GENIUS
ACADEMY LTD.

EDEXCEL
A-LEVEL
MATHEMATICS

REVISION & PRACTICE
[PREDICTED PAPERS 2025
PURE MATHS]

Master A-LEVEL Maths with clarity and confidence—
turning knowledge into real success.

Preface

The AL Maths Book 2025: Exam-Style Questions and Predicted Papers is designed to provide students with a challenging and effective preparation experience. These predicted papers are intentionally set to be **10% more difficult than actual AL Maths exams**, helping students build resilience, confidence, and advanced problem-solving skills. **To account for this increased difficulty, the grade boundaries have been adjusted—55% for a Grade A and 70% for a Grade A*—ensuring a rigorous yet realistic assessment framework.**

Practicing exam papers that are harder than the standard offers several key benefits. It enhances confidence by making the actual exam feel more manageable, sharpens problem-solving skills, and improves time management by training students to work efficiently under pressure. Additionally, it boosts adaptability, enabling students to handle unfamiliar or complex questions with ease. Rather than relying on memorization, students develop a deeper understanding of mathematical concepts, which translates into higher exam performance, reduced exam anxiety, and greater endurance for extended problem-solving tasks. This approach also provides a competitive advantage, preparing students for advanced mathematics at the university level.

This book is not just about achieving high grades—it equips students with essential mathematical skills that extend beyond AL Maths. By working through these challenging predicted papers, students will cultivate the confidence and competence necessary to excel in their exams and future mathematical studies.

"Master AL Maths with clarity and confidence—turning knowledge into real success."
Genius Academy Ltd

10 Essential Tips for A-Level Maths Success

1. Master the Basics
A-Level Maths builds upon fundamental concepts from previous levels, such as algebra, trigonometry, differentiation, and integration. Without a strong grasp of these basics, solving complex problems will be difficult. Spend time revising key formulas, identities, and principles to ensure you have a solid foundation. The better your understanding, the easier it will be to approach higher-level questions.

2. Practice Past Papers Regularly
One of the most effective ways to prepare for the exam is by solving past papers under timed conditions. This helps you become familiar with the structure of the paper, the type of questions frequently asked, and the marking scheme. Analyzing past questions allows you to identify patterns and recurring topics, enabling you to focus on areas that carry the most weight in the exam.

3. Understand, Don't Memorize
Mathematics is about understanding, not just memorization. Instead of trying to memorize formulas blindly, learn why they work and how they are derived. This will help you apply them correctly in different scenarios, especially in problem-solving questions that require critical thinking. A clear conceptual understanding will also prevent confusion when variations of familiar problems appear in the exam.

4. Manage Your Time Effectively
Effective time management is crucial during the exam. Divide your time wisely among different sections based on their weightage and difficulty level. Avoid spending too much time on a single question—if you're stuck, move on and return to it later if time permits. Practicing under timed conditions before the exam will help you develop a strategy for answering efficiently within the given timeframe.

5. Show Full Working Steps
Examiners often award marks for intermediate steps, even if the final answer is incorrect. Always show your working clearly and systematically to maximize partial marks. This is especially important for long, structured questions where step-by-step problem-solving is required. Writing down every logical step also reduces careless errors and makes it easier to spot mistakes when reviewing your answers.

6. Identify Weak Areas and Improve
Regularly assess your strengths and weaknesses. Keep track of the topics or question types you struggle with the most and dedicate extra time to improving them. Seek help from teachers, tutors, or online resources if necessary. Breaking down difficult concepts into simpler parts and practicing repeatedly will help reinforce your understanding and improve your confidence.

🔵 7. Use a Scientific Calculator Efficiently

Your calculator is a powerful tool that can save you time during the exam—if you know how to use it properly. Familiarize yourself with important functions such as solving equations, calculating derivatives and integrals, working with complex numbers, and statistical calculations. Avoid relying on the calculator for basic arithmetic, but use it strategically for time-consuming calculations and to verify answers.

🟠 8. Double-Check Your Answers

Many students lose valuable marks due to simple calculation mistakes or misinterpretation of questions. If time allows, always review your answers, especially for algebraic simplifications and numerical calculations. Verify whether your final answers make logical sense within the context of the problem. Checking your work can help catch errors that you might have overlooked in the first attempt.

🟣 9. Develop Problem-Solving Strategies

Some exam questions are designed to challenge your thinking rather than just test your ability to apply formulas. If you encounter a difficult problem, don't panic—break it into smaller, more manageable parts. Look for patterns, draw diagrams, or approach the problem from a different angle. Practicing a variety of question types will enhance your problem-solving skills and make it easier to handle unfamiliar or tricky questions.

🟡 10. Stay Consistent and Confident

Consistency is key to mastering A-Level Maths. Instead of cramming at the last minute, develop a study schedule that allows for regular practice and gradual improvement. Stay motivated, believe in your ability to improve, and don't be discouraged by setbacks. Confidence plays a significant role in how you approach the exam—if you have prepared well, trust yourself and tackle the questions with a positive mindset.

A Level Maths Predicted Papers 2025

Paper 1 (Set 1): Pure Mathematics 1

We (Genius Academy) are one of the fastest growing Tuition Centres in the UK. We have experienced and qualified Tutors who are supporting **more than 600 students** with Tutoring, Detailed Revision Notes, Predicted Papers for a range of UK exam boards including AQA, Edexcel, OCR.

We offer one to one, group classes, and Paper classes for 11+, 13+ **Key Stages, GCSE, iGCSE and Advanced Levels for a wider range of subjects including: Maths, Further Maths, Physics, Chemistry, Biology, Computer Science, English, Geography, Psychology, Business Studies and Economics.

Our aim is to provide a high-quality teaching and learning experience while motivating our students and guiding them to perform well in their studies.

Email : geniusacademy.uk@gmail.com

Telephone No: 07878467435

Genius Academy - Your Pathway to Success (geniusacademytutors.com)

This AL Maths paper 1 (Set 1: Predicted Paper 2025) has been created based on the most common topics from previous past papers. This paper should be excellent for helping students revise for exams; however, it should not be relied upon as the sole basis for revision.

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"Your Pathway to Success"

Paper Reference: Paper 1: Pure	**Student Name:**
Time Allowed: 2 hours	**Total Marks:** /100

Instructions:

- *Calculators can be used for this paper.*
- *Fill in the boxes with your name/ID.*
- *Answer all questions.*
- *Use the spaces provided to answer the questions.*
- *All steps should be included in you answer.*
- *Diagrams unless otherwise indicated, are NOT accurately drawn,*

Information:

- *The total mark for this paper is 100.*
- *The marks that each question carries are provided.*

Advice:

- *Each question should be read carefully before answering.*
- *The management is important.*
- *Try to answer all questions provided.*
- *If you have time left at the end, re-check your answers.*

For Examiner's Use	
Question	**Mark**
TOTAL	

1.

(a) Sketch the graph of $y = |Sin2x| + 3, \quad 0 \leq x \leq 2\pi$

(b) Sketch the graph of $y = \ln(7x - 5) \quad x > \frac{5}{7}$

(3)

2.

Find the exact value of x for which

$$3(\ln 3x)^3 - 12(\ln 3x)^2 + 6\ln 3x = 24. \ \ x > 0$$

(3)

3.

Range of Intersection Values with a Parabolic Curve: A curve C is given parametrically by $x = 1 + 4\sin\ t$ and $y = 3 - 2\cos t,$ for $0 \leq t \leq \pi$.

- Convert the parametric equations to a Cartesian equation of the form $y = f(x)$.
- Find the maximum and minimum values of k for which the line $y = kx + 1$ intersects the curve at two distinct points.

(4)

4.

(a) Sketch the graph of the equation $y = |4x - 3a|$, where $a > 0$. state the coordinates of the points where the graph intersects the coordinate axes.

(b) Solve, in terms of a, the inequality:

$$|4x - 3a| \leq 2x + 2a$$

(c) Find, in terms of a, the range of possible values of $g(x)$, where:

$$g(x) = 6a - \left|\frac{2a}{3} - x\right|$$

Given that

$$|4x - 3a| \leq 2x + 2a$$

(6)

5.

$$f(x) = \frac{100x^2 + 76x + 18}{(5x+2)^2(1-2x)} \qquad x \neq -\frac{2}{5} \quad x \neq \frac{1}{2}$$

Given that $f(x)$ can be expressed in the form

$$\frac{P}{5x+2} + \frac{Q}{(5x+2)^2} + \frac{R}{1-2x}$$

Where P, Q and R are constants

(a) 1. Find the value of Q and the value of R

2. Show that $P = 0$

(b) 1. Use binomial expansions to show that, in ascending powers of x

$$f(x) = l + mx + nx^2 + \ldots$$

where l, m and n are simplified fractions to be found.

2. Find the range of values of x for which this expansion is valid.

(8)

6.

(a) Show that:

$$\frac{1+\cos 4\theta}{1-\cos 4\theta} = \cot^2 2\theta$$

(b) Hence solve the equation:

$$\frac{1+\cos 4x}{1-\cos 4x} = 1 + 4\cot^2 x$$

for $0 < x < 2\pi$.

(6)

7.

The number of bacteria in a laboratory dish decreases due to the addition of a chemical that is proportional to the square of the bacterial count. Initially, there are 1,200 bacteria in the dish. After 5 hours, the number of bacteria is reduced to 800.

(a) Form a differential equation for the number of bacteria N and solve it to find $N(t)$ in terms of time t.

(b) Determine the time it will take for the bacteria to reduce to 300.

(6)

8.

The value V (in £) of a rare coin t years after it was first valued on 1st January 2000 is modeled by the equation:

$$V = A \times e^{kt}$$

where A and K are constants.

Given that the value of the coin was £ 15,000 on 1st January 2005 and £ 30,000 on 1st January 2015 :

a) 1. Find the value of K to 4 decimal places.

2. Show that A is approximately 10,600.

b) With reference to the model, interpret the meaning of the constants A and K in the context of the value of the coin.

c) Using the model, find the year during which the value of the coin first exceeds £ 75,000.

(8)

9.

The curve C is defined by:

$$y = \frac{\ln x}{e^x}, x > 0.$$

1. Show that the x -coordinate of the stationary point lies between 1.5 and 2.5.

2. Use the Newton - Raphson method to determine the x-coordinate of the stationary point to 8 decimal places.

(6)

10.

Using the substitution $u = x^2 + 1$, evaluate:

$$\int x(x^2 + 1)e^{x^2+1}\, dx$$

(6)

11.

Relative to a fixed origin O :

- The point A has position vector $2i - j + 3k$.
- The point B has position vector $6i + 2j - k$.
- The point C has position vector $3i + 8j - 4k$.

(a) Find $|\overrightarrow{AB}|$ giving your answer in simplified surd form.

(b) If $ABCD$ forms a parallelogram, find the position vector of point D.

(c) The point F is such that $BF: FC = 3: 1$. Find the coordinates of F.

(5)

12.

(a) Show that:

$$\int x^2 \sin(kx)\,dx = \frac{-x^2\cos(kx)}{k} + \frac{2x\sin(kx)}{k^2} + \frac{2coskx}{k^3} + C$$

where k is a constant and C is the integration constant.

(b) Evaluate the definite integral:

$$\int_0^{\pi} x^2 \sin(3x)\,dx.$$

(5)

13.

The first three terms of an arithmetic sequence are:

$$\ln(2)\,, \qquad \ln(2^k+1)\,, \qquad \ln(2^{k+1}+2).$$

Find the exact value of k.

(5)

14.

The vertical height, H meters, above the water level is modelled by the equation:

$$H = 4 + 3\cos\left(\frac{\pi t}{4}\right) - 2\sin\left(\frac{\pi t}{4}\right),$$

Where t is the time in seconds after the wheel starts rotating.

(a) express $3\cos\left(\frac{\pi t}{4}\right) - 2\sin\left(\frac{\pi t}{6}\right)$ in the form $R\ \cos\left(\frac{\pi t}{4} + \alpha\right)$.

(b) Find:

- The maximum height H,
- The time t when the maximum height occurs (to one decimal place).

(9)

15.

A circle C has the equation:

$$x^2 + y^2 - 6x + 8y - 11 = 0$$

a) Find the centre and radius of the circle.

b) From the point $P(0, 6)$, two tangents are drawn to the circle. Find the equations of these tangents.

(5)

16.

(a) Use proof by contradiction to show that $\log_3(7)$ is irrational.

(5)

17.

(a) Express $\frac{1}{x(1-x)}$ in partial fractions.

(b) A population of bacteria in a culture is modelled by the differential equation:

$$\frac{dP}{dt} = P\left(1 - \frac{P}{K}\right),$$

where P is the population, t is the time, and K is the carrying capacity. Solve the differential equation to show that:

$$P = \frac{K}{1 + Ce^{-t}}$$

Find C given $P(0) = P_{0,}$ where $P_0 < K$.

(C) Calculate the time it takes for the population to reach half the carrying capacity K.

(10)

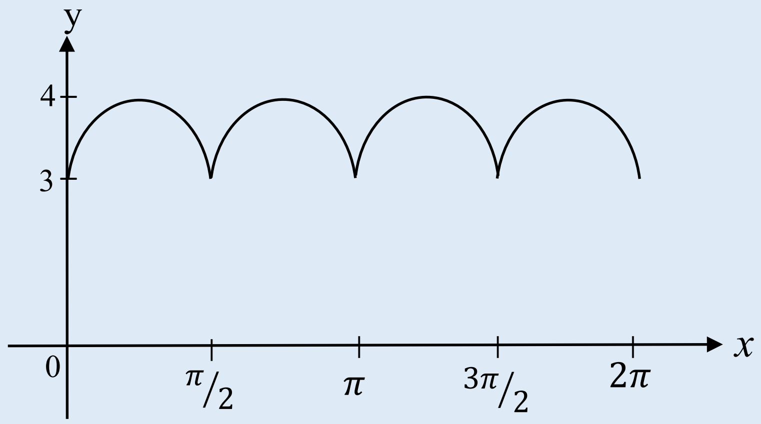
END

A Level Maths Predicted Papers 2025
Paper 1 (Set 1): Pure Mathematics 1

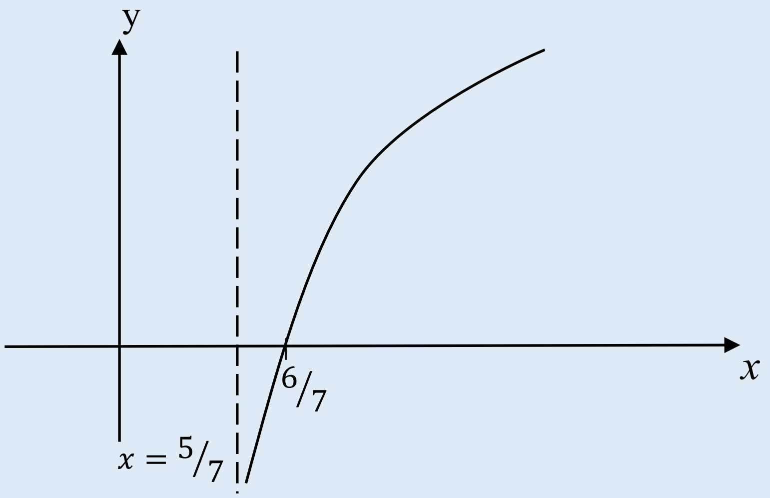
Solutions

1.

a) $y = |\sin 2x| + 3$



b) $y = ln|7x - 5|$



2.

$$3(ln3x)^3 - 12(\ln(3x))^2 + 6ln3x = 24$$

Take $ln3x = u$

$$3u^3 - 12u^2 + 6u - 24 = 0$$

$$u^3 - 4u^2 + 2u - 8 = 0$$

$u = 4 \Rightarrow 4^3 - 4(4)^2 + 2(4) - 8$

$= 0$

$(u - 4)$ a factor

$$\begin{array}{r|l} & 3u^2 + 6 \\ \hline u - 4 & 3u^3 - 12u^2 + 6u - 24 \\ & \underline{3u^3 - 12u^2} \\ & \quad 0 + 6u - 24 \\ & \quad \underline{6u - 24} \\ & \quad 0 \end{array}$$

$(u-4)3(u^2+2) = 3u^3 - 12u^2 + 6u - 24$

$\Rightarrow 3u^3 - 12u^2 + 6u - 24 = (u-4)(u^2+2)$

$u = 4$ is a solution $\qquad u^2 + 2 = 0$

$u^2 = (-2)$ No solution

$ln3x = 4$

$3x = e^4$

$x = {}^1/_3\, e^4$

3.

