H

National
Qualifications
2022

X847/76/11

Mathematics
Paper 1 (Non-calculator)

FRIDAY, 6 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.

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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

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

or $\mathbf{a.b} = a_1b_1 + a_2b_2 + a_3b_3$ 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

Attempt ALL questions

1. Determine the equation of the line perpendicular to $5x + 2y = 7$, passing through $(-1, 6)$. **3**

2. Evaluate $2\log_3 6 - \log_3 4$. **3**

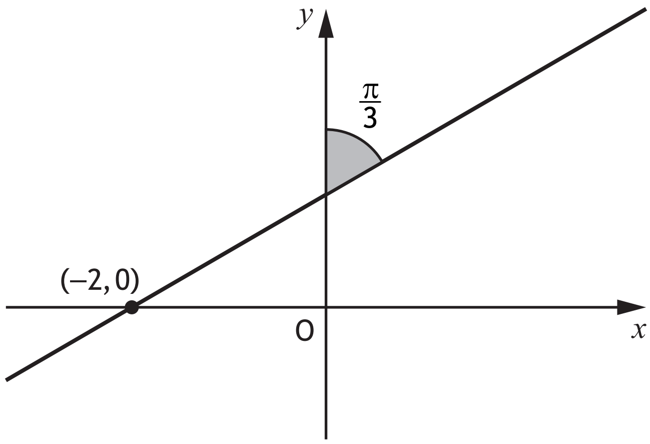
3. A function, h, is defined by $h(x) = 4 + \frac{1}{3}x$, where $x \in \mathbb{R}$.
Find the inverse function, $h^{-1}(x)$. **3**

4. Differentiate $y = \sqrt{x^3} - 2x^{-1}$, where $x > 0$. **3**

[Turn over

MARKS

5. A line makes an angle of $\frac{\pi}{3}$ radians with the y-axis, and passes through the point $(-2, 0)$ as shown below.



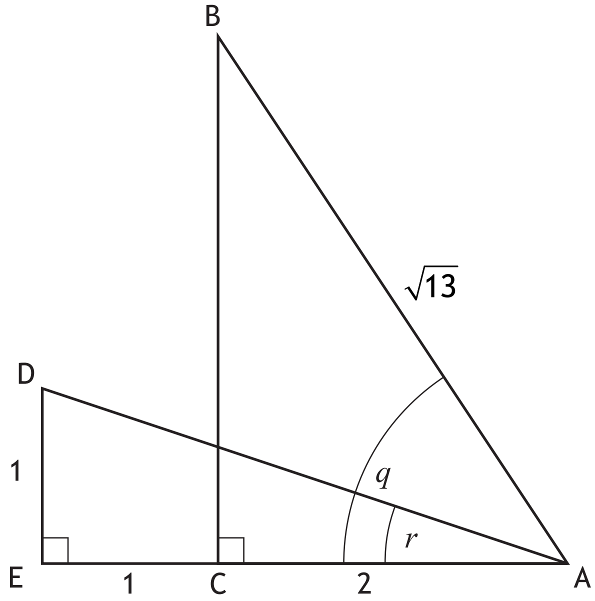
Determine the equation of the line. **3**

6. Evaluate $\int_{-5}^{2} (10 - 3x)^{-\frac{1}{2}}\, dx$. **4**

MARKS

7. Triangles ABC and ADE are both right angled.

Angle BAC $= q$ and angle DAE $= r$ as shown in the diagram.



(a) Determine the value of:

(i) $\sin r$ **1**

(ii) $\sin q$. **1**

(b) Hence determine the value of $\sin(q-r)$. **3**

8. Solve $\log_6 x + \log_6 (x+5) = 2$, where $x > 0$. **4**

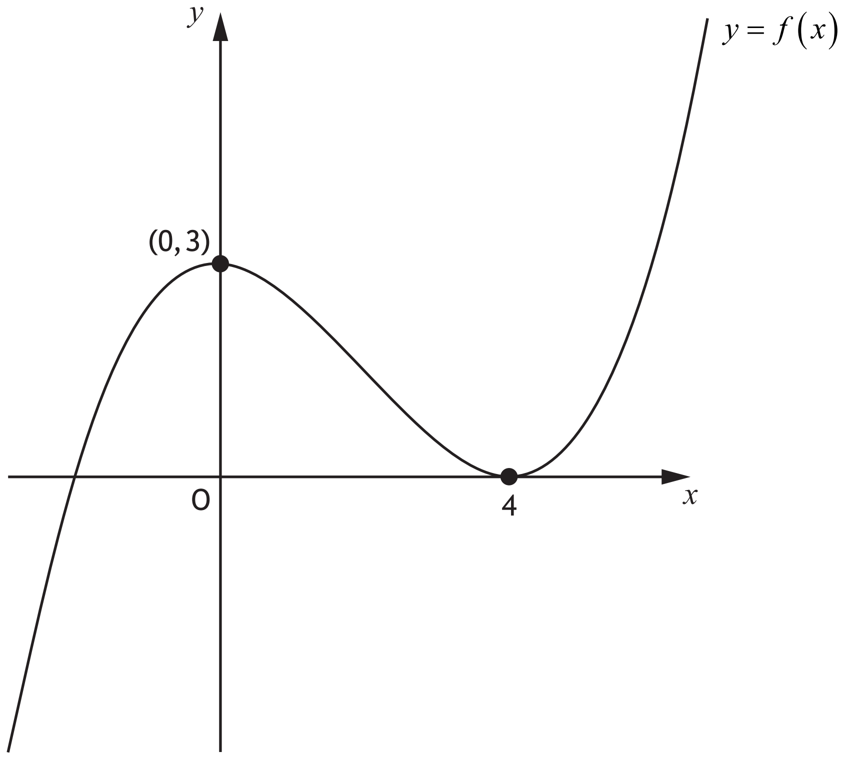
9. Solve the equation $\cos 2x° = 5\cos x° - 3$ for $0 \leq x < 360$. **5**

[Turn over

MARKS

10. The diagram shows the graph of a cubic function with equation $y = f(x)$.

The curve has stationary points at $(0, 3)$ and $(4, 0)$.



(a) Sketch the graph of $y = 2f(x) + 1$. **3**

Use the diagram provided in the answer booklet.

(b) State the coordinates of the stationary points on the graph of $y = f\left(\frac{1}{2}x\right)$. **1**

MARKS

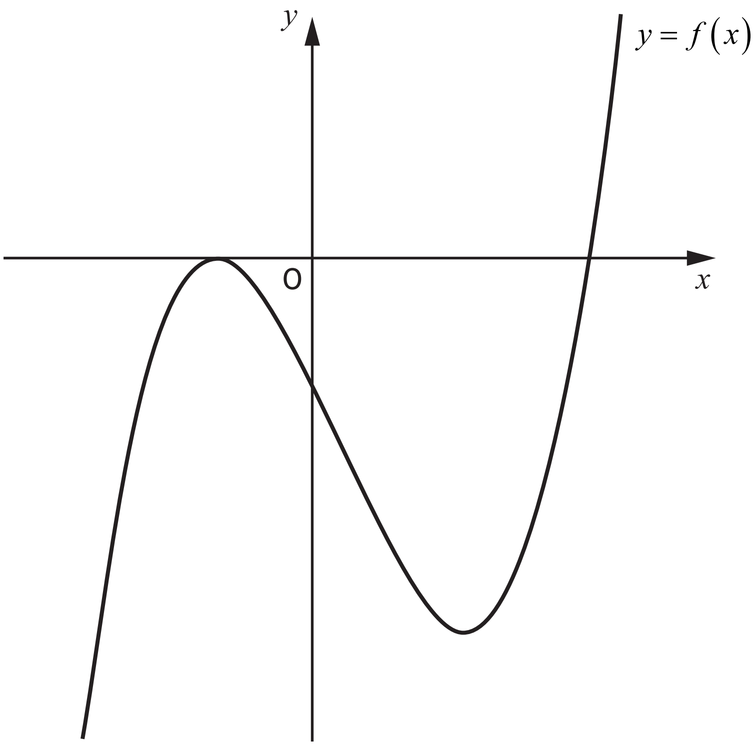
11. Express $2x^2+12x+23$ in the form $p(x+q)^2+r$. **3**

12. Given that $f(x)=4\sin\left(3x-\frac{\pi}{3}\right)$, evaluate $f'\left(\frac{\pi}{6}\right)$. **3**

13. (a) (i) Show that $(x+2)$ is a factor of $f(x)=x^3-2x^2-20x-24$. **2**

(ii) Hence, or otherwise, solve $f(x)=0$. **3**

The diagram shows the graph of $y=f(x)$.



(b) The graph of $y=f(x-k)$, $k>0$ has a stationary point at (1, 0).

State the value of k. **1**

[Turn over

MARKS

14. C_1 is the circle with equation $(x-7)^2 + (y+5)^2 = 100$.

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

(ii) Hence, or otherwise, show that the point P(−2, 7) lies outside C_1. **2**

C_2 is a circle with centre P and radius r.

(b) Determine the value(s) of r for which circles C_1 and C_2 have exactly one point of intersection. **2**

[END OF QUESTION PAPER]