



National
Qualifications
2026

X847/76/11

**Mathematics
Paper 1 (Non-calculator)**

THURSDAY, 7 MAY
9:00 AM – 10:15 AM



Total marks — 55

Attempt ALL questions.

You must NOT use a calculator.

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

You will not earn marks for answers obtained by readings from scale drawings.

Write your answers clearly in the spaces provided in the answer booklet. The size of the space provided for an answer is not an indication of how much to write. You do not need to use all the space.

Additional space for answers is provided at the end of the answer booklet. If you use this space you must clearly identify the question number you are attempting.

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FORMULAE LIST

Circle

The equation $x^2 + y^2 + 2gx + 2fy + c = 0$ represents a circle centre $(-g, -f)$ and radius $\sqrt{g^2 + f^2 - c}$.

The equation $(x - a)^2 + (y - b)^2 = r^2$ represents a circle centre (a, b) and radius r .

Scalar product

$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos \theta$, where θ is the angle between $\mathbf{a}$ and $\mathbf{b}$

or $\mathbf{a} \cdot \mathbf{b} = a_1b_1 + a_2b_2 + a_3b_3$ where $\mathbf{a} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$.

Trigonometric formulae

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A$$

$$= 2 \cos^2 A - 1$$

$$= 1 - 2 \sin^2 A$$

Table of standard derivatives

$f(x)$	$f'(x)$
$\sin ax$	$a \cos ax$
$\cos ax$	$-a \sin ax$

Table of standard integrals

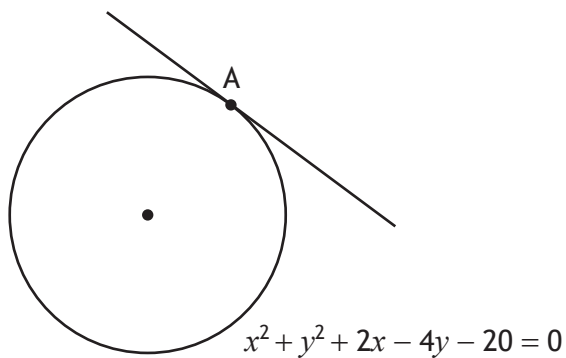
$f(x)$	$\int f(x)dx$
$\sin ax$	$-\frac{1}{a} \cos ax + c$
$\cos ax$	$\frac{1}{a} \sin ax + c$

Total marks — 55
Attempt ALL questions

1. Express $2x^2 + 20x + 3$ in the form $p(x+q)^2 + r$. 3

2. Find $\int \left(15x^{\frac{2}{3}} + \frac{7}{x^2} \right) dx, x > 0$. 4

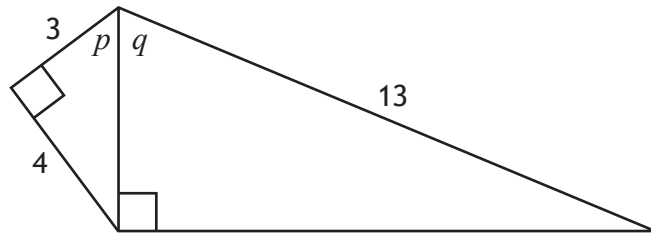
3. A circle has equation $x^2 + y^2 + 2x - 4y - 20 = 0$.
Point A(2,6) lies on the circle.



