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ADDITIONAL MATHEMATICS**0606/13**

Paper 1

May/June 2020**2 hours**

You must answer on the question paper.

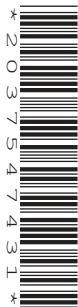
No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Blank pages are indicated.

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 $\triangle ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} bc \sin A$$

3**1**

$$f(x) = 3 + e^x \quad \text{for } x \in \mathbb{R}$$

$$g(x) = 9x - 5 \quad \text{for } x \in \mathbb{R}$$

(a) Find the range of f and of g . [2]

(b) Find the exact solution of $f^{-1}(x) = g'(x)$. [3]

(c) Find the solution of $g^2(x) = 112$. [2]

4

2 (a) Given that $\log_2 x + 2\log_4 y = 8$, find the value of xy .

[3]

(b) Using the substitution $y = 2^x$, or otherwise, solve $2^{2x+1} - 2^{x+1} - 2^x + 1 = 0$.

[4]

5

- 3** At time t s, a particle travelling in a straight line has acceleration $(2t+1)^{-\frac{1}{2}} \text{ms}^{-2}$. When $t = 0$, the particle is 4 m from a fixed point O and is travelling with velocity 8ms^{-1} away from O .

(a) Find the velocity of the particle at time t s. [3]

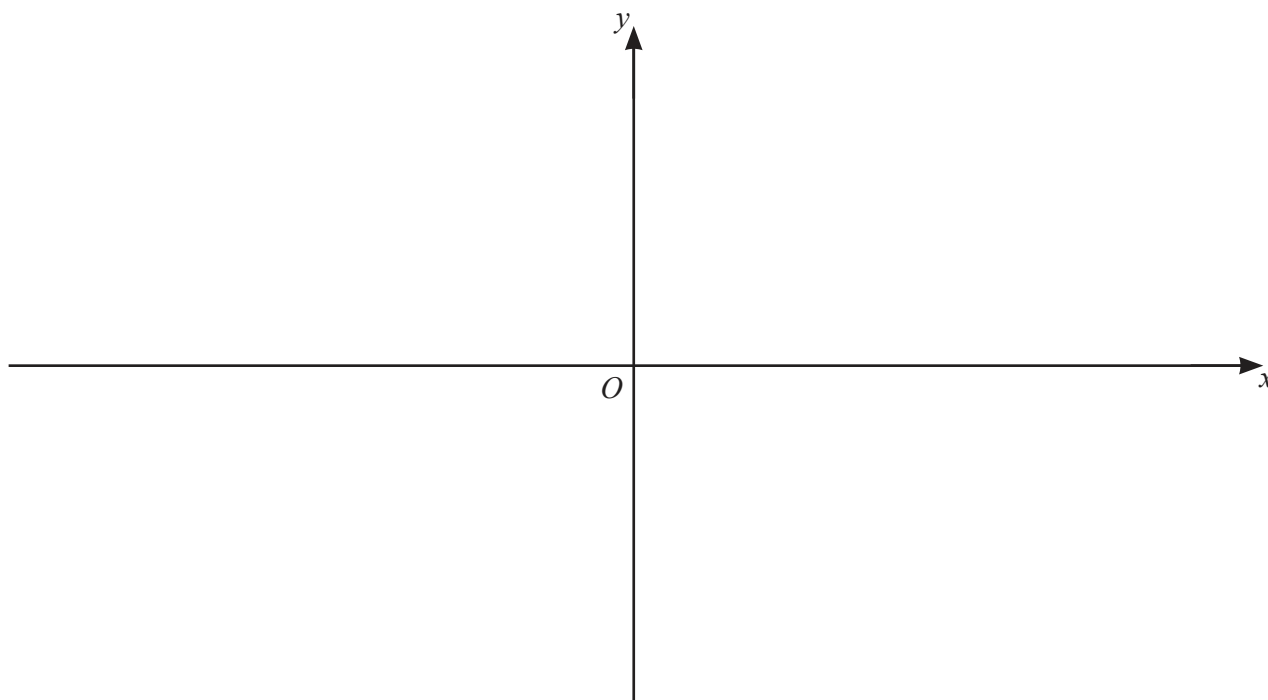
(b) Find the displacement of the particle from O at time t s. [4]

6

4 (a) Write $2x^2 + 3x - 4$ in the form $a(x + b)^2 + c$, where a , b and c are constants. [3]

(b) Hence write down the coordinates of the stationary point on the curve $y = 2x^2 + 3x - 4$. [2]

(c) On the axes below, sketch the graph of $y = |2x^2 + 3x - 4|$, showing the exact values of the intercepts of the curve with the coordinate axes. [3]



(d) Find the value of k for which $|2x^2 + 3x - 4| = k$ has exactly 3 values of x . [1]

5 $p(x) = 6x^3 + ax^2 + 12x + b$, where a and b are integers.

$p(x)$ has a remainder of 11 when divided by $x - 3$ and a remainder of -21 when divided by $x + 1$.

(a) Given that $p(x) = (x - 2)Q(x)$, find $Q(x)$, a quadratic factor with numerical coefficients. [6]

(b) Hence solve $p(x) = 0$. [2]

8

6 (a) Find the unit vector in the direction of $\begin{pmatrix} 5 \\ -12 \end{pmatrix}$. [1]

(b) Given that $\begin{pmatrix} 4 \\ 1 \end{pmatrix} + k \begin{pmatrix} -2 \\ 3 \end{pmatrix} = r \begin{pmatrix} -10 \\ 5 \end{pmatrix}$, find the value of each of the constants k and r . [3]

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(c) Relative to an origin O , the points A , B and C have position vectors $\mathbf{p}$, $3\mathbf{q} - \mathbf{p}$ and $9\mathbf{q} - 5\mathbf{p}$ respectively.

