MATHS WITH DAN

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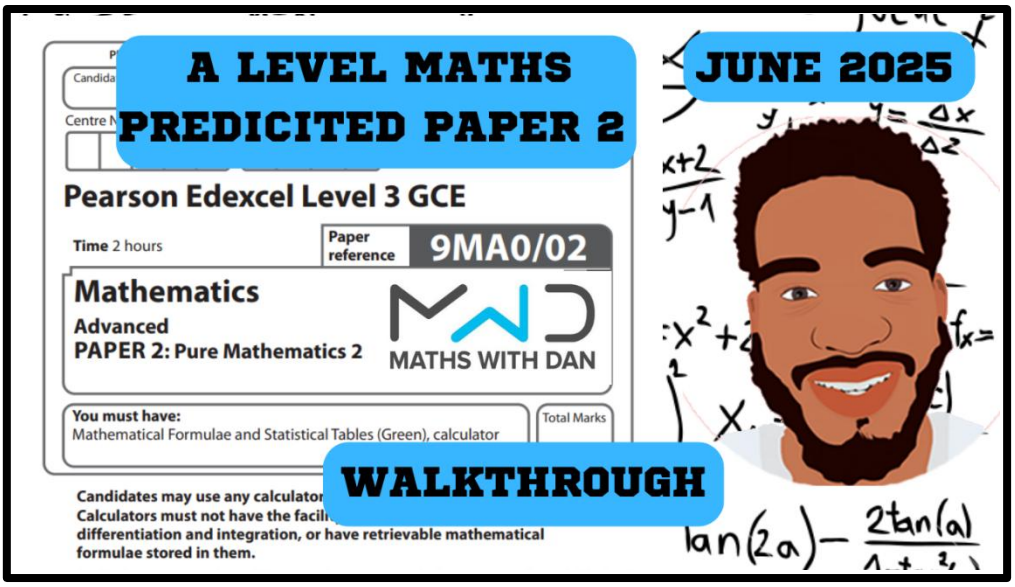

Hello there! I hope your revision is going splendidly.

Welcome to my Predicted Paper 2 for Edexcel A Level Maths June 2025!

My name is Daniel, I am a full time GCSE and A Level Maths tutor with a First-Class degree In BSc Mathematics.

In addition to my tutoring sessions, I run a YouTube channel where I offer detailed walkthroughs of past GCSE and A-Level Maths papers. I am also on TikTok and Instagram, where I go through quick-fire questions to help students stay sharp, whether they're scrolling late at night or on their way to school!

This paper includes a variety of questions gathered from past exam papers (all publicly available) and questions created by me! I've uploaded a full video walkthrough for this paper on my YouTube channel – it's a great way to check your answers and understand the methods. You can access it by scanning the QR code below or in the top right corner of each page! Do the paper FIRST before watching the video!

SCAN THE QR CODE FOR THE ENTIRE WALKHTROUGH

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Colour Scheme and Question Breakdown

In this predicted paper, the topics have been carefully selected based on what was not included in my Paper 1, ensuring a balanced and realistic coverage across both papers — just like the real exams.

You can:

- Download the Paper 1 PDF here
- Watch the full Paper 1 walkthrough on YouTube
- Download the Pure Topic Breakdown document used to plan both papers
- Watch the video explanation of how both papers were created

The topics in this paper are colour-coded using the following scheme:

COLOUR SCHEME

- Core Topics that come up every year
- Almost every year
- In between "Almost every year" and "Appears occasionally"
- Appears occasionally
- Not as frequent
- Topics that haven't come up recently and I think will appear

MORE INFO

• There are 15 questions in this question paper. The total mark for this paper is 111.

• You have 2 hours 15 mins to complete the paper.

• The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.

• Try to answer every question.

• Check your answers if you have time at the end.