- Find the equation of the tangent to the circle at A. 4

[Turn over

4. The diagram shows two right-angled triangles with angles p and q as marked.



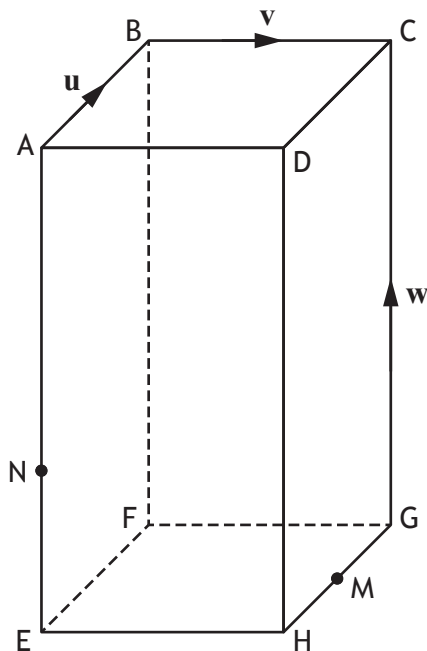
- (a) Determine the exact value of $\sin q$. 1
- (b) Find the exact value of:
- (i) $\sin(p + q)$ 4
- (ii) $\cos(p + q)$. 2
- (c) Hence find the exact value of $\tan(p + q)$. 1
-
5. Functions f and g are defined on $\mathbb{R}$, the set of real numbers, by $f(x) = 2x^2 + 5$ and $g(x) = x + 3$.
- (a) Find an expression for:
- (i) $f(g(x))$ and 2
- (ii) $g(f(x))$. 1
- (b) State the range of $g(f(x))$. 1

6. ABCD,EFGH is a cuboid.

$$\overrightarrow{AB} = \mathbf{u}, \overrightarrow{BC} = \mathbf{v} \text{ and } \overrightarrow{GC} = \mathbf{w}.$$

The point M is the mid-point of HG.

The point N divides EA with the ratio 1:2.



Express the vector $\overrightarrow{MN}$ in terms of $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{w}$.

2

7. Determine the gradient of the tangent to the curve with equation $y = 2x + 4\sqrt{x}$, $x > 0$, at the point where $x = 9$.

4

8. Solve $\log_2 x + \log_2 (x + 2) = 3$, where $x > 0$.

4

[Turn over

9. (a) Show that the points D(−1,6,1), E(1,2,7) and F(2,0,10) are collinear.

3

Point G is such that F divides DG in the ratio 3:4.

- (b) Find the coordinates of G.

2

10. Find $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} 6 \sin\left(3x - \frac{\pi}{2}\right) dx$.

4

11. (a) (i) Show that $(x + 2)$ is a factor of $x^3 + 7x^2 + 18x + 16$.

2

- (ii) Explain why $(x + 2)$ is the only linear factor of $x^3 + 7x^2 + 18x + 16$.

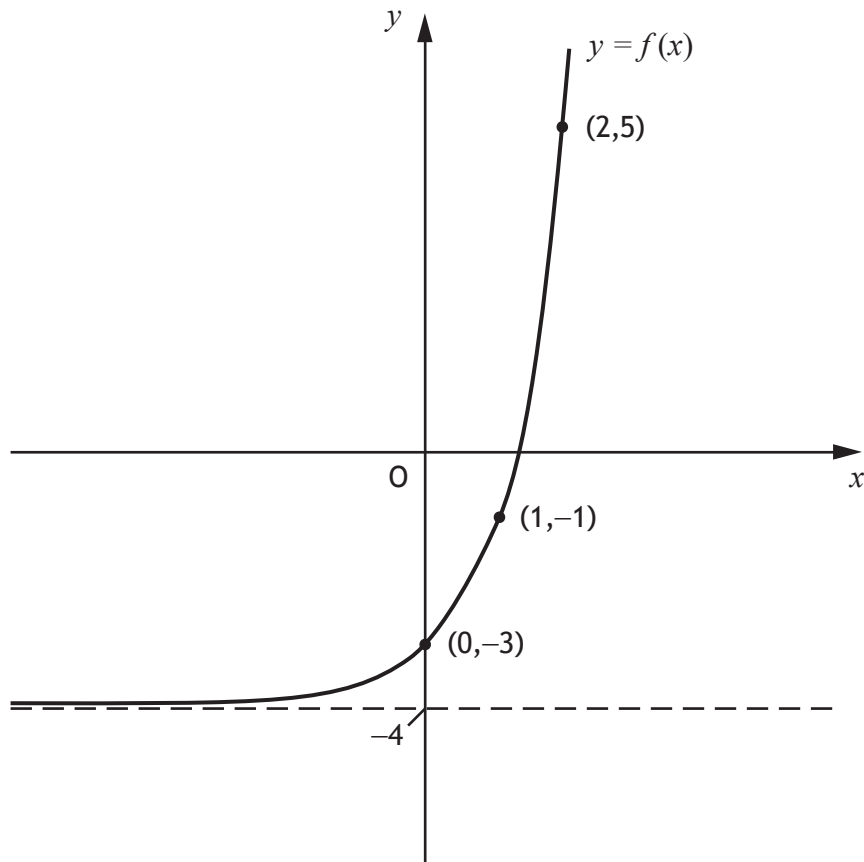
Give a reason for your answer.

