Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Equations, inequalities and graphs

Time allowed: 1 hour 10 minutes

Subject code **0606**

Additional Mathematics

Questions from Paper 1 and Paper 2

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
Questions 2-3, 7 (Paper 1): no calculator.
Questions 1, 4-6, 8-10 (Paper 2): calculator allowed.

Total marks

/ 44

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 44 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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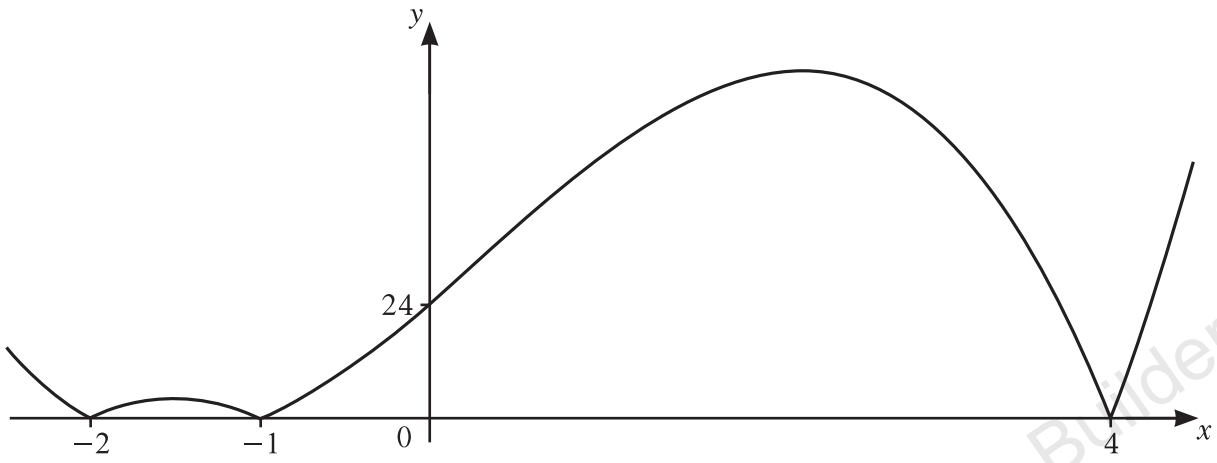
Print at 100% (Actual size) so diagrams keep their real measurements.

1 Solve $|3x+2| = x+4$. [3]

Modulus equations and inequalities Click for more variations

1	$x = 1$	**B1**	
	$-3x - 2 = x + 4$ oe	**M1**	
	$x = -1.5$ oe	**A1**	

2



The diagram shows the graph of $y = |\mathrm{p}(x)|$, where $\mathrm{p}(x)$ is a cubic function. Find the two possible expressions for $\mathrm{p}(x)$. [3]

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Cubic graphs and cubic inequalities Click for more variations

2	$y = \pm 3(x+2)(x+1)(x-4)$	**3**	**B1** for 3 **B1** for $(x+2)(x+1)(x-4)$ **B1** for $\pm$

3 Solve the equation $x^{\frac{1}{3}} + 1 = \dfrac{6}{x^{\frac{1}{3}}}$. [4]

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Equations that become quadratics (substitution) Click for more variations

3	$x^{\frac{2}{3}} + x^{\frac{1}{3}} - 6 \ (=0)$ oe soi	**B1**	For multiplying through by $x^{\frac{1}{3}}$ Allow if substitution is used
	$\left(x^{\frac{1}{3}} + 3\right)\left(x^{\frac{1}{3}} - 2\right) \ (=0)$ oe	**M1**	Allow if substitution is used
	$x = -27$	**A1**	**A0** if rejects $x = -27$
	$x = 8$	**A1**	

4 Solve the equation $|7x + 5| = |3x - 13|$. [4]

Modulus equations and inequalities Click for more variations

4	$7x + 5 = 3x - 13$	M1	Equate and attempt to solve
	$x = -4.5$ o.e.	A1	
	$7x + 5 = 3x + 13$	M1	Equate
	$x = 0.8$ o.e.	A1	Mark final answers
	OR	[4]	
	Square and Equate	M1	Both expressions must have 3 terms
	$10x^2 + 37x - 36 (= 0)$ o.e.	A1	Three terms
	$(5x - 4)(2x + 9) [= 0]$	M1	Factorise or formula of three term
	$x = 0.8$ and $x = -4.5$	A1	quadratic.
	OR		
	Plot $y = \lvert 7x + 5 \rvert$	M1	Shape and intercepts must be correct
	Plot $y = \lvert 3x - 13 \rvert$	M1	Shape and intercepts must be correct
	$x = 0.8$	A1	
	$x = -4.5$	A1	

