6.7D Inequalities on Graphs: Fluency and Exam Drill

EDEXCEL 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).

Figure (to be drawn): *Grid of x and y axes supplied for students to draw on.*

(Total for Question 1 is 2 marks)

2 On the axes, draw the boundary line for $2x + y = 4$ and shade the region representing $2x + y \leq 4$. Label the boundary and show whether it is solid or dashed.

Figure (to be drawn): *Grid of x and y axes supplied for students to draw on.*

(Total for Question 2 is 2 marks)

3 State whether the point (1, 1) satisfies the inequality $y \geq 2x - 1$. You must show the substitution.

(Total for Question 3 is 1 mark)

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)

5 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.

Figure (to be drawn): *Grid of x and y axes supplied for students to draw on.*

(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 5 is 3 marks)

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6 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 6 is 2 marks)

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7 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.

Figure (to be drawn): *Grid of x and y axes supplied for students to draw on.*

(Total for Question 7 is 2 marks)

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8 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 8 is 2 marks)

9 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 9 is 3 marks)

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10 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.

Figure (to be drawn): *Grid of x and y axes supplied for students to draw on.*

(Total for Question 10 is 3 marks)

Mark scheme · 6.7D Inequalities on Graphs: Fluency and Exam Drill

Question 1

- **M1** correct boundary line drawn as $y = x + 2$ with a dashed line (inequality is strict) or equivalent linear plot oe
- **A1** region above the line shaded (y greater than $x + 2$) cao
- **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

- **M1** correct boundary line drawn (rearrange to $y = -2x + 4$) and drawn as a solid line since inequality is $\le$ oe
- **A1** region shaded below or on the line (points such as (0,0) satisfy $2*0+0 \le 4$) cao
- **Answer: Solid line $y = -2x + 4$ drawn; region below and including the line shaded. Check point (0,0): $0 \le 4$, so shading below is correct.**

Question 3

- **B1** correct statement that (1,1) satisfies the inequality with substitution: $1 \ge 2*1 - 1 = 1$, so true cao
- **Answer: Yes. Substitution: $1 \ge 2*1 - 1 = 1$, so $1 \ge 1$ is true, therefore (1,1) satisfies the inequality.**

Question 4

- **B1** choose (2, 2) and show it satisfies both inequalities: $2 < 2+1$ and $2 > -2+3$ oe
- **Answer: (2, 2). Check: $2 < 3$ and $2 > 1$ so both inequalities hold.**

Question 5

- (a) **M1** both lines drawn correctly ($y = -1/2\ x + 1$ and $y = x - 1$), drawn as solid lines, with the overlapping region shaded appropriately oe
- **(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) **M1** substitute: $-1/2\ x + 1 = x - 1$ or equivalent correct equation oe
- (b) **A1** $x = 4/3$, $y = 1/3$ cao
- **(b) Answer: (4/3, 1/3)**

Question 6

- **M1** 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
- **A1** (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
- **Answer: Vertices: (0,0) and (0,1). Reason: (0,0) is intersection of $x \ge 0$ and $y \ge 0$; (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 7

- **M1** correct overlapping region shaded: above the line $y = -x + 2$ (dashed) and at or below $y = 3$ (solid) oe
- **A1** correct integer point given and checked, for example (0,3) with $3 > -0 + 2$ and $3 \le 3$ cao
- **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; $3 \le 3$ true.**

Question 8

- **M1** 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
- **A1** conclude this is impossible because $2x+1 > 2x-1$ for all x so there is no y satisfying both; therefore no solution cao
- **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 9

- (a) **M1** set x - 2 = -x + 4 and form 2x = 6 or equivalent oe
- (a) **A1** x = 3, y = 1 so intersection (3, 1) cao
- **(a) Answer: (3, 1)**
- (b) **B1** 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
- **(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 10

- **M1** 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
- **A1** list integer x in -2..6 with x ≥ 2: 2, 3, 4, 5, 6 cao
- **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.**