$x = 1 + 4\ \sin t$ —— ①

$y = 3 - 2\ \cos t$ —— ②

① $\Rightarrow \sin t = \frac{x-1}{4}$, ② $\Rightarrow \cos t = \frac{3-y}{2}$

$\sin^2 t + \cos^2 t = \left(\frac{x-1}{4}\right)^2 + \left(\frac{3-y}{2}\right)^2$

$1 = \left(\frac{x-1}{4}\right)^2 + \left(\frac{3-y}{2}\right)^2$ —— ③

$\left(\frac{3-y}{2}\right)^2 = 1 - \left(\frac{x-1}{4}\right)^2$

$y - 3 = \left[\pm\sqrt{1 - \left(\frac{x-1}{4}\right)^2}\right]2$

$y = 3 \pm 2\sqrt{\frac{1-(x-1)^2}{4}}$

③ $\Rightarrow (x-1)^2 + 4(3-y)^2 = 16$

$(x-1)^2 + 4(y-3)^2 = 16$

$(x-1)^2 + 4(kx-2)^2 = 16$

$x^2 + 1 - 2x + 4k^2x^2 + 16 - 16kx = 16$

$(1+4k^2)x^2 - 2(1+8k)x + 1 = 0$

$b^2 - 4ac > 0 \Rightarrow [-2(1+8k)]^2 - 4(1+4k^2)(1) > 0$

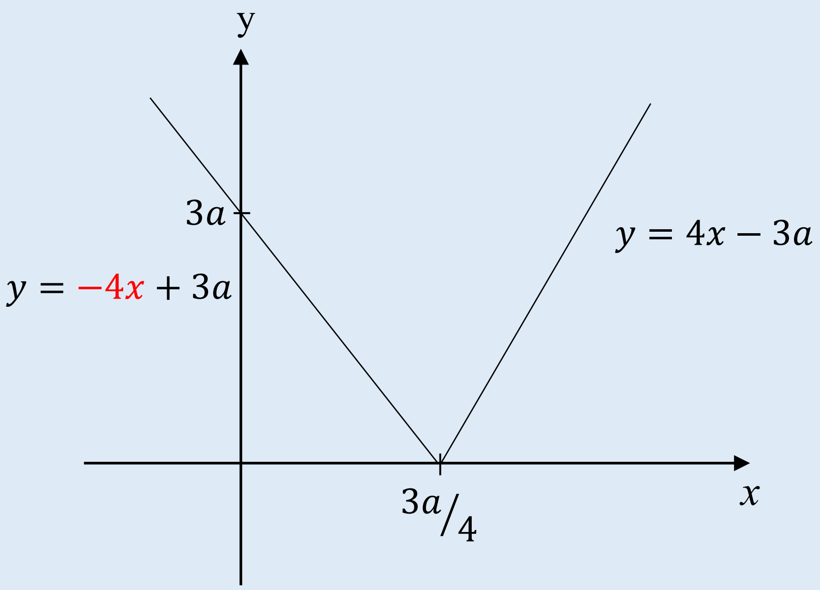
$64k^2 + 16k + 1 - 4k^2 - 1 > 0$

$60k^2 + 16k > 0$

$4k(15k+4) > 0 \ \Rightarrow \left(k < {}^{-4}/_{15}\ \ and\ \ k > 0\right)$

4.

a) $y = |4x - 3a|$



b) $-(4x - 3a) \leq 2x + 2a$ and $4x - 3a \leq 2x + 2a$

$6x \geq a$ $\quad$ $2x \leq 5a$

$x \geq a/_6$ $\quad$ $x \leq 5a/_2$

c) $g(x) = 6a - \left|\frac{2a}{3} - x\right|$

$x \geq a/_6 \qquad x \leq 5a/_2$

$x = a/_6 \;;\quad 6a - |2a/_3 - a/_6| = 11a/_2$

$x = 5a/_2 \;;\quad 6a - |2a/_3 - 5a/_2| = 25a/_6$

$25a/6 \leq g(x) \leq 6a$

5.

$$f(x) = \frac{100x^2 + 76x + 18}{(5x+2)^2(1-2x)}$$

$$100x^2 + 76x + 18 = P(5x+2)(1-2x) + Q(1-2x) + R(5x+2)^2$$

$$x = {}^{-2}/_5 \Rightarrow Q = 2$$

$$x = {}^{1}/_2 \Rightarrow R = 4 \ \ and\ P = 0$$

b) $f(x) = \frac{2}{(5x+2)^2} + \frac{4}{(1-2x)}$

$$= 2(5x+2)^{-2} + 4(1-2x)^{-1} = 2 \times 2^{-2}\left(1 + {}^{5}/_{2}\,x\right)^{-2} + 4(1-2x)^{-1}$$

$$\Rightarrow \tfrac{2}{4}\left[1 + (-2)\left({}^{5}/_{2}\,x\right) + \tfrac{(-2)(-3)}{21}\left({}^{5}/_{2}\,x\right)^2\right]$$

$$+4\left[1 + (-1)(-2x) + \tfrac{(-1)(-2)}{21}(-2x)^2\right]$$

$$\Rightarrow {}^{1}/_{2}\left[1 - 5x + \frac{75}{4}x^2\right] + 4[1 + 2x + 4x^2]$$

$$\Rightarrow {}^{9}/_{2} - {}^{11}/_{2}\,x + \frac{343}{4}x^2$$

$$-{}^{2}/_{5} < x < {}^{2}/_{5} \quad and \quad -{}^{1}/_{2} < x < {}^{1}/_{2}$$

$$-{}^{2}/_{5} < x < {}^{2}/_{5}$$

6.

a) $\frac{1+\cos 4\theta}{1-\cos 4\theta} = \cot^2 2\theta$

$$\Rightarrow \frac{2\cos^2 2\theta}{2\sin^2 2\theta}$$

$$\Rightarrow \cot^2 2\theta$$

b) $\frac{1+\cos 4x}{1-\cos 4x} = 1 + 4\cot^2 x$

$$\Rightarrow \cot^2 2x = 1 + 4\cot^2 x$$

$$\Rightarrow \left(\frac{1}{\tan 2x}\right)^2 = 1 + \frac{4}{\tan^2 x}$$

$$\Rightarrow \left(\frac{1-\tan^2 x}{2\tan x}\right)^2 = 1 + \frac{4}{\tan^2 x}$$

$$\Rightarrow (1-\tan^2 x)^2 = 4\tan^2 x + 16$$

$$\Rightarrow \tan^4 x - 2\tan^2 x + 1 = 16 + 4\tan^2 x$$

$$\Rightarrow \tan^4 x - 6\tan^2 x - 15 = 0$$

$\tan^2 x = 7.89 \quad or \quad \tan^2 x = -1.89$

$\tan x = 2.809$

$x = 1.23,\ 4.37$

7.

a)

$$\frac{dN}{dt} = -kN^2$$

$$\int \frac{dN}{N^2} = \int -k\,d\,t$$

$$\Rightarrow {}^{-1}/_{N} = -k\,t + c$$

$t = 0$

$N = 1200$

$$\frac{-1}{1200} = 0 + c$$

$$c = {}^{-1}/_{1200}$$

$$-{}^{1}/_{N} = -k\,t\,{}^{-1}/_{1200} \Rightarrow \frac{1}{N} = k\,t + \frac{1}{1200}$$

$t = 5$

$N = 800 \qquad \Rightarrow \frac{1}{800} = k(5) + \frac{1}{1200}$

$$k = \frac{1}{12000}$$

$$\frac{1}{N} = \frac{t}{12000} + \frac{1}{1200} = \frac{t+10}{12000}$$

$$N = \frac{12000}{t+10}$$

b) $300 = \frac{12000}{t+10}$

$t + 10 = 40$

$t = 30$ hours

8.

$V = A \times e^{kt}$

a) $15000 = Ae^{5k}$ —— ①

$30000 = Ae^{15k}$ —— ②

$\frac{②}{①} \Rightarrow e^{10k} = 2$

$10k = ln2$

$k = \frac{ln2}{10} = 0.07$

b) $15000 = Ae^{\frac{ln2}{10}5}$

$15 \times 10^3 = Ae^{0.07\times5}$

$A = \frac{15\times10^3}{e^{0.35}} = 10570$

A → Initial value of coin on 2000 January

B → Price increase rate of the coin

c) $V = 10570e^{0.07t}$

$75000 = 10570e^{0.07t}$

$t = \left(ln\frac{75000}{10570}\right) \times \frac{1}{0.07} = 27.99 = 28\ years$

2028

9.

1) $y = \frac{lnx}{e^x}$

$$\frac{dy}{dx} = \frac{e^x(^1/_x) - lnx(e^x)}{(e^x)^2} = \frac{e^x(^1/_x - lnx)}{e^{2x}}$$

$$= \frac{^1/_x - lnx}{e^x}$$

$$^{dy}/_{dx} \quad x = 1.5 \quad \Rightarrow \frac{^1/_{1.5} - ln1.5}{e^{1.5}}$$

$$= 0.0582$$

$$^{dy}/_{dx} \quad x = 2.5 \quad \Rightarrow \frac{^1/_{2.5} - ln2.5}{e^{2.5}}$$

$$= -0.0423$$

Change of sign obtained

2) $f(x) = \frac{lnx}{e^x}$ $\qquad f'(x) = \frac{^1/_x - lnx}{e^x}$

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

$$x_1 = 1.5 \Rightarrow x_2 = 1.5 - \frac{f(1.5)}{f^1(1.5)} = 1.5 - \frac{0.09}{0.058} = -0.052$$

$$\dots x_2 \; x_3 \dots x_4 \checkmark$$

10.

$u = x^2 + 1 \longrightarrow \int x\,(x^2 + 1)e^{x^2+1}dx$

$u = x^2 + 1$

$\frac{du}{dx} = 2x \qquad \Rightarrow \int \frac{(x^2 + 1)e^{x^2+1}(2xdx)}{2}$

$du = 2x.dx \qquad \Rightarrow \int \frac{ue^u}{2}du$

$$\Rightarrow {}^{1}/_{2}\int u.e^{u}.du$$

$$p = u \quad \rightarrow \quad {}^{dp}/_{du} = 1$$

$${}^{dv}/_{du} = e^{u} \quad \rightarrow v = e^{u}$$

$$\Rightarrow {}^{1}/_{2}\left[u \times e^{u} - \int e^{u}\, du\right]$$

$$\Rightarrow {}^{1}/_{2}\, ue^{u} - {}^{1}/_{2}\, e^{u} + c$$

$$= {}^{1}/_{2}\,(x^{2}+1)e^{(x^{2}+1)} - {}^{1}/_{2}\, e^{(x^{2}+1)} + c$$

$$= {}^{1}/_{2}\,(x^{2})e^{(x^{2}+1)} + c$$

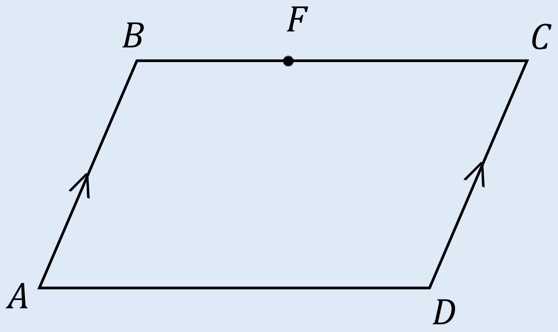
11.

a) $$\overrightarrow{AB} = \begin{pmatrix} 6 \\ 2 \\ -1 \end{pmatrix} - \begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix} = \begin{pmatrix} 4 \\ 3 \\ -4 \end{pmatrix}$$

$$\overrightarrow{AB} = 4\underset{\sim}{i} + 3\underset{\sim}{j} - 4\underset{\sim}{k}$$

$$\left|\overrightarrow{AB}\right| = \sqrt{4^{2} + 3^{2} + (-4)^{2}} = \sqrt{41}$$

b) $$\overrightarrow{AB} = \overrightarrow{DC}$$



$$\begin{pmatrix} 4 \\ 3 \\ -4 \end{pmatrix} = \overrightarrow{OC} - \overrightarrow{OD}$$

$$\overrightarrow{OD} = \begin{pmatrix} 3 \\ 8 \\ -4 \end{pmatrix} - \begin{pmatrix} 4 \\ 3 \\ -4 \end{pmatrix} = \begin{pmatrix} -1 \\ 5 \\ 0 \end{pmatrix} = -\underset{\sim}{i} + 5\underset{\sim}{j}$$

c) $$\overrightarrow{OF} = \overrightarrow{OB} + \overrightarrow{BF}$$

$$\overrightarrow{OF} = \overrightarrow{OB} + {}^{3}/_{4}\,\overrightarrow{BC}$$

$$= \begin{pmatrix} 6 \\ 2 \\ -1 \end{pmatrix} + {}^{3}/_{4}\begin{pmatrix} -3 \\ 6 \\ -3 \end{pmatrix}$$

$$= \begin{pmatrix} 6 - \frac{9}{4} \\ 2 + \frac{18}{4} \\ -1 - \frac{9}{4} \end{pmatrix} = \begin{pmatrix} \frac{15}{4} \\ \frac{13}{2} \\ -\frac{13}{4} \end{pmatrix}$$

$$\overrightarrow{BC} = \overrightarrow{OC} - \overrightarrow{OB}$$

$$\begin{pmatrix} 3 \\ 8 \\ -4 \end{pmatrix} - \begin{pmatrix} 6 \\ 2 \\ -1 \end{pmatrix} = \begin{pmatrix} -3 \\ 6 \\ -3 \end{pmatrix}$$

12.

$$\int x^2 \sin(kx)\, dx$$

$$u = x^2 \ \rightarrow \ \frac{du}{dx} = 2x$$

$$\frac{dv}{dx} = \sin(kx) \rightarrow v = \frac{-\cos(kx)}{k}$$

$$\frac{-x^2 \cos kx}{k} - \int (-)\frac{\cos(kx)}{k} \times 2x\, dx$$

$$\frac{-x^2 \cos kx}{k} + \frac{2}{k}\int x \ \cos(kx) \ dx$$

$$u = x \ \rightarrow \ \frac{du}{dx} = 1$$

$$\frac{dv}{dx} = \cos kx \ \rightarrow v = \frac{\sin kx}{k}$$

$$\frac{-x^2 \cos kx}{k} + \frac{2}{k}\left[\frac{x\sin kx}{k} - \int \frac{\sin kx}{k} dx\right]$$

$$\frac{-x^2 \cos kx}{k} + \frac{2}{k}\left[\frac{x\sin kx}{k} + \frac{\cos kx}{k^2}\right] + c$$

$$\frac{-x^2 \cos kx}{k} + \frac{2x \sin kx}{k^2} + \frac{2\cos kx}{k^3} + c$$

$$\int_0^{\pi} x^2 \sin(3x)\, dx = \left[-\frac{x^2 \cos(3x)}{3} + \frac{2x \sin(3x)}{9} + \frac{2\cos(3x)}{27}\right]_0^{\pi}$$

$$\Rightarrow \left({\pi^2}/{3} - \frac{2}{27}\right) - \left(\frac{2}{27}\right)$$

$$\Rightarrow {\pi^2}/{3} - {4}/{27}$$

13.

$ln(2)\,, ln(2^k + 1), ln(2^{k+1} + 2) \ldots \ldots$

$$ln(2^k + 1) - ln(2) = \frac{ln(2^{k+1} + 2) - ln\,(2)}{2}$$

$$\Rightarrow ln\left(\frac{2^k + 1}{2}\right) = \frac{ln(2^k + 1)}{2}$$

$$\Rightarrow \left(\frac{2^k + 1}{2}\right)^2 = (2^k + 1)$$

$$\Rightarrow \frac{(2^k + 1)}{4}[2^k + 1 - 4] = 0$$

$\Rightarrow 2^k + 1 = 0$ or $2^k - 3 = 0$

$2^k = (-1)$ or $2^k = 3$

No solution $\quad k = \log_2 3$

14.

$$H = 4 + 3\cos\left(\frac{\pi t}{4}\right) - 2\sin\left(\frac{\pi t}{4}\right)$$

$$3\cos\left({\pi t}/{4}\right) - 2\sin\left({\pi t}/{4}\right) = R\cos\left({\pi t}/{4} + \alpha\right)$$

$R\cos\alpha = 3 \quad , \quad R\sin\alpha = 2$

$$R = \sqrt{3^2 + 2^2} = \sqrt{13}$$

$\tan\alpha = {2}/{3}$

$\alpha = 0.588$

$$H = 4 + \sqrt{13}\cos\left({\pi t}/{4} + 0.588\right)$$

$Hmax = 4 + \sqrt{13} \;\; ; \;\; 1 \leq \cos\alpha \leq 1$

${\pi t}/{4} + 0.588 = 2\pi$

$$t = \frac{(2\pi - 0.588)4}{\pi} = 7.25$$

15.

a) $x^2 + y^2 - 6x + 8y - 11 = 0$

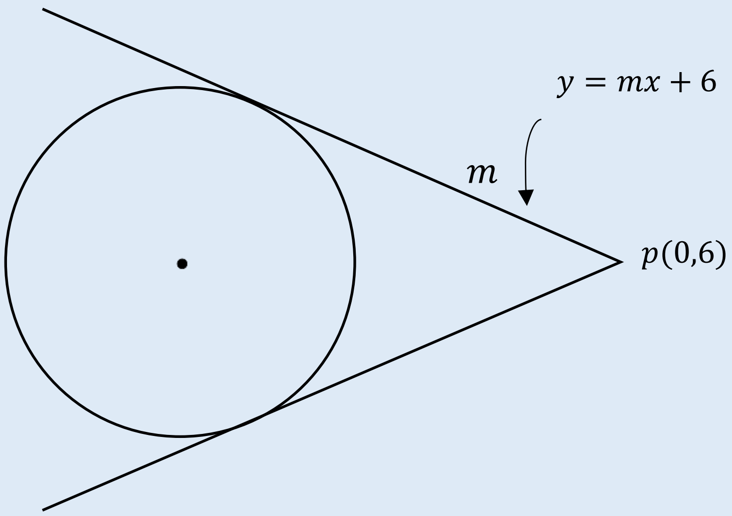
$x^2 - 6x + y^2 + 8y - 11 = 0$

$(x-3)^2 - 9 + (y+4)^2 - 16 - 11 = 0$

$(x-3)^2 + (y+4)^2 = 36$

centre $\Rightarrow (3, -4)$ radius $\Rightarrow \sqrt{36} = 6$

b)



Line $eqn \Rightarrow y = mx + 6$

$(x-3)^2 + (mx + 10)^2 = 36$

$x^2 - 6x + 9 + m^2x^2 + 20mx + 100 = 36$

$(1 + m^2)x^2 + (20m - 6)x + 73 = 0$

Consider $b^2 - 4ac$ which is equal to zero

$$(20m - 6)^2 - 4 \times (1 + m^2) \times 73 = 0$$

$$m = -0.79, 3.00$$

$$y = -0.79x + 6$$

$$y = 3.00x + 6$$

16.