A Few Key Topics Not in the Paper:

- **Log Linear Modelling**
- **Exponential Modelling**
- **Integration By Parts (In Paper 1)**
- **Integration By Substitution (In Paper 1)**

QUESTION BREAKDOWN

1. Integration
2. The Factor Theorem
3. Parametric to Cartesian
4. Recurrence Relations
5. Laws of Logarithms
   The Discriminant
6. Arithmetic and Geometric Sequences and Series
   (In Context)
7. Differentiation – The Product Rule and Chain Rule
   Set Notation
8. Vectors
9. Calculus – Modelling with Differentiation
   Radians – Sectors and Arcs
10. The Modulus Function
11. Implicit Differentiation
12. Partial Fractions
    Integrating Partial Fractions
13. Trigonometric Identities and Solving Equations
14. Forming Rates of Change
    Differential Equations
15. Parametric Integration
    Double Angle Formula
    Integration - The Reverse Chain Rule

I couldn't include everything! These topics are just as likely to appear as the others, so make sure to revise them thoroughly.

Wishing you the best of luck on this paper and the real exam! You got this.

1. Integration

$$f(x) = 8x^3 - 4\sqrt{x} + \frac{3x^2 + 2}{x}, \quad x > 0$$

Find

$$\int f(x)\, dx$$

Giving each term in simplest form. **(4)**

2. The Factor Theorem

$$f(x) = (x - 5)(x^2 - 4x + k) - 30$$

where k is a constant.

Given that $(x - 3)$ is a factor of f(x), find the value of k.

(3)

3. Parametric Equations

A curve C has parametric equations

$$x = \frac{t}{t-2}, \quad y = \frac{1}{t} + 3, \quad t \in \mathbb{R},\ t > 2$$

Show that all points on C lie on the curve with Cartesian equation

$$y = \frac{ax - 1}{bx}$$

where a and b are constants to be found.

(3)

4. Recurrence Relations

A sequence $u_1, u_2, u_3, \ldots$ is defined by

$$u_{n+1} = b - au_n$$

$$u_1 = 3$$

where a and b are constants.

(a) Find, in terms of a and b,

(i) u_2

(ii) u_3

(2)

Given

- $\sum_{n=1}^{3} u_n = 153$
- $b = a + 9$

(b) show that

$$a^2 - 5a - 66 = 0$$

(3)

(c) Hence find the larger possible value of u_2

(3)

5. Logarithms

$f(x) = \log_k(12x - 3x^2)$, $0 < x < 4$ and $k > 1$

Given that the equation $f(x) = 2$ has exactly two real solutions, determine the set of possible values for k.

(5)

6. Differentiation

In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

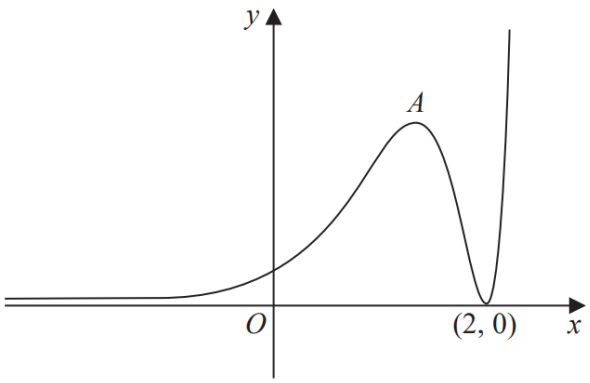

Figure 1

Figure 1 shows a sketch of part of the curve with equation $y = \mathrm{f}(x)$ where

$$\mathrm{f}(x) = (x-2)^2 \mathrm{e}^{3x} \qquad x \in \mathbb{R}$$

The curve has a maximum turning point at A and a minimum turning point at $(2, 0)$

(a) Use calculus to find the exact coordinates of A.

(5)

Given that the equation $\mathrm{f}(x) = k$, where k is a constant, has **at least** two distinct roots,

(b) Find the set of values of k, giving your answer in set notation. **(2)**

7. Sequences and Series

A metal post is repeatedly hit in order to drive it into the ground.

Given that

- on the 1st hit, the post is driven 100 mm into the ground
- on the 2nd hit, the post is driven an **additional** 98 mm into the ground
- on the 3rd hit, the post is driven an **additional** 96 mm into the ground
- the **additional** distances the post travels on each subsequent hit form an arithmetic sequence

(a) show that the post is driven an **additional** 62 mm into the ground with the 20th hit.

(1)

(b) Find the **total distance** that the post has been driven into the ground after 20 hits.

(2)

Given that for each subsequent hit after the 20th hit

- the **additional** distances the post travels form a geometric sequence with common ratio r
- on the 22nd hit, the post is driven an **additional** 60 mm into the ground

(c) find the value of r, giving your answer to 3 decimal places.

