

100 Days of A Level Maths

Week 1 QUIZ

Days 1 – 7

Day 1

Express y in terms of x :

$$3^{2y} \times 27^x = \frac{1}{9\sqrt{3}}$$

Day 2

Simplify:

$$\sqrt{28} - 3\sqrt{63} - \sqrt{175}$$

Day 3

Solve:

$$x^4 - x^2 - 6 = 0$$

Day 4

Solve:

$$4^{2x} - 20(4^x) + 64 = 0$$

Day 5

Find the values of k for which the equation $6x^2 - 24x + k = 0$ has exactly one solution

Day 6

Find the range of values of p for which $x^2 + 5x - p = 0$ has no real solutions

Day 7

Solve $x^2 - 10x + 16 > 0$ giving your answer in set notation

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Week 2 QUIZ

Days 8 – 14

Day 8

Sketch $y = (x - 1)(3 - x)(x + 2)$

Day 9

Find the equation of the straight line with gradient 5 that passes through $(-3, 8)$

Day 10

Given that the distance between $(x, 9)$ and $(7, 19)$ is $2\sqrt{29}$, show that $x^2 - 14x + 33 = 0$

Day 11

Write down the equation of a circle with centre $(-3, -7)$ and radius $3\sqrt{7}$

Day 12

Find the centre and radius of the circle with equation $x^2 + y^2 + 18x - 6y = 54$

Day 13

Divide $3x^3 + 23x^2 + 33x - 35$ by $(x + 5)$

Day 14

Given that $(x - 3)$ is a factor of $7x^3 - 23x^2 + 5x + b$, find the value of b

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Week 3 - QUIZ

Days 15 – 21

Day 15

Prove that the difference of the squares of two consecutive even numbers is always divisible by 4

Day 16

Use Pascal's Triangle to find the expansion of $(2x + 5y)^3$

Day 17

The coefficient of x^3 in the expansion of $(1 + px)^6$ is 14580. Find the value of p

Day 18

In the triangle ABC , $AB = (x - 3)$ cm, $BC = (x + 3)$ cm, $AC = 8$ cm and $\angle BAC = 60^\circ$. Use the cosine rule to find the value of x

Day 19

Simple rules for trig equations

How do you find the secondary solution when solving $\sin \theta = k$ when k is a number?

Day 20

Solve for $0 < \theta < 360^\circ$

$$\cos 3\theta = \frac{\sqrt{3}}{2}$$

Day 21

Solve, for $-180^\circ < \theta < 180^\circ$

$\cos \theta = 0.6$, giving your answers to 3sf

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Week 4 - QUIZ

Days 22 – 28

Day 22

Solve $3 \cos^2 x + 7 \sin x - 5 = 0$ for $0^\circ < x \leq 360^\circ$, giving your answers to 3sf

Day 23

Given that $5 \cos x \sin y = \sin x \cos y$, express $\cot x$ in terms of $\cot y$

Day 24

Given that $\mathbf{a} = 5\mathbf{i} - \mathbf{j}$ and $\mathbf{b} = 2\mathbf{i} + 5\mathbf{j}$

find t if $\mathbf{a} - t\mathbf{b}$ is parallel to $-5\mathbf{i} + 10\mathbf{j}$

Day 25

Given that $\overrightarrow{AB} = \begin{pmatrix} -9 \\ 3 \end{pmatrix}$ and $\mathbf{a} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$, find the magnitude of \mathbf{b}

Day 26

Differentiate the following with respect to x

(i) $y = 2x^6 - 2x^2$

(ii) $y = 3\sqrt{x} + \frac{8}{x^5}$

Day 27

$$f(x) = x^3 - \frac{3}{2}x^2 - 18x$$

Find the exact range of values for x for which $f(x)$ is a decreasing function

Day 28

Find the x coordinates for the stationary points of the curve $y = \frac{4}{3}x^3 - 6x^2 - 40x + 12$

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Week 5 - QUIZ

Days 29 – 35

Day 29

Given that $s = 5t^3 - 4t^{-2}$ find $\frac{d^2s}{dt^2}$

Day 30

The curve with equation $y = ax^2 - 11x + b$ has gradient 0 at $(\frac{11}{2}, -\frac{1}{4})$. Find a and b .