Assume $\log_3 7$ rational

$$\log_3 7 = {}^{p}/_{q}$$

$$7 = 3^{p/q}$$

$$7^q = 3^p$$

This is not possible

Therefore, assumption is wrong

$\log_3 7$ irrational number

17.

a) $$\frac{1}{x(x-1)} = \frac{A}{x} + \frac{B}{x-1}$$

$$1 = A(x-1) + B(x)$$

$$x = 1 \qquad B = 1$$

$$x = 0 \qquad A = -1$$

$$\frac{1}{x(x-1)} = -\frac{1}{x} + \frac{1}{x-1}$$

b)

$$\frac{dp}{dt} = p\left(1 - \frac{p}{k}\right)$$

$$\frac{dp}{dt} = p\left(\frac{k-p}{k}\right)$$

$$\int \frac{k}{p(k-p)}\,dp = \int 1 \ dt$$

$$\Rightarrow \int \frac{1}{p} + \frac{1}{k-p}\,dp = \int 1 \ dt$$

$$\Rightarrow ln|p| + \frac{ln|k-p|}{(-1)} = t + c$$

$$\Rightarrow ln\left|\frac{p}{k-p}\right| = t + c$$

$$\frac{k}{p(k-p)} = \frac{A}{p} + \frac{B}{k-p}$$

$$k = A(k-p) + B(p)$$

$$p = k \qquad k = B(k) \Rightarrow B = 1$$

$$p = 0 \qquad A = 1$$

$$\Rightarrow ln\left|\frac{p}{k-p}\right| = t + c$$

$$\frac{p}{k-p} = e^{t+c}$$

$$p = ke^{t+c} - pe^{t+c}$$

$$p(1+e^{t+c}) = ke^{t+c}$$

$$p = \frac{ke^{t+c}}{1+e^{t+c}} = \frac{k}{1+e^{-(t+c)}} = \frac{k}{1+\left({}^{1}/_{e^{c}}\right) \times e^{-t}}$$

$$p = \frac{k}{1+c^{1}e^{-t}}$$

$$p(0) = p_0 \Rightarrow p_0 = \frac{k}{1+ce^{0}}$$

$$(1+c)p_0 = k$$

$$c = \left(\frac{k}{p_0} - 1\right)$$

c) $p = {}^{k}/_{2} \Rightarrow {}^{k}/_{2} = \frac{k}{1+\left(\frac{k}{p_0}-1\right)^{e^{-t}}}$

$$1 + \left(\frac{k}{p_0} - 1\right)^{e^{-t}} = 2$$

$$e^{-t} = \frac{1}{\frac{(k-p_0)}{p_0}} = \frac{p_0}{k-p_0}$$

$$\Rightarrow t = -ln\left[\frac{p_0}{k-p_0}\right]$$

A Level Maths Predicted Papers 2025

Paper 2: Pure Mathematics 2 (Set 1)

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This AL Maths paper 2 (Set Predicted Paper 2025) has been created based on the most common topics from previous past papers. This paper should be excellent for helping students revise for exams; however, it should not be relied upon as the sole basis for revision.

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Paper Reference: Paper 2: Pure	**Student Name:**
Time Allowed: 2 hours	**Total Marks:** /100

Instructions:

- *Calculators can be used for this paper.*
- *Fill in the boxes with your name/ID.*
- *Answer all questions.*
- *Use the spaces provided to answer the questions.*
- *All steps should be included in you answer.*
- *Diagrams unless otherwise indicated,*
  are NOT accurately drawn,

Information:

- *The total mark for this paper is 100.*
- *The marks that each question carries are provided.*

Advice:

- *Each question should be read carefully before answering.*
- *The management is important.*
- *Try to answer all questions provided.*
- *If you have time left at the end, re-check your answers.*

For Examiner's Use	
Question	**Mark**
TOTAL	

1.

Given that x is measured in radians, use small angle approximations to simplify the following expression.

$$\frac{\cos 5x - 1}{5x \sin x}$$

(3)

2.

The functions $f(x)$and $g(x)$ are defined by:

$$f(x) = e^{3x} + 4, \qquad g(x) = \ln(x), \qquad x > 0.$$

(a) State the range of $f(x)$.

(b) Find $f\big(g(x)\big)$, simplifying your answer.

(c) Determine the inverse function $f^{-1}(x)$.

(d) Verify that $f\big(f^{-1}(x)\big) = x$.

(7)

3.

The table below shows corresponding values of *x* and *y* for $\int \frac{(1+sinx)^2}{cos^2x}$

The values of *y* are given to 4 decimal places as appropriate.

x	0.5	1.0	1.5	2.0	2.5	3.0
y						

(a) Complete the table giving the missing values for y to 4 decimal places.

(b) Using the trapezium rule with all the values of y in the table, find an estimate for

$$\int_{0.5}^{3} \frac{(1 + sinx)^2}{cos^2x}\, dx$$

(c) Integrate it

$$\int \frac{(1+sinx)^2}{cos^2x}\,dx$$

(10)

4.

An object is moving in such a way so that its coordinates relative to a fixed origin O are given by

$x = 8\cos t - 6\sin t + 2, \qquad y = 6\cos t + 8\sin t - 2,$

Where t is the time in seconds.

Initially the object was at the point with coordinates (5,2).

a) show that the motion of the particle is governed by the differential equation

$$\frac{dy}{dx} = \frac{a-x}{b+y}$$

Find, in exact form, the possible values of the y coordinates of the object when its x coordinate is 2.

(8)

5.

Given that

$g'(x) = 3x^3 + rx - 25$ where r is a constant

$(x - 3)$ is a factor of h(x)

the g(x) intercept of C is 12

A curve R has equation $y = g(x)$, find, in simplest form, g (x)

(4)

6.

Find the value of this series

$$\sum_{n=3}^{\infty} \cos(180n)^0 \left[\frac{3}{4}\right]^n$$

(3)

7.

Prove, from first principles, that the derivative of $\frac{\text{Sin } 3x}{4}$ is $\frac{3 \text{ Cos } 3x}{4}$

(3)

8.

A cubic curve S is described by the equation:

$$y = (7 - x)(3 + x)^2$$

(a) Plot the graph of S. The sketch must clearly show all points where the curve intersects the coordinate axes.

(b) Draw separate graphs for the following equations, making sure to include the points where each graph meets the coordinate axes:

1. $y = (7 - 2x)(3 + 2x)^2$
2. $y = (7 + x)(3 - x)^2$
3. $y = (6 - x)(4 + x)^2$

(5)

9.

Determine the range of x values for which the curve $y = 4x^3 + 2x^2 + x + 25$ is convex.

(4)

10.

Expand $(2 - 3x)^6$ to find the first four terms in ascending powers of x.

Find the coefficient of x^2 in the expansion of:

$$\frac{(2-3x)^6}{(1-x)}$$

(8)

11.

A cylindrical tank with radius 2 m and height 5 m has water flowing in at a constant rate of $0.4\text{m}^3/\text{min}$ and leaving at rate proportional to the square root of the water depth, $0.3\sqrt{h}\ \text{m}^3/\text{min}$.

a) Show that the governing equation is:

$$\pi r^2 \frac{dh}{dt} = 0.4 - 0.3\sqrt{h}.$$

B)

Find the a general solution of differential equations

$$7\frac{dy}{dx}cosx = y^2(sinx)(tanx)$$

Giving the answers in the form of $y = f(x)$

(10)

12.

Let $y = c^x$ where $c > 0$ and $c \neq 1$.

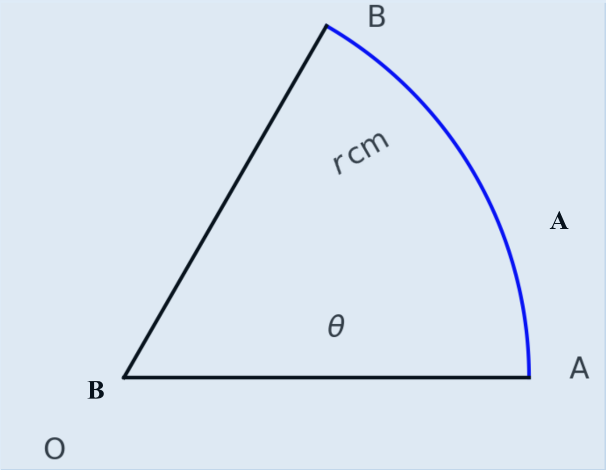
a) Prove that $\frac{dy}{dx} = c^x$ In c.

A curve has the equation $y = \sin(x) + 4 \times 2^{-x}$, where $x > 0$.

b) Find the equation of tangents at the point of the curve where $x = \pi/4$

(5)

13.



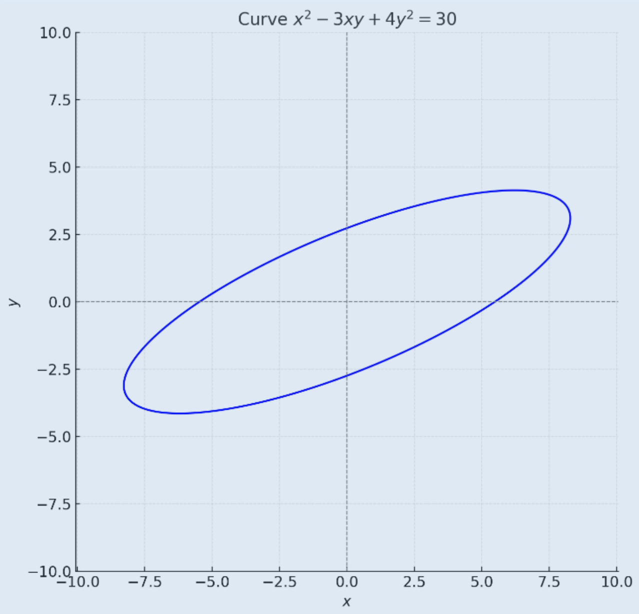
The diagram shows a sector AOB of a circle with centre O and radius r cm

- The angle AOB is θ radians
- The area of the sector AOB is 21 cm^2

Given that the perimeter of the sector is 7 times the length of the arc AB, find the exact value of r

(5)

14.



The diagram illustrates the curve given by the equation:

$$x^2 - 3xy + 4y^2 = 30$$

(a) Show that $\frac{dy}{dx} = \frac{3y-2x}{8y-3x}$

The curve models the shape of a car racing track, with both x and y measured in km. Points A and B represent the locations on the track that are furthest west and east from the origin O, respectively.

(b) Using the result from part (a), find the exact coordinates of point A, the furthest East point.

(c) Briefly describe the method to find the coordinates of the point that is furthest north of the origin O. (You do not need to carry out the calculation)

(5)

15.

(a) Prove the trigonometric identity:

$$\sin 3A = 3\sin A - \sin^3 A$$

(b) Using the result from part (a), solve the equation: $-180 \leq x \leq 360$

$$1 - \sin 3x = \cos^2 x$$

(5)

16.

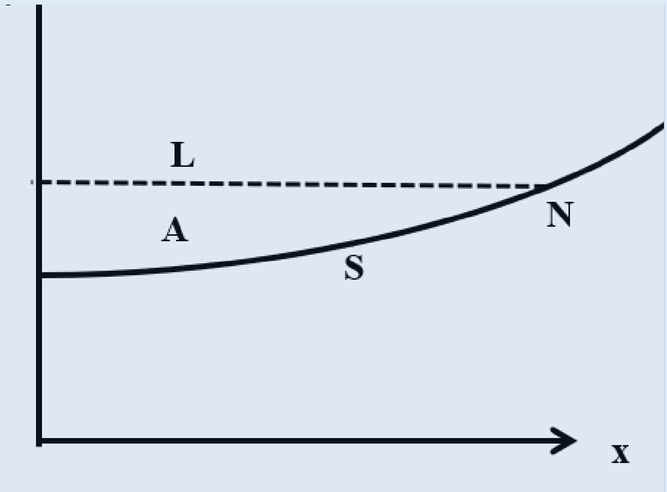


Figure shows a parametric curve S, defined by the equations:

$$x = \frac{1}{3}\theta sin\theta, \ y = \frac{4}{3}sec\theta \quad 0 \leq \theta \leq \frac{5\pi}{12}$$

The point N on S corresponds to $\theta = \frac{\pi}{3}$

(a) Determine the exact Cartesian coordinates of N in simplest form.

The horizontal line L intersects the curve S at N, and the shaded region A in the figure is bounded by S, L, and the y-axis.

(b) Prove that the area of A can be expressed as:

$$P\pi\sqrt{3} - Q\int_0^{\frac{\pi}{3}} (tan\theta + \theta)\, d\theta$$

where P and Q are rational constants to be determined.

(c) Using algebraic integration, compute the exact value of the area of A.

(10)

17.

The curve defined by the equation $y = 3 \times 4^x$ intersects with the curve defined by $y = 25 - 4 \times 4^{x+2}$at the point K.