2

- (b) Find the coordinates of the point(s) where the curves with equations $y = 2x^3 + 20x^2 + 27x + 9$ and $y = 6x^2 - 9x - 23$ intersect.

4

12. An exponential function, f , is defined for $x \in \mathbb{R}$.
The diagram shows the graph of $y = f(x)$.



The inverse function, $f^{-1}(x)$, exists.

- (a) On the diagram in your answer booklet, sketch the graph of the inverse function. 2

The inverse function is of the form $f^{-1}(x) = \log_a(x + b)$.

- (b) (i) Determine the values of a and b . 2
(ii) State the domain of the inverse function, $f^{-1}(x)$. 1

[END OF QUESTION PAPER]

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**Mathematics
Paper 2**

THURSDAY, 7 MAY
10:30 AM – 1:00 PM

Total marks — 80

Attempt ALL questions.

You may use a calculator.

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

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FORMULAE LIST

Standard derivatives	
$f(x)$	$f'(x)$
$\sin^{-1} x$	$\frac{1}{\sqrt{1-x^2}}$
$\cos^{-1} x$	$-\frac{1}{\sqrt{1-x^2}}$
$\tan^{-1} x$	$\frac{1}{1+x^2}$
$\tan x$	$\sec^2 x$
$\cot x$	$-\operatorname{cosec}^2 x$
$\sec x$	$\sec x \tan x$
$\operatorname{cosec} x$	$-\operatorname{cosec} x \cot x$
$\ln x$	$\frac{1}{x}$
e^x	e^x

Standard integrals	
$f(x)$	$\int f(x) dx$
$\sec^2(ax)$	$\frac{1}{a} \tan(ax) + c$
$\frac{1}{\sqrt{a^2-x^2}}$	$\sin^{-1}\left(\frac{x}{a}\right) + c$
$\frac{1}{a^2+x^2}$	$\frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + c$
$\frac{1}{x}$	$\ln x + c$
e^{ax}	$\frac{1}{a} e^{ax} + c$

Summations

(Arithmetic series) $S_n = \frac{1}{2}n[2a + (n-1)d]$

(Geometric series) $S_n = \frac{a(1-r^n)}{1-r}, r \neq 1$

$$\sum_{r=1}^n r = \frac{n(n+1)}{2}, \quad \sum_{r=1}^n r^2 = \frac{n(n+1)(2n+1)}{6}, \quad \sum_{r=1}^n r^3 = \frac{n^2(n+1)^2}{4}$$

Binomial theorem

$$(a+b)^n = \sum_{r=0}^n \binom{n}{r} a^{n-r} b^r \text{ where } \binom{n}{r} = {}^nC_r = \frac{n!}{r!(n-r)!}$$

Maclaurin expansion

$$f(x) = f(0) + f'(0)x + \frac{f''(0)x^2}{2!} + \frac{f'''(0)x^3}{3!} + \frac{f^{iv}(0)x^4}{4!} + \dots$$

FORMULAE LIST (continued)

De Moivre's theorem

$$[r(\cos \theta + i \sin \theta)]^n = r^n (\cos n\theta + i \sin n\theta)$$

Vector product

$$\begin{aligned} \mathbf{a} \times \mathbf{b} &= |\mathbf{a}| |\mathbf{b}| \sin \theta \hat{\mathbf{n}} \\ &= \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \mathbf{i} \begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} - \mathbf{j} \begin{vmatrix} a_1 & a_3 \\ b_1 & b_3 \end{vmatrix} + \mathbf{k} \begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix} \end{aligned}$$

Matrix transformation

Anti-clockwise rotation through an angle, θ , about the origin, $\begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix}$

[Turn over

Total marks — 80
Attempt ALL questions

1. Differentiate $f(x) = 3\sin^{-1} 7x$. 2

2. Write down the binomial expansion of $\left(x^2 - \frac{5}{x}\right)^4$ and simplify your answer. 4

3. (a) Find and simplify the Maclaurin expansion, up to and including the term in x^3 , for:

(i) e^{3x} 2

(ii) $\ln(1+x)$. 2

(b) Hence find and simplify the Maclaurin expansion, up to and including the term in x^3 , for

$$e^{3x} \ln\left(\frac{1}{1+x}\right). \quad \text{2}$$

4. (a) Use the Euclidean algorithm to find d , the greatest common divisor of 1428 and 567. 1

(b) Find integers a and b such that $1428a + 567b = d$. 2

5. Given $y = x^{4x}$, use logarithmic differentiation to find $\frac{dy}{dx}$.
Write your answer in terms of x . 5

6. (a) An arithmetic sequence has terms $u_3 = 6$ and $u_{11} = 10$.

For this sequence, find the:

- | | |
|-----------------------------------|---|
| (i) common difference | 1 |
| (ii) first term | 1 |
| (iii) sum of the first 109 terms. | 1 |

- (b) The terms $v_3 = 18$ and $v_4 = 27$ form part of a geometric sequence.

For this sequence, find:

- | | |
|--|---|
| (i) the common ratio | 1 |
| (ii) the first term | 1 |
| (iii) an expression, in terms of n , for the sum of the first n terms. | 1 |

- (c) Find **algebraically** the least value of n such that the sum of the geometric series exceeds the sum of the first 109 terms in the arithmetic sequence.

1

7. A curve is defined parametrically by

$$x = 3 \ln(2t + 1), \quad y = t - \frac{1}{2}t^2, \quad \text{where } t > 0.$$

- | | |
|--|---|
| (a) Find an expression for $\frac{dy}{dx}$. Simplify your answer. | 2 |
| (b) Find the coordinates of the stationary point on the curve. | 2 |

8. The volume, V cubic metres, of water held in a reservoir is given by

$$V = 18(2 + \sqrt{h})^6 - 1152$$

where h metres is the depth of water.

Water is pumped out of the reservoir at a constant rate of $0.6 \text{ m}^3 \text{ s}^{-1}$.

Find the rate of change of the depth of water in the reservoir when the depth is 9 metres.

4

[Turn over

9. Express 3442_5 in base 9.

10. A curve is defined by the equation $x^2e^{6y} + x^2 + y^5 = 50$.

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

4

(b) Given $x > 0$, explain why the derivative is never zero.

1

11. Find $\int \frac{2x+4}{x^2+4} dx$.

4

12. Prove by induction that $7^n + 2$ is divisible by 3 for all $n \in \mathbb{N}$.

5

13. (a) Express using partial fractions $\frac{x+3}{(x+7)(x+5)}$.

2

(b) Hence find the particular solution of the differential equation

$$\frac{dy}{dx} + \frac{2}{x+3}y = \frac{1}{(x+7)(x+5)(x+3)}, \text{ where } x \geq 0,$$

given that $y = 0$ when $x = 3$.

7

14. The plane π contains the points P(2, 3, -4), Q(3, 5, 1) and R(6, 0, -6).

(a) Determine the Cartesian equation of π .

4

The line L has symmetric equations $\frac{x-8}{2} = \frac{y+2}{-1} = \frac{z+2}{3}$.

L intersects π at the point S.

(b) Find the coordinates of S.

3

(c) Calculate the size of the acute angle between L and π .

3

15. Let r be a positive real number and consider the following statement:

If r is irrational then $\sqrt{r}$ is irrational.

- | | |
|---|---|
| (a) Write down the contrapositive of the statement. | 1 |
| (b) Hence prove that the statement is true. | 3 |

- | | |
|--|---|
| 16. (a) Given $y = \ln(\cos x)$, $0 \leq x < \frac{\pi}{2}$, show that $\frac{dy}{dx} = -\tan x$. | 2 |
|--|---|

For a function $g(x)$, it is known that

$$\int xg(x)dx = 2x \tan 2x - \int 2 \tan 2x dx.$$

- | | |
|---|---|
| (b) (i) Determine the exact value of $\int_0^{\frac{\pi}{6}} xg(x)dx$. | 2 |
| (ii) Find an expression for $g(x)$ in terms of x . | 1 |

[END OF QUESTION PAPER]

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