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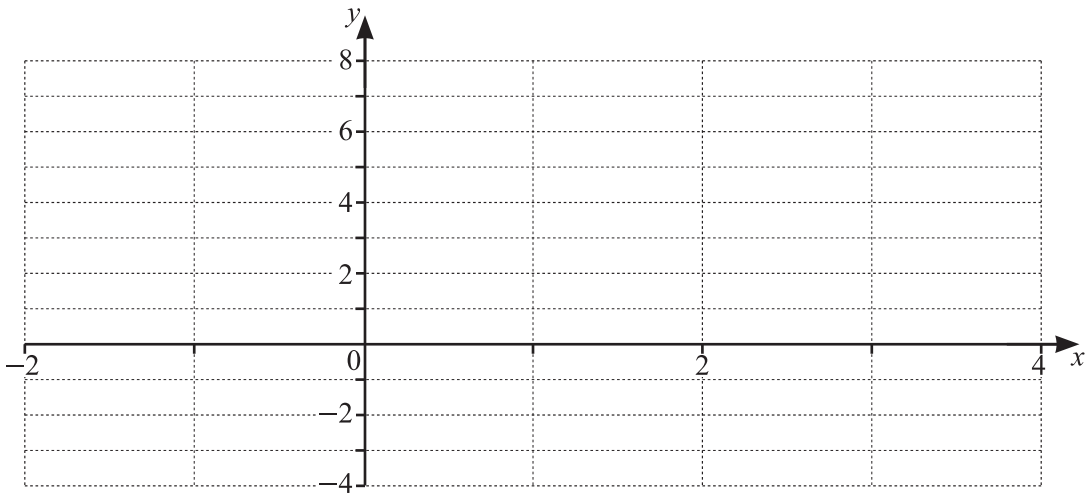
5 Solve the inequality $|5x+2| \geqslant 3$. [4]

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Modulus equations and inequalities Click for more variations

5	$5x+2*3$ and $5x+2*-3$ oe	**M1**	where * could be = or any inequality sign
	Critical values: $\frac{1}{5}$, -1 soi	**A2**	**A1** for one correct value
	$x \leqslant -1 \quad x \geqslant \frac{1}{5}$ oe mark final answer	**A1**	
	Alternative method		
	$(5x+2)^2 * 3^2$	**(M1)**	where * could be = or any inequality sign
	Critical values: $\frac{1}{5}$, -1 soi	**(A2)**	**A1** for $25x^2+20x-5[*0]$
	$x \leqslant -1 \quad x \geqslant \frac{1}{5}$ oe mark final answer	**(A1)**	

6 **(i)** On the axes below, draw the graph of $y = |2x-3|$.

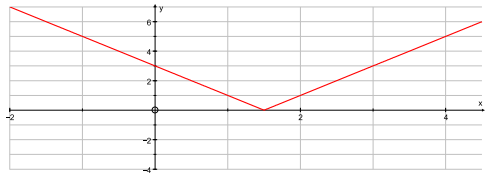


[2]

(ii) Solve the equation $7-|2x-3|=0$. [3]

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Modulus equations and inequalities Click for more variations

6(i)		**B2**	**B1** shape **B1** Correct intersection with axes.
6(ii)	$7 = 2x - 3 \rightarrow x = 5$	**B1**	
	Uses $7 = 3 - 2x$ oe	**M1**	
	$x = -2$	**A1**	