Using algebraic methods, determine the exact x-coordinate of the point K

(5)

END

A Level Maths Predicted Papers 2025

Paper 2 (Set 1): Pure Mathematics 2

Solutions

1.

$$\frac{\cos 5x - 1}{5x \sin x}$$

$$\Rightarrow \frac{1 - \frac{(5x)^2}{2} - 1}{5x \times x}$$

$$\Rightarrow \frac{\frac{-25x^2}{2}}{5x^2}$$

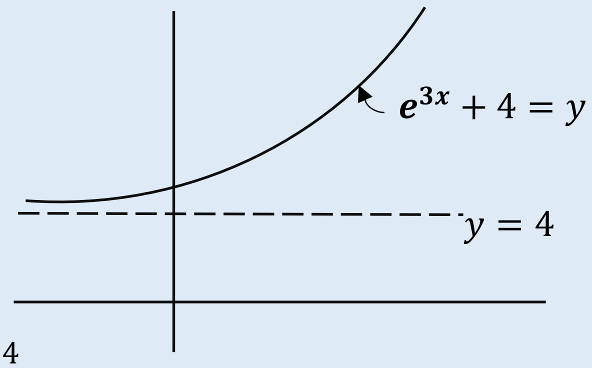
$$\Rightarrow {}^{-5}/_{2}$$

2.

$$f(x) = e^{3x} + 4, \quad g(x) = ln(x), \quad x > 0$$

a)

$$y = e^{3x} + 4 \Rightarrow$$



range $\Rightarrow f(x) > 4$

b) $fg(x) = e^{3lnx} + 4$

$$= e^{lnx^3} + 4$$

$$= x^3 + 4$$

c) $y = e^{3x} + 4$

$$y - 4 = e^{3x}$$

$$ln(y - 4) = 3x$$

$$x = \frac{ln(y-4)}{3}$$

$$f^{-1}(x) = \frac{ln(x-4)}{3}$$

d) $ff^{-1}(x) = e^{3\left(\frac{ln(x-4)}{3}\right)} + 4$

$= e^{ln(x-4)} + 4$

$= x - 4 + 4$

$= x$

3)

$$\int \frac{(1+\sin x)^2}{\cos^2 x}$$

a)

x	0.5	1.0	1.5	2.0	2.5	3.0
y	2.842	11.62	797.4	21.05	3.981	1.329

b) Area $= {}^{1}/_{2} \times 0.5 \times (2.842 + 1.329 + 2(11.62 + 797.4 + 21.05 + 3.981))$

$= 418.068$

c)

$$\int \frac{(1+\sin x)^2}{\cos^2 x} dx$$

$$\Rightarrow \int \frac{(1 + 2\sin x + \sin^2 x)}{\cos^2 x} dx$$

$$\Rightarrow \int \left(\frac{1}{\cos^2 x} + \frac{2\sin x}{\cos^2 x} + \frac{\sin^2 x}{\cos^2 x}\right) dx$$

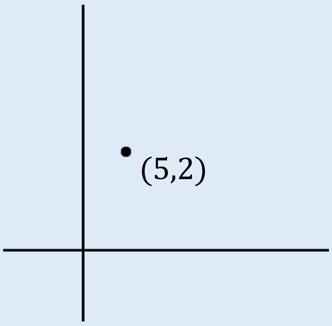
$$\Rightarrow \int \left(\sec^2 x + 2(\sin x)\left(\frac{1}{\cos^2 x}\right) + \sec^2 x - 1\right) dx$$

$$\Rightarrow \int (2\sec^2 x + 2secxtanx - 1)$$

$= (2\tan x + 2secx - x)$+c

4)

$$x = 8\cos t - 6\sin t + 2$$
$$y = 6\cos t + 8\sin t - 2$$



a) $\left.{dx}\middle/{dt}\right. = -8\sin t - 6\cos t$

$\left.{dy}\middle/{dt}\right. = -6\sin t + 8\cos t$

$$\left.{dy}\middle/{dx}\right. = \left.{\left.{dy}\middle/{dt}\right.}\middle/{\left.{dx}\middle/{dt}\right.}\right.$$

$$= \frac{-6\sin t + 8\cos t}{-8\sin t - 6\cos t}$$

$$= \frac{8\cos t - 6\sin t}{-(6\cos t + 8\sin t)}$$

$$= \frac{x-2}{-(y+2)}$$

$$= \frac{2-x}{2+y} \quad \Rightarrow \quad \begin{array}{l} a = 2 \\ b = 2 \end{array}$$

$$\frac{dy}{dx} = \frac{2-x}{2+y}$$

b) $x = 2$

$8\cos t - 6\sin t + 2 = 2$

$8\cos t - 6\sin t = 0$

$\tan t = {}^{8}/_{6} = {}^{4}/_{3} \;\rightarrow\; t = 0.927$

$y = 6\cos(0.927) + 8\sin(0.927) - 2$

$= 8$

5)

$g^1(x) = 3x^3 + rx - 25$

$$g(x) = \int (3x^4 + rx - 25)\, dx$$

$$= 3x^3/4 + {}^{rx^2}/_{2} - 25x + C$$

$g(3) = 3(3^3)/4 + r\left(3^2/_2\right) - 25(3) + C = 0$

$$243/4 + {}^{9r}/_2 - 75 + c = 0 \text{ — } ①$$

$g(0) = 0 + C = 12$

$$C = 12 \text{ — } ②$$

$$① \Rightarrow {}^{9r}/_2 = 9/4$$

$$r = 0.5$$

$g(x) = 0.75x^4 + 0.25x^2 - 25x + 12$

6)

$$\sum_{n=3}^{\alpha} \cos(180n)^\circ \left[{}^3/_4\right]^n$$

$\underline{n = 3}$ $\quad \cos(180 * 3)\left({}^3/_4\right)^3 = -\left({}^3/_4\right)^3$

$\underline{n = 4}$ $\quad \cos(180 * 4)\left({}^3/_4\right)^4 = \left({}^3/_4\right)^4$

$n = 5$ $\quad \cos(180 * 5)\left({}^3/_4\right)^3 = -\left({}^3/_4\right)^5$

$$\text{Series} \Rightarrow -\left({}^3/_4\right)^3 + \left({}^3/_4\right)^4 + -\left({}^3/_4\right)^5 + \ldots\ldots.$$

$$r = {}^{\left({}^3/_4\right)^4}\Big/_{-\left({}^3/_4\right)^3} \Rightarrow \left({}^{-3}/_4\right), \quad a = -\left({}^3/_4\right)^3$$

$$S_\propto = \frac{a}{1-r} = \frac{-\left({}^3/_4\right)^3}{1-\left({}^{-3}/_4\right)} = \frac{-\left({}^3/_4\right)^3}{{}^7/_4} = {}^{-27}/_{112}$$

7)

$$f(x) = \frac{\sin 3x}{4}$$

$$f^1_{(x)} = \lim_{h\to 0} \frac{f(x+h) - (f(n)}{h}$$

$$f(x+h) - (f(n) = \frac{\sin(3x+3h)}{4} - \frac{\sin(3n)}{4}$$

$$= {}^1/_4\left[\sin 3x \cos 3h + \cos 3x \sin 3h - \sin 3x\right]$$

$$= {}^{1}/_{4}\,[\sin 3x\,(\cos 3h - 1) + \cos 3x \sin 3h]$$

$$f^{1}_{(x)} = \lim_{h\to 0} {}^{1}/_{4} \frac{[\sin 3x\,(\cos 3h - 1) + \cos 3x \sin 3h]}{h}$$

$$= \lim_{h\to 0} {}^{1}/_{4} \left[\frac{\sin 3x\left(1 - \frac{(3h)^2}{2} - 1\right)}{h} + \frac{\cos 3x(3h)}{h}\right]$$

$$= \lim_{h\to 0} {}^{1}/_{4} \left[\sin 3x \left({}^{-9h}/_{2}\right) + 3\cos 3x\right]$$

$$= {}^{1}/_{4}\,(0 + 3\cos 3x)$$

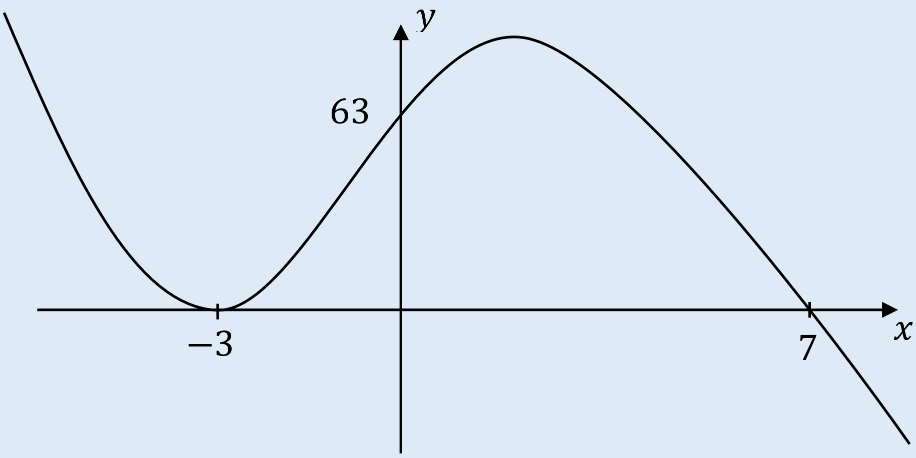
$$= {}^{3}/_{4} \cos 3x$$

8)

$$y = (7 - x)(3 + x)^2 = f(x)$$

a) $y = -(x - 7)(x + 3)^2$

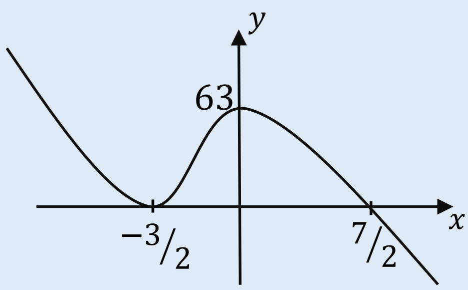
Roots $\Rightarrow x = -3, 7$



b)

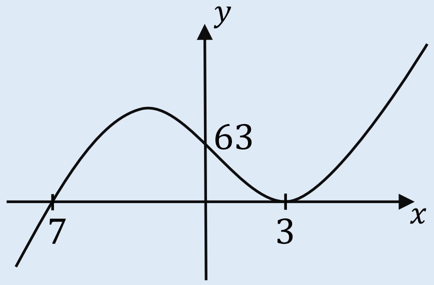
(1) $y = (7 - 2x)(3 + 2x)^2 \qquad \Rightarrow \begin{pmatrix} {}^{x}/_{2} \\ 0 \end{pmatrix}$

$= f(2x)$



(2) $\quad y = (7+x)(3-x)^2 \qquad \Rightarrow \begin{pmatrix} -x \\ 0 \end{pmatrix}$

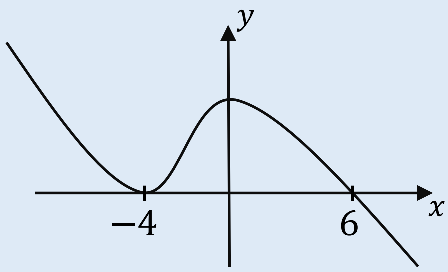
$\quad = f(-x)$



(3) $\quad y = (6-x)(4+x)^2 \qquad \Rightarrow \begin{pmatrix} -1 \\ 0 \end{pmatrix}$

$\quad = \left(7-(x+1)\right)\left(3+(x+1)\right)^2$

$\quad = f(x+1)$



9)

$y = 4x^3 + 2x^2 + x + 25$

for convex $\Rightarrow \; f^{11}(x) > 0$

$f^1(x) = 12x^2 + 4x + 1$

$f^{11}(x) = 24x + 4$

$24x + 4 > 0$

$6x + 1 > 0$

$x > {}^{-1}/_{6}$

10)

$$(2-3x)^6 = 2^6 + 6(2)^5(-3x) + \frac{6\times 5(2)^4}{2!}(-3x)^2 + \frac{6\times 5\times 4}{3!}(2)^3(-2x)^3$$

$$= 64 - 576x + 2160x^2 - (1280)x^3$$

$$\frac{(2-3x)^6}{(1-x)} = (2-3x)^6(1-x)^{-1}$$

$$(1-x)^{-1} = 1 + (-1)(-x) + \frac{(-1)(-2)}{2!}(-x)^2 + \ldots\ldots\ldots.$$

$$= 1 + x + x^2 + \ldots\ldots\ldots\ldots.$$

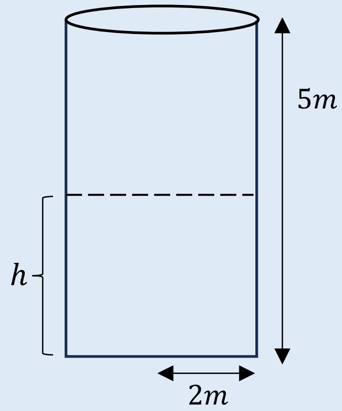
$$(2-3x)^6(1-x)^{-1} = (64-576x+2160x^2+\cdots)(1+x+x^2+\cdots)$$

$x^2 \qquad 64-576+2160$

$= 1648$

11)

$$\frac{dv}{dt} = 0.4m^3 \ / \ \text{min}$$



a) $\frac{dv}{dt} = -k\sqrt{h} = -0.3\sqrt{h}m^3 \ / \ \text{min}$

$v = \pi r^2 h$

$dv/_{dh} = \pi r^2$

$dv/_{dt} = dv/_{dh} \times dh/_{dt}$

$\pi r^2 \, dh/_{dt} = \frac{dv}{dt} = \left(0.4-0.3\sqrt{h}\right)$

$\pi r^2 \frac{dh}{dt} = 0.4-0.3\sqrt{h}$

b)

$7\frac{dy}{dx}cosx = y^2(sinx)(tanx)$

$7dy\frac{1}{y^2} = tanx^2dx$

$\int \frac{7}{y^2}dy = \int tanx^2dx$

$\int 7y^{-1}\,dy = \int secx^2 - 1dx$

$-7y^{-1} = tanx - x + c$

$y = \frac{7}{x - tanx - c}$

12)

a) $y = c^x$

$lny = lnc^x$

$lny = x.lnc$

$^1/_y \, {}^{dy}/_{dx} = lnc \times [1]$

$\frac{dy}{dx} = ylnc = c^x lnc$

$y = \sin(x) + 4 \times 2^{-x} = \sin x + 4\left(^1/_2\right)^x$

b) $\frac{dy}{dx} = \cos x + 4\left(^1/_2\right)^x ln\left(^1/_2\right)$

$= \cos x + 4(2^{-x})(-)\ln(2)$

$= \cos x - 4(2^{-x})ln2$

$x = {}^\pi/_4 \Rightarrow y = \sin\left(^\pi/_4\right) + 4 \times 2^{-\pi/4}$

$= {}^1/_{\sqrt{2}} + \frac{4}{2^{\pi/4}}$ $\left(^\pi/_4, 3.03\right)$

Gradient $\Rightarrow$ $\cos\left(^\pi/_4\right) - 4\left(2^{-\pi/4}\right)ln2$

$= {}^1/_{\sqrt{2}} - 4\left(2^{-\pi/4}\right)ln2$

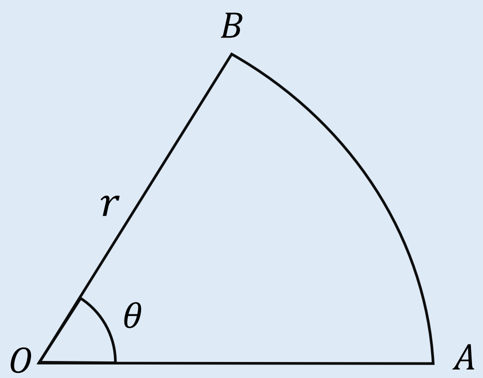
$= -0.9$

$\Rightarrow y - 3.03 = -0.9\left(x - {}^\pi/_4\right)$

$y = -0.9x + \left(\frac{0.9\pi}{4} + 3.03\right)$

$y = -0.9x + 3.74$

13)



Area $\Rightarrow {}^1/_2 r^2\theta$

$21 = {}^1/_2 r^2\theta$

$r^2\theta = 42$

perimeter $\Rightarrow 2r + r\theta$

$\Rightarrow r\theta$

$7r\theta = 2r + r\theta$

$$6r\theta = 2r$$

$$\theta = {}^{1}/_{3}$$

$$r^2({}^{1}/_{3}) = 42$$

$$r^2 = 126$$

$$r = 3\sqrt{14}$$

14)

$$x^2 - 3xy + 4y^2 = 30 \text{ — } ②$$

a) $2x - 3\left(x \times \frac{dy}{dx} + y(1)\right) + 8y\frac{dy}{dx} = 0$

$$2x - 3x\frac{dy}{dx} - 3y + 8y\frac{dy}{dx} = 0$$

$$\frac{dy}{dx}(8y - 3x) = 3y - 2x$$

$$\frac{dy}{dx} = \frac{3y - 2x}{8y - 3x}$$

b) to find A and B

$$8y - 3x = 0$$

$$3x = 8y \text{ — } ① \Rightarrow y = {}^{3x}/_{8}$$

$$② \Rightarrow x^2 - 3x({}^{3x}/_{8}) + 4({}^{3x}/_{8})^2 = 30$$

$$7\left({}^{x^2}/_{16}\right) = 30$$

$$x^2 = 480/7$$

$$x = 4\sqrt{210}/7$$

$$(4\sqrt{210}/7, 3\sqrt{210}/14)$$

(c)

$$\frac{dy}{dx} = \frac{3y - 2x}{8y - 3x} = 0$$

$$3y - 2x = 0$$

$y = 2x/3$ find the x, y values

15)

a) $\sin(3A) = \sin(2A + A)$

$$= \sin(2A) . \cos A + \cos(2A) . \sin A$$

$$= 2\sin A \cos A \cos A + (1 - 2\sin^2 A)\sin A$$

$$= 2\sin A\,(1 - \sin^2 A) + (1 - 2\sin^2 A)\sin A$$

$$= 3\sin A - 4\sin^3 A$$

b) $1 - \sin 3x = \cos^2 x$

$$1 - (3\sin x - 4\sin^3 x) = 1 - \sin^2 x$$

$$4\sin^3 x + \sin^2 x - 3\sin x = 0$$

$$\sin x\,(4\sin^2 x + \sin x - 3) = 0$$

$$\sin x\,(4\sin x - 3)(\sin x + 1) = 0$$

$\sin x = 0$ or	$\sin x = {}^{3}/_{4}$ or	$\sin x = (-1)$
$x = -180, 0, 180, 360$	$x = 48.6, 131.4$	$x = -90, 270$

