (a) -
    (b) $k < 1,\ k > 4$
13. (a) -
    (b) $-8 < q < 0$
14. (a) -
    (b) $-8 < k < 4$
15. (a) -
    (b) $k < -2,\ k > 6$
16. $k < -\frac{17}{8}$
17. (a) $p = 4$
    (b) $x = -4$