7 Solve the equation $\left|x^2 - 5x\right| = 6$. [5]

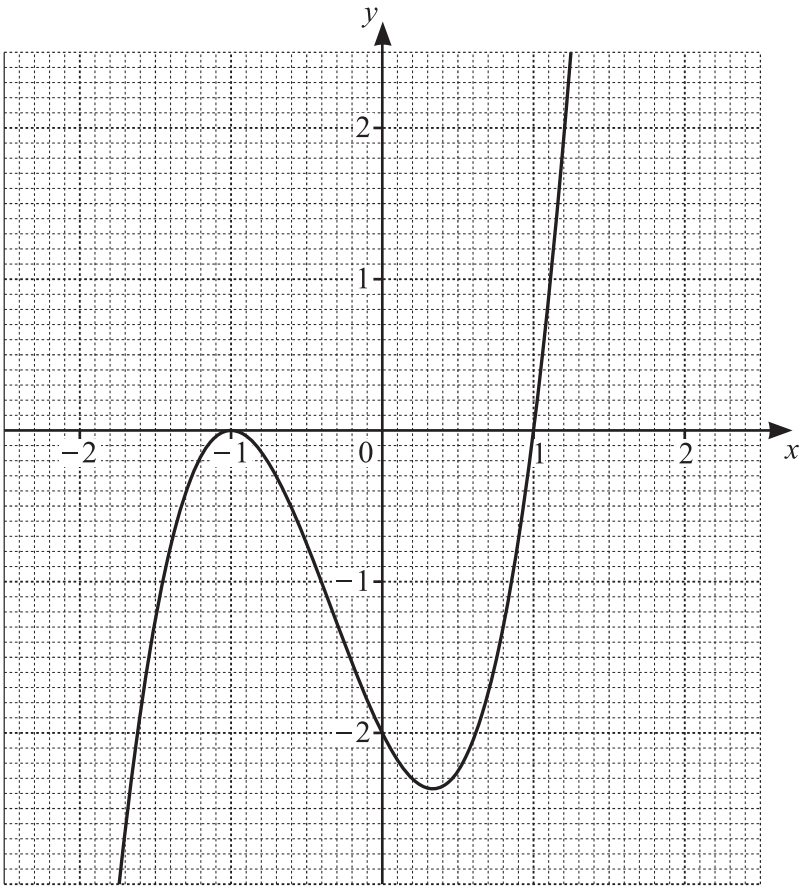
Modulus equations and inequalities Click for more variations

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7	$x^2 - 5x = 6 \Rightarrow x^2 - 5x - 6 = 0$ $(x - 6)(x + 1) = 0$	**M1**	or $x = \frac{5 \pm \sqrt{25 - 4 \times (-6)}}{2}$
	$x = 6$ or -1	**A1**	
	$x^2 - 5x = -6 \Rightarrow x^2 - 5x + 6 = 0$	**M1**	
	$(x - 3)(x - 2) = 0$	**M1**	or $x = \frac{5 \pm \sqrt{25 - 4 \times 6}}{2}$
	$x = 3$ or 2	**A1**	
	Alternative method		
	$\left(x^2 - 5x\right)^2 = 36$	**(M1)**	
	$x^4 - 10x^3 + 25x^2 - 36 = 0$	**(A1)**	
	$(x - 3)(x - 2)(x - 6)(x + 1) = 0$	**(M1)**	Attempt to factorise into 4 brackets
	$x = -1$ or 2 or 3 or 6	**(A1A1)**	**A1** for any two

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8



The diagram shows the graph of $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = a(x+b)^2(x+c)$ and a, b and c are integers.

(a) Find the value of each of a, b and c. [2]

(b) Hence solve the inequality $\mathrm{f}(x) \leqslant -1$. [3]

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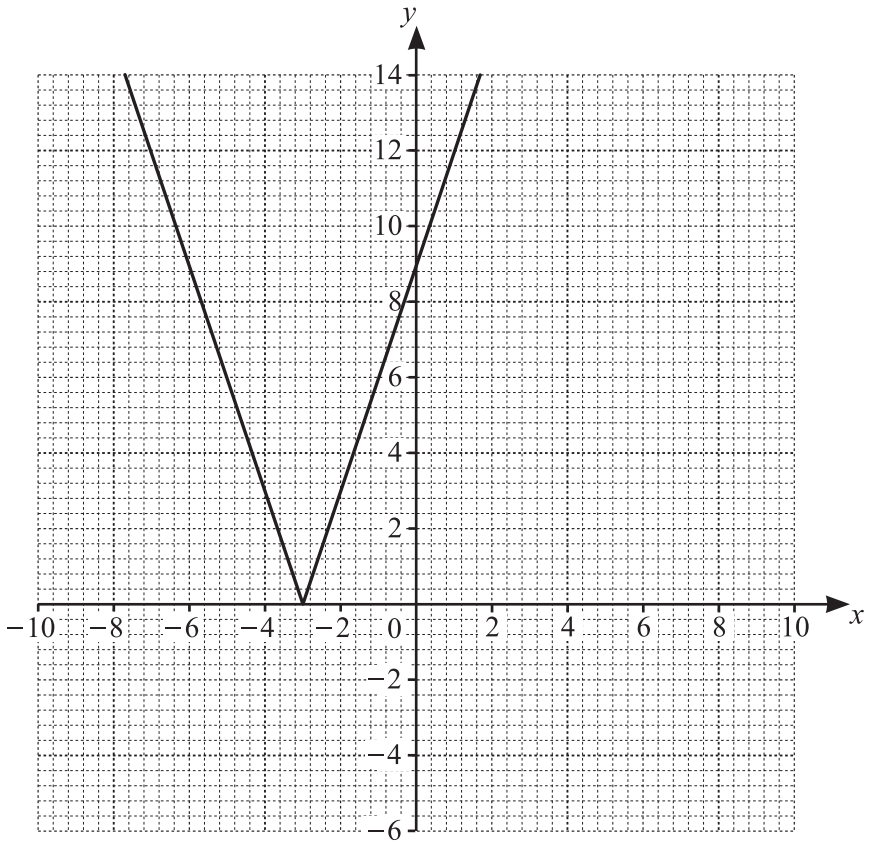
Cubic graphs and cubic inequalities Click for more variations