16)

$$x = {}^{1}/_{3}\,\theta \sin\theta\,,\ \ y = {}^{4}/_{3}\sec\theta$$

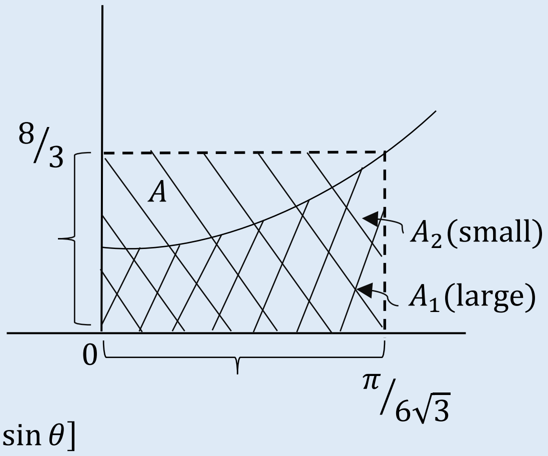
a) $N = \left({}^{1}/_{3}\left({}^{\pi}/_{3}\right)\left({}^{\sqrt{3}}/_{2}\right), {}^{4}/_{3} * 2\right)$

$$N = \left(\frac{\pi}{6\sqrt{3}}, {}^{8}/_{3}\right)$$

b) Area $(A) = A_1 - A_2$

$$A_1 = {}^{8}/_{3} \times \frac{\pi}{6\sqrt{3}} = \frac{4}{9\sqrt{3}}$$

$$A_1 = \frac{4}{27}(\pi)\sqrt{3}$$



$$A_2 = \int y . dx. \qquad , \quad \frac{dx}{d\theta} = {}^{1}/_{3}\,[\theta\cos\theta + \sin\theta]$$

$$dx = {}^{1}/_{3}\,(\theta\cos\theta + \sin\theta)d\theta$$

$$A_2 = \int_0^{\pi} {}^4/_3 \sec\theta \times {}^1/_3\,(\theta\cos\theta + \sin\theta)d\theta$$

$$= {}^4/_9 \int_0^{\pi/3} (\theta + \tan\theta)\, d\theta$$

$$A = \frac{4}{27}(\sqrt{3}\pi) - \frac{4}{9}\int_0^{\pi/3} (\theta + \tan\theta)\, d\theta$$

$x = 0$

$\theta \sin\theta = 0$

$\theta = 0$

$x - {}^{\pi}/_{6\sqrt{3}}$

$y = {}^4/_3$

${}^8/_3 = \sec\theta\,({}^4/_3)$

$\sec\theta = 2$

$\theta = {}^{\pi}/_3$

c)

$$Area \;= \frac{4}{27}(\sqrt{3}\pi) - \frac{4}{9}\int_0^{\pi/3} (\theta + \tan\theta)\, d\theta$$

$$= \frac{4\sqrt{3}\pi}{27} - {}^4/_9\left[{}^{\theta^2}/_2 + ln|\sec x|\right]_0^{\pi/3}$$

$$= \frac{4\sqrt{3}\pi}{27} - \frac{4}{9}\left({}^{\pi^2}/_{18} + ln2 - 0\right)$$

$$= \frac{4\sqrt{3}\pi}{27} - \frac{2\pi^2}{9} - {}^4/_9\, ln2$$

17)

$y = 3 \times 4^x$

$3 \times 4^x = 25 - 4 \times 4^{x+2}$

$3 \times 4^x = 25 - 4(4^x \times 4^2)$

Take $4^x = t$

$3t = 25 - 64t$

$67t = 25$

$t = {}^{25}/_{67}$

$4^x = {}^{25}/_{67}$

$x = \log_4\left({}^{25}/_{67}\right) = -0.71$

A Level Maths Predicted Papers 2025

Paper 1: Pure Mathematics 1 (Set 2)

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This AL Maths paper 1 (Set 2: Predicted Paper 2025) has been created based on the most common topics from previous past papers. This paper should be excellent for helping students revise for exams; however, it should not be relied upon as the sole basis for revision.

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Paper Reference: Paper 1: Pure	**Student Name:**
Time Allowed: 2 hours	**Total Marks:** /100

Instructions:

- *Calculators can be used for this paper.*
- *Fill in the boxes with your name/ID.*
- *Answer all questions.*
- *Use the spaces provided to answer the questions.*
- *All steps should be included in you answer.*
- *Diagrams unless otherwise indicated, are NOT accurately drawn,*

Information:

- *The total mark for this paper is 100.*
- *The marks that each question carries are provided.*

Advice:

- *Each question should be read carefully before answering.*
- *The management is important.*
- *Try to answer all questions provided.*
- *If you have time left at the end, re-check your answers.*

For Examiner's Use

Question	Mark
TOTAL	

1.

(a) Find an approximate value of

$$8cos\theta + (2 + sin\theta + tan\theta)^2$$

Given that θ is small and is measured in radians.

(b) Hence determine an approximate solution to $8cos\theta + (2 + sin\theta + tan\theta)^2 = 38tan\theta$

(3)

2.

Give that $(x - 3)$ is a factor of $g(x)$, find the values of the constant k

$$g(x) = 2x^3 + 5x^2 - k^2x + k$$

(3)

3.

Given that

$h'(x) = 3x^3 + rx - 25$ where r is a constant

$(x + 4)$ is a factor of $h(x)$

the $h(x)$ intercept of C is 15

A curve S has equation $y = h(x)$, find, in simplest form, $h(x)$

(4)

4.

$$f(x) = \frac{p}{x} + qx$$

Where p and q are constant, $x \in \mathbb{R}$

(a) Find $f^{-1}(x)$

$$r(x) = 2x^2 + 6x + 3 \qquad x \in \mathbb{R}$$

(*b*) Sketch the curve with the equation $y = r(x)$, indicating any points of intersection with the coordinate axes and the coordinates of any turning point.

(*c*) Describe fully the transformation that maps the curve with equation $y = g(x)$ onto the curve with equation $y = g(x)$ where

$$g(x) = 2(x + 3)^2 + 6x - 3 \qquad x \in \mathbb{R}$$

(6)

5.

A curve has parametric equations

$$x = 7 + 2sint\ t \in \mathbb{R}$$

$$\frac{y}{2} - cost = 1.5$$

(a) Show that a Cartesian equation of the curve C is $(x - a)^2 + (y - b)^2 = r^2$ and hence sketch the curve.

The line *l* has equation *y* = 7*x* + *p* where *k* is a constant.

Given that *l* is a tangent to *C*,

(*b*) find the possible values of *p*, giving your answers as simplified surds.

(8)

6.

Sketch the graphs of the following equations. Sate the equations of any asymptotes and any points where the graphs cross the x – axes and y – axes and state the domain and range for $f(x), g(x),\ h(x)$.

(a) $f(x) = \log_2 (x - 5)$

(b) $g(x) = |\ln (x - 5)|+5$

(c) $h(x) = \left|\frac{1}{(x+2)(x-5)}\right|$

(6)

7.

Prove, from first principles, that the derivative of $\cos 3x$ is $-3 \sin 3x$

(4)

8.

a) Express $2\sin 2\theta + 5\cos 2\theta$ in the form $R\sin(2\theta + \alpha)$ where R and α are constants,

$0 < \alpha < 90$ and $R > 0$

b) Hence find the maximum value of $3\sin 2\theta + 4\cos 2\theta$ and the smallest positive value of θ for which this maximum occurs.

(c) Hence find the maximum and minimum value of $\dfrac{70}{7+(2\sin 2\theta + 5\cos 2\theta)^2}$

d)

The length of daylight, f(t) at a location in Newcastle can be modelled using the equation

$$f(t) = 20 + 2\sin\left(\frac{250t}{365}\right) + 5\cos\left(\frac{250t}{365}\right) \qquad 0 \le t < 24$$

e) Find the value of t when this minimum number of daylight hours occurs.

(10)

9.

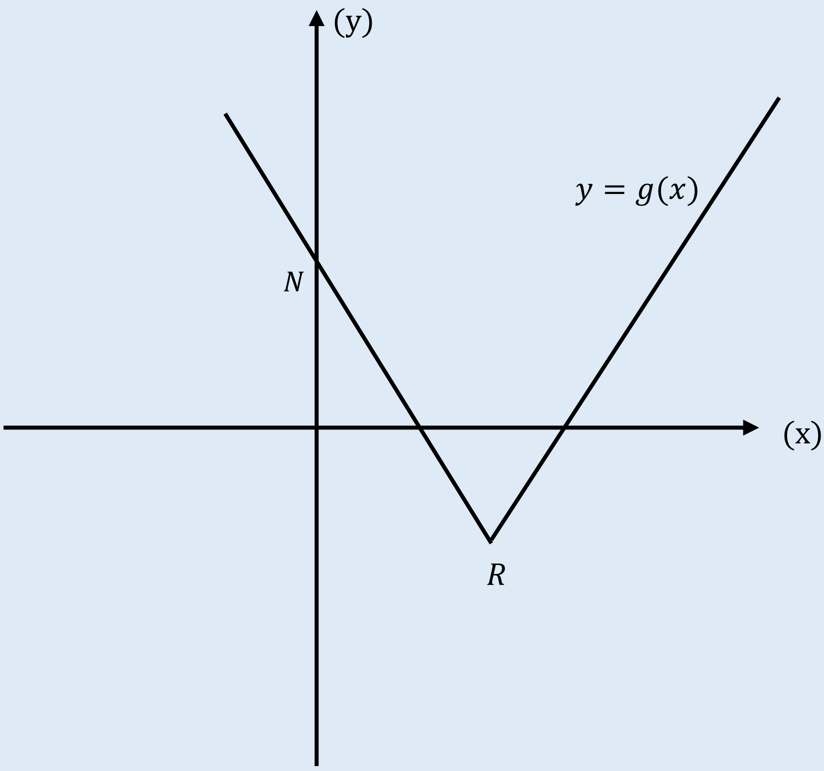


Figure shows the equations of $y = g(x)$, where

$$g(x) = 5|px - 4| - 3$$

and p is positive constatnt

The graph $y = g(x)$ intersects the Y-axis at the point N and has a mimium point at R

(a) Find, the x coordinate of R in terms of p

(b) Final the y coordinate of N

Given that the $y = 3 - 4x$ intersects the graph y=g(x) at (i) at two distint points (ii) at one point (iii) does not intersects

(c) find the range of possible values of p for all 3 cases

(d) Find the range of values of x that satisfy the inequality interms of p

$$5|px - 4| - 3 < 2x + 5$$

(10)

10.

A Student is studying the number of rabbits and the number of cats on village.

The number of rabbits, measured in thousands, R, is modelled by the equation

$$R = 75 + 25\,e^{0.07t}$$

where t is the number of years from the start of the study.

According to the model,

(*a*) find the number of rabbits at the start of the study,

The number of cats, measured in thousands, C, is modelled by the equation

$$C = 30 + 40e^{0.14t}$$

where t is the number of years from the start of the study.

When $t = t_1$, according to the models, there are an equal number of rabbits and cats.

(*b*) Find the value of t_1

(*c*) Hence find the rate of increase in the number of rabbits in this population

15 years from the start of the study

(6)

11.

(a) Find the first four terms, in ascending powers of x, of the binomial expansion of

$$\frac{2x+3}{\sqrt{25-16x}}$$

writing each term in simplest form.

(b) State the range of values of x for which each expansion is valid

(5)

12.

(a) Find $\overrightarrow{AB}$

Point A has position vector 3i+4j-5k

Point B has position vector 5i+7j-3k

Point C has position vector 8i+12j+8k

Wehere O is Origin

(b) Find the angle of ABC

(c) Show that quadrilateral OABC is trapezium

(5)

13.

(a) Prove that

$$\frac{\cos 2x+1}{\sin 2x}+\frac{\sin 2x}{1+\cos 2x}=2cosec2x$$

(b) Hence or otherwise solve $0 < x < 2\pi$

$$\frac{\cos(3x+\frac{\pi}{4})+1}{\sin(3x+\frac{\pi}{4})}+\frac{\sin(3x+\frac{\pi}{4})}{1+\cos(3x+\frac{\pi}{4})}=-5$$

(5)

14.

Show that

$$\sum_{x=1}^{n} ln\left[\frac{\sqrt{x}}{\sqrt{x+1}}\right] + \sum_{n=3}^{\infty} \cos(180n)^0 \left[\frac{5}{7}\right]^n = -\frac{1}{2}\ln(n+1) - \frac{125}{588}$$

(5)

15.

(a) Find a general solution of the differential equations

$$e^{3x}\frac{dy}{dx} = cosec^2 y$$

Giving the answers in the form $f(x, y) = c$

(10)

16.

The table below shows corresponding values of x and y for $\int \frac{lnx}{x}$

The values of y are given to 4 decimal places as appropriate.

x		2.5	3.0	3.5	4.0	4.5	5.0
y	0.3466		0.3662		0.3466		0.3219

(a) *Complete the table giving the missing values for y to 4 decimal places.*

(b) Using the trapezium rule with all the values of y in the table, find an estimate for

$$\int_2^5 \frac{lnx}{x}\,dx$$

(c) Find exact value of

$$\int_2^5 \frac{lnx}{x}\,dx$$

(d) Calculate the percentage error of the approximation in part (b).

Using your answer to part (c) and making your method clear, estimate

(e) (i) $\int_2^5 \frac{lnx^2}{x}\ dx$

(ii) $\int_2^5 \frac{ln7x}{x}\ dx$

(10)

END

A Level Maths Predicted Papers 2025

Paper 1 (Set 2): Pure Mathematics 1

Solutions

1.

a) $8\left(1-{}^{\theta^2}/_2\right)+(2+\theta+\theta)^2$

$= 8-4\theta^2+4(1+2\theta+\theta^2)$

$= 8\theta+12$

b) $8\cos\theta+(2+\sin\theta+\tan\theta)^2 = 38\tan\theta$

$\Rightarrow 8\theta+12 = 38\theta$

$\Rightarrow 30\theta \quad = 12$

$\Rightarrow \theta = {}^{12}/_{30} \; = 0.4rad$

2.

$g(x) = 2x^3+5x^2-k^2x+k$

$g(3) = 0$

$g(3) = 2(3)^3+5(3)^2-k^2(3)+k = 0$

$54+45-3k^2+k = 0$

$3k^2-k-99 = 0$

$$k = \frac{+1\pm\sqrt{1^2-4(3)(-99)}}{2(3)}$$

$k = 5.91$ or -5.58

3.

$h^1(x) = 3x^3+rx-25$

$$h(x) = \frac{3x^4}{4}+\frac{rx^2}{2}-25x+c$$

$$h(x) = \frac{3x^4}{4}+\frac{rx^2}{2}-25x+15$$

$$h(-4) = \frac{3(-4)^4}{4}+\frac{r(-4)^2}{2}-25(-4)+15 = 0$$

$192+8r+100+15 = 0$

$$r = \frac{-307}{8}$$

$$h(x) = \frac{3}{4}x^4-\frac{307}{16}x^2-25x+15$$

4.

$$f(x) = {}^{p}/_{x} + qx$$

a) $y = {}^{p}/_{x} + qx$

$yx = p + qx^2$

$qx^2 - yx + p = 0$

$x = \dfrac{y \pm \sqrt{y^2 - 4qp}}{2q}$

hence

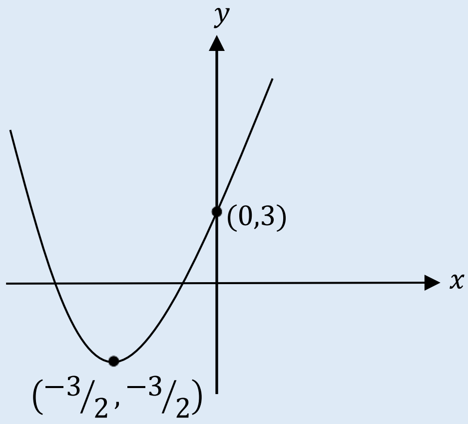
$f^{-1}(x) = \frac{x \pm \sqrt{x^2 - 4pq}}{2q}$

b) $r(x) = 2x^2 + 6x + 3$

$= 2(x^2 + 3x + {}^{3}/_{2})$

$= 2\left(\left(x + {}^{3}/_{2}\right)^2 + {}^{3}/_{2} - {}^{9}/_{4}\right)$

$= 2\left(x + {}^{3}/_{2}\right) - {}^{3}/_{2}$



c) $g(x) = 2(x+3)^2 + 6x - 3$

$= 2(x+3)^2 + 6(x+3) - 18 - 3$

$= 2(x+3)^2 + 6(x+3) - 21$

Transformation vector $\Rightarrow \begin{pmatrix} -3 \\ -24 \end{pmatrix}$

5.