Day 31

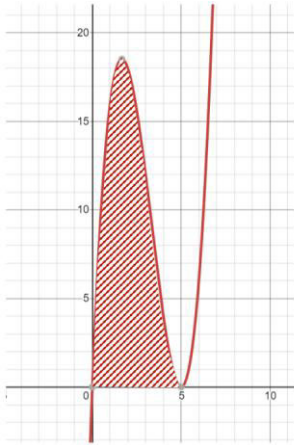
Work out $\int (3x^6 - x^{-\frac{5}{2}} - 8x^{-3}) dx$

Day 32

Given that $f'(x) = 12x^3 + 4x - 5$ and that $f(2) = 47$, find $f(x)$.

Day 33

The graph shows $y = x(x - 5)^2$. Find the shaded area.



Day 34

Rewrite each statement using logarithms or powers

(i) $4^{-3} = \frac{1}{64}$

(ii) $c^3 = d$

(iii) $\log_7 343 = 3$

(iv) $\log_y z = x$

Day 35

Solve the equation

$$\log_x 4 + 2 \log_x 5 = 2$$

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Week 6 - QUIZ

Days 36 – 42

Day 36

Solve $3^{2x}e^{2x-5} = 5$ giving your answer as an exact value

Day 37

The number of rabbits, R , in a population after m months is modelled by the formula $R = 12e^{0.2m}$

- (a) State the initial number of rabbits in the population
- (b) Find the number of months that it takes for the population of rabbits to exceed 200.

Day 38

Prove that there exist no integers a and b for which $25a + 15b = 1$

Day 39

Prove by contradiction that if a is rational and b is irrational, then $a - b$ is irrational

Day 40

Express $\frac{2x+11}{(x+1)(x+4)}$ as partial fractions

Day 41

The equation $|x + 2| = k - \frac{1}{2}x$ has no solutions. Find the range of values of k

Day 42

Given that $f(x) = \ln x - 5$, find $f^{-1}(x)$, and draw $f(x)$ and $f^{-1}(x)$ on the same axes, indicating any intersections and equations of asymptotes.

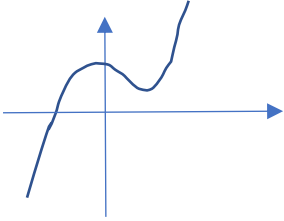
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Week 7 - QUIZ

Days 43 – 49

Day 43

Given that $y = f(x)$ is drawn below, sketch the graphs of $|f(x)|$ and $f(|x|)$



Day 44

The first 3 terms of an arithmetic sequence are:

$$9, \quad 4k + 7, \quad 55 - 2k$$

Show that the sum of the first n terms is a square number

Day 45

In a geometric series $S_4 = 15$ and $S_\infty = 16$

Find the possible values of r

Day 46

Given that $a_1 = p$ and $a_{n+1} = \frac{1}{a_n}$ find $\sum_{r=1}^{1000} a_r$ in terms of p

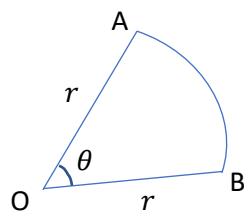
Day 47

Find the binomial expansion of $(8 + 3x)^{\frac{1}{3}}$ up to and including the x^2 term

Day 48

Given that θ is small and measured in radians, find an approximate value for $\frac{\cos 4\theta - 1}{\theta \sin 2\theta}$

Day 49



The area of the sector is 25cm^2

Given that the perimeter of the sector is 5 times the length of the arc AB, find the value of r .

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Week 8

Days 50 – 56

Day 50

Prove that $\operatorname{cosec} \theta - \sin \theta \equiv \cos \theta \cot \theta$

Day 51

Using the identity $1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$, show that $\cot \theta = \pm \frac{a}{\sqrt{b}}$, where a and b are integers to be found if $7 \cot^2 \theta + 3 \operatorname{cosec}^2 \theta = 12$.

Day 52

Given that $\tan \frac{\pi}{6} = \frac{\sqrt{3}}{3}$ and $\tan \frac{5\pi}{12} = 2 + \sqrt{3}$ use the addition formula for \tan to find an exact value for $\tan \frac{7\pi}{12}$

Day 53

Solve for $0 \leq x \leq \frac{\pi}{2}$

$7 \cos 2x = \operatorname{cosec} 2x$, giving answers to 3sf

Day 54

Prove that $\frac{1 - \cos 2x}{1 + \cos 2x} \equiv \tan^2 x$

Day 55

Given that $2 \cos \theta + 5 \sin \theta = R \cos(\theta - \alpha)$ where $R > 0$ and $0 < \alpha < 90^\circ$ find the exact value of R and the value of α to 3 sf in degrees.

