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## 4037/11

**May/June 2024**

**2 hours**

You must answer on the question paper.

No additional materials are needed.

- 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.

- 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.

**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*

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

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

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

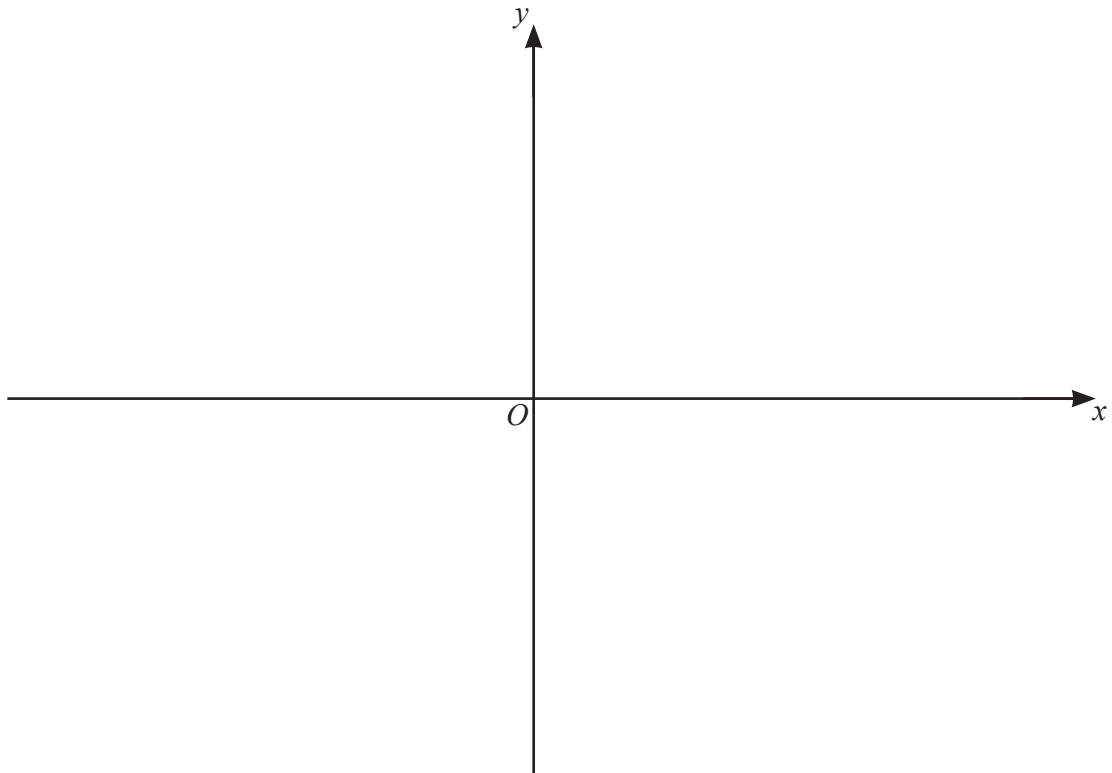
**2. TRIGONOMETRY***Identities*

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

*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 (a) On the axes, sketch the graph of  $y = -\frac{1}{5}(x+2)(2x-1)(x+5)$ , stating the intercepts with the axes. [3]



- (b) Hence solve the inequality  $-\frac{1}{5}(x+2)(2x-1)(x+5) \geq 0$ . [2]

**2 DO NOT USE A CALCULATOR IN THIS QUESTION.**

The polynomial  $p$  is such that  $p(x) = 6x^3 - 35x^2 + 34x + 45$ .