(i) Find $\overrightarrow{AB}$ in terms of $\mathbf{p}$ and $\mathbf{q}$. [1]

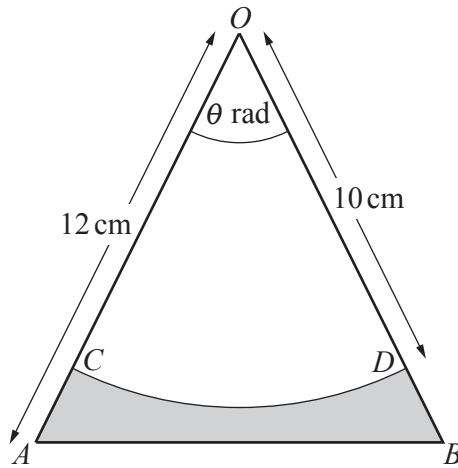
(ii) Find $\overrightarrow{AC}$ in terms of $\mathbf{p}$ and $\mathbf{q}$. [1]

(iii) Explain why A , B and C all lie in a straight line. [1]

(iv) Find the ratio $AB : BC$. [1]

10

7



The diagram shows an isosceles triangle OAB such that $OA = OB = 12\text{ cm}$ and angle $AOB = \theta$ radians. Points C and D lie on OA and OB respectively such that CD is an arc of the circle, centre O , radius 10 cm . The area of the sector $OCD = 35\text{ cm}^2$.

(a) Show that $\theta = 0.7$. [1]

(b) Find the perimeter of the shaded region. [4]

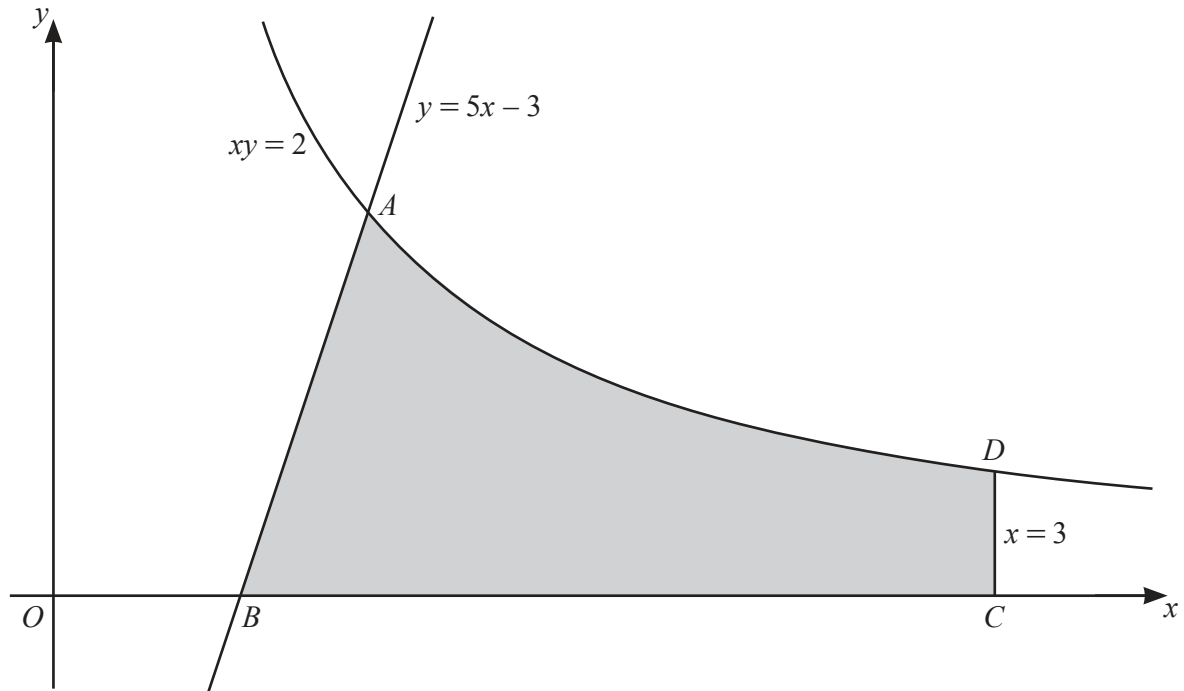
(c) Find the area of the shaded region. [3]

- 8 (a)** An arithmetic progression has a first term of 7 and a common difference of 0.4. Find the least number of terms so that the sum of the progression is greater than 300. [4]

- (b)** The sum of the first two terms of a geometric progression is 9 and its sum to infinity is 36. Given that the terms of the progression are positive, find the common ratio. [4]

12

9



The diagram shows part of the curve $xy = 2$ intersecting the straight line $y = 5x - 3$ at the point A . The straight line meets the x -axis at the point B . The point C lies on the x -axis and the point D lies on the curve such that the line CD has equation $x = 3$. Find the exact area of the shaded region, giving your answer in the form $p + \ln q$, where p and q are constants. [8]

13**Additional working space for question 9.**

14

- 10 (a)** Given that $y = x\sqrt{x+2}$, show that $\frac{dy}{dx} = \frac{Ax+B}{2\sqrt{x+2}}$, where A and B are constants. [5]

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(b) Find the exact coordinates of the stationary point of the curve $y = x\sqrt{x+2}$. [3]

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

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