Diploma Programme
Programme du diplôme
Programa del Diploma

# Mathematics: analyses and approaches
# Higher level
# Mock paper 1

Monday May 11th 2026 (morning)

Candidate session number

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2 hours

**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- No calculator is allowed for this paper.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **Mathematics: analyses and aproaches formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[87 marks]**



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# Section A

Write the answers in the spaces provided.

1. It is given that $\log_{10} a = \frac{1}{3}$ , where a > 0.

a) calculate $\log_{10} \frac{1}{a}$ [2]

b) Calculate $\log_{1000} a$ [3]

2. Consider integers a and b such that $a^2 + b^2$ is exactly divisible by 4 .
Prove by contradiction that a and b cannot both be odd. [5]

3. Consider the expansion of $\left(8x^3-\frac{1}{2x}\right)^n$ where n $\in \mathbb{Z}$

a) What is the fourth term of the expansion when n=4? [1]

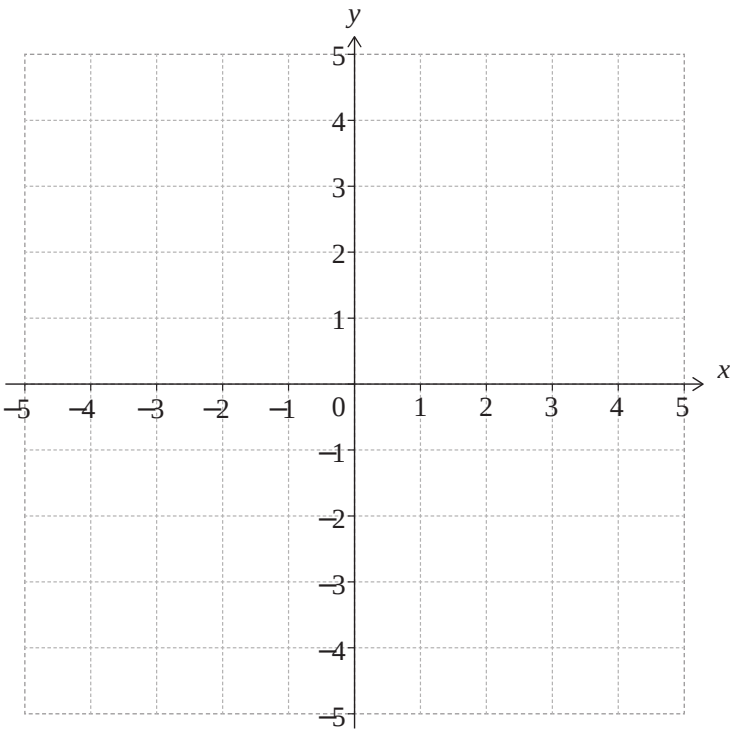
b) Find all possible values of n for which the expansion has a constant term that is not zero. [5]

4. A function is defined as $f(x)=1-\frac{1}{x-2}$ where $x \in \mathbb{R}$

a) Write down the equations of the horizontal and vertical asymptotes this function has [2]

b) Find the x and y intercepts [2]

c) Sketch it in such a way that what has been found in a and b is shown. [1]



