HIGHER

6.7 Inequalities on Graphs: Test Pack

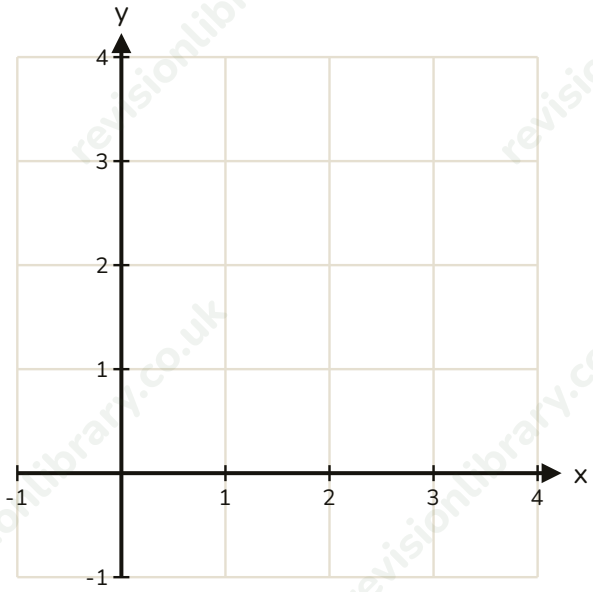
EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 On the axes below, draw the boundary line y = x + 2 and shade the region representing the inequality y > x + 2. Label the boundary clearly (use a dashed line where appropriate).



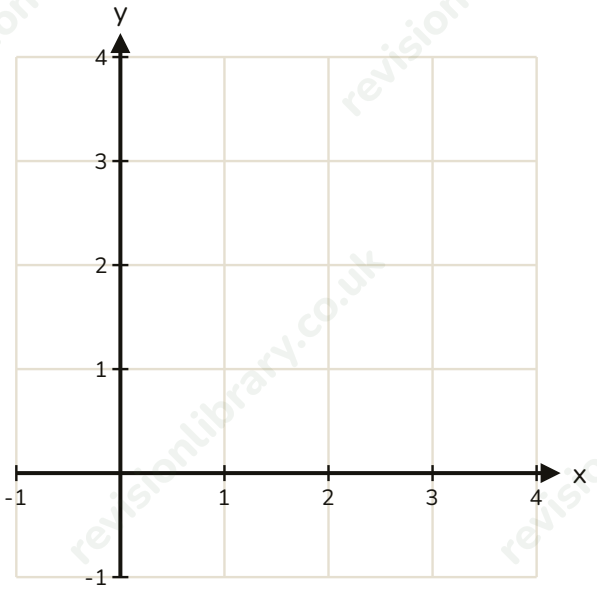
(Total for Question 1 is 2 marks)

2 State whether the point (1, 1) satisfies the inequality y ≥ 2x - 1. You must show the substitution.

(Total for Question 2 is 1 mark)

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3 Shade the region that satisfies $y > -x + 2$ and $y \leq 3$. Give one integer-valued point (x,y) that lies in the shaded region and show the checking calculations.



(Total for Question 3 is 2 marks)

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4 Which of the following points lies in the region satisfying both inequalities $y < x + 1$ and $y > -x + 3$? Select the correct option.

- ☐ (1, 2)
- ☐ (0, 1)
- ☐ (2, 2)
- ☐ (1, 3)

(Total for Question 4 is 1 mark)

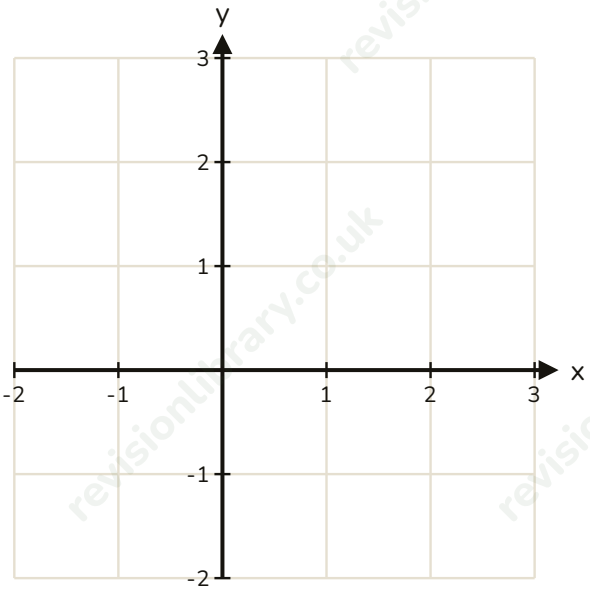
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5 A feasible region is defined by the inequalities $x \geq 0$, $y \geq 0$ and $y \leq 2x + 1$. Which of the following points are vertices (corner points) of this region: (0,0), (0,1), (1,3)? Explain your answer.

(Total for Question 5 is 2 marks)

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6 Sketch the two lines $y \geq -1/2\ x + 1$ and $y \leq x - 1$ on the axes. Label both boundary lines clearly (solid lines). (a) On the sketch show the region that satisfies both inequalities. (b) Find the coordinates of the point where the two boundary lines intersect.