8(a)	$a = 2$, $b = 1$, $c = -1$	**B2**	**B1** for any two correct
8(b)	Finds three correct critical values: -1.5 to -1.4 inclusive -0.4 0.8 to 0.9 inclusive	**B1**	
	A correct pair of inequalities	**B2**	**B1** for either inequality correct

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9 **(a)** Solve the equation $\frac{|4x-5|}{7} = 1$. [2]

(b)



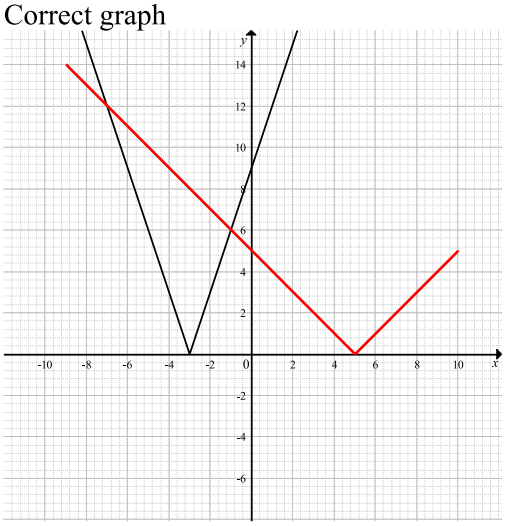
The diagram shows the graph of $y = |3x+9|$.

By drawing a suitable graph on the same diagram, solve the inequality $|3x+9| \leqslant |x-5|$. [3]

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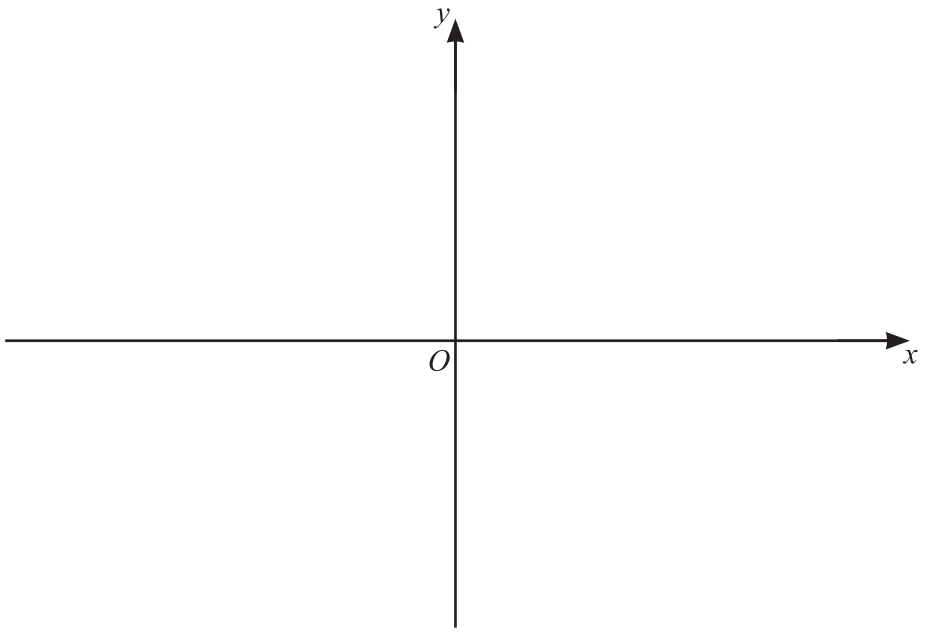
Modulus equations and inequalities Click for more variations

9(a)	$4x - 5 = 7$ and $4x - 5 = -7$ oe, soi	**M1**	
	$x = 3, x = -\frac{1}{2}$	**A1**	

9(b)	Correct graph  AND $-7 \leqslant x \leqslant -1$	**3**	**B1** for correct graph and **B2 dep** for $-7 \leqslant x \leqslant -1$; dependent on a correct graph for $-7 \leqslant x \leqslant -1$ or **B1 STRICT FT** for *their* critical values from the two intersections of *their* straight-line section of graph providing it has negative gradient