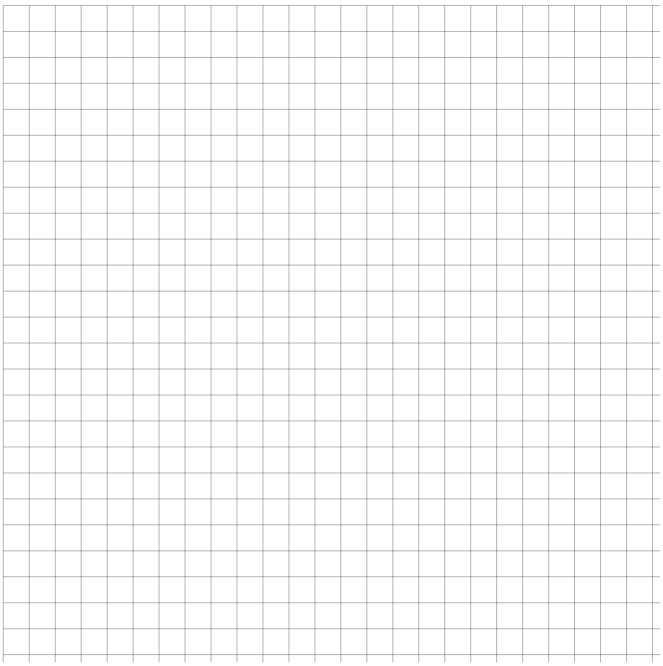

5. Given the functions

$f(x)=4\,sinx+2.5$

$g(x)=4\sin\left(x-\frac{3\pi}{2}\right)+2.5+q$

a) Sketch both functions. [2]

b) Describe the transformations done to f in order to obtain g and what effect they had. [2]



c) g(x) passes through (0,r). Knowing that $g(x)\geq 7$ , find the smallest possible value of r [5]

6. Two events A and B are such that p(A)=0.4, p(A|B)=0.25 and p(A ∪ B)=0.55 .
Calculate p(B). [5]

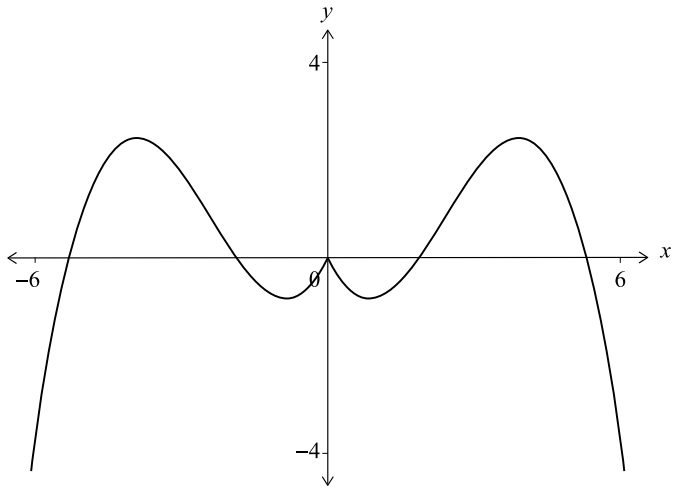
7. Claire rolls a six-sided die 16 times. These are the results.

| Score | Frequency |
|---|---|
| 1 | p |
| 2 | q |
| 3 | 4 |
| 4 | 2 |
| 5 | 0 |
| 6 | 3 |

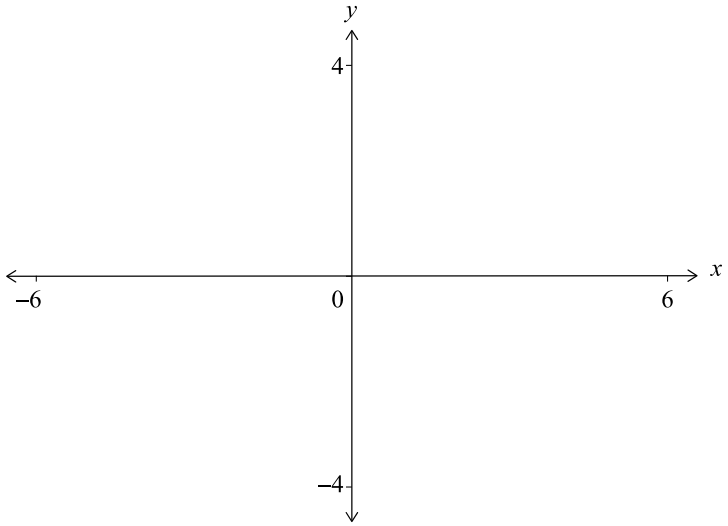
Given that the mean score is 3:
a) Find the value of p and q [5]

b) Each of Claire's scores is multiplied by 10 in order to ~~determine~~ calculate the final score for a game she's playing. Write down the mean final score [1]