Day 56

Find the cartesian equation of the curve with parametric equations $x = \sin t$ and $y = \tan 2t$

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Week 9 - QUIZ

Days 57 – 63

Day 57

Find where the curve with parametric equations $y = 2t^2 - 3t$ and $x = 2t + 3$, $t > 0$, crosses the line with equation $y = 2x + 9$

Day 58

1. $\frac{d}{dx}(e^x)$
2. $\frac{d}{dx}(5^x)$
3. $\frac{d}{dx}(\ln x)$
4. $\frac{d}{dx}(\sin x)$
5. $\frac{d}{dx}(\cos x)$
6. $\frac{d}{dx}(\tan x)$
7. $\frac{d}{dx}(\sec x)$
8. $\frac{d}{dx}(\cot x)$
9. $\frac{d}{dx}(\operatorname{cosec} x)$

Day 59

The Chain Rule

$$f(\text{blah}) \rightarrow f'(\text{blah}) \times \text{blah}'$$

Find $f'(x)$:

1. $f(x) = (3x^5 - 7)^5$
2. $f(x) = e^{6x - \sin 3x}$
3. $f(x) = \ln(7x^2 + 4x)$

Day 60

The Product Rule

If $y = uv$, then $\frac{dy}{dx} = uv' + vu'$

Differentiate $y = \cos(3x^2) \ln(4x^3)$. Simplify your answer fully.

Day 61

The Quotient Rule

If $y = \frac{u}{v}$, then $\frac{dy}{dx} = \frac{vu' - uv'}{v^2}$

Find $\frac{dy}{dx}$ when $y = \frac{e^{2x}}{x^5}$. Simplify your answer fully.

Day 62

Given that $x = \sqrt{5} \sin 4t$ and $y = 3 \cos 4t$, show that $\frac{dy}{dx} = -\frac{a}{b} \sqrt{5} \tan 4t$ where a and b are integers to be found.

Day 63

Find an expression for $\frac{dy}{dx}$ in terms of x and y :

$$7xy^2 + 2y + 5x + 12 = x^6$$

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Week 10 - QUIZ

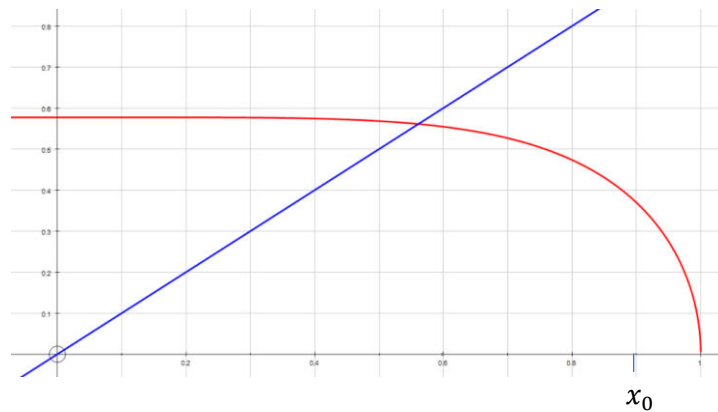
Days 64 – 70

Day 64

Given that $V = 9\pi r^3$ and that $\frac{dV}{dt} = 15$, find $\frac{dr}{dt}$ when $r = 10$

Day 65

Use the graph of the iterative formula to decide whether the root will converge or diverge



Day 66

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

Using $x_1 = 6$ as a first approximation of a root of the equation $x^2 - 8x + 11 = 0$, find a second approximation using the Newton-Raphson method.