(2)

After a total of N hits, the post will have been driven more than 3 m into the ground.

(d) Find, showing all steps in your working, the smallest possible value of N.

(4)

8. Vectors

A lightweight drone is programmed to fly between three key delivery points.

Relative to a fixed base O,

- the point A has position vector $-2\mathbf{i}+5\mathbf{j}$
- the point B has position vector $4\mathbf{i}+q\mathbf{j}$, where q is a constant
- the point C has position vector $p\mathbf{i}+8\mathbf{j}$, where p is a constant

All position vectors are measured in **kilometres**.

(a) Given that the straight-line distance from point A to point B is exactly **10 km**, find the possible values of q.

(3)

The drone travels from point A to point C.
Given that the angle between $\overrightarrow{AC}$ and the unit vector $\mathbf{i}$ is $\frac{\pi}{4}$ radians,

(b) show that $p = 1$.

(3)

9. Modelling with Differentiation

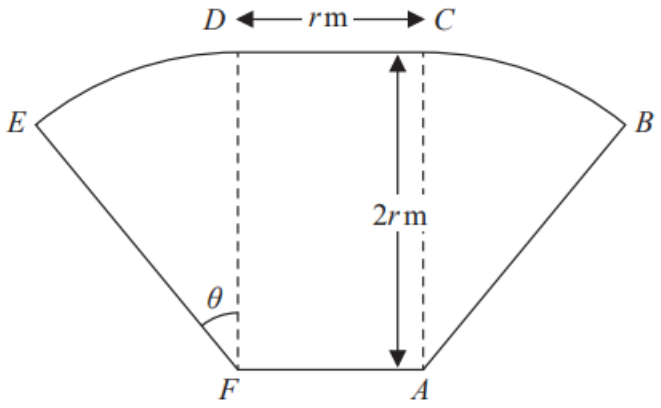

Figure 4

Figure 4 shows the plan view of the design for a stage at a trade fair.

The shape of the stage $ABCDEFA$, consists of a rectangle $ACDF$ joined to two congruent sectors of circles. ABC is a sector of a circle centre A and FDE is a sector of a circle centre F.

Given that $AC = 2r$ metres, $CD = r$ metres, angle $DFE = \theta$ radians and the area of the stage is $30\,\text{m}^2$,

(a) show that the perimeter, P metres, of the stage, is given by

$$P = 4r + \frac{30}{r}$$

(5)

(b) Use calculus to find the minimum value for P, giving your answer in the form $a\sqrt{b}$, where a and b are integers to be found.

(4)

(c) Justify that the value of P found in part (b) is the minimum.

(2)

10. The Modulus Function

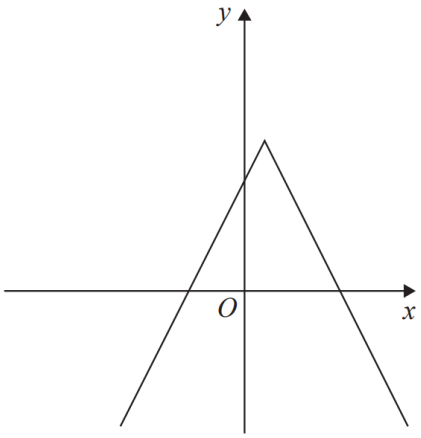

Figure 2

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

The graph shown in Figure 2 has equation

$$y = a - |2x - b|$$

where a and b are positive constants, $a > b$

(a) Find, giving your answer in terms of a and b,

(i) the coordinates of the maximum point of the graph,

(ii) the coordinates of the point of intersection of the graph with the y-axis,

(iii) the coordinates of the points of intersection of the graph with the x-axis.

(5)

On the next page, there is a copy of Figure 2 called Diagram 1.