$$x = 7 + 2\sin t - (1)$$

$${}^{y}/_{2} - \cos t = 1.5 - (2)$$

a) $(1) \Rightarrow \sin t = \frac{x-7}{2}$

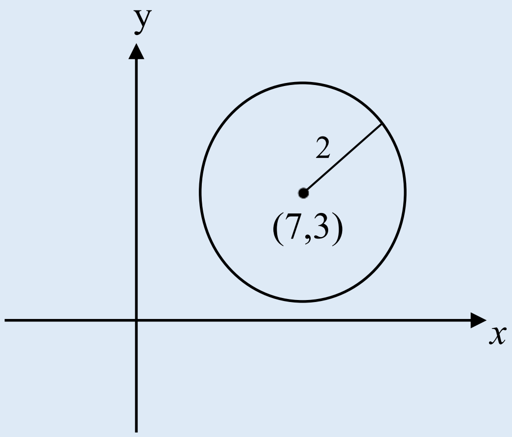
$(2) \Rightarrow \cos t = {}^{y}/_{2} - 1.5 \Rightarrow \frac{y-3}{2}$

$\sin^2 t + \cos^2 t = 1$

$$\left(\frac{x-7}{2}\right)^2 + \left(\frac{y-3}{2}\right)^2 = 1$$

$(x-7)^2 + (y-3)^2 = 4 = 2^2, \quad a = 7, \ b = 3, \quad r = 2$

$(x-7)^2 + (y-3)^2 = 2^2$



b) $y = 7x + p$

$(x-7)^2 + (7x + p - 3)^2 = 4$

$x^2 - 14x + 49 + 49x^2 + 14x(p-3) + (p-3)^2 = 4$

$50x^2 + 14x(p-4) + (p-3)^2 + 45 = 0$

Tangent, there fore $b^2 - 4ac = 0$

$14^2(p-4)^2 - 4(50)((p-3)^2 + 45) = 0$

$14^2(p-4)^2 - 200((p-3)^2 + 45) = 0$

$196(p^2 - 8p + 16) - 200(p^2 - 6p + 54) = 0$

$-4p^2 - 368p - 7664 = 0$

$p^2 + 92p + 1916 = 0$

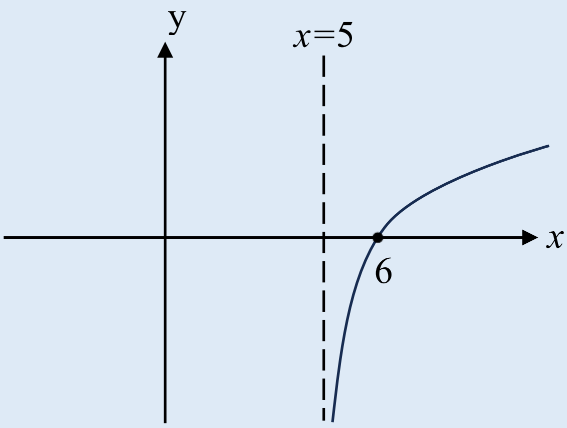
$$p = \frac{-92 \pm \sqrt{92^2 - 4(1916)}}{2}$$

$$p = \frac{-92 \pm \sqrt{800}}{2}$$

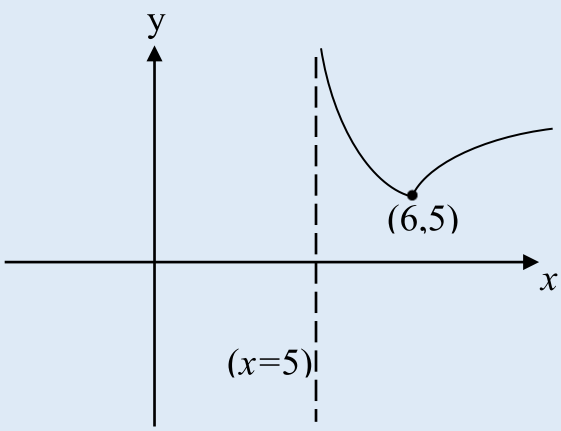
(+) $p = -46 + 10\sqrt{2}$ (-) $p = -46 - 10\sqrt{2}$

6.

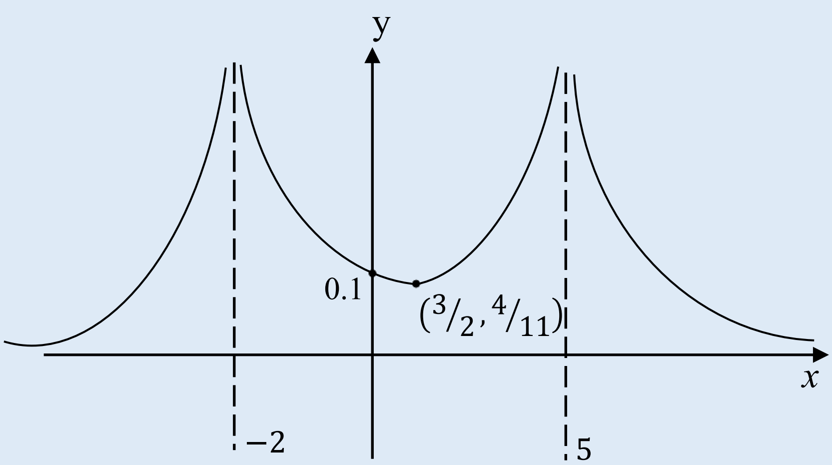
a) $f(x) = \log_2(x-5)$



b) $g(x) = |ln\ (x-5)| + 5$



c) $y = \left|\frac{1}{(x+2)(x-5)}\right|$



7.

$$f^1(x) = \lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$$

$f(x) = \cos 3x$

$f(x+h) = \cos 3\,(x+h)$

$\qquad\quad = \cos\,(3x+3h)$

$f(x+h) - f(x) = \cos(3x+3h) - \cos(3x)$

$\qquad = \cos(3x)\cos(3h) - \sin(3x)\sin(3h) - \cos 3x$

$\qquad = \cos(3x)\,(\cos(3h)-1) - \sin(3x)\sin(3h)$

$$f^1(x) = \lim_{h \to 0} \frac{\cos(3x)\,(\cos(3h)-1)}{h} - \frac{\sin(3x)\sin(3h)}{h}$$

$$= \lim_{h \to 0} \frac{\cos(3x)\,(\cos 3h-1)\times 3}{3h} - 3\sin(3x)\frac{\sin(3h)}{3h}$$

$= 3\cos(3x)(0) - 3\sin(3x)\,(1)$

$= -3\sin(3x)$

8.

a) $2\sin(2\theta) + 5\cos(2\theta)$

$R\sin(2\theta+\alpha) = R\sin 2\theta\cos\alpha + R\cos 2\theta\sin\alpha.$

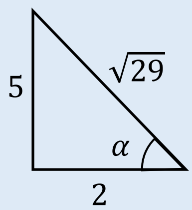
$R\cos\alpha = 2$ $\qquad\qquad$ $R\sin\alpha = 5$

$\tan\alpha = {}^5/_2$

$R\left({}^5/_{\sqrt{29}}\right) = 5$

$R = \sqrt{29}$

$\alpha = 68.19°$



b) $2\sin(2\theta) + 5\cos(2\theta) = \sqrt{29}\sin(2\theta + 68.19)$

maximum value $\Rightarrow \sqrt{29}$

occurs when

$2\theta + 68.19 \to 90°$

$\theta = 10.91°$

c)

$$f(\theta) = \frac{70}{7 + (2\sin 2\theta + 5\cos 2\theta)^2}$$

$f(\theta)max = \frac{70}{7+29}$ $\qquad\qquad$ $f(\theta)max = \frac{70}{7+0} \Rightarrow 10$

$= \frac{70}{36} = 1.94$

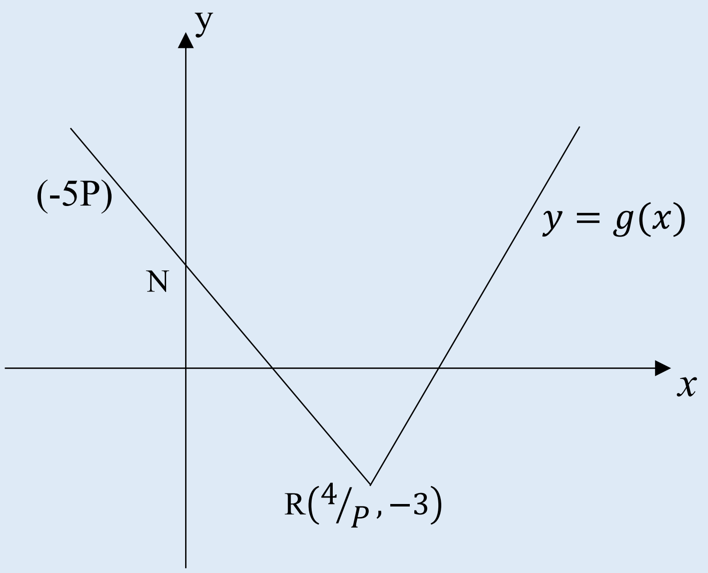
d) $f(t) = 20 + 2\sin\left(\frac{250t}{365}\right) + 5\cos\left(\frac{250t}{365}\right)$

$= 20 + \sqrt{29}\sin\left(\frac{250t}{365} + 68.19\right)$

$f(t)min$ occurs when $\sin\left(\frac{250t}{365} + 68.19\right) = -1$

t = 294.64 days

9.



$g(x) = 5|px - 4| - 3$

a) $g(x)_{min} = 0 - 3$

when $px - 4 = 0$

$x = 4/p$

b) $-5(px - 4) - 3$

$\Rightarrow -5px + 20 - 3$

$\Rightarrow -5px + 17$; $17 \longleftarrow y$ coordinate of N

c) i. $3 - 4(^4/_p) > -3$ and $-5p < -4$

$6 > {}^{16}/_p$ $p > {}^4/_5$

$p > {}^{16}/_6$

$p > {}^8/_3$

$p > {}^8/_3$

ii. $3 - 4(^4/_p) = (-3)$

$6 = {}^{16}/_p$

$p = {}^8/_3$

iii. $3 - 4(^4/_p) < -3$ and $-5p < -4$

$6 < {}^{16}/_p$

$p < {}^{16}/_6$

$p < {}^8/_3$ and $p > {}^4/_5$

${}^4/_5 < p < {}^8/_3$

d) $5|px - 4| - 3 < 2x + 5$

$5|px - 4| - 3 < 2x + 5$

(+)	(−)
$5(px - 4) < 2x + 8$	$-5(px - 4) < 2x + 8$
$5px - 2x < 28$	$-5px - 2x < 8 - 20$
$x(5p - 2) < 28$	$x(5p + 2) > 12$
$x < \frac{28}{5p-2}$	$x > \frac{12}{(5p+2)}$

10. $R = 75 + 25e^{0.07t}$

a) $at\ \ t = 0$

$R_{t-0} \Rightarrow 75 + 25 = 100$

$C = 30 + 40e^{0.14t}$

b) $30 + 40e^{0.14t_1} = 75 + 25e^{0.07t_1}$

$40e^{0.14t_1} = 45 + 25e^{0.07t_1}$

$8e^{0.14t_1} = 9 + 5e^{0.07t_1}$

Take $e^{0.07t_1} = p$

$8p^2 = 9 + 5p$

$8p^2 - 5p - 9 = 0$

$p = \frac{5 \pm \sqrt{25+4(8)(9)}}{2(8)}$; $P = 1.41$ or -0.79

$e^{0.07t_1} = 1.41$

$0.07t_1 = ln1.41$

$t_1 = \frac{ln1.41}{0.07} = 4.908$

c)

$\frac{dR}{dt} = 0 + 25e^{0.07t} \times 0.07$

$\left(\frac{dR}{dt}\right)_{t=15} = 25 \times 0.07 \times e^{0.07t}$

$= 5.0$

11.

a) $\frac{2x+3}{\sqrt{25-16x}}$

$= (2x+3)(25-16x)^{-1/2}$

$= 2\left(x + 3/2\right) \frac{1}{\sqrt{25}}\left(1 - 16/25\,x\right)^{-1/2}$

$= \frac{2}{5}\left(x + 3/2\right)\left(1 - 16/25\,x\right)^{-1/2}$

$\left(1 - 16/25\,x\right)^{-1/2} = 1 + \left(-1/2\right)\left(-16/25\,x\right) + \frac{(-1/2)(-3/2)}{2!}\left(\frac{-16}{25}x\right)^2 + \frac{(-1/2)(-3/2)(-5/2)}{3!}\left(-16/25\,x\right)^3$

$$= 1 + {}^{8}/_{25}\,x + \frac{96}{625}x^2 + \frac{768}{3125}x^3$$

$$\frac{2}{5}\left(x + {}^{3}/_{2}\right)\left(1 - {}^{16}/_{25}\,x\right)^{-1/2} = \frac{2}{5}\left(x + {}^{3}/_{2}\right)\left(1 + {}^{8}/_{25}\,x + \frac{96}{625}x^2 + \frac{768x^3}{3125}\right)$$

$$= \frac{3}{5} + \frac{74}{125}x + \frac{688}{3125}x^2 + \frac{3264x^3}{15625}$$

b) $\left|-\frac{16}{25}x\right| < 1$

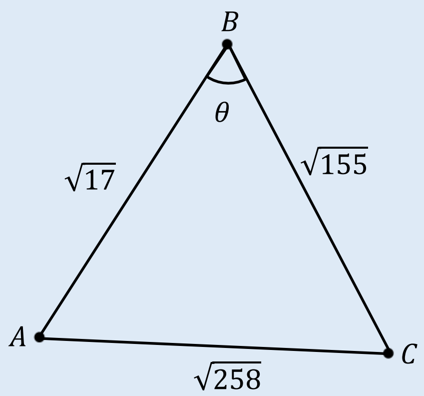
$|x| < {}^{25}/_{16} \quad -25/16 < x < {}^{25}/_{16}$

12.

a) $\overrightarrow{AB} = \begin{pmatrix} 5 \\ 7 \\ -3 \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}$

$= 2i + 3\underset{\sim}{j} + 2\underset{\sim}{k}$

b)



$\left|\overrightarrow{AB}\right| = \sqrt{4 + 9 + 4}$

$= \sqrt{17}$

$\overrightarrow{BC} = 3i + 5\underset{\sim}{j} + 11\underset{\sim}{k}$

$\left|\overrightarrow{BC}\right| = \sqrt{9 + 25 + 121}$

$= \sqrt{155}$

$\overrightarrow{AC} = 5i + 8\underset{\sim}{j} + 13\underset{\sim}{k}$

$\left|\overrightarrow{AC}\right| = \sqrt{25 + 64 + 169}$

$$= \sqrt{258}$$

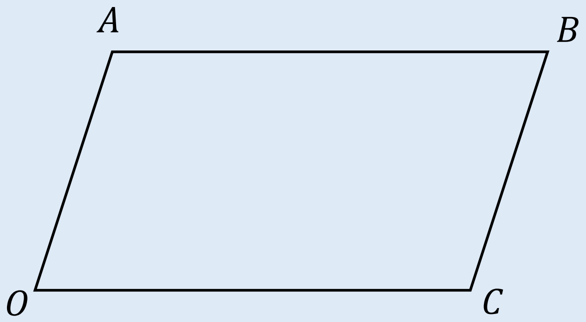
$$\cos\theta = \frac{(\sqrt{17})^2 + (\sqrt{155})^2 - (\sqrt{258})^2}{2\sqrt{17} \times \sqrt{155}}$$

$$= \frac{17 + 155 - 258}{2\sqrt{17} \times \sqrt{155}}$$

$\cos\theta = -0.8376$

$\theta = 146.9°$

c)



$\overrightarrow{OC} = 8i + 12\underset{\sim}{j} + 8\underset{\sim}{k}$

$\overrightarrow{AB} = 2i + 3\underset{\sim}{j} + 2\underset{\sim}{k}$

$\overrightarrow{OC} = 4\overrightarrow{AB}$

$OABC$ is a trapezium

13.

a)

$$\frac{\cos 2x+1}{\sin 2x} + \frac{\sin 2x}{1+\cos 2x} = 2\,\mathrm{cosec}\,2x$$

L.H.S $\Rightarrow$

$$= \frac{2\cos^2 x}{2\sin x.\cos x} + \frac{2\sin x.\cos x}{2\cos^2 x.}$$

$$= \frac{\cos x}{\sin x} + \frac{\sin x}{\cos x.}$$

$$= \frac{\cos^2 x.+\sin^2 x}{\sin x.\cos x.}$$

$$= \frac{1 \times 2}{2 \sin x . \cos x.}$$

$$= \frac{2}{\sin 2x.} \Rightarrow 2 cosec\, 2x$$

b)

$2 cosec\left(3x + \pi/_4\right) = (-5)$

$\sin\left(3x + \pi/_4\right) = -\,0.4.$

$0 < x < 2\pi.$

$0 < 3x < 6\pi.$

$\pi/_4 < 3x + \pi/_4 < 6\pi + \pi/_4.$

$\pi/_4 < 3x + \pi/_4 < \frac{25\pi}{4.}$

$3x + \pi/_4 \Rightarrow$

3.55

5.87

9.84

12.15

16.12

18.44

$$x = 1/_3 \begin{pmatrix} 3.55 \\ 5.87 \\ 9.84 \\ 12.15 \\ 16.12 \\ 18.44 \end{pmatrix} - \pi/_4 = \begin{matrix} 0.92 \\ 1.69 \\ 3.02 \\ 3.79 \\ 5.11 \\ 5.88 \end{matrix}$$