Day 67

Integrate the following:

- (a) $\int 4 \cos x \, dx$
- (b) $\int -\sec^2 x \, dx$
- (c) $\int -5e^x \, dx$

(d) $\int \frac{1}{2x} dx$

(e) $\int \frac{1}{9} \sin x dx$

(f) $\int \sec x \tan x dx$

Day 68 *TRY $y = \dots$ *

Integrate the following:

(a) $\int \cos 4x dx$

(b) $\int 7e^{9x} dx$

(c) $\int -2 \sec 6x \tan 6x dx$

(d) $\int \frac{1}{(6x-1)^3} dx$

Day 69

$$\int \cos^2 x dx$$

Day 70 *General patterns*

$$\int \frac{5 \sin 2x}{\cos 2x} dx$$

$$\int 18x^2 e^{2x^3} dx$$

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Week 11 - QUIZ

Days 71 – 77

Day 71

$$\int -\sin(5x - 1) \cos^6(5x - 1) dx$$

Day 72

$$\int \frac{2x + 3}{x^2} dx$$

$$\int \frac{5x - 3}{x + 1} dx$$

Day 73

$$\int 2xe^{3x} dx$$

Day 74

$$\int \ln 5x dx$$

Day 75

Use the substitution $u = 2x + 5$ to find $\int (2x - 1) \sqrt{2x + 5} \, dx$

Day 76

Solve $(x^2 + x^3) \frac{dy}{dx} = y(4x + 6x^2)$

Day 77

Solve $(x + x^2) \frac{dy}{dx} = (1 + 2x) \operatorname{cosec} y$

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Week 12 - QUIZ

Days 78 – 84

Day 78

Given that A has coordinates $(7, -1, 2)$ and B has coordinates $(k, 0, 4)$, and the distance $AB = 3$, find the values of k .

Day 79

Find the angle that $\mathbf{a} = 4\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ makes with the positive x axis.

Day 80

Given that $(3a + b)\mathbf{i} + \mathbf{j} + a\mathbf{k} = 7\mathbf{i} - b\mathbf{j} + 4\mathbf{k}$

find the values of a , b and c

Exam Questions

Day 81

Show that the equation

$$5 \sin x = 1 + 2 \cos^2 x$$

can be written in the form

$$2 \sin^2 x + 5 \sin x - 3 = 0$$

(2)

Day 82

Given that $k \in \mathbb{Z}^+$

Show that $\int_k^{4k} \frac{5}{4x-k} dx$ is independent of k

Day 83 and 84

A curve C has equation

$$y = \frac{2}{3}x^3 + \frac{9}{2}x^2 - 5x + 7$$

(a) Find (i) $\frac{dy}{dx}$

(ii) $\frac{d^2y}{dx^2}$

(b) Verify that C has a stationary point when $x = -5$

(c) Determine the nature of this stationary point, giving a reason for your answer.

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Week 13 - QUIZ

Days 85 – 91

Day 85

The curve C has the equation

$$\cos 2x + \cos 3y = 1, \quad -\frac{\pi}{4} \leq x \leq \frac{\pi}{4}, \quad 0 \leq y \leq \frac{\pi}{6}$$

- (a) Find $\frac{dy}{dx}$ in terms of x and y .

(3)

Day 86

A colony of bees is being studied.

The number of bees in the colony at the start of the study was 30 000

Three years after the start of the study, the number of bees in the colony is 34 000

A model predicts that the number of bees in the colony will increase by $p\%$ each year, so that the number of bees in the colony at the end of each year of study forms a geometric sequence.

Assuming the model,

- (a) find the value of p , giving your answer to 2 decimal places.

(3)

Day 87

The function f is defined by

$$f(x) = 2 + \ln(2x - 1), \quad x \in \mathbb{R}, \quad x > 0.5$$

(a) Find the exact value of $ff(1)$

(2)

Day 88

Point A has coordinates $(-3, 4, 9)$.

The vector $\overrightarrow{AB} = \begin{pmatrix} 4 \\ -5 \\ 2 \end{pmatrix}$, and the vector $\overrightarrow{CD} = \begin{pmatrix} -2 \\ 2.5 \\ -1 \end{pmatrix}$.

(a) Find the coordinates of the point B .

[1 mark]

(b) State, with a reason, whether or not the vectors \overrightarrow{AB} and \overrightarrow{CD} are parallel.

[2 marks]

Disprove the statement: $n^2 - n + 3$ is a prime number for all values of n

A sequence is defined for $k \geq 1$ by the recurrence relation

$$u_{k+1} = pu_k - 2, \quad u_1 = 2,$$

where p is a constant.

(a) Write down expressions for u_2 and u_3 in terms of p .

[2 marks]

Given that the sequence is periodic with order 2, and given as well that $u_1 \neq u_2$,

(b) Find the value of p .