(b) On Diagram 1, sketch the graph with equation

$$y = |x| - 1$$

(2)

Given that the graphs $y = |x| - 1$ and $y = a - |2x - b|$ intersect at $x = -3$ and $x = 5$

(c) find the value of a and the value of b

(4)

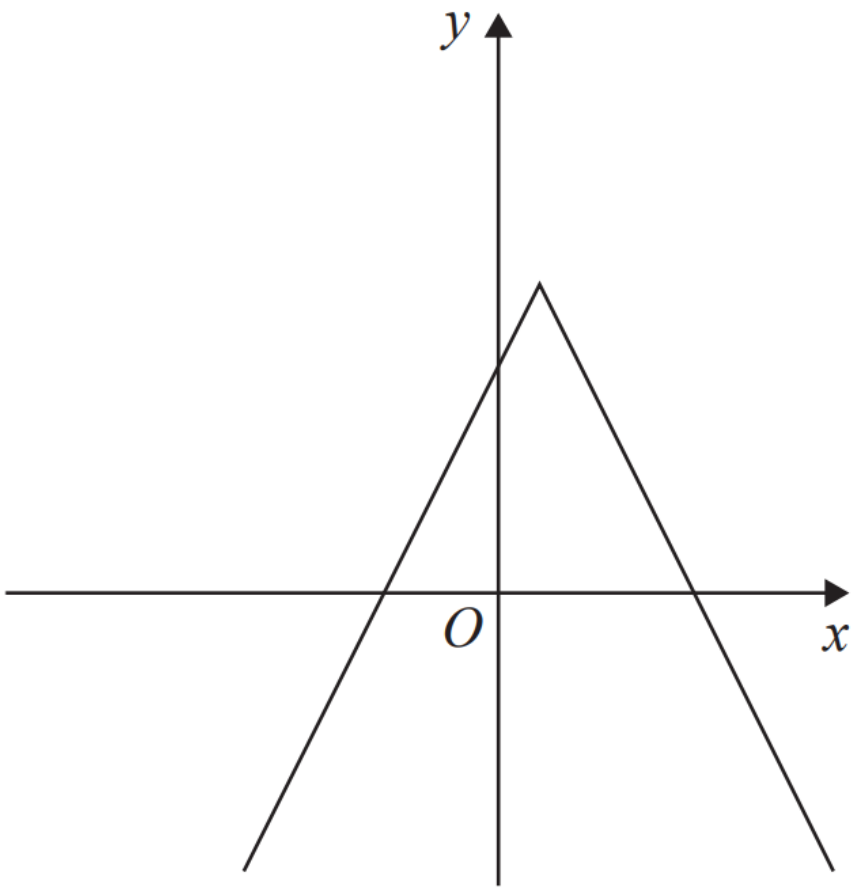

Diagram 1

11. Implicit Differentiation

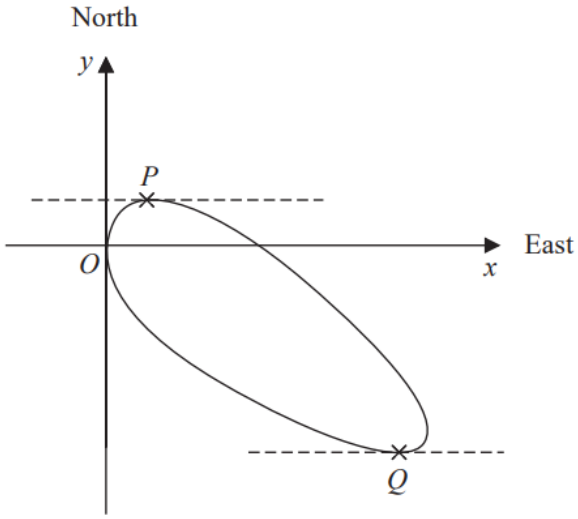

Figure 4

Figure 4 shows a sketch of the closed curve with equation

$$(x + y)^3 + 10y^2 = 108x$$

(a) Show that

$$\frac{dy}{dx} = \frac{108 - 3(x + y)^2}{20y + 3(x + y)^2}$$

(5)

The curve is used to model the shape of a cycle track with both x and y measured in km.

The points P and Q represent points that are furthest north and furthest south of the origin O, as shown in Figure 4.

Using the result given in part (a),

(b) find how far the point Q is south of O. Give your answer to the nearest 100 m.

(4)

12. Partial Fractions

Given that

$$\frac{3x+4}{(x-2)(2x+1)^2} \equiv \frac{A}{x-2} + \frac{B}{2x+1} + \frac{C}{(2x+1)^2}$$

(a) find the values of the constants A, B and C.