14.

$$\sum_{x=1}^{n} ln\left[\frac{\sqrt{x}}{\sqrt{x+1}}\right] + \sum_{n=3}^{\alpha} \cos(180n)^\circ \left(\frac{5}{7}\right)^n = -{}^1\!/_2\, ln\,(n+1)\frac{-125}{588}$$

$$ln\frac{\sqrt{x}}{\sqrt{x+1}} = ln\sqrt{x} - ln\sqrt{x+1}$$

$$= {}^1\!/_2\,(lnx - ln\ \ x+1)$$

$${}^1\!/_2\sum_{x=1}^{n} lnx - ln\ \ x+1 = {}^1\!/_2\,(ln1 - ln2 + ln2 - ln3 \ldots\ldots\ldots ln(n-1) - lnn + lnn - ln\,(n+1))$$

$$= {}^1\!/_2\,(ln1 - ln\,(n+1))$$

$$= -\,{}^1\!/_2\, ln\,(n+1)$$

$$\sum_{n=3}^{\alpha} \cos(180n)^\circ \left(\frac{5}{7}\right)^n = -\left({}^5\!/_7\right)^3 + \left({}^5\!/_7\right)^4 - \left({}^5\!/_7\right)^5 + \cdots \ldots\ldots\ldots$$

$$= \left({}^{-5}\!/_7\right)^3 + \left({}^{-5}\!/_7\right)^4 + \left({}^{-5}\!/_7\right)^5 + \cdots \ldots\ldots\ldots + \left({}^{-5}\!/_7\right)^n$$

$$s_\alpha = \frac{\left({}^{-5}\!/_7\right)^3}{1-\left({}^{-5}\!/_7\right)} = \frac{-125}{12\times 49} = \frac{-125}{588}$$

There fore

$$\sum_{n=1}^{n} ln\left[\frac{\sqrt{x}}{\sqrt{x+1}}\right] + \sum_{n=3}^{\alpha} \cos(180n)\,^\circ \left({}^5\!/_7\right)^n$$

$$\Rightarrow\ -{}^1\!/_2\, l\,n(n+1) - \frac{125}{588}$$

15.

a)

$$e^{3x}\frac{dy}{dx} = cosec^2 y$$

$$\int sin^2 y\, dy = \int e^{-3x}\, dx$$

$$\int \left[\frac{1}{2} - \frac{1}{2}cos^2 y\right] dy = \int e^{-3x}\, dx$$

$$\frac{y}{2} - \frac{1}{4}sin2y = -\frac{e^{-3x}}{3} + c_1$$

$$6y - 3sin2y + 4e^{-3x} = c$$

16.

a)

x	2.0	2.5	3.0	3.5	4.0	4.5	5.0
y	0.3466	0.3665	0.3662	0.3579	0.3466	0.3342	0.3219

$$y = \frac{lnx}{x}$$

b) using trapezium rule.

$\Rightarrow {}^{1}/_{2} \times 0.5 \times (0.3466 + 0.3219 + 2(0.3665 + 0.3662 + 0.3579 + 0.3466 + 0.3342))$

$\Rightarrow 1.052825$

c)

$$\int_2^5 \frac{lnx}{x} dx$$

$$\Rightarrow \left[\frac{(lnx)^2}{2}\right]_2^5$$

$\Rightarrow {}^{1}/_{2}\,((ln5)^2 - (ln2)^2)$

$\Rightarrow {}^{1}/_{2}\,ln10 \times ln2.5 = 1.054918$

d) percentage error $\Rightarrow \frac{|1.052825-1.054918|}{1.054918} \times 100$

$= 0.198$

$= 0.2\%$

e) i.

$$\int_{2}^{5} \frac{lnx^2}{x} dx$$

$$\Rightarrow \int_{2}^{5} 2\frac{lnx}{x} dx$$

$$\Rightarrow 2\int_{2}^{5} \frac{lnx}{x} dx \Rightarrow 2 \times 1.05$$

$$\Rightarrow 2.1$$

ii.

$$\int_{2}^{5} \frac{ln7x}{x} dx$$

$$= \int_{2}^{5} \frac{ln7}{x} + \frac{lnx}{x} dx$$

$$= \int_{2}^{5} \frac{ln7}{x} dx + \int_{2}^{5} \frac{lnx}{x} dx$$

$$= [lnx]_2^5 \; ln7 + 1.05$$

$$= ln2.5 \times ln7 + 1.05$$

$$= 1.78 \quad + \quad 1.05$$

$$\Rightarrow 2.83$$

A Level Maths Predicted Papers 2025

Paper 2: Pure Mathematics 2 (Set 2)

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This AL Maths paper 2 (Set 2: Predicted Paper 2025) has been created based on the most common topics from previous past papers. This paper should be excellent for helping students revise for exams; however, it should not be relied upon as the sole basis for revision.

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Paper Reference: Paper 2: Pure	**Student Name:**
Time Allowed: 2 hours	**Total Marks:** /100

Instructions:

- *Calculators can be used for this paper.*
- *Fill in the boxes with your name/ID.*
- *Answer all questions.*
- *Use the spaces provided to answer the questions.*
- *All steps should be included in you answer.*
- *Diagrams unless otherwise indicated, are NOT accurately drawn,*

Information:

- *The total mark for this paper is 100.*
- *The marks that each question carries are provided.*

Advice:

- *Each question should be read carefully before answering.*
- *The management is important.*
- *Try to answer all questions provided.*
- *If you have time left at the end, re-check your answers.*

For Examiner's Use	
Question	**Mark**
TOTAL	

1.

Find the maximum value of the function h(x)

$$h(x) = \frac{1}{2^{2x} - 2^{x+2} + 25}$$

(3)

2.

In the binomial expansion of $\left[\frac{2x+5}{x}\right] \times [2 + 3x]^7$

Find the coefficient of x^3

(4)

3.

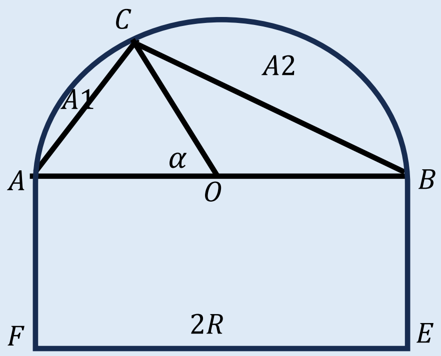


Figure 1

The Figure 1 shows a semicircle with radius R cm, where AB is the diameter with O as the center. Point C lies on the circular part of the semicircle such that AOC = α α radians. The chords AC and BC define two segments A_1 and A_2 respectively.

If the area of A_2 is three times as large as the area of A_1 show that:

$$\pi + 2sin\alpha = 4\alpha$$

(5)

4.

(a) Sketch the graph of $y = |Sinx| + 3, 0^o \leq x \leq 360^o$

(b) Explain $|Sinx| + 3 \geq |Sinx + 3|$ for all real values of x

(4)

5.

Given that x and y satisfy the equation:

$$logx - log2y = \log\left(\frac{x}{2} + y\right)$$

(a) Show that $x = \frac{2y^2}{(1-y)}$

(b) Determine the restrictions on y, giving reasons for your answers.

(c) Solve the following logarithmic equations

$$\log_4 x - \log_x 4 = 1$$

(5)

6.

(a) Prove that for all positive value of m and n

$$\frac{m^2}{n} + \frac{n^2}{m} \geq 2\sqrt{mn}$$

(b) Show by counterexample that this inequality does not hold if either m or n are negative or zero

(5)

7.

Solve the differential equation:

$$\frac{dy}{dx} = xcos(3x)sin^2(y)$$

When $x = \frac{\pi}{3}$, $y = 1$, giving the answers in the form $coty = g(x)$

(10)

8.

The curve C1 is given by $y = \ln(10 - x)$. The line is given by $y = x$ and They intersect at single point $x = a$

(a) Show that $2 < a < 3$

$$g(x) = xe^{-x^2} + 0.25$$

(b) Using $x_0 = -0.3$ as a first approximation, apply the Newton–Raphson method to $g(x)$ to obtain a third approximation. Give your answer to 3 decimal places.

(10)

9.

(a) Solve, for $0 \leq x \leq \pi$ the equation

$$6sin2x = sec2x$$

(b) Solve, for $0 \leq x \leq 360^o$ the equation

$$3sin2x - 4cos2x = 2$$

(10)

10.

A scientist observes the rate of growth of a bacterial culture. The population P of the culture, in thousands, after t hours is governed by the differential equation:

$$\frac{dp}{dt} = \frac{kp}{(t+1)}$$

where k is a constant.

(a) Find the general solution of the differential equation.

(b) Given that the population P at t = 0 is 2, and the population after 5 hours is 6, find the exact value of k.

(11)

11. Find exact value of

$$\int_{8}^{20} \frac{5dx}{(x-4)(2+\sqrt{x-4})}$$

(7)

12.

The Parametric equations of a curve are given by

$x = sin\theta + cos2\theta$, $y = cos\theta sin2\theta,\quad 0 \le \theta \le 2\pi$

Determine the coordinates of the stationary points of curve

(6)

13.

Given that p and q are integers and p + q is odd

Use algebra to prove by contradiction that at least one of p and q is odd.

(4)

14.

$f(x) = \frac{1}{x} \quad x \in R, x \neq 0$

t(x)= $\frac{5x-9}{x-2} \quad x \in R, x \neq 2$

(a) Prove that t(x)= $af(x+b)+c$. Given that a, b and c are integers.

(b) Sketch the both graphs of $f(x)$ and $t(x)$ in same plot.

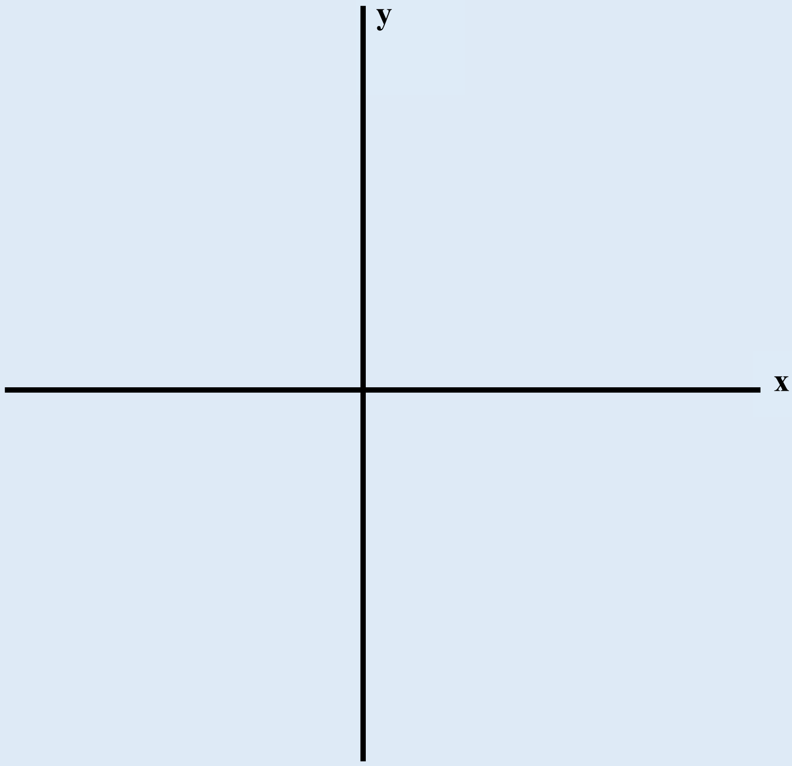


Figure 2

(c) Find the coordinates of intersection points of $t(x)$ and the line with following equation

$y - 6x - 5 = 0$

(10)

15.

The equation of curve is given by

$$2^y = \frac{x^2-2x+7}{x+4}$$

(a) Show clearly that $\frac{dy}{dx} = \frac{f(x)}{g(x)}$

(b) Find the exact coordinate of the tutrning point of the curve

(6)

END

A Level Maths Predicted Papers 2025

Paper 2 (Set 2): Pure Mathematics 2

Solutions

1.

$$h(x) = \frac{1}{2^{2x} - 2^{x+2} + 25}$$

$$h(x) = \frac{1}{(2^x)^2 - 2^x \times 2^2 + 25}$$

take $2^x = t$

$$h(x) = \frac{1}{t^2 - 4t + 25} = \frac{1}{(t-2)^2 - 4 + 25}$$

$$h(x) = \frac{1}{(t-2)^2 + 21}$$

$$h(x) = \frac{1}{0 + 21} = \frac{1}{21}$$

2.

$$\left(\frac{2x+5}{x}\right)(2+3x)^7$$

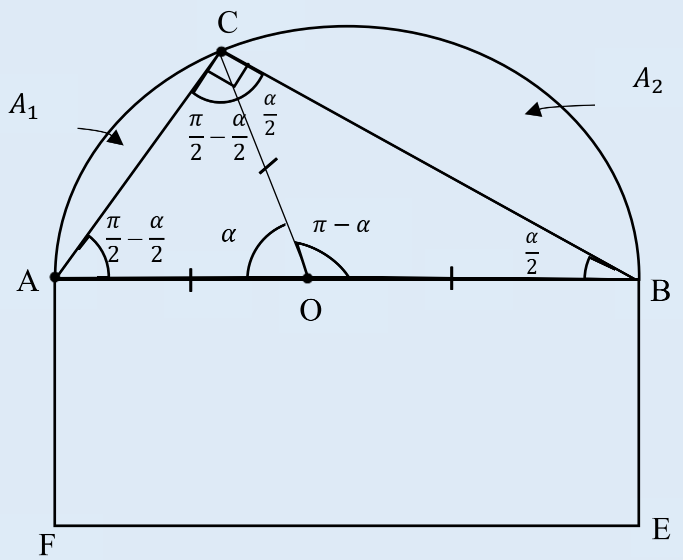
$$\Rightarrow \left(2 + \frac{5}{x}\right)(2+3x)^7$$

x^3 term $\quad 2 \times 7_{c_3} \times 2^4 \times (3)^3 + 5 \times 7_{c_4} \times 2^3 \times 3^4$

$\Rightarrow 30240 \quad + \quad 113400$

$\Rightarrow 143640$

3.