**(a)** Find  $p(x)$  in the form  $(2x - 5)q(x) + r$ , where  $q(x)$  is a polynomial and  $r$  is a constant. [3]

**(b)** Hence write the expression  $p(x) - 5$  as a product of linear factors. [2]

**(c)** Hence write down the solutions of the equation  $p(x) = 5$ . [1]

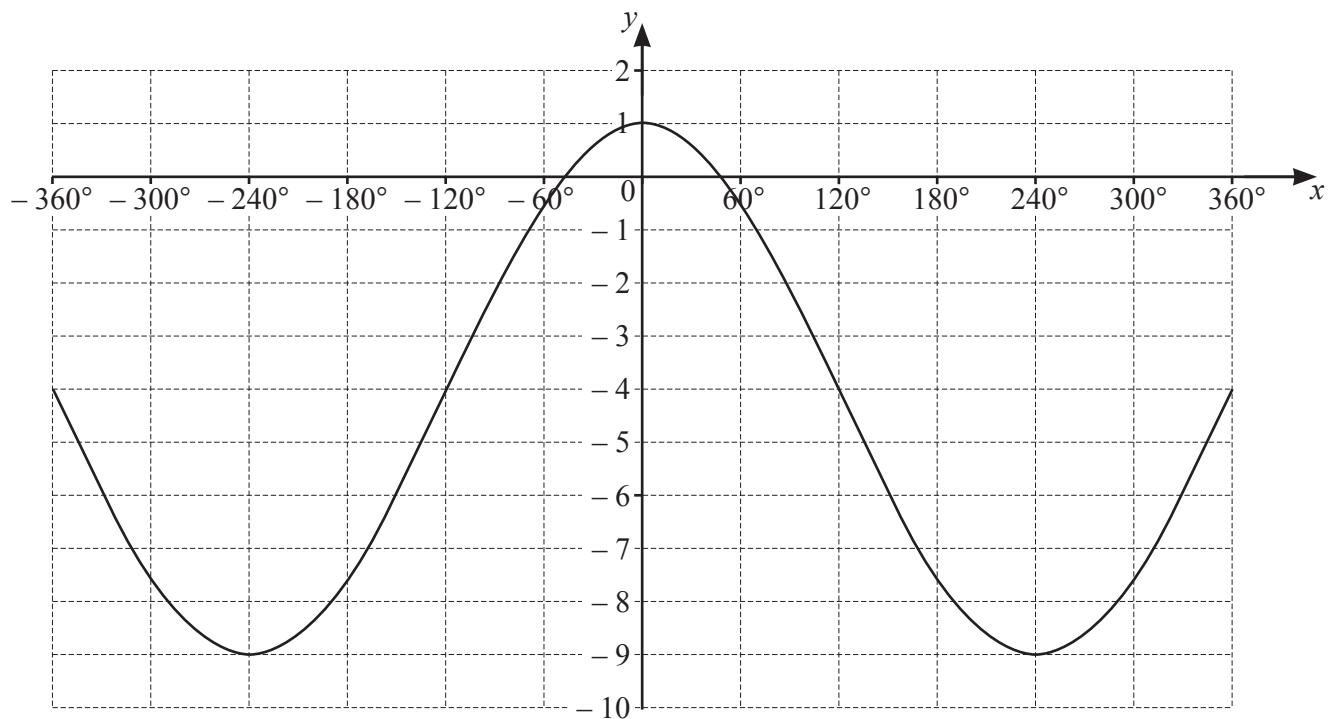
- 3 (a) Write  $1 + \lg(x^2 - 1) - 2 \lg(x - 1)$ , where  $x > 1$ , as a single logarithm to base 10. Give your answer in its simplest form. [4]

- (b) Solve the equation  $4 \log_5(x + 1) = 9 \log_{(x+1)} 5$ , giving your answers in the form  $a + b\sqrt{c}$ , where  $a, b$  and  $c$  are constants. [5]

- 4 (a) The first three terms, in ascending powers of  $x$ , in the expansion of  $(3+px)^n$  are  $243 + 810x + qx^2$ , where  $n$ ,  $p$  and  $q$  are constants. Find the values of  $n$ ,  $p$  and  $q$ . [5]

- (b) Find the term independent of  $y$  in the expansion of  $\left(2y - \frac{1}{3y^2}\right)^6$ . Give your answer in exact form. [2]

- 5 (a) The diagram shows the graph of  $y = a \cos bx + c$ , for  $-360^\circ \leq x \leq 360^\circ$ , where  $a$ ,  $b$  and  $c$  are constants. Find the values of  $a$ ,  $b$  and  $c$ . [3]



- (b) The line  $y = p$  is a tangent to the curve  $y = 3 - 2 \sin 6\theta$ . Write down the possible values of  $p$ . [2]

6 Find  $\int_2^4 \left( \frac{2}{2x-3} - \frac{3}{(3x-5)^2} \right) dx$ , giving your answer in exact form. [4]

7 Given that  $2 + \cot \theta = 3x$  and  $\sin \theta = \sqrt{y}$ , find  $y$  in terms of  $x$ . [3]

- 8 Solve the equation  $4 \sin^2\left(2\alpha - \frac{\pi}{3}\right) = 1$  for  $-\frac{\pi}{2} \leq \alpha \leq \frac{\pi}{2}$ . Give your answers in terms of  $\pi$ . [5]

- 9 (a) Solve the following simultaneous equations.

$$e^{x+y} \times e^{3x-2y} = 1$$

$$x^2y = 256 \quad [5]$$

- (b) Solve the equation  $10e^{(2x-1)} - 11 = 6e^{(1-2x)}$ , giving your answer in exact form. [4]

**10** In this question, all distances are in metres and time,  $t$ , is in seconds.

A particle  $P$  is at a fixed point  $O$  at time  $t = 0$ .

The velocity,  $v$ , of  $P$  is given by  $v = 3 \sin 2t$  for  $t \geq 0$ .

**(a)** Find the exact value of  $t$  for which the velocity is zero for the first time after  $P$  leaves  $O$ . [2]

**(b)** Find an expression, in terms of  $t$ , for the displacement of  $P$  from  $O$  at time  $t$ . [4]

(c) Find the distance travelled by  $P$  for  $0 \leq t \leq \pi$ .

[3]

- 11** The tangent to the curve  $y = (3x - 1)^{\frac{1}{3}}$  at the point where  $x = 3$  meets the coordinate axes at the points  $A$  and  $B$ . The point with coordinates  $(a, a)$  lies on the perpendicular bisector of the line  $AB$ . Find the exact value of  $a$ . [10]

Continuation of working space for Question 11.

**Question 12 is printed on the next page.**

12 (a) It is given that  $y = \frac{\ln 3x}{x^2}$  for  $x > 0$ .

Find  $\frac{dy}{dx}$ . Give your answer in the form  $\frac{A + B \ln 3x}{x^3}$ , where  $A$  and  $B$  are integers. [4]

(b) Hence find  $\int \frac{\ln 3x}{x^3} dx$ . [4]

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