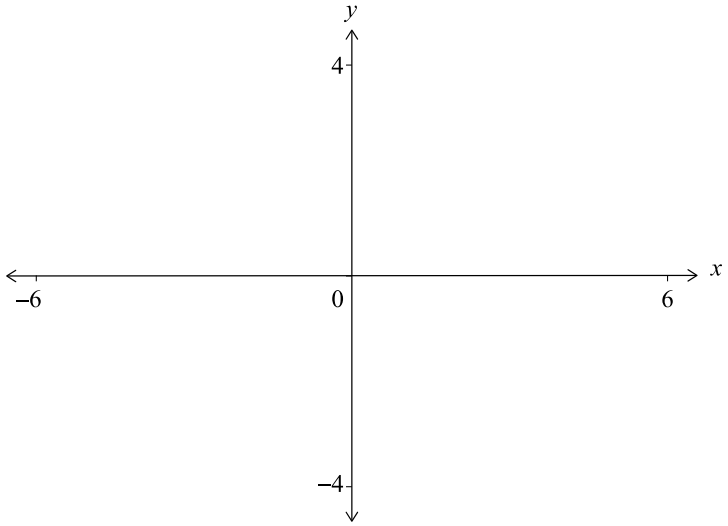
8. The graph of $y=f(|x|)$ for $-6\le x\le 6$ is shown in this diagram.




a) On the following axes, sketch the graph of $y=|f(|x|)|$ for $-6\le x\le 6$ [2]




b) It is given that f is an odd function.
On the following axes, sketch the graph of $y=f(x)$ for $-6\le x\le 6$ [2]



# Section B

Write the answers in the separate answer paper provided.

9. Consider the function $g(x)=x^2+bx+c$
The graph of g has an axis of symmetry at x=2, and its roots are -1/2 and p, where p $\in \mathbb{Q}$

a) show that p=9/2 [1]

b) Find the values of b and c [3]

c) Find the coordinates of the apex of g(x) [2]

10. Consider the series $\ln x+p\ln x+\frac{1}{3}lnx\ldots$ where x $\in \mathbb{R}$ , x > 1 and p $\in \mathbb{R}$ , p ≠ 0
We don't know the value of p, so it could be geometric or arithmetic.

a) Consider that the series is geometric
i) Show that $p=\pm\frac{1}{\sqrt{3}}$ [1]
ii) Hence or otherwise show that the series is convergent [2]

iii) Given that p>0 and $S_\infty=3+\sqrt{3}$ find the value of x. [3]

b) Consider now that the series is arithmetic and therefore has a common difference d.
i) Show that $p=\frac{2}{3}$ [4]
ii) Write down d in the form $k\cdot lnx$ , where k $\in \mathbb{Q}$ [1]

iii) The sum of the first n terms of the series is $\ln\left(\frac{1}{x^3}\right)$ . Find the value of n. [5]

11. Prove, using induction, that

$\sum_{k=1}^{n} k^3=\frac{n^2(n+1)^2}{4}$ for all natural n larger than 0. [3]

12. Consider the complex number $\phi=(a+bi)^3$ where a, b $\in \mathbb{R}$

a) Calculate, in terms of a and b, the real and imaginary parts of $\phi$ [3]

b) Hence or otherwise, show that $(1+\sqrt{3}i)^3=-8$ [2]

The roots of the equation $z^3=-8$ are u, v and w, where u is $1+\sqrt{3}i$ and v $\in \mathbb{R}$

c) Find v and w, giving your answers in cartesian form. [2]

The numbers u, w and w are represented in the complex plane by the points U, V and W.

When these points are rotated counter-clockwise $\frac{\pi}{4}$ radians, they form three new points U', V' and W', which represent three complex numbers u', v' and w' respectively.

d) Find u', v' and w' and give your answers in the form of $re^{i\theta}$ where $-\pi \leq \theta \leq \pi$ [4]

e) Given that u', v' and w' are the solutions to the equation
$z^3 = c + di$ where c,d $\in \mathbb{R}$
Find c and d. [3]

f) It is given that u, v, w, u', v' and w' are all solutions to the equation
$z^n = \alpha$ where n $\in \mathbb{N}$ and $\alpha \in \mathbb{C}$ . Find the smallest possible value of n. [3]

Bonus: if the equation in f) had any solutions other than the ones mentioned, find them. Else show that it doesn't have any more [4bonus]