$A_1 area \Rightarrow \,^1/_2 \times R^2 \times \alpha - \,^1/_2 \times R^2 \times \sin\alpha$

$\Rightarrow \,^1/_2\, R^2(\alpha - \sin\alpha)$

$A_2 area \Rightarrow \,^1/_2\, R^2(\pi - \alpha) - \,^1/_2\, R^2 \sin(\pi - \alpha)$

$= \,^1/_2\, R^2(\pi - \alpha - \sin\alpha)$

$A_2 = 3A_1$

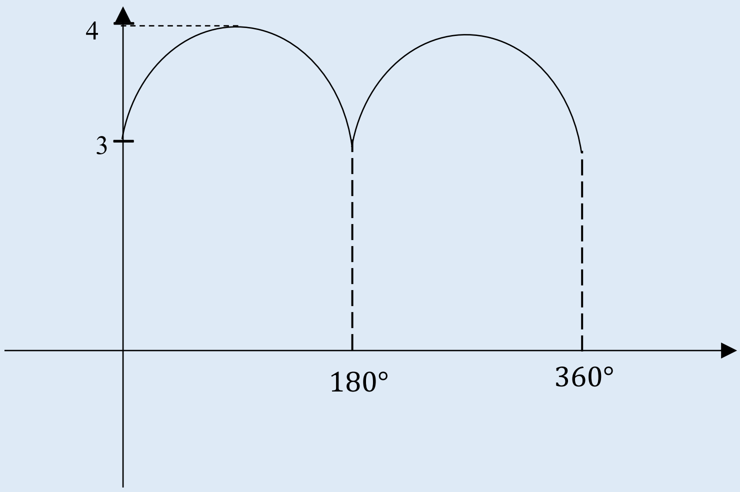
$^1/_2\, R^2(\pi - \alpha - \sin\alpha) = 3 \times \,^1/_2 \times R^2(\alpha - \sin\alpha)$

$\pi - \alpha - \sin\alpha = 3\alpha - 3\sin\alpha$

$\Rightarrow \;\pi + 2\sin\alpha = 4\alpha$

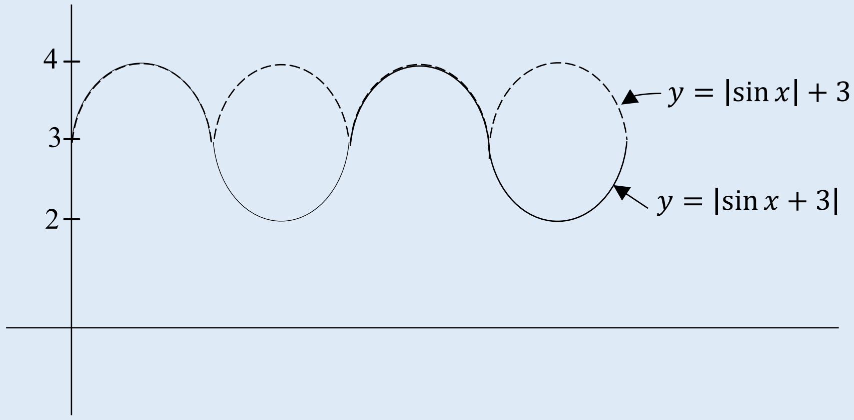
4.

a) $y = |\sin x| + 3 \quad ; \quad 0 \le x \le 360°$



b) $|\sin x| + 3 \ge |\sin x + 3|$

$-1 \le \sin x \le 1$	$-1 \le \sin x \le 1$
$-1 + 3 \le \sin x + 3 \le 1 + 3$	$0 \le \lvert\sin x\rvert \le 1$
$2 \le \sin x + 3 \le 4$	$3 \le \lvert\sin x\rvert + 3 \le 4$
$2 \le \lvert\sin x + 3\rvert \le 4$	$3 \le \lvert\sin x\rvert + 3 \le 4$



Therefore $|\sin x| + 3 \geq |\sin x + 3|$

5.

$$\log x - \log 2y = \log\left(\frac{x}{2} + y\right)$$

a) $\log \frac{x}{2y} = \log\left(\frac{x}{2} + y\right)$

$\frac{x}{2y} = \frac{x}{2} + y$

$x = xy + 2y^2$

$x(1-y) = 2y^2$

$x = \frac{2y^2}{(1-y)}$

b) Consider

$\log 2y$

$2y > 0$

$y > 0$

Consider

$x = \frac{2y^2}{1-y} : y \neq 1$

$1 - y > 0 \quad as \quad x > 0$

$y < 1$

Therefore $0 < y < 1$

c)

$\log_4 x - \log_x 4 = 1$

$\log_4 x - \frac{1}{\log_4 x} = 1 \longrightarrow$ take $\log_4 x = t$

$t - \frac{1}{t} = 1$

$t^2 - t - 1 = 0$

$t = \frac{1 \pm \sqrt{1+4}}{2} = \frac{1+\sqrt{5}}{2}$

$\log_4 x = \frac{1+\sqrt{5}}{2}$ or $\log_4 x = \frac{1-\sqrt{5}}{2}$

$x = 4^{\left(\frac{1+\sqrt{5}}{2}\right)}$ or $x = 4^{\left(\frac{1-\sqrt{5}}{2}\right)}$

$x = 9.42$ or $x = 0.42$

6.

a) $\frac{m^2}{n} + \frac{n^2}{m} \geq 2\sqrt{mn}$

$\Rightarrow \frac{m^2}{n} + \frac{n^2}{m} \geq 2\sqrt{mn}$

$\Rightarrow \frac{m^3+n^3}{nm} \geq 2\sqrt{mn}$

$\Rightarrow m^3 + n^3 \geq 2(mn)^{3/2}$; $m, n > 0$

$\Rightarrow m^3 - 2m^{3/2}n^{3/2} + n^3 \geq 0$

$\Rightarrow \left(m^{3/2} - n^{3/2}\right)^2 \geq 0$

Therefore consider $\left(m^{3/2} - n^{3/2}\right)^2 \geq 0$

$m^3 + n^3 - 2(mn)^{3/2} \geq 0$

$m^3 + n^3 \geq 2(mn)^{3/2}$

$\frac{m^2}{n} + \frac{n^2}{m} \geq 2(mn)^{1/2}$

b) consider $m = (-1)$, $n = (-4)$

L.H.S

$$\frac{(-1)^2}{(-4)} + \frac{(-4)^2}{-1}$$

$$\frac{-1}{4} - 16$$

R.H.S

$$2\sqrt{(-4)(-1)}$$

$$\Rightarrow 2\sqrt{4}$$

$$\Rightarrow 4$$

$\text{L.H.S} < \text{R.H.S}$

Therefore false.

7.

$$\frac{dy}{dx} = x\cos(3x)\sin^2(y)$$

$$\frac{1}{\sin^2 y}dy = x.\cos(3x).dx$$

Integrate both side

$$\int \frac{1}{\sin^2 y}dy = \int x.\cos(3x)\,dx.$$

$$\int cosec^2 y\ dy = \int x.\cos(3x)\,dx.$$

$$u = x \qquad \frac{du}{dx} = 1$$

$$\frac{dv}{dx} = \cos 3x \qquad v = \frac{\sin 3x}{3}$$

$$-\cot y = \frac{x\sin 3x}{3} - \int \frac{\sin 3x}{3}dx + C_1$$

$$-\cot y = \frac{x\sin 3x}{3} + \frac{\cos 3x}{3\times 3} + C$$

$$-\cot y = \frac{x\sin 3x}{3} + \frac{\cos 3x}{9} + C$$

$$x = {}^{\pi}/_{3},\ y = 1$$

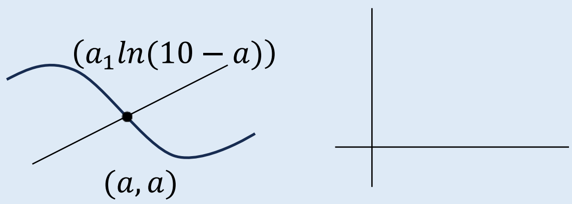
$$-\cot 1 = \underbrace{\frac{{}^{\pi}/_{3} \times \sin {}^{3\pi}/_{3}}{3}}_{=0} + \frac{\cos\pi}{9} + C$$

$C = {}^{1}/_{9} - \cot(1)$

$$\cot y = \frac{-x\sin 3x}{3} - \frac{\cos 3x}{9} - \frac{1}{9} + \cot(1)$$

8.

a) $y = ln\,(10 - x)$



$a = \ln\,(10 - a)$

$e^{a} = 10 - a$

$ln(10 - x) = x$

$ln(10 - x) - x = 0$

When $x = 2$

$= ln(10 - 2) - 2$

$= ln(8) - 2$

$= 0.079$

When $x = 3$

$ln(10 - 3) - 3$

$\Rightarrow ln\,7 - 3$

$\Rightarrow -1.05$

b) $g(x) = xe^{-x^2} + 0.25$

$$x_{n+1} = x_n - \frac{f_{(x)}}{f^1_{(x_n)}}$$

$g_{(x)} = xe^{-x^2} + 0.25$

$g^1_{(x)} = 1.e^{-x^2} + x.e^{-x^2} \times (-2x) + 0$

$= e^{-x^2}(1 - 2x^2)$

$$x_{n+1} = x_n - \frac{\left(x_n e^{-x_n^2} + 0.25\right)}{e^{-x_n^2}(1 - 2x_n^2)}$$

$x_0 = -0.3$

$$x_1 = x_0 - \frac{\left(x_0 e^{-x_n^2} + 0.25\right)}{e^{-x_n^2}\left(1 - 2x_n^2\right)}$$

$x_0 = -0.3$

$x_1 = -0.27$

$x_2 = -0.27$

$x_3 = -0.27$

Third approximation

$x = 0.269$

9.

a) $0 \le x \le \pi$

$6 \sin 2x = \sec 2x$

$6 \sin 2x = \frac{1}{\cos 2x}$

$6 \sin 2x \ \cos 2x = 1$

$3 \sin 4x = 1$

$3 \sin 4x = {}^{1}/_{3}$

$4x = 0.339 \ , \ 0.280$

$x = 0.08 \quad , \ 0.70$

b) $3 \sin 2x - 4 \cos 2x = 2 \qquad (0 \le x \le 360)$

$5\left(\frac{3}{5} \sin 2x - \frac{4}{5} \cos 2x\right) = 2$

${}^{3}/_{5} \longrightarrow \cos\alpha \quad , {}^{4}/_{5} \longrightarrow \sin\alpha. \longrightarrow$

$\alpha = 53.13$

$\sin 2x \cos\alpha - \cos 2x \, . \sin\alpha = {}^{2}/_{5}$

$\sin(2x - \alpha) = {}^{2}/_{5}$

$-53.13 \le 2x - \alpha \le 666.87$

$2x - \alpha = 23.58, \overleftrightarrow{156.42, 383.57, 516.42}$

$x = 104.78, 218.35, 284.78$

10.

$$\frac{dp}{dt} = \frac{kp}{(k+1)}$$

a) $\frac{1}{kp}dp = \frac{1}{(t+1)}dt$

Integrate

$$\int \frac{1}{kp}dp = \int \frac{1}{(t+1)}dt$$

$\Rightarrow \frac{1}{k}ln|p| = ln|t+1| + lnc$

$\Rightarrow lnp = kln|(t+1) \times c|$

b) $t = 0\ , p = 2$

$ln2 = kln|1 \times c|$

$ln|c| = {}^{1}/_{k}\, ln2 \quad —(1)$

$t = 5\ , p = 6$

$ln6 = kln|6 \times c|$

$ln6 = kln6 + k\left(\frac{1}{k}ln2\right)$

$kln6 = ln3$

$$k = \frac{ln3}{ln6}$$

Therefore $ln|c| = \frac{ln6}{ln3} \times ln2$

11.

$$\int_{8}^{20} \frac{5dx}{(x-4)\left(2+\sqrt{x}-4\right)}$$

Take $\sqrt{x-4} = u$

$$x - 4 = u^2$$

$$dx = 2u.du.$$

$$\int_{2}^{4} \frac{5.2u.du}{u^2(2+u)} = 10\int_{2}^{4} \frac{1}{u.(u+2)}du.$$

$$\frac{1}{u(u+2)} = \frac{A}{u} + \frac{B}{u+2}$$

$$= 10\int_{2}^{4}\left(\frac{1}{2u} - \frac{1}{2(u+2)}\right)du.$$

$$1 = A(U+2) + B(U)$$

$$= \frac{10}{2}\left[ln|u| - ln|u+2|\right]_2^4$$

$$= 5\left[ln\left|\frac{4}{6}\right| - ln\left|\frac{2}{4}\right|\right]$$

$$= 5\left[ln\left(\frac{4}{6} \times \frac{4}{2}\right)\right]$$

$$= 5ln({}^{4}/_{3})$$

$$\left(\begin{array}{l} 0 = A + B \\ 1 = 2A \\ A = {}^{1}/_{2}, B = {}^{-1}/_{2} \end{array}\right)$$

12.

$x = \sin\theta + \cos 2\theta.$, $y = \cos\theta \,.\, \sin 2\theta$ $q \leq \theta \leq 2\pi$

$$\frac{dy}{dx} = \frac{dy}{d\theta} \times \frac{d\theta}{dx}$$

$$\frac{dx}{d\theta} = \cos\theta - 2\sin 2\theta. \qquad \frac{dy}{d\theta} = \cos\theta\left(2\cos 2\theta\right) - \sin 2\theta \,.\, \sin\theta.$$

$$= 2\cos 2\theta \,.\, \cos\theta - \sin 2\theta \ \sin\theta.$$

$$\frac{dy}{dx} = \frac{2\cos 2\theta.\cos\theta - \sin 2\theta.\sin\theta}{\cos\theta. -2\sin 2\theta.}$$

For $\frac{dy}{dx} = 0$

$$2\cos 2\theta \,.\, \cos\theta - \sin 2\theta \,.\, \sin\theta = 0$$

$$2\cos 2\theta.\cos\theta = \sin 2\theta \,.\, \sin\theta.$$

$$\tan 2\theta \,.\, \tan\theta = 2.$$

$$\left(\frac{2\tan\theta}{1-\tan^2\theta}\right)\tan\theta = 2$$

$$2\tan^2\theta = 2(1-\tan^2\theta)$$

$$2\tan^2\theta = 1$$

$$\tan^2\theta = {}^1/_2$$

$$\tan\theta = \pm\frac{1}{\sqrt{2}}$$

$\tan\theta = \frac{1}{\sqrt{2}}$ or $\tan\theta = -{}^1/_{\sqrt{2}}$

$\theta = 0.62, 3.76$ $\theta = 2.52,\ 5.66$

13.

Take p, q both even.

$$p = 2k$$

$$q = 2n$$

$$p + q = 2k + 2n$$

$$= 2(k+n)$$

This is even

Therefore at least one of p and q must be odd.

14.

$$f_{(x)} = \frac{1}{x} \quad , \quad t_{(x)} = \frac{5x-9}{x-2}$$

a) $\frac{5x-9}{x-2} = a\left(\frac{1}{x+b}\right) + c$

take R.H.S $\Rightarrow \frac{a}{x+b} + c \Rightarrow \frac{a+c(x+b)}{x+b} = \frac{(x+(a+cb)}{(x+b)}$

compare, $\quad x - 2 = x + b$

$b = -2$

$5x = Cx$

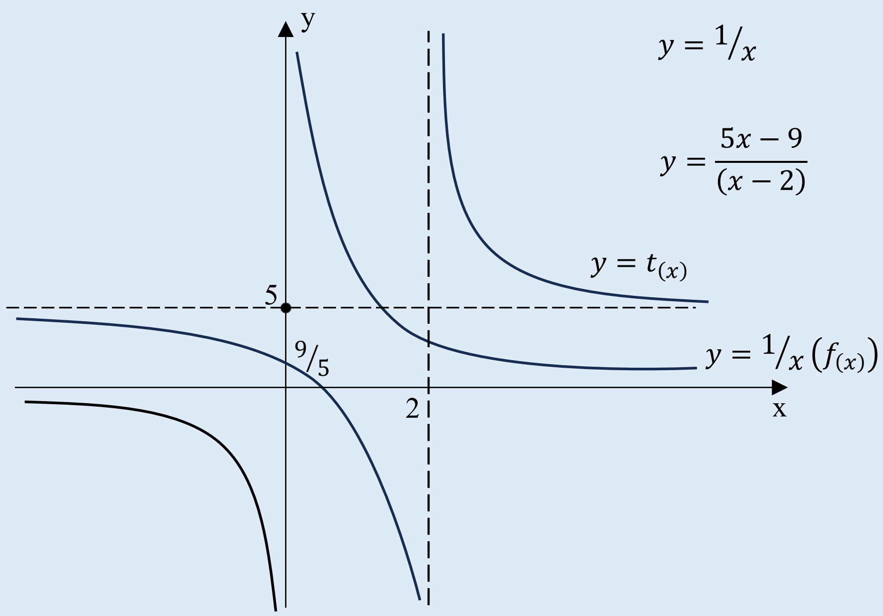
$C = 5$ $\qquad\qquad \frac{5x-9}{x-2} = \frac{1}{x-2} + 5$

$-9 = a + cb$

$-9 = a + 5(-2)$

$a = 1$

b)



c) $\frac{5x-9}{x-2} = 6x + 5 \leftarrow y = 6x + 5$

$5x - 9 = (6x + 5)(x - 2)$

$5x - 9 = 6x^2 - 12x + 5x - 10$

$6x^2 - 12x - 1 = 0$

$x = \frac{12 \pm \sqrt{144+24}}{12}$

$x = 2.08$ or -0.08

15.

a) $2^y = \frac{x^2-2x+7}{x+4}$

$$2^y ln2 \frac{dy}{dx} = d\frac{\frac{x^2 - 2x + 7}{x + 4}}{dx}$$

$\frac{dy}{dx} \times ln2 = \frac{x+4}{(x^2-2x+7)} \times \frac{[(x+4)(2x-2)-(x^2-2x+7)(1)]}{(x+4)^2}$

$= \frac{x+4}{(x^2-2x+7)} \times \frac{[2x^2+6x-8-x^2+2x-7]}{(x+4)^2}$

$\frac{dy}{dx} = \frac{(x^2+8x-15)}{(x^2-2x+7)(x+4)\times ln2}$ $\left(\frac{f_{(x)}}{g_{(x)}}\right)$

b) For turning point $\frac{dy}{dx} = 0$

$x^2 + 8x - 15 = 0$

$x = \frac{-8 \pm \sqrt{64+60}}{2} = \frac{-8 \pm \sqrt{124}}{2}$

$x = \frac{-8 \pm \sqrt{31}}{2}$

$x = -4 + \sqrt{31}$ or $x = -4 - \sqrt{31}$

$y = \frac{1}{ln2} \times ln\left(\frac{(-4+\sqrt{31})^2 - 2(-4+\sqrt{31})^2 + 7}{(-4+\sqrt{31})+4}\right)$ or $y = \frac{1}{ln2} \times ln\left(\frac{(-4-\sqrt{31})^2 - 2(-4-\sqrt{31})^2 + 7}{(-4-\sqrt{31})+4}\right)$