(a) Sketch both boundary lines and shade the region satisfying both inequalities. **(1)**

(b) Work out the coordinates of their intersection point. **(2)**

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(Total for Question 6 is 3 marks)

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7 Find the intersection point of the boundary lines $y = x - 2$ and $y = -x + 4$. Then state whether the point (4,2) lies in the region satisfying both $y \geq x - 2$ and $y \leq -x + 4$. Show your working.

(a) Find the intersection point of $y = x - 2$ and $y = -x + 4$. **(2)**

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(b) Does (4,2) satisfy both inequalities $y \geq x - 2$ and $y \leq -x + 4$? Explain. **(1)**

.....

.....

(Total for Question 7 is 3 marks)

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8 A region R is defined by the inequalities $x \geq 1$, $2x + 3y < 9$ and $y < 6$. By substituting, decide whether each of the points A(7, 7), B(7, 5) and C(3, 7) lies inside R.

(Total for Question 8 is 3 marks)

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9 A region is above the solid line $y = 2x - 2$, below the dashed line $y = 9$, and to the right of the solid line $x = 1$. Write down the three inequalities that define the region.

(Total for Question 9 is 3 marks)

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10 A triangle has vertices (3, 3), (6, 3) and (3, 9). Write down three inequalities that together define the triangular region, including its boundary lines.

(Total for Question 10 is 3 marks)

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11 A region is above the dashed line $y = 2x$, below the dashed line $y = 6$, and to the right of the solid line $x = 1$. Write down the three inequalities that define the region.

(Total for Question 11 is 3 marks)

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12 x and y are integers. How many points with integer coordinates satisfy all of the inequalities $x \geq 2$, $y \geq 0$ and $x + y \leq 9$?

(Total for Question 12 is 3 marks)

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13 A region R is defined by the inequalities $x > 1$, $3x + 3y \leq 9$ and $y < 5$. By substituting, decide whether each of the points A(1, 1), B(4, -1) and C(5, 6) lies inside R.

(Total for Question 13 is 3 marks)

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14 A region is above the solid line $y = 3x + 3$, below the dashed line $y = 5$, and to the right of the solid line $x = 2$. Write down the three inequalities that define the region.

(Total for Question 14 is 3 marks)

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15 x and y are integers that satisfy $x \geq 1$, $y \geq 1$ and $x + 3y \leq 14$. Find the greatest possible value of $x + y$.

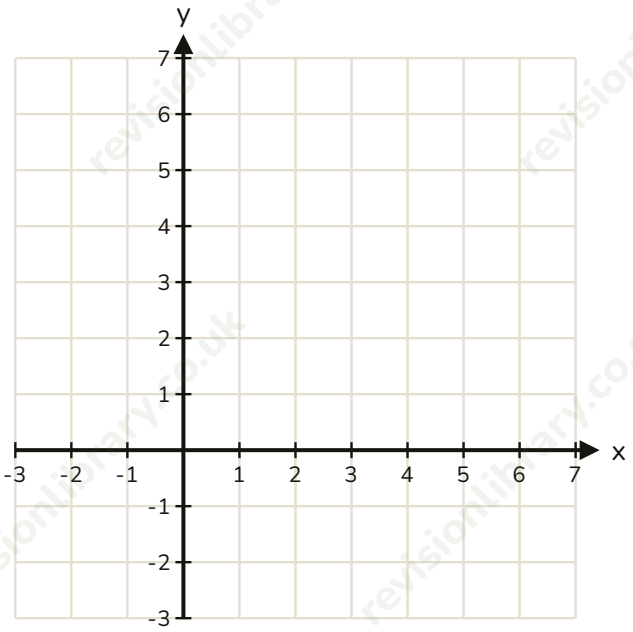
(Total for Question 15 is 3 marks)

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16 Explain why there is no point that can satisfy both $y > 2x + 1$ and $y < 2x - 1$. Give a short algebraic justification.

(Total for Question 16 is 2 marks)

17 On the axes sketch the lines $y = 1/2\ x + 1$ and $y = -x + 4$, and shade the region where $y \leq 1/2\ x + 1$ and $y \geq -x + 4$. For which integer values of x in the range -2 to 6 inclusive is there at least one value of y that satisfies both inequalities? Show your working.



(Total for Question 17 is 3 marks)

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Mark scheme · 6.7 Inequalities on Graphs: Test Pack

Question 1

correct boundary line drawn as y = x + 2 with a dashed line (inequality is strict) or equivalent linear plot oe **M1**

region above the line shaded (y greater than x + 2) cao **A1**

Answer: Dashed line y = x + 2; region above the line shaded. Example check point: (0,3) gives 3 > 2, so the region above the line is correct (cao).

Question 2

correct statement that (1,1) satisfies the inequality with substitution: 1 ≥ 2*1 - 1 = 1, so true cao **B1**

Answer: Yes. Substitution: 1 ≥ 2*1 - 1 = 1, so 1 ≥ 1 is true, therefore (1,1) satisfies the inequality.

