HIGHER

2.9 Quadratic Inequalities: Solving and Graphing Regions: 2-hour Pack

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 120 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Solve $x^2 - 12x + 35 \geq 0$

(Total for Question 1 is 3 marks)

2 Solve $x^2 \leq 2$

(Total for Question 2 is 2 marks)

3 x satisfies both $x^2 + 6x + 8 \leq 0$ and $2x - 3 \leq 5$.
Find the set of possible values of x.

(Total for Question 3 is 4 marks)

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4 The quadratic equation $5x^2 + 3x + k = 0$ has equal roots.
Find the value of k.

(Total for Question 4 is 3 marks)

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5 The region R is defined by the inequalities
$y \geq x^2 - 3$ and $y < 2$
Find the number of points with integer coordinates that lie in R (including points on the boundary where the inequality allows it).

(Total for Question 5 is 4 marks)

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6 Solve $x^2 \geq -x + 30$

(Total for Question 6 is 4 marks)

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7 Solve $x^2 > 121$

(Total for Question 7 is 2 marks)

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8 The quadratic equation $3x^2 + 8x + k = 0$ has no real roots.
Find the range of values of k.

(Total for Question 8 is 3 marks)

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9 Find all the integer values of x that satisfy $x^2 + x - 20 < 0$

(Total for Question 9 is 4 marks)

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10 The region R is defined by the inequalities
$y \geq (x + 1)^2 - 2$ and $y \leq 6$
Find the number of points with integer coordinates that lie in R (including points on the boundary where the inequality allows it).

(Total for Question 10 is 4 marks)

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11 Solve $x^2 > 11$

(Total for Question 11 is 2 marks)

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12 x satisfies both $x^2 - 4x - 45 < 0$ and $2x - 1 \geq 5$.
Find the set of possible values of x.

(Total for Question 12 is 4 marks)

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13 The quadratic equation $3x^2 + 6x + k = 0$ has two distinct real roots.
Find the range of values of k.

(Total for Question 13 is 3 marks)

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14 Find all the integer values of x that satisfy $-x^2 + 2x + 15 > 0$

(Total for Question 14 is 4 marks)

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15 The region R is defined by the inequalities
$y \geq (x + 1)^2 - 4$ and $y < 3$
Find the number of points with integer coordinates that lie in R (including points on the boundary where the inequality allows it).

(Total for Question 15 is 4 marks)

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16 Solve $x^2 - 4x - 5 \geq 0$

(Total for Question 16 is 3 marks)

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17 x satisfies both $x^2 - 2x - 35 < 0$ and $2x - 3 \geq -9$.
Find the set of possible values of x.

(Total for Question 17 is 4 marks)

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18 Find all the integer values of x that satisfy $-x^2 - 3x + 28 \geq 0$

(Total for Question 18 is 4 marks)

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19 The quadratic equation $kx^2 + 10x + 2 = 0$ has no real roots.
Find the range of values of k.

(Total for Question 19 is 4 marks)

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20 The region R is defined by the inequalities

$y \geq x^2 - 5$ and $y \leq 1$

Find the number of points with integer coordinates that lie in R (including points on the boundary where the inequality allows it).

(Total for Question 20 is 4 marks)

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21 The equation $kx^2 - 4x + 5 = 0$ has two distinct real roots.

Find the possible values of k.

(Total for Question 21 is 4 marks)

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22 The quadratic equation $5x^2 + 5x + k = 0$ has no real roots.

Find the range of values of k.

(Total for Question 22 is 3 marks)

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23 Find all the integer values of x that satisfy $x^2 + x - 56 < 0$

(Total for Question 23 is 4 marks)

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24 Consider the quadratic expression $q(x) = -x^2 + 6x - 5$. Solve $q(x) \geq 0$ and give the solution for x.

(Total for Question 24 is 2 marks)

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Mark scheme · 2.9 Quadratic Inequalities: Solving and Graphing Regions: 2-hour Pack

Question 1

factorises (or uses the formula) to find the critical values	**M1**
critical values x = 5 and x = 7	**A1**
x ≤ 5 or x ≥ 7	**A1**

Answer: x ≤ 5 or x ≥ 7

Question 2

critical values $x = \sqrt{2}$ and $x = -\sqrt{2}$	**M1**
$-\sqrt{2} \leq x \leq \sqrt{2}$	**A1**

Answer: $-\sqrt{2} \leq x \leq \sqrt{2}$

Question 3

factorises and finds the critical values of the quadratic inequality	**M1**
-4 ≤ x ≤ -2	**A1**
solves the linear inequality to get x ≤ 4	**M1**
overlap of the two solution sets: -4 ≤ x ≤ -2	**A1**

Answer: -4 ≤ x ≤ -2

Question 4

uses the discriminant $b^2 - 4ac = 3^2 - 4 \times 5 \times k = 9 - 20k$	**M1**
sets $b^2 - 4ac = 0$ for equal roots: 9 - 20k = 0	**M1**
k = 9/20	**A1**

Answer: k = 9/20

Question 5

finds where the curve meets the line y = 2: $(x)^2 = 5$	**M1**
finds the possible integer x values, from the largest and smallest x with the curve not above the line	**M1**
counts the integer y values for each x: x = -2: 1, x = -1: 4, x = 0: 5, x = 1: 4, x = 2: 1	**M1**
total = 15	**A1**