(4)

(b) Hence find the exact value of

$$\int_7^{12} \frac{3x+4}{(x-2)(2x+1)^2}\,\mathrm{d}x$$

giving your answer in the form $p\ln q + r$ where p, q and r are rational numbers.

(6)

13. Trigonometric Identities and Solving Equations

In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

(a) Show that the equation

$$\frac{3\sin\theta\cos\theta}{\cos\theta+\sin\theta} = (2+\sec 2\theta)(\cos\theta-\sin\theta)$$

can be written in the form

$$3\sin 2\theta - 4\cos 2\theta = 2$$

(3)

(b) Hence solve for $\pi < x < \frac{3\pi}{2}$

$$\frac{3\sin x\cos x}{\cos x+\sin x} = (2+\sec 2x)(\cos x-\sin x)$$

giving the answer to 3 significant figures.

(5)

14. Forming Rates of Change – Differential Equations

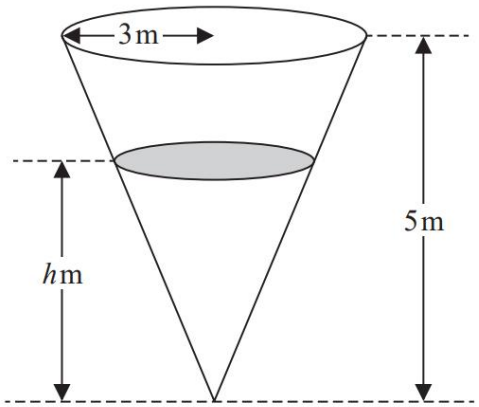

Diagram not drawn to scale

Figure 3

Figure 3 shows a container in the shape of an inverted right circular cone which contains some water.

The cone has an internal radius of 3m and a vertical height of 5m as shown in Figure 3.

At time t seconds, the height of the water is h metres, the volume of the water is $V\text{m}^3$ and water is leaking from a hole in the bottom of the container at a constant rate of $0.02\text{m}^3\ \text{s}^{-1}$

[*The volume of a cone of radius r and height h is* $\frac{1}{3}\pi r^2 h$.]

(a) Show that, while the water is leaking,

$$h^2 \frac{\mathrm{d}h}{\mathrm{d}t} = -\frac{1}{k\pi}$$

where k is a constant to be found. **(5)**

Given that the container is initially full of water,

(b) express h in terms of t. **(3)**

(c) Find the time taken for the container to empty, giving your answer to the nearest minute. **(2)**

15. Parametric Integration

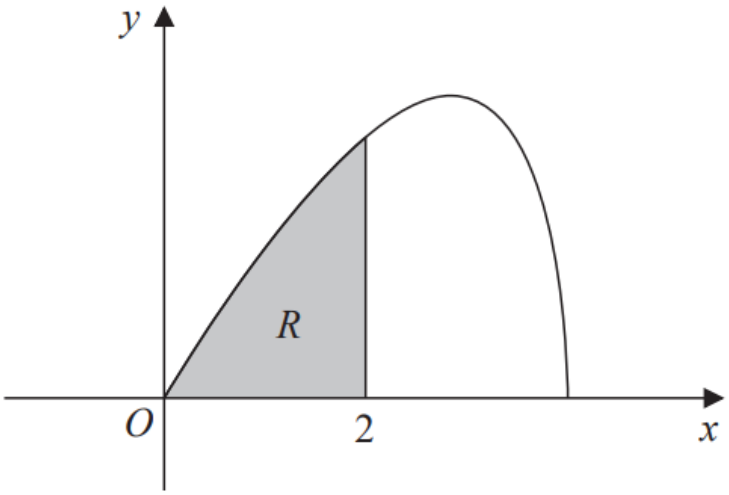

Figure 3

Figure 3 shows a sketch of the curve with parametric equations

$$x = 4\sin t\,, \quad y = 3\sin 2t\,, \quad 0 \leq t \leq \frac{\pi}{2}$$

The region R, shown shaded in Figure 3, is bounded by the curve, the x-axis and the line with equation $x = 2$

Find the exact area of R.

(*Solutions relying entirely on calculator technology are not acceptable.*) **(7)**

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Congratulations on completing the paper! I hope it was comprehensive and has helped you with your revision.

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Take care!