Question 3

correct overlapping region shaded: above the line y = -x + 2 (dashed) and at or below y = 3 (solid) oe **M1**

correct integer point given and checked, for example (0,3) with 3 > -0 + 2 and 3 ≤ 3 cao **A1**

Answer: Shaded region above y = -x + 2 and at or below y = 3. Example integer point: (0,3). Check: 3 > -0 + 2 -> 3 > 2 true; 3 ≤ 3 true.

Question 4

choose (2, 2) and show it satisfies both inequalities: 2 < 2+1 and 2 > -2+3 oe **B1**

Answer: (2, 2). Check: 2 < 3 and 2 > 1 so both inequalities hold.

Question 5

identify that (0,0) and (0,1) are intersections of two boundary lines so are vertices, but (1,3) lies on the sloping boundary only **M1**

(0,0) and (0,1) are the corner points; (1,3) is not a vertex since it only lies on y = 2x + 1 and not on another boundary cao **A1**

Answer: Vertices: (0,0) and (0,1). Reason: (0,0) is intersection of x ≥ 0 and y ≥ 0; (0,1) is intersection of x = 0 and y = 2x + 1. Point (1,3) lies on the sloping line only, not at an intersection of two boundaries.

Question 6

(a) both lines drawn correctly (y = -1/2 x + 1 and y = x - 1), drawn as solid lines, with the overlapping region shaded appropriately oe **M1**

(a) Answer: Both solid lines drawn; the overlapping region (where y is at least -1/2 x + 1 and at most x - 1) shaded.

(b) substitute: -1/2 x + 1 = x - 1 or equivalent correct equation oe **M1**

(b) x = 4/3, y = 1/3 cao **A1**

(b) Answer: (4/3, 1/3)

Question 7

(a) set x - 2 = -x + 4 and form 2x = 6 or equivalent oe **M1**

(a) x = 3, y = 1 so intersection (3, 1) cao **A1**

(a) Answer: (3, 1)

(b) correctly state No with a check showing 2 ≥ 4 - 2 is true but 2 ≤ -4 + 4 is false, so (4,2) is not in the region oe **B1**

(b) Answer: No. Check: y ≥ x - 2 -> 2 ≥ 2 true; y ≤ -x + 4 -> 2 ≤ 0 false. Therefore (4,2) is not in the region.

Question 8

substitutes a point into the inequalities **M1**

checks every inequality for each point **M1**

A: no, B: no, C: no cao **A1**

Answer: A: no, B: no, C: no

Question 9

y ≥ 2x - 2 with correct inequality sign **B1**

y < 9 with correct sign **B1**

x ≥ 1 with correct sign **B1**

Answer: y ≥ 2x - 2, y < 9, x ≥ 1

Question 10

x ≥ 3 and y ≥ 3 **B1**

gradient or equation of the sloping boundary found **M1**

2x + y ≤ 15 oe **A1**

Answer: x ≥ 3, y ≥ 3, 2x + y ≤ 15

Question 11

y > 2x with correct inequality sign **B1**

y < 6 with correct sign **B1**

x ≥ 1 with correct sign **B1**

Answer: y > 2x, y < 6, x ≥ 1

Question 12

draws or considers the three boundary lines **M1**

counts the points row by row (or column by column) **M1**

36 cao **A1**

Answer: 36

Question 13

substitutes a point into the inequalities **M1**

checks every inequality for each point **M1**

A: no, B: yes, C: no cao **A1**

Answer: A: no, B: yes, C: no

Question 14

y ≥ 3x + 3 with correct inequality sign **B1**

y < 5 with correct sign **B1**

x ≥ 2 with correct sign **B1**

Answer: y ≥ 3x + 3, y < 5, x ≥ 2

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Question 15

identifies the region defined by the inequalities	**M1**
tests corner or boundary integer points	**M1**
12 cao	**A1**

Answer: 12

Question 16

recognise and state that y must be greater than 2x+1 and simultaneously less than 2x-1, giving inequality 2x+1 < y < 2x-1 or equivalent	**M1**
conclude this is impossible because 2x+1 > 2x-1 for all x so there is no y satisfying both; therefore no solution cao	**A1**

Answer: No solution. Algebraic explanation: the two inequalities require 2x + 1 < y < 2x - 1. But 2x + 1 > 2x - 1 for all x (since 1 > -1), so there is no value of y between these two conflicting bounds.

Question 17

form inequality for existence of a valid y: -x + 4 ≤ 1/2 x + 1 (lower bound ≤ upper bound) oe	**M1**
solve -x + 4 ≤ 1/2 x + 1 to get 3 ≤ 3/2 x or x ≥ 2 oe	**M1**
list integer x in -2..6 with x ≥ 2: 2, 3, 4, 5, 6 cao	**A1**

Answer: Integer x values: 2, 3, 4, 5, 6. Work: need -x + 4 ≤ 1/2 x + 1 (lower bound at most upper bound) -> 4 - 1 ≤ 1/2 x + x -> 3 ≤ 3/2 x -> x ≥ 2, so all integers in the given range from 2 to 6 qualify.

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