Answer: 15

Question 6

rearranges to $x^2 + x - 30 \geq 0$	**M1**
factorises (or uses the formula) to find the critical values	**M1**
critical values x = -6 and x = 5	**A1**
x ≤ -6 or x ≥ 5	**A1**

Answer: x ≤ -6 or x ≥ 5

Question 7

critical values x = 11 and x = -11	**M1**
x < -11 or x > 11	**A1**

Answer: x < -11 or x > 11

Question 8

uses the discriminant $b^2 - 4ac = 8^2 - 4 \times 3 \times k = 64 - 12k$	**M1**
sets $b^2 - 4ac < 0$ for no real roots: 64 - 12k < 0	**M1**
k > 16/3	**A1**

Answer: k > 16/3

Question 9

factorises to find the critical values	**M1**
critical values x = -5 and x = 4	**A1**
writes the solution set -5 < x < 4	**M1**
integers: -4, -3, -2, -1, 0, 1, 2, 3	**A1**

Answer: -4, -3, -2, -1, 0, 1, 2, 3

Question 10

finds where the curve meets the line y = 6: $(x + 1)^2 = 8$	**M1**
finds the possible integer x values, from the largest and smallest x with the curve not above the line	**M1**
counts the integer y values for each x: x = -3: 5, x = -2: 8, x = -1: 9, x = 0: 8, x = 1: 5	**M1**
total = 35	**A1**

Answer: 35

Question 11

critical values $x = \sqrt{11}$ and $x = -\sqrt{11}$	**M1**
$x < -\sqrt{11}$ or $x > \sqrt{11}$	**A1**

Answer: $x < -\sqrt{11}$ or $x > \sqrt{11}$

Question 12

factorises and finds the critical values of the quadratic inequality	**M1**
-5 < x < 9	**A1**
solves the linear inequality to get x ≥ 3	**M1**
overlap of the two solution sets: 3 ≤ x < 9	**A1**

Answer: 3 ≤ x < 9

Question 13

uses the discriminant $b^2 - 4ac = 6^2 - 4 \times 3 \times k = 36 - 12k$	**M1**
sets $b^2 - 4ac > 0$ for two distinct real roots: 36 - 12k > 0	**M1**
k < 3	**A1**

Answer: k < 3

Question 14

factorises to find the critical values	**M1**
critical values x = -3 and x = 5	**A1**
writes the solution set -3 < x < 5	**M1**
integers: -2, -1, 0, 1, 2, 3, 4	**A1**

Answer: -2, -1, 0, 1, 2, 3, 4

Question 15

finds where the curve meets the line y = 3: $(x + 1)^2 = 7$	**M1**
finds the possible integer x values, from the largest and smallest x with the curve not above the line	**M1**
counts the integer y values for each x: x = -3: 3, x = -2: 6, x = -1: 7, x = 0: 6, x = 1: 3	**M1**
total = 25	**A1**

Answer: 25

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Question 16

factorises (or uses the formula) to find the critical values	**M1**
critical values x = -1 and x = 5	**A1**
x ≤ -1 or x ≥ 5	**A1**

Answer: x ≤ -1 or x ≥ 5

Question 17

factorises and finds the critical values of the quadratic inequality	**M1**
-5 < x < 7	**A1**
solves the linear inequality to get x ≥ -3	**M1**
overlap of the two solution sets: -3 ≤ x < 7	**A1**

Answer: -3 ≤ x < 7

Question 18

factorises to find the critical values	**M1**
critical values x = -7 and x = 4	**A1**
writes the solution set -7 ≤ x ≤ 4	**M1**
integers: -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4	**A1**

Answer: -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4

Question 19

uses the discriminant $b^2 - 4ac = 100 - 8k$	**M1**
sets $b^2 - 4ac < 0$	**M1**
k > 25/2	**A1**
checks that k ≠ 0 so that the equation is a genuine quadratic	**B1**

Answer: k > 25/2

Question 20

finds where the curve meets the line y = 1: $(x)^2 = 6$	**M1**
finds the possible integer x values, from the largest and smallest x with the curve not above the line	**M1**
counts the integer y values for each x: x = -2: 3, x = -1: 6, x = 0: 7, x = 1: 6, x = 2: 3	**M1**
total = 25	**A1**

Answer: 25

Question 21

uses the discriminant $b^2 - 4ac = 16 - 20k$	**M1**
sets $b^2 - 4ac > 0$	**M1**
k < 4/5	**A1**
k ≠ 0 because the equation must remain quadratic	**B1**

Answer: k < 4/5 and k ≠ 0

Question 22

uses the discriminant $b^2 - 4ac = 5^2 - 4 \times 5 \times k = 25 - 20k$	**M1**
sets $b^2 - 4ac < 0$ for no real roots: 25 - 20k < 0	**M1**
k > 5/4	**A1**

Answer: k > 5/4

Question 23

factorises to find the critical values	**M1**
critical values x = -8 and x = 7	**A1**
writes the solution set -8 < x < 7	**M1**
integers: -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6	**A1**

Answer: -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6

Question 24

rearranges or factorises, noting $-x^2 + 6x - 5 = -(x^2 - 6x + 5)$ and finds roots x = 1 and x = 5	**M1**
1 ≤ x ≤ 5 cao	**A1**

Answer: 1 ≤ x ≤ 5

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