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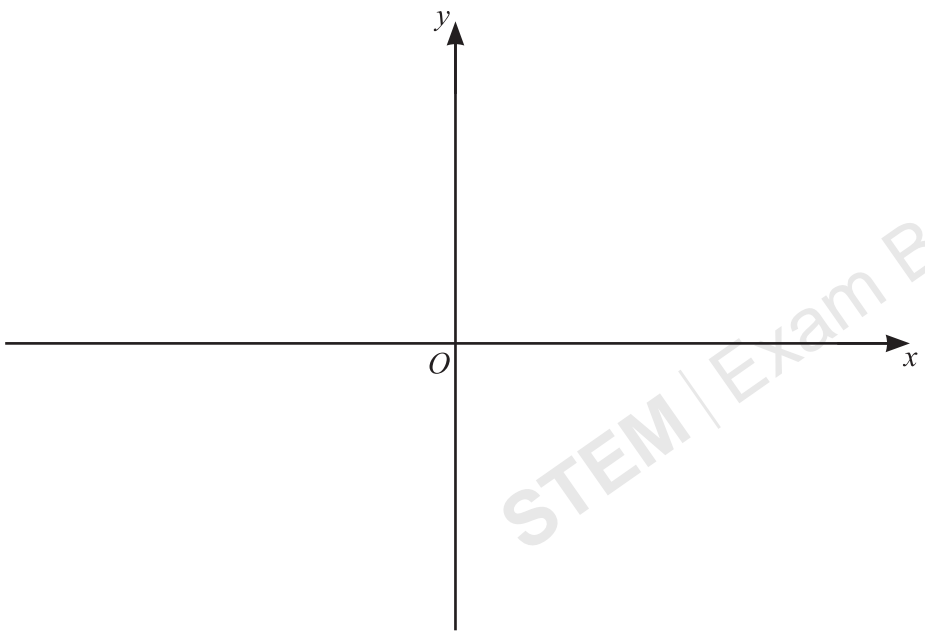
10 **(a)** On the axes, sketch the graph of $y = (2x-5)(x+3)(1-x)$, stating the intercepts with the coordinate axes. [3]



(b) Hence

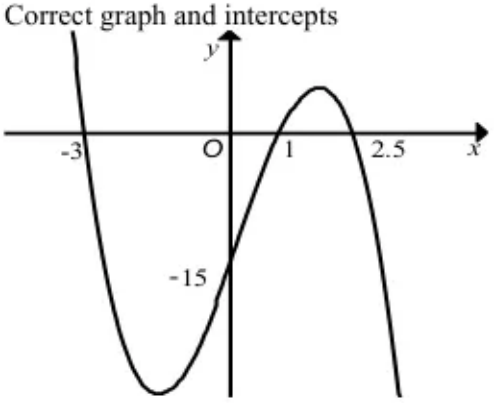
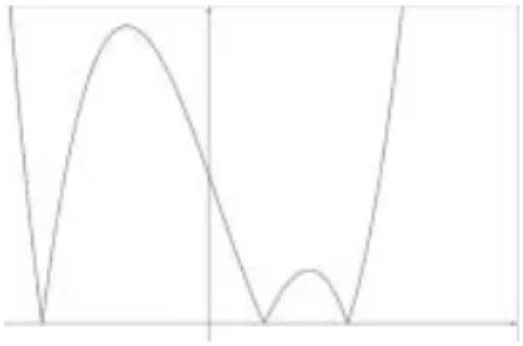
(i) solve the inequality $(2x-5)(x+3)(1-x) \leqslant 0$ [2]

(ii) on the axes below, sketch the graph of $y = |(2x-5)(x+3)(1-x)|$. [1]



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10(a)	Correct graph and intercepts  	**B3**	**B1** for correct shape; the ends must extend above and below the x-axis **B1** for correct roots indicated; must have attempted a cubic shape **B1** for correct y-intercept indicated; must have attempted a cubic shape
10(b)(i)	$-3 \leqslant x \leqslant 1$, $x \geqslant 2.5$ mark final answer	**B2**	**FT** *their* **(a)** providing it is an equivalent cubic shape and has 3 stated or indicated roots for **B2, B1** or **SC1** **B1** for one correct inequality out of two If 0 scored then **SC1** for $-3 < x < 1$, $x > 2.5$ or $-3 < x \leqslant 1$, $x > 2.5$ or $-3 \leqslant x < 1$, $x > 2.5$
10(b)(ii)	Graph of correct shape, with cusps, positive y-intercept and x-intercepts which match **(a)** 	**B1**	**FT** *their* **(a)** providing it is an equivalent cubic shape

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