National Qualifications 2025

X847/76/11

Mathematics Paper 1 (Non-calculator)

MONDAY, 12 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.

Use **blue** or **black** ink.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

X8477611

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

$$\sin(\mathrm{A} \pm \mathrm{B}) = \sin\mathrm{A}\cos\mathrm{B} \pm \cos\mathrm{A}\sin\mathrm{B}$$
$$\cos(\mathrm{A} \pm \mathrm{B}) = \cos\mathrm{A}\cos\mathrm{B} \mp \sin\mathrm{A}\sin\mathrm{B}$$
$$\sin 2\mathrm{A} = 2\sin\mathrm{A}\cos\mathrm{A}$$
$$\begin{aligned}\cos 2\mathrm{A} &= \cos^2\mathrm{A} - \sin^2\mathrm{A} \\ &= 2\cos^2\mathrm{A} - 1 \\ &= 1 - 2\sin^2\mathrm{A}\end{aligned}$$

Table of standard derivatives

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

Table of standard integrals

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

MARKS

Total marks — 55 marks

Attempt ALL questions

1. A curve has equation $y = x^3 - 2x^2 + 5$.

Find the equation of the tangent to this curve at the point where $x = 2$. **4**

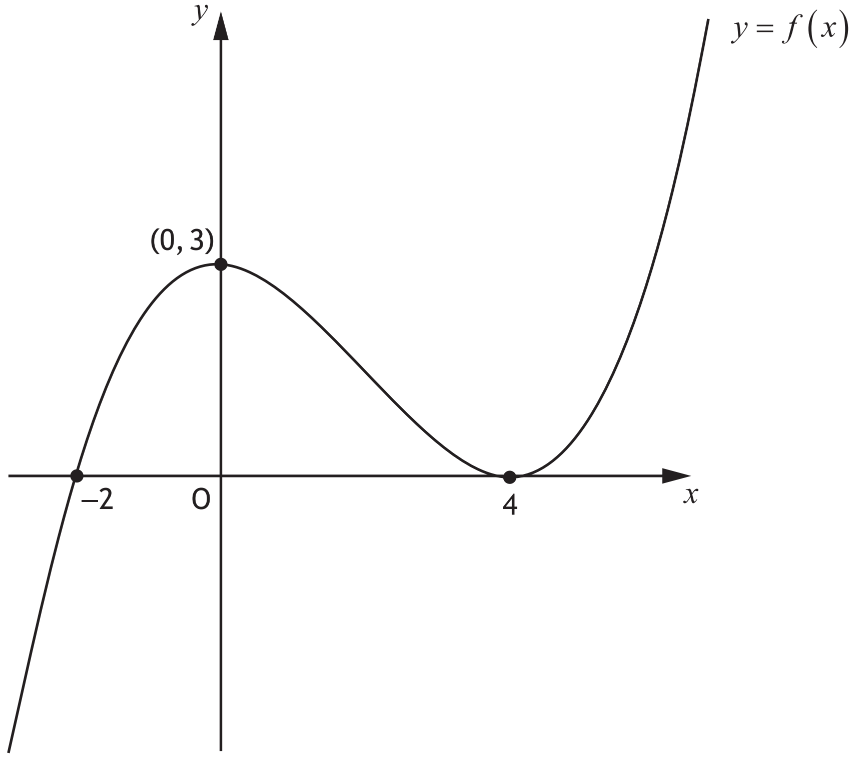
2. Find the equation of the perpendicular bisector of the line joining A$(1, 4)$ and B$(9, 10)$. **4**

3. Find $\int \left(\frac{12}{x^2} + x^{\frac{1}{2}} \right) dx,\ x > 0$. **4**

4. Evaluate $3\log_3 2 + \log_3 \frac{1}{24}$. **3**

[Turn over

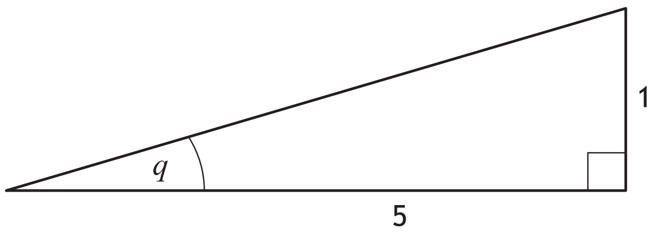
5. The diagram shows the graph of $y = f(x)$, with stationary points at (0, 3) and (4, 0).



On the diagram in your answer booklet, sketch the graph of $y = f(-x) + 3$. **2**

MARKS

6. The diagram shows a right-angled triangle with angle q.

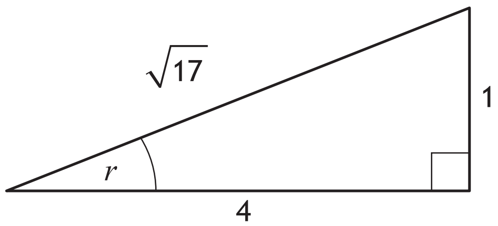


(a) Determine the value of:

(i) $\sin 2q$ **3**

(ii) $\cos 2q$. **1**

A second right-angled triangle has angle r as shown.



(b) Find the value of $\sin(2q - r)$. **3**

7. (a) Show that $(x+3)$ is a factor of $5x^3 + 16x^2 - x - 12$. **2**

(b) Hence, or otherwise, solve $5x^3 + 16x^2 - x - 12 = 0$. **3**

8. Given that $\log_a 75 = 2 + \log_a 3$, $a > 0$, find the value of a. **3**

[Turn over

MARKS

9. Find the coordinates of the points of intersection of the line with equation $y = x + 1$ and the circle with equation $x^2 + y^2 - 2x + 6y - 15 = 0$. **4**

10. The vectors $\mathbf{u}$ and $\mathbf{v}$ are such that:

- $\mathbf{u} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$
- $\mathbf{v} = \begin{pmatrix} 1 \\ 3 \\ k \end{pmatrix}$
- the angle between $\mathbf{u}$ and $\mathbf{v}$ is 45°.

Find the value of k, where $k > 0$. **5**

11. The equation $9x^2 + 3kx + k = 0$ has two real and distinct roots.

Determine the range of values for k.

Justify your answer. **4**

12. Given that:

- $\dfrac{dy}{dx} = 6\cos x + 8\sin 2x$, and
- $y = 4$ when $x = \dfrac{\pi}{6}$,

express y in terms of x. **4**

MARKS

13. A function, f, is defined on the set of real numbers.

The derivative of f is $f'(x) = (x+5)(2-x)$.

(a) Find the x-coordinates of the stationary points on the curve with equation $y = f(x)$ and determine their nature. **3**

It is known that:

- f is a cubic function
- $f(0) < 0$
- the equation $f(x) = 0$ has exactly one solution. The solution lies between –10 and 10.

(b) Draw a sketch of a possible graph of $y = f(x)$ on the diagram in your answer booklet. **3**

[END OF QUESTION PAPER]

[BLANK PAGE]

DO NOT WRITE ON THIS PAGE

H

National
Qualifications
2025

X847/76/12

Mathematics
Paper 2

MONDAY, 12 MAY

10:45 AM – 12:15 PM

Total marks — 65

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.

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.

Use **blue** or **black** ink.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

X8477612

A/HTP

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

$$\sin(\mathrm{A} \pm \mathrm{B}) = \sin \mathrm{A} \cos \mathrm{B} \pm \cos \mathrm{A} \sin \mathrm{B}$$

$$\cos(\mathrm{A} \pm \mathrm{B}) = \cos \mathrm{A} \cos \mathrm{B} \mp \sin \mathrm{A} \sin \mathrm{B}$$

$$\sin 2\mathrm{A} = 2 \sin \mathrm{A} \cos \mathrm{A}$$

$$\begin{aligned} \cos 2\mathrm{A} &= \cos^2 \mathrm{A} - \sin^2 \mathrm{A} \\ &= 2\cos^2 \mathrm{A} - 1 \\ &= 1 - 2\sin^2 \mathrm{A} \end{aligned}$$

Table of standard derivatives

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

Table of standard integrals

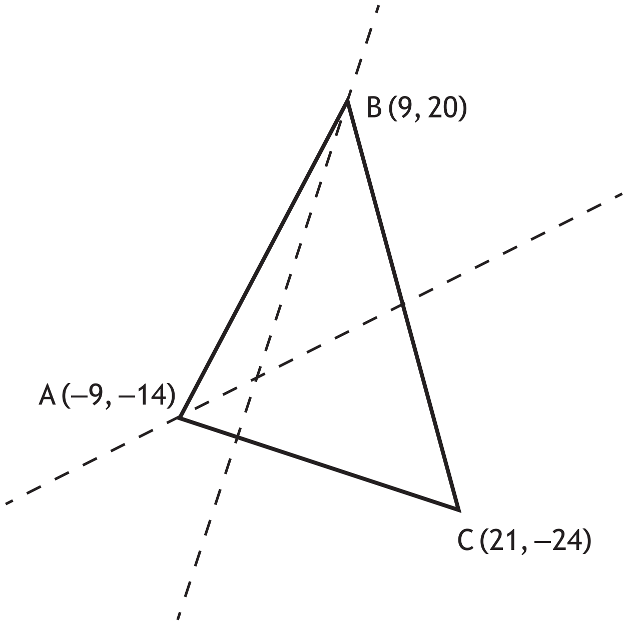
$f(x)$	$\int f(x)dx$
$\sin ax$	$-\frac{1}{a}\cos ax + c$
$\cos ax$	$\frac{1}{a}\sin ax + c$

MARKS

Total marks — 65

Attempt ALL questions

1. Triangle ABC has vertices A (–9, –14), B (9, 20) and C (21, –24).



(a) Find the equation of the altitude through B. **3**

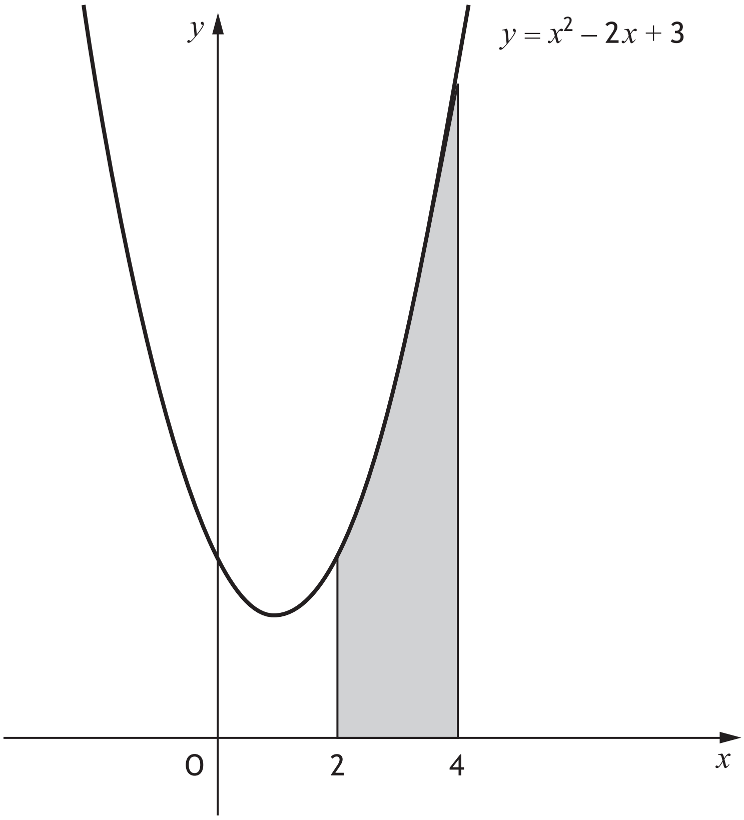
(b) Find the equation of the median through A. **3**

(c) Determine the point of intersection of the altitude through B and the median through A. **2**

2. Express $2x^2 + 16x + 5$ in the form $p(x+q)^2 + r$. **3**

[Turn over

3. The diagram shows the graph of $y = x^2 - 2x + 3$.



Calculate the shaded area. **4**

4. A function, g, is defined by $g(x) = (x-4)^3$, where $x \in \mathbb{R}$.
Find the inverse function, $g^{-1}(x)$. **3**

5. (a) Show that the points A$(-3, 2, -1)$, B$(6, -1, 5)$ and C$(12, -3, 9)$ are collinear. **3**

(b) State the ratio in which B divides AC. **1**

6. (a) Express $5\cos x - 9\sin x$ in the form $k\cos(x+a)$ where $k > 0$ and $0 < a < 2\pi$. **4**

(b) Hence solve $5\cos x - 9\sin x = 7$ for $0 \le x < 2\pi$. **3**

MARKS

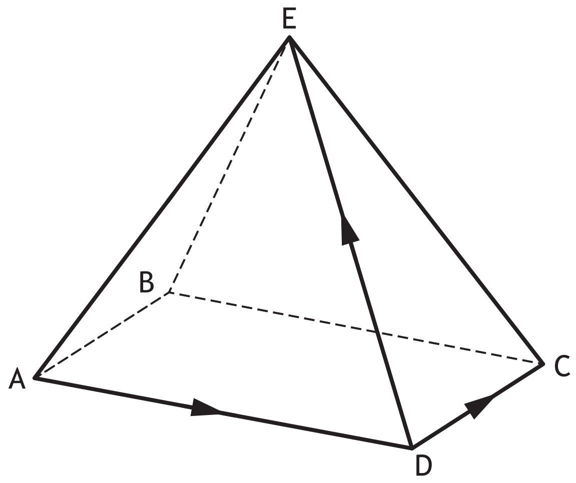
7. Find $\int (3x+2)^7\,dx$. **2**

8. E,ABCD is a rectangular-based pyramid as shown.

$\overrightarrow{AD} = 6\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$

$\overrightarrow{DC} = 2\mathbf{i} - 4\mathbf{j} + 2\mathbf{k}$

$\overrightarrow{DE} = -4\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$



Express $\overrightarrow{BE}$ in terms of $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$. **2**

9. A sequence satisfies the recurrence relation $u_{n+1} = mu_n + 4$, where m is a constant.

(a) The sequence approaches a limit of 10 as $n \to \infty$.

Determine the value of m. **2**

(b) Given that $u_1 = 19$, calculate the value of u_0. **1**

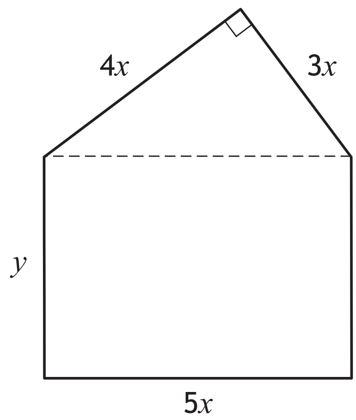
[Turn over

10. A hotel owner is designing signs showing the room numbers.

Each sign is a rectangle with a right-angled triangle above it.

The length and breadth of the rectangle are $5x$ centimetres and y centimetres respectively.

The shorter sides of the triangle are $3x$ centimetres and $4x$ centimetres.



The area of the sign is 150 square centimetres.

(a) Show that the perimeter, P cm, of the sign is given by

$$P = 9.6x + \frac{60}{x}.$$ **3**

Each sign will be lit using a lighting strip placed around its perimeter.

The hotel owner requires the perimeter, P, of the sign to be as small as possible.

(b) Find the minimum value of P. **6**

MARKS

11. Solve $3\sin 2x° + 4\cos x° = 0$ for $0 \le x < 360$. **4**

12. Functions f and g are defined on the set of real numbers by:

- $f(x) = x^5 + 3$
- $g(x) = 1 - x^3$.

(a) Find an expression for $h(x)$, where $h(x) = f(g(x))$. **2**

(b) Find $h'(x)$. **2**

13. A radioactive substance, which has been collected, decays over time.

The mass of the radioactive substance remaining is modelled by

$$M = 150e^{-0.0054t}$$

where M is the mass, in micrograms, t years after the radioactive substance was collected.

(a) Determine the initial mass of the radioactive substance. **1**

(b) Calculate the time taken for the mass of the radioactive substance to decay to 120 micrograms. **4**

[Turn over

MARKS

14. Circle C_1 has equation $(x+5)^2+(y-6)^2=9$.

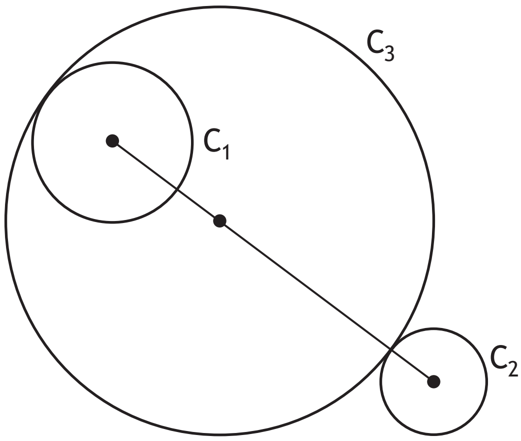
(a) State the centre and radius of C_1. **2**

Circle C_2 has equation $x^2+y^2-14x+6y+54=0$.

(b) State the centre and radius of C_2. **2**

Circles C_1, C_2 and C_3 are touching as shown in the diagram.

The centre of circle C_3 lies on the line joining the centres of C_1 and C_2.



(c) Determine the equation of C_3. **3**

[END OF QUESTION PAPER]