[4 marks]

For the value of p found in part (b),

(c) Calculate $\sum_{n=1}^{1001} u_n$

[2 marks]

Day 91

Given that $(x + 1)$ is a factor of $f(x) = x^3 - 5x^2 + 3x + 9$, fully factorise $f(x)$.

[4 marks]

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Week 14

Days 92 – 98

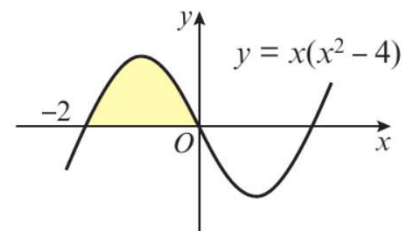
Day 92

Given that $x^2 + 2x + 3 \equiv (x + a)^2 + b$,

- (a) Find the value of the constants a and b [2 marks]
- (b) Sketch the graph of $y = x^2 + 2x + 3$, indicating clearly the coordinates of any intersections with the coordinate axes [3 marks]

Day 93

The sketch shows part of the curve with equation $y = x(x^2 - 4)$.
Find the area of the shaded region.



Day 94

Given that $a, b > 0$ and that a and b satisfy the equation

$$\log a + \log b = \log(a + b)$$

Show that

$$a = \frac{b}{b - 1}$$

Day 95

Given that $x = y^2 \ln y$, $y > 0$,

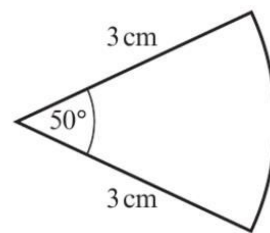
a find $\frac{dx}{dy}$ (4 marks)

b Use your answer to part **a** to find in terms of e , the value of $\frac{dy}{dx}$ at $y = e$. (2 marks)

Day 96

A teacher asks a student to find the area of the following sector.
The attempt is shown below.

$$\begin{aligned}\text{Area} &= \frac{1}{2}r^2\theta \\ &= \frac{1}{2} \times 3^2 \times 50 \\ &= 225 \text{ cm}^2\end{aligned}$$



a Identify the mistake made by the student.

(1 mark)

b Calculate the correct area of the sector.

(2 marks)

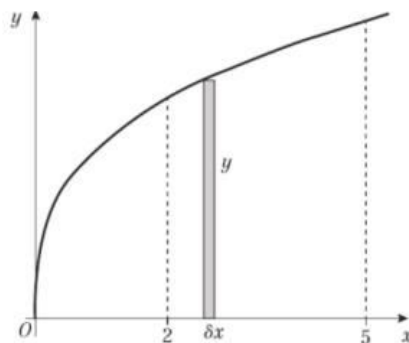
Day 97

The diagram shows a sketch of the curve with equation $y = \sqrt[3]{x}$, $x > 0$.

The area under the curve between $x = 2$ and $x = 5$ can be thought of as a series of thin strips of height y and width δx .

Calculate $\lim_{\delta x \rightarrow 0} \sum_{x=2}^5 \sqrt[3]{x} \delta x$, giving your answer correct to 4 significant figures.

(3 marks)



The function f has domain $-5 \leq x \leq 7$ and is linear from $(-5, 6)$ to $(-3, -2)$ and from $(-3, -2)$ to $(7, 18)$.

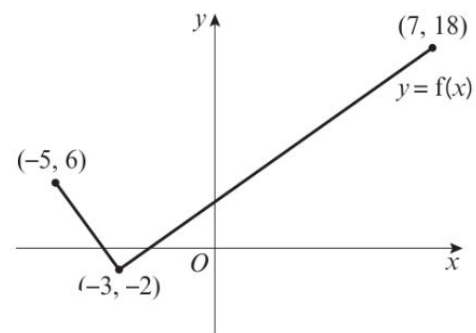
The diagram shows a sketch of the function.

a Write down the range of f .

(1 mark)

b Find $ff(-3)$.

(2 marks)



100 Days of A Level Maths

Week 15 - QUIZ

Days 99 – 100

Day 99

Find the value of

$$\sum_{r=8}^{\infty} 15 \times \left(\frac{1}{5}\right)^r$$

Day 100

Given

$$5^x \times 25^y = \frac{1}{125\sqrt{5}}$$

express y as a function of x .