eClassroom

INTERNATIONAL A LEVEL MATHEMATICS • FURTHER PURE MATHEMATICS 2

Further Pure 2

Chapter 1: Inequalities

Exam Questions by Topic

Pearson Edexcel International Advanced Level (WFM02/01) • Calculator allowed

Multi-step exam questions at the difficulty of the real WFM02 paper, with a full mark scheme

Chapters (tap a chapter to jump to it)		Qs	Marks	Page	My score
1	**Inequalities** Rational and modulus inequalities, critical values, graphs	10	80	2	
2	**Series** Method of differences, partial fractions, telescoping sums	10	80	separate file	
3	**Complex Numbers** Exponential form, de Moivre's theorem, trigonometric identities, nth roots	10	80	separate file	
4	**Further Argand Diagrams** Loci, regions and transformations of the complex plane	10	80	separate file	
5	**First-Order Differential Equations** Integrating factors, substitutions, general and particular solutions	10	80	separate file	
6	**Second-Order Differential Equations** Auxiliary equations, complementary functions, particular integrals, substitutions	10	80	separate file	
7	**Maclaurin and Taylor Series** Higher derivatives, standard and compound series, Taylor series, series solutions	10	80	separate file	
8	**Polar Coordinates** Polar curves, areas, tangents parallel and perpendicular to the initial line	10	80	separate file	

Full mark scheme Free courses More worksheets

Name ..... Class ..... Date .....

CHAPTER 1 • KEY SKILLS

1 Inequalities

Specification FP2: Inequalities • 10 questions • 80 marks • about 96 minutes

1 Never multiply blindly

Do not multiply by an expression whose sign is unknown. Multiply by its square, or collect everything on one side.

2 Single fraction

Write as $\frac{f(x)}{g(x)} > 0$: the critical values are the zeros of the numerator and of the denominator.

3 Signs or sketch

Test the sign in each interval, or sketch $y = f(x)/g(x)$ (or both sides), to choose the regions.

4 Excluded values

A value making a denominator zero is never included, even with $\leqslant$ or $\geqslant$

5 Modulus cases

$|f(x)| = g(x)$ gives $f(x) = g(x)$ or $-f(x) = g(x)$. Check each root in the original: some are invalid.

6 Use the graph

Sketch both sides: the solution is where one graph is above the other, including regions where one side is negative.

7 Equal curves first

Setting the two sides equal gives the crossing points directly; add the asymptotes as further critical values.

8 Parameters

"No solution" or "always true" conditions come from a discriminant $b^2 - 4ac < 0$

9 Notation

Give intervals such as $x < -5$ or $-2 < x < 1$, or $\{x : x < -5\} \cup \{x : -2 < x < 1\}$

Skills map every skill above is tested at least once; interleaved skills come from GCSE or other chapters

Skill	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Marks	6	6	6	6	6	10	10	10	10	10
1 Never multiply blindly	•	•			•		•		•	•
2 Single fraction	•			•	•		•			•
3 Signs or sketch	•	•		•	•	•	•	•		•
4 Excluded values	•	•		•	•		•	•		•
5 Modulus cases			•			•		•		•
6 Use the graph			•			•		•		•
7 Equal curves first						•	•	•		
8 Parameters									•	
9 Notation	•	•	•	•	•	•	•	•	•	•
Interleaved: quadratics, cubics and the discriminant (P1, P2)		•		•		•		•	•	
Interleaved: the modulus function and graphs (P3)			•			•		•		•
Interleaved: algebraic fractions (P3)	•				•		•	•	•	•

Exam difficulty. Questions 1 to 5 check each skill on its own. Questions 6 to 10 are multi-step questions built like the last questions on a real WFM02 paper, where one part leads into the next and skills from different topics are combined.

Must learn. Find every critical value (crossings and asymptotes), check modulus roots in the original, then sketch to choose the regions. Use $<$ next to a value that makes a denominator zero.

★★★★★

Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

1. **(a)** Use algebra to find the set of values of x for which $\frac{x+1}{x-2} < 3$

(5)

(b) Write down the set of values of x for which $\frac{x+1}{x-2} \leqslant 3$

(1)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 1 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 1 is 6 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

2. Use algebra to find the set of values of x for which

$$\frac{2}{x-1} \geqslant x$$

(6)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 2 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 2 is 6 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

3. **(a)** On the same axes, sketch the graphs of $y = |x - 3|$ and $y = 2x$.

(2)

(b) Hence, or otherwise, solve the inequality $|x - 3| > 2x$

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at **www.eclassroom.org.uk**

Question 3 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 3 is 6 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

4.

(a) Find the set of values of x for which $\dfrac{x^2-4}{x+1} > 0$

(4)

(b) Explain why $x = -1$ cannot be included in the solution of $\dfrac{x^2-4}{x+1} \geqslant 0$

(1)

(c) Write your answer to part (a) using set notation.

(1)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 4 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 4 is 6 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

5. Showing all your algebraic working, determine the values of x that satisfy

$$\frac{1}{x+2} > \frac{2}{x-1}$$

giving your answer in set notation.

(6)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 5 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 5 is 6 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

6. **(a)** On the same axes, sketch the graphs of $y = |x^2 - 4|$ and $y = 3x$, showing the coordinates of any points where the first graph meets the axes.

(3)

(b) Find the x-coordinates of the points where the graphs meet, explaining why any other roots of your equations are rejected.

(5)

(c) Hence solve the inequality $|x^2 - 4| < 3x$

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 6 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 6 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 6 is 10 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

7. **(a)** Use algebra to find the set of values of x for which $\frac{x+1}{x-3} \geqslant \frac{x}{x+2}$

(6)

(b) Hence write down the set of values of x for which $\frac{x+1}{x-3} < \frac{x}{x+2}$

(2)

(c) Explain why multiplying both sides of the inequality in part (a) by $(x-3)(x+2)$ is not a valid method.

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 7 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 7 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 7 is 10 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

8. **(a)** On the same axes, sketch the graphs of $y = |x - 2|$ and $y = \frac{6}{x+3}$, $x \neq -3$, showing any asymptotes.

(3)

(b) Using algebra, find the set of values of x for which $|x - 2| \geqslant \frac{6}{x+3}$

(7)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 8 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 8 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 8 is 10 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

9. **(a)** Solve the inequality $\frac{3x}{x^2+2} \geqslant 1$

(3)

(b) Explain why it was valid to multiply both sides by x^2+2 in part (a).

(1)

(c) Find the set of values of the constant k, where $k > 0$, for which the inequality $\frac{3x}{x^2+2} \geqslant k$ has no real solutions.

(4)

(d) Hence state the range of the function $f(x) = \frac{3x}{x^2+2}, x \in \mathbb{R}$

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 9 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 9 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 9 is 10 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

10. **(a)** By considering the cases $x \geqslant 0$ and $x < 0$, find the set of values of x for which $\dfrac{|x|}{x-1} < 2$

(6)

(b) Hence write down the set of values of x for which $\dfrac{|x|}{x-1} \geqslant 2$

(2)

(c) Find the set of values of x for which $\dfrac{|x|}{x-1} < -1$

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 10 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 10 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 10 is 10 marks)

TOTAL FOR CHAPTER 1 IS 80 MARKS

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk