

Mathematical Formulae**1. ALGEBRA***Quadratic Equation*

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Arithmetic series $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $u_n = ar^{n-1}$

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

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

2. TRIGONOMETRY*Identities*

$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

Formulae for $\triangle ABC$

$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$

1 Find constants a , b and c such that $\frac{\sqrt{p}q^{\frac{2}{3}}r^{-3}}{(pq^{-1})^2r^{-1}} = p^a q^b r^c$. [3]

- 2 A particle moves in a straight line such that its displacement, s metres, from a fixed point, at time t seconds, $t \geq 0$, is given by $s = (1 + 3t)^{-\frac{1}{2}}$.

(a) Find the exact speed of the particle when $t = 1$. [3]

(b) Show that the acceleration of the particle will never be zero. [2]

3 A function f is such that $f(x) = \ln(2x+1)$, for $x > -\frac{1}{2}$.

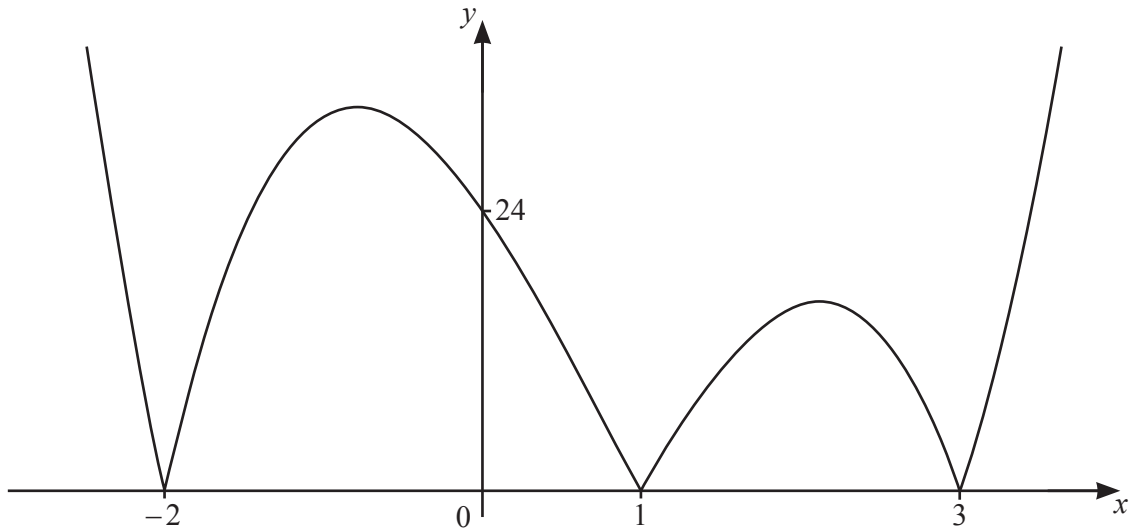
(a) Write down the range of f . [1]

A function g is such that $g(x) = 5x - 7$, for $x \in \mathbb{R}$.

(b) Find the exact solution of the equation $gf(x) = 13$. [3]

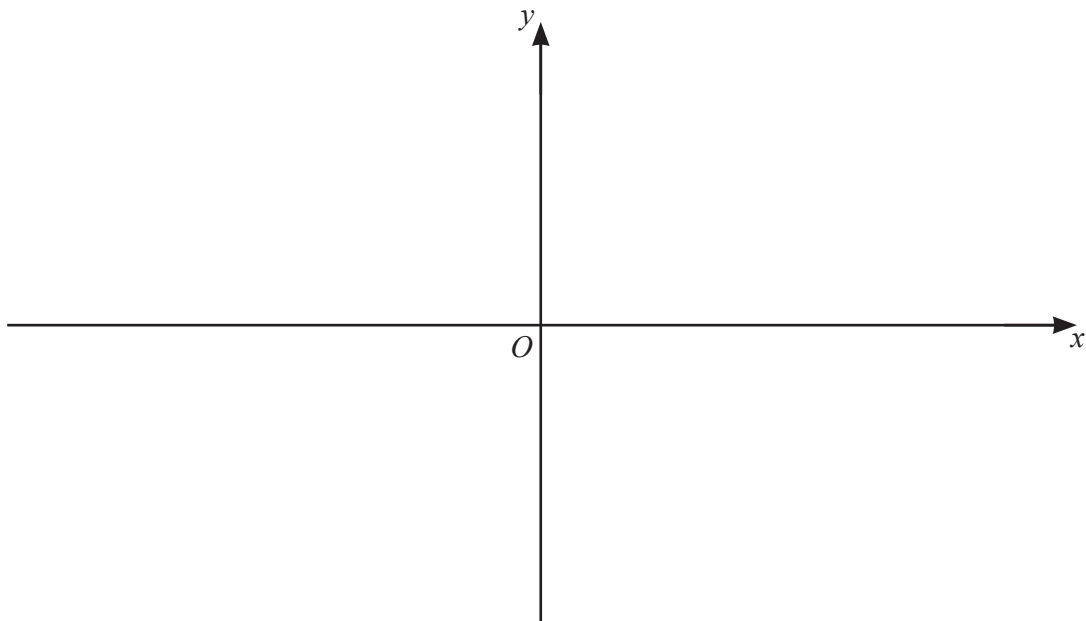
(c) Find the solution of the equation $f'(x) = g^{-1}(x)$. [6]

4 (a)



The diagram shows the graph of $y = |f(x)|$, where $f(x)$ is a cubic. Find the possible expressions for $f(x)$. [3]

- (b) (i) On the axes below, sketch the graph of $y = |2x + 1|$ and the graph of $y = |4(x - 1)|$, stating the coordinates of the points where the graphs meet the coordinate axes. [3]



- (ii) Find the exact solutions of the equation $|2x + 1| = |4(x - 1)|$. [4]

- 5 (a) Find the vector which is in the opposite direction to $\begin{pmatrix} 15 \\ -8 \end{pmatrix}$ and has a magnitude of 8.5. [2]

- (b) Find the values of a and b such that $5\begin{pmatrix} 3a \\ b \end{pmatrix} + \begin{pmatrix} 2a+1 \\ 2 \end{pmatrix} = 6\begin{pmatrix} b+a \\ 2 \end{pmatrix}$. [3]

- 6 (a) Write down the values of k for which the line $y = k$ is a tangent to the curve $y = 4 \sin\left(x + \frac{\pi}{4}\right) + 10$. [2]

(b) (i) Show that $\frac{1 + \tan \theta}{1 - \cos \theta} + \frac{1 - \tan \theta}{1 + \cos \theta} = \frac{2(1 + \sin \theta)}{\sin^2 \theta}$. [4]

(ii) Hence solve the equation $\frac{1 + \tan \theta}{1 - \cos \theta} + \frac{1 - \tan \theta}{1 + \cos \theta} = 3$, for $0^\circ \leq \theta \leq 360^\circ$. [4]

- 7 (a) The first three terms of an arithmetic progression are $\lg 3$, $3\lg 3$, $5\lg 3$. Given that the sum to n terms of this progression can be written as $256 \lg 81$, find the value of n . [5]

(b) DO NOT USE A CALCULATOR IN THIS PART OF THE QUESTION.

The first three terms of a geometric progression are $\ln 256$, $\ln 16$, $\ln 4$. Find the sum to infinity of this progression, giving your answer in the form $p \ln 2$. [4]

8 DO NOT USE A CALCULATOR IN THIS QUESTION.

- (a) Find the exact coordinates of the points of intersection of the curve $y = x^2 + 2\sqrt{5}x - 20$ and the line $y = 3\sqrt{5}x + 10$. [4]

- (b) It is given that $\tan \theta = \frac{\sqrt{3}-1}{2+\sqrt{3}}$, for $0 < \theta < \frac{\pi}{2}$. Find $\operatorname{cosec}^2 \theta$ in the form $a + b\sqrt{3}$, where a and b are constants. [5]

- 9 A circle, centre O and radius r cm, has a sector OAB of fixed area 10 cm^2 . Angle AOB is θ radians and the perimeter of the sector is P cm.

(a) Find an expression for P in terms of r . [3]

(b) Find the value of r for which P has a stationary value. [3]

(c) Determine the nature of this stationary value. [2]

(d) Find the value of θ at this stationary value. [1]

- 10** The normal to the curve $y = \tan\left(3x + \frac{\pi}{2}\right)$ at the point P with coordinates $(p, -1)$, where $0 < p \leq \frac{\pi}{6}$, meets the x -axis at the point A and the y -axis at the point B . Find the exact coordinates of the mid-